September 27, 2007

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

SUBJECT: BEAVER VALLEY POWER STATION, UNIT NO. 1 - RELIEF REQUEST NOS. PRR1, PRR2, PRR3, PRR4, PRR5, PRR6, PRR7, PRR8, PRR9, PRR10, PRR11, PRR12, PRR 13, AND VRR1 REGARDING THE FOURTH 10-YEAR INSERVICE TESTING PROGRAM RELIEF REQUESTS (TAC NOS. MD5118 - MD5131)

Dear Mr. Sena:

By letter dated March 28, 2007, as supplemented by letter dated July 19, 2007, FirstEnergy Nuclear Operating Company (FENOC, licensee), submitted 14 relief requests for authorization of alternatives and granted reliefs associated with the inservice testing program fourth 10-year interval update for the Beaver Valley Power Station, Unit No. 1 (BVPS-1). By letter dated July, 19, 2007, the licensee withdrew Relief Request No. PRR1.

Based on the information provided by the licensee, the Nuclear Regulatory Commission staff has concluded that pursuant to Section 50.55a(a)(3)(i) of Part 50 of *Title 10 of the Code of Federal Regulations* (10 CFR), Relief Request Nos. PRR2, PRR4, PRR8, PRR13, and VRR1 are authorized on the basis that the proposed alternatives would provide an acceptable level of quality and safety. Pursuant to 10 CFR 50.55a(a)(3)(ii), Relief Request Nos. PRR9, PRR10, PRR 11, and PRR12 are authorized on the basis that compliance with the specified requirements of the American Society of Mechanical Engineers (ASME) *Code for Operation and Maintenance of Nuclear Power Plants* (OM Code) would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety. Pursuant to 10 CFR 50.55a(f)(6)(i), Relief Request Nos. PRR3, PRR5, PRR6, and PRR7 are granted and alternative requirements are imposed on the basis that the ASME Code requirements are impractical for the facility.

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

Sincerely,

/RA/

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

Docket No. 50-334

Enclosure:
As stated

cc w/encl: See next page

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

Sincerely,

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Enclosure:
As stated

cc w/encl: See next page

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Beaver Valley Power Station, Unit Nos. 1 and 2

cc:

Joseph J. Hagan
President and Chief Nuclear Officer
FirstEnergy Nuclear Operating Company
Mail Stop A-GO-14
76 South Main Street
Akron, OH 44308

James H. Lash
Senior Vice President of Operations
and Chief Operating Officer
FirstEnergy Nuclear Operating Company
Mail Stop A-GO-14
76 South Main Street
Akron, OH 44308

Danny L. Pace
Senior Vice President, Fleet Engineering
FirstEnergy Nuclear Operating Company
Mail Stop A-GO-14
76 South Main Street
Akron, OH 44308

Jeannie M. Rinckel
Vice President, Fleet Oversight
FirstEnergy Nuclear Operating Company
Mail Stop A-GO-14
76 South Main Street
Akron, OH 44308

David W. Jenkins, Attorney
FirstEnergy Corporation
Mail Stop A-GO-15
76 South Main Street
Akron, OH 44308

Manager, Fleet Licensing
FirstEnergy Nuclear Operating Company
Mail Stop A-GO-2
76 South Main Street
Akron, OH 44308

Ohio EPA-DERR
ATTN: Zack A. Clayton
P.O. Box 1049
Columbus, OH 43266-0149

Director, Fleet Regulatory Affairs
FirstEnergy Nuclear Operating Company
Mail Stop A-GO-2
76 South Main Street
Akron, Ohio 44308

Manager, Site Regulatory Compliance
FirstEnergy Nuclear Operating Company
Beaver Valley Power Station
Mail Stop A-BV-A
P.O. Box 4, Route 168
Shippingport, PA 15077

Richard Anderson
Vice President, Nuclear Support
FirstEnergy Nuclear Operating Company
76 South Main Street
Mail Stop A-GO-14
Akron, Ohio 44308

Commissioner James R. Lewis
West Virginia Division of Labor
749-B, Building No. 6
Capitol Complex
Charleston, WV 25305

Director, Utilities Department
Public Utilities Commission
180 East Broad Street
Columbus, OH 43266-0573

Director, Pennsylvania Emergency
Management Agency
2605 Interstate Dr.
Harrisburg, PA 17110-9364

cc:

Dr. Judith Johnsrud
Environmental Coalition on Nuclear Power
Sierra Club
433 Orlando Avenue
State College, PA 16803

Director
Bureau of Radiation Protection
Pennsylvania Department of
  Environmental Protection
Rachel Carson State Office Building
P.O. Box 8469
Harrisburg, PA 17105-8469

Mayor of the Borough of Shippingport
P.O. Box 3
Shippingport, PA 15077

Regional Administrator, Region I
U.S. Nuclear Regulatory Commission
475 Allendale Road
King of Prussia, PA 19406

Resident Inspector
U.S. Nuclear Regulatory Commission
P.O. Box 298
Shippingport, PA 15077

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

REGARDING THE FOURTH 10-YEAR INTERVAL INSERVICE TESTING PROGRAM FOR

RELIEF REQUEST NOS. PRR1, PRR2, PRR3, PRR4, PRR5, PRR6, PRR7,

PRR8, PRR9, PRR10, PRR11, PRR12, PRR13, AND VRR1

FIRSTENERGY NUCLEAR OPERATING COMPANY

FIRSTENERGY NUCLEAR GENERATION CORP.

BEAVER VALLEY POWER STATION, UNIT NO. 1

DOCKET NO. 50-334

1.0 INTRODUCTION

By letter dated March 28, 2007, Agencywide Document Access and Management System (ADAMS) accession number ML070890491, as supplemented by letter dated July, 19, 2007, ADAMS accession number ML072040259, FirstEnergy Nuclear Operating Company (FENOC, licensee), submitted 14 relief requests regarding the fourth 10-year inservice testing (IST) program interval for Beaver Valley Power Station, Unit No. 1 (BVPS-1). The licensee requested alternative authorization and relief from certain IST requirements of the 2001 Edition through 2003 Addenda of the American Society of Mechanical Engineers (ASME) *Code for Operation and Maintenance of Nuclear Power Plants* (OM Code). By letter dated July, 19, 2007, the licensee withdrew Relief Request No. PRR1. The BVPS-1 fourth 10-year IST interval commences on September 20, 2007.

2.0 REGULATORY EVALUATION

Section 50.55a of Part 50 of *Title 10 of the Code of Federal Regulations* (10 CFR), requires that IST of certain ASME Code Class 1, 2, and 3 pumps and valves be performed at 120-month (10-year) IST program intervals in accordance with the specified ASME Code and applicable addenda incorporated by reference in the regulations, except where alternatives have been authorized or relief has been requested by the licensee and granted by the Commission pursuant to paragraphs (a)(3)(i), (a)(3)(ii), or (f)(6)(i) of 10 CFR 50.55a. In accordance with 10 CFR 50.55a(f)(4)(ii), licensees are required to comply with the requirements of the latest edition and addenda of the ASME Code incorporated by reference in the regulations 12 months prior to the start of each 120-month IST program interval. In accordance with 50.55a(f)(4)(iv), IST of pumps and valves may meet the requirements set forth in subsequent editions and addenda that are incorporated by reference in 10 CFR 50.55a(b), subject to the Commission approval. Portions of editions or addenda may be used provided that all related requirements of the respective editions and addenda are met. In proposing alternatives or requesting relief, the licensee must demonstrate that: (1) the proposed alternatives provide an acceptable level of quality and safety; (2) compliance would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety; or (3) conformance is impractical for the facility. Section 50.55a authorizes the Commission to approve alternatives and to grant relief from ASME OM Code requirements upon making necessary findings. The Nuclear Regulatory Commission (NRC) guidance contained in Generic Letter (GL) 89-04, "Guidance on Developing Acceptable Inservice Testing Programs," provides alternatives to ASME Code requirements which are acceptable. Further guidance is given in GL 89-04, Supplement 1, and NUREG-1482 Revision 1, "Guidance for Inservice Testing at Nuclear Power Plants."

3.0 TECHNICAL EVALUATION

3.1 Relief Request No. PRR2

3.1.1 Code Requirements/Components Affected

The licensee requested relief from ISTB-3510(b)(1), which requires that the full-scale range of each analog instrument shall be not greater than three times the reference value.

Instrument	Associated Pumps
PI-1CC-100A PI-1CC-100B PI-1CC-100C	1CC-P-1A 1CC-P-1B 1CC-P-1C
FI-1CC-117 FI-1CC-118 FI-1CC-119	1CC-P-1A 1CC-P-1B 1CC-P-1C
PDI-1CC-119	1CC-P-1A 1CC-P-1B 1CC-P-1C
FI-1FW-100A FI-1FW-100B FI-1FW-100C	1FW-P-3A 1FW-P-3B

3.1.2 Instruments PI-1CC-100A, PI-1CC-100B, and PI-1CC-100C

3.1.2.1 Licensee's Basis for Request

The discharge pressure gauges PI-1CC-100A, PI-1CC-100B, and PI-1CC-100C for the Reactor Plant Component Cooling Water (CCR) pumps 1CC-P-1A, 1CC-P-1B, and 1CC-P-1C have a range of 0 - 400 pounds per square inch gauge (psig). The licensee stated, "The use of a pump curve is allowed for these pumps per PRR3, and the typical pressure readings are slightly lower than 1/3 of the gauge range, varying between 108 - 124 psig. The calibration accuracy of the gauges is ± 1%, which would yield a reading more accurate than the ASME 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 ± 3.70%, which is less than the ± 6% required by the ASME Code for the Group A test. During comprehensive testing, temporary pressure instrumentation will be used that has a calibrated accuracy of at least ± 0.5 % of full scale with a sufficient range to satisfy the ± 1.5% required by the ASME Code for the comprehensive test."

3.1.2.2 Licensee's Proposed Alternative Testing

The existing permanently installed pump instrument is acceptable for Group A tests because the indicated accuracy is less than or equal to ± 6% as calculated at the reference value.

3.1.2.3 Staff Evaluation

Despite the fact that PI-1CC-100A, PI-1CC-100B, and PI-CC-100C do not meet the 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 Code. Based on the least accurate instrument that would theoretically be allowed by the Code, the minimum required indicated accuracy is ± 6% for Group A tests (documented by NUREG-1482 Revision 1, Section 5.5.1). The indicated accuracies of PI-1CC-100A, PI-1CC-100B, and PI-1CC-100C, as derived based upon the current reference value, are as follows:

Minimum reference value = 108 psig
Full scale range = 400 psig
Instrument tolerance = ± 4 psig (± 1% x 400 psig)

Therefore, the indicated accuracy is as follows:

± 4 psig / 108 psig x 100% = ± 3.7%

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

3.1.3 Instruments FI-1CC-117, FI-1CC-118, and FI-1CC-119

3.1.3.1 Licensee's Basis for Request

Flow indicators FI-1CC-117, FI-1CC-118, and FI-1CC-119, for pumps 1CC-P-1A, 1CC-P-1B, and 1CC-P-1C, are located in the branch lines of the component cooling water system and are used only if the installed pressure differential indicators (PDIs) are over-ranged.

In that case, the typical flow expected would be enough to meet the Code requirements, except for FI-1CC-117, which could be placed in service with a flow of 4000 gpm [gallons per minute]. FI-1CC-117 is sized for all flow conditions with a range of 0 - 14,000 gpm and an accuracy of 1.5%. It is in the 24-inch CCR header supplying cooling loads inside containment. When the [residual heat removal] RHR system is in operation, the flow through the CCR header is significantly higher. The calibration accuracy of this gauge would yield a reading more accurate than the requirements. These flow instruments will be used during both Group A tests and comprehensive tests since the combination of range and accuracy yields a reading of ± 5.25%, less than the ± 6% required by the Code.

3.1.3.2 Licensee's Proposed Alternative Testing

The existing permanently installed pump instrument is acceptable for Group A and comprehensive tests because the indicated accuracy is less than or equal to ± 6% as calculated at the reference value. The reading accuracy achieved from the installed instruments meet the intent of the Code and yields an acceptable level of quality and safety for Group A and comprehensive tests.

3.1.3.3 Staff Evaluation

Despite the fact that FI-1CC-117, FI-1CC-118, and FI-1CC-119 do not meet the ASME 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 Code. Based on the least accurate instrument that would theoretically be allowed by the Code, the minimum required indicated accuracy is ± 6% for both Group A and comprehensive tests (This fact is documented by NUREG-1482 Revision 1, Section 5.5.1). The indicated accuracies of FI-1CC-117, FI-1CC-118, and FI-1CC-119, as derived based upon the current reference value, are as follows:

Reference value = 4,000 gpm
Full scale range = 14,000 gpm
Instrument tolerance = ± 210 gpm (± 1.5% x 14,000 gpm)

Therefore, the indicated accuracy is as follows:

± 210 gpm / 4,000 gpm x 100 % = ± 5.25%

As demonstrated, the indicated accuracies of FI-1CC-117, FI-1CC-118, and FI-1CC-119 are better than that which is theoretically allowed by the ASME Code. The reading accuracy achieved from the installed instruments meets the intent of the ASME Code and yields an acceptable level of quality and safety for Group A and comprehensive tests.

3.1.4 Instrument PDI-1CC-119

3.1.4.1 Licensee's Basis for Request

The flow indicator PDI-1CC-119, for pumps 1CC-P-1A, 1CC-P-1B, and 1CC-P-1C is located in the CCR header supplying the cooling loads in the auxiliary building and has a range of 0 - 150 inches water column (inwc). The licensee stated, "Since the use of a pump curve is approved per relief, the reference flow may not be at a specific flow point." Typical test flow differential pressure is 43 - 46 inwc, so the flow gauge range is greater than three times the reference flow. The gauge accuracy is 0.5%. This gauge will be used for both Group A and comprehensive tests since the combination of accuracy and range yields a reading of ± 1.74%, less than the ± 6 % required by the ASME Code.

3.1.4.2 Licensee's Proposed Alternative Testing

The existing permanently installed pump instrument is acceptable for Group A and comprehensive tests because the indicated accuracy is less than or equal to ± 6% as calculated at the reference value.

3.1.4.3 Staff Evaluation

Pump flow rate is determined through direct calculation from the reading of differential pressure gauge PDI-1CC-119. This analytically derived flow rate is permitted by ISTB-3510(a), which states "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." Despite the fact that PDI-1CC-119 does not meet the ASME Code requirement for range, it is capable of providing an indicated accuracy at the reference value that is superior to the minimum indicated accuracy that would be required by the ASME Code. Based on the least accurate instrument that would theoretically be allowed by the ASME Code, the minimum required indicated accuracy is ± 6% for both Group A and comprehensive tests (documented by NUREG-1482 Revision 1, Section 5.5.1). The indicated accuracy of PDI-1CC-119, as derived based upon the current reference value, is as follows:

Minimum reference value = 43 inwc
Full scale range = 150 inwc
Instrument tolerance = ± 0.75 inwc (± 0.5% x 150 inwc)

Therefore, the indicated accuracy is as follows:

± 0.75 inwc / 43 inwc x 100 % = ± 1.74%

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

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

3.1.5.1 Licensee's Basis for Request

Flow indicators FI-1FW-100A, FI-1FW-100B, and FI-1FW-100C are located in the three lines to the steam generators from the auxiliary feedwater (AFW) pumps 1FW-P-3A and 1FW-P-3B. The licensee stated, "The flow indicators are sized to measure accident flow from the turbine-driven AFW Pump as well as the Motor-Driven AFW Pumps, with a range of 0 - 400 gpm. The reference value for the Motor-Driven Pumps, full-flow test is approx. 110 gpm, 27.5% of the range. The calibration accuracy of the flow meters is 1.0%, which would yield a reading more accurate than Code requirements. These flow instruments will be used during both the Group B tests and Comprehensive tests since the combination of range and accuracy yields a reading of ±3.63 percent which is less than the ±6 percent required by Code."

3.1.5.2 Licensee's Proposed Alternative Testing

The existing permanently installed pump instruments are acceptable for Group B and comprehensive tests because the indicated accuracy is less than or equal to ± 6% as calculated at the reference value.

3.1.5.3 Staff Evaluation

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

Reference value = 110 gpm
Full scale range = 400 gpm
Instrument tolerance = ± 4.0 gpm (± 1.0% x 400 gpm)

Therefore, the indicated accuracy is as follows:

± 4.0 gpm / 110 gpm x 100 % = ± 3.63%

As demonstrated, the indicated accuracies of FI-1FW-100A, FI-1FW-100B, and FI-1FW-100C are better than the accuracy specified by the ASME Code. The reading accuracy achieved from the installed instruments meets the intent of the ASME Code and yields an acceptable level of quality and safety for Group B and comprehensive tests.

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

3.1.6.1 Licensee's Basis for Request

The PI-1FW-156, PI-1FW-156A, and PI-1FW-156B gauges are the suction pressure gauges for the AFW pumps 1FW-P-2, 1FW-P-3A, and 1-FW-P-3B. In 1991, the existing 0 - 160 psig gauges were replaced with the present 0 - 60 psig gauges. The licensee stated, "This range was selected as a compromise between the IST Program requirements and possible accident pressures (i.e., River Water supplying the AFW Pumps). The 0-60 psig range will accommodate the accident pressure and typical test pressure of 10 psig. With a calibration accuracy of 0.5%, this results in a reading more accurate than 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 ±3.0 percent which is less than the ±6 percent required by Code for the Group B test. During Comprehensive testing, temporary pressure instrumentation will be used having a calibrated accuracy of at least ±0.5 percent of full scale with a sufficient range to satisfy the ±1.5 percent required by the Code for the Comprehensive test."

3.1.6.2 Licensee's Proposed Alternative Testing

The existing permanently installed pump instrument is acceptable for Group B tests because the indicated accuracy is less than or equal to ± 6% as calculated at the reference value.

3.1.6.3 Staff Evaluation

Despite the fact that PI-1FW-156, PI-1FW-156A, and PI-1FW-156B do not meet the ASME 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 Code. Based on the least accurate instrument that would theoretically be allowed by the ASME Code, the minimum required indicated accuracy is ± 6 % for Group B tests. Comprehensive tests for pressure gauges require an accuracy of 1.5 % (documented by NUREG-1482 Revision 1, Section 5.5.1). The indicated accuracies of PI-1FW-156, PI-1FW-156A, and PI-1FW-156B, as derived based upon the current reference value, are as follows:

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

Therefore, the indicated accuracy is as follows:

± 0.3 psig / 10 psig x 100% = ± 3.0%

As demonstrated, the indicated accuracies of PI-1FW-156, PI-1FW-156A, and PI-1FW-156B are better than the accuracy specified by the ASME Code. The reading accuracy achieved from the installed instruments meet the intent of the ASME Code and yields an acceptable level of quality and safety for Group B tests.

3.1.7 Conclusion

Based on the above evaluations, the NRC staff has concluded that the licensee's proposed alternatives to the ASME Code accuracy requirements for instruments during pump testing are authorized pursuant to 10 CFR 50.55a(a)(3)(i) on the basis that the alternatives provide an acceptable level of quality and safety. The licensee's proposed alternatives provide reasonable assurance of the operational readiness of the pumps. These alternatives are authorized for the fourth 10-year IST program interval of BVPS-1.

3.2 Relief Request No. PRR3

The licensee requested relief for the component cooling water pumps 1CC-P-1A, 1CC-P-1B, and 1CC-P-1C (Class 3 pumps) from the requirements of ISTB-5121, "Group A Test Procedure," and ISTB-5123, "Comprehensive Test Procedure."

3.2.1 Code Requirements/Components Affected

ISTB-5121 requires that Group A tests shall be conducted with the pump operating at a specified reference point. ISTB 5121(b) requires that the resistance of the system shall be varied until the flow rate equals the reference point. The differential pressure shall then be determined and compared to its reference value. Alternatively, the flow rate shall be varied until the differential pressure equals the reference point and the flow rate determined and compared to the reference flow rate value.

ISTB-5123 requires that comprehensive tests shall be conducted with the pump operating at a specified reference point. ISTB-5123(b) requires that for centrifugal and vertical line shaft pumps, the resistance of the system shall be varied until the flow rate equals the reference point. The differential pressure shall then be determined and compared to its reference value. Alternatively, the flow rate shall be varied until the differential pressure equals the reference point and the flow rate determined and compared to the reference flow rate value.

3.2.2 Licensee’s Basis for Request

The licensee stated:

> The amount of Reactor Plant Component Cooling Water System flow is dependent on the plant's seasonal heat load requirements and on River Water System and seasonal Ohio River water temperatures. The overall amount of flow may vary by several hundred gallons per minute between cold winter months and hot summer months.
>
> Varying Component Cooling header flows by adding or removing heat loads from service in order to increase or decrease flow rate to a specific reference value is impractical. An exact flow rate cannot be duplicated because flow to some heat exchangers cannot be throttled and those that can be throttled are not always capable of being throttled due to system heat load requirements. The test is typically performed by either isolating or placing into service non-essential heat exchangers which results in a gross flow change. For this reason, a wider range of flow values, as on a pump curve, is needed as a reference.
>
> In addition, to throttle flow to a reference value during hot summer months when flow demand is greatest requires the use of a manual butterfly valve at the discharge of the pumps. A butterfly valve is not designed to be used as a throttle valve so throttling may result in excessive wear and premature failure of the valve. No other valves are available to throttle header flow. Also, operating experience has shown that any throttling of the pump discharge butterfly valves results in a large reduction in cooling water flow to the Reactor Coolant Pump thermal barrier heat exchangers, bearing lube oil coolers and motor stator air coolers. Reduced header flows result in low flow alarms and heat up of the Reactor Coolant Pumps to near required manual pump trip set points which could ultimately result in a plant trip. Finally, the added thermal cycling of these coolers for pump testing could cause premature degradation of these heat exchangers.

3.2.3 Licensee’s Proposed Alternative Testing

The licensee stated:

> A pump curve, developed per the guidelines provided in NUREG-1482, Rev. 1, Section 5.2.2, "Reference Curves," will be used to compare flow rate with developed pump head at the flow conditions dictated by plant seasonal heat load requirements per 1OST-15.1, 1OST-15.2 and 1OST-15.3 (Reactor Plant Component Cooling Water Pump Tests) during each quarterly Group A test and biennial Comprehensive test. Since normal flow varies, the most limiting vibration acceptance criteria will be used over this range of flows based on baseline vibration data obtained at various flow points on the pump curve.
>
> ISTB-3320, "Establishment of Additional Set of Reference Values," provides for multiple sets of reference values. A pump curve is merely a graphical representation of the fixed response of the pump to an infinite number of flow conditions which are based on some finite number of reference values verified by measurement. Relief is, therefore, required to use a pump curve, which provides a reasonable alternative in trending pump performance and degradation to that required by the Code. Flow will be permitted to vary as system conditions require. Delta-P will be calculated and converted to a developed head for which ranges will be applied.

The licensee has also stated that the methodology for development and use of pump curves meets the requirements of Code Case OMN-9.

3.2.4 Staff Evaluation

ISTB-5121 and ISTB-5123 require that flow rate and differential pressure be evaluated against reference values to monitor pump condition and to allow detection of hydraulic degradation. The component cooling water pumps 1CC-P-1A, 1CC-P-1B, and 1CC-P-1C operate under varying flow and differential pressure conditions, depending on the load requirements. It would not be practical to establish a fixed reference point for testing the pumps because of system constraints that could result in a plant trip and damage to equipment.

When it is impractical to test a pump at a reference value of flow and differential pressure, testing in the "as-found" condition and comparing values to an established reference curve may be an acceptable alternative. Pump curves represent a set of infinite reference points of flow rate and differential pressure. Establishing a reference curve for the pump when it is known to be operating acceptably, and basing the acceptance criteria on this curve, can permit evaluation of pump condition and detection of degradation.

The licensee proposed to follow the NRC guidelines specified in NUREG-1482 Revision 1, Section 5.2 for the use of pump curves. The licensee will also meet the requirements of ASME Code Case OMN-9 in the development and use of pump curves, which is acceptable per Regulatory Guide (RG) 1.92. Therefore, the licensee's proposed alternative testing for the pumps provides an acceptable alternative to the ASME Code requirements.

3.2.5 Conclusion

Based on the above evaluation, the NRC staff has concluded that compliance with the ASME Code requirements is impractical for the pump testing, and considering the burden on the licensee if the ASME Code requirements are imposed, relief is granted from the ASME Code requirements and the alternative is imposed, pursuant to 10 CFR 50.55a(f)(6)(i). The relief granted is authorized by law and will not endanger the common defense and security and is otherwise in the public interest, giving due consideration to the burden upon the licensee if the ASME Code requirements were imposed on the facility. This alternative is authorized for the fourth 10-year IST program interval of BVPS-1.

3.3 Relief Request No. PRR4

3.3.1 Code Requirements/Components Affected

The licensee requested relief for the diesel fuel oil transfer pumps 1EE-P-1A, 1EE-P-1B, 1EE-P-1C, and 1EE-P-1D (Class 3 pumps) from the requirements of ISTB-3550, “Flow Rate,” and Table ISTB-3000-1, “Inservice Test Parameters.”

ISTB-3550 requires that when measuring flow rate, a rate or quantity meter shall be installed in the pump test circuit. If a meter does not indicate flow rate directly, the record shall include the method used to reduce the data.

Table ISTB-300-1 identifies flow rate as a required test parameter, and Note 1 states that for positive displacement pumps, flow rate shall be measured or determined.

3.3.2 Licensee’s Basis for Request

The licensee stated:

> There is no installed instrumentation provided to measure flow rate for these Emergency Diesel Generator Fuel Oil Transfer Pumps. However, 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 Storage Tank to the Day Tank. The reading scale for measuring the level change over time, and the calculational method yield an accuracy within ±2% as required by Table ISTB-3500-1, "Required Instrument Accuracy".

3.3.3 Licensee’s Proposed Alternative Testing

The licensee stated:

> Flow rate 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 Comprehensive tests per 1OST-36.1 and 1OST-36.2 (Emergency Diesel Generator and Fuel Oil Transfer Pump Tests).

For the comprehensive test, the pumps will be run for at least 2 minutes in accordance with ISTB-5100(a)(1).

> This proposed alternative is consistent with the guidelines provided in NUREG-1482, Rev.1, Section 5.5.2. Calculating flow rate by a level change in the day tank should be

> considered acceptable since the level of accuracy required by Table ISTB-3500-1 is satisfied and the method provides reasonable assurance of pump operational readiness.

3.3.4 Staff Evaluation

ISTB-3550, “Flow Rate,” states that when measuring flow rate, a rate or quantity meter shall be installed in the pump test circuit. If a meter does not indicate flow rate directly, the record shall include the method used to reduce the data.

The licensee proposed (for the Group B tests and comprehensive tests) to calculate the flow rate for the diesel fuel oil transfer pumps 1EE-P-1A, 1EE-P-1B, 1EE-P-1C, and 1EE-P-1D by measuring the level change over time in the diesel generator fuel oil day tank, and converting this data into pump flow rate. The reading scale for measuring the level change over time, and the calculational method yield an accuracy within ± 2% as required by Table ISTB-3500-1, “Required Instrument Accuracy.” This proposed alternative is consistent with the guidelines provided in Section 5.5.2 of NUREG-1482 Revision 1.

3.3.5 Conclusion

Based on the above evaluation, the NRC staff has concluded that the licensee’s proposed alternative to the ASME Code requirements for measuring flow rate during pump testing are authorized pursuant to 10 CFR 50.55a(a)(3)(i) on the basis that the alternative provides an acceptable level of quality and safety. The licensee’s proposed alternative provides reasonable assurance of the operational readiness of the pumps. This alternative is authorized for the fourth 10-year IST program interval of BVPS-1.

3.4 Relief Request No. PRR5

3.4.1 Code Requirements/Components Affected

The licensee requested relief for the diesel fuel oil transfer pumps 1EE-P-1A, 1EE-P-1B, 1EE-P-1C, and 1EE-P-1D (Class 3 pumps) from the requirements of ISTB-5323(e), “Comprehensive Test Procedure.”

ISTB-5323(e) requires that all deviations from the reference values shall be compared with the ranges of Table ISTB-5300-1 or Table ISTB-5300-2, as applicable, and corrective action taken as specified in ISTB-6200.

3.4.2 Licensee’s Basis for Request

The licensee stated:

> The test acceptance criteria for pressure (P) and flow (Q) limits, as applicable to Group B tests and Comprehensive tests, given in Table ISTB-5300-1 for positive displacement

pumps (except reciprocating) are as follows:

Group B Tests	Acceptable	Alert	Required Action
	0.90 to 1.10Q_r	None	<.90 or >1.10Q_r

Comprehensive Tests	Acceptable	Alert	Required Action
	0.95 to 1.03Q_r	0.93 to <0.95Q_r	<0.90 or >1.03Q_r
	0.93 to 1.03P_r	0.90 to <0.93P_r	<0.90 or >1.03P_r

These limits are too restrictive for the Fuel Oil Transfer Pumps at BVPS-1. The baseline discharge pressures for these four pumps range from 6.8 psig to 13.0 psig. Applying the Acceptable limits from the ASME OM Code for these values, the average allowable degradation from the reference value is only 0.7 psig for the Comprehensive test. The discharge pressure has historically varied by as much as 1 psig from one test to the next and between 1 to 2 psig over the course of a year which is more than the Acceptable Range for discharge pressure.

The baseline flows for these four pumps range from 9.0 to 13.3 gpm. The average allowable degradation for flow is therefore only 1.1 gpm for the Group B test and only 0.56 gpm for the Comprehensive test. The flow values also vary from test to test and between 1 to 1.5 gpm over the course of a year which is more than the Acceptable Range for flow.

The ASME OM Code limits are too restrictive, and therefore, impractical to apply. Normal historic variation in discharge pressure and flow would require the pumps to enter the Alert or Required Action Ranges. Trends would not be observed because the pumps would have to be declared inoperable before enough data could be obtained to determine if the data obtained is a true indication of a degrading condition or data scatter. In addition, the ASME OM Code trending would also pick-up variations caused by fouling of the suction strainer or discharge filter or by chattering of the relief valve. An allowable variation larger than 0.7 psig or 0.56 gpm is therefore needed for both the Group B test and the Comprehensive test, as applicable, to trend pump performance.

NUREG-1482 Revision 1, Section 5.6, “Operability Limits of Pumps,” states that if expanded ranges are needed, relief must be obtained. “The request for relief must include the licensee’s basis for the expanded ranges and the basis for finding that the pump performance does not demonstrate degrading conditions. The basis for acceptable pump performance pertains to the pump and not the system, though pump performance must meet system requirements to remain in an analyzed condition.”

Therefore, BVPS-1 requests relief to use expanded ranges for flow during the Group B tests and discharge pressure and flow during the Comprehensive tests for the Fuel Oil Transfer Pumps. The proposed ranges to be used during both the Group B tests and Comprehensive tests are as follows:

Group B Tests	Acceptable	Alert	Required Action
	0.80 to $1.15Q_r$	None	<0.80 or >$1.15Q_r$

Comprehensive Tests	Acceptable	Alert	Required Action
	0.90 to $1.15Q_r$	0.80 to <$0.90Q_r$	<0.80 or >$1.15Q_r$
	0.80 to $1.20P_r$	0.70 to <$0.80P_r$	<0.70 or >$1.20P_r$

The function of these pumps is to be able to deliver fuel to the day tank to supply the Diesel Generator under full load. The amount of fuel that is required to be delivered is 3.6 gpm, significantly lower than the reference values for all of the pumps. In addition, due to the nature of positive displacement pumps, flow should be the more consistent parameter. The proposed range for the flow value is more restrictive because the flow rate is the more critical parameter for the system. The high flow limit is based on approximately half of the allowable variation expected in pumps with this rated flow rate, from the Hydraulic Institute Test Standard for Rotary Pumps, 14th edition.

These ranges would only result in an allowed variation of -2.04 psig and +1.36 psig for the lowest expected pressure reading (6.8 psig) and -1.8 gpm and +0.9 gpm for the lowest expected flow reading (9 gpm). In addition, during discussions with Ingersoll-Dresser Pumps, the pump manufacturer, when questioned about a limiting value for pump performance, the pump manufacturer has stated that as the pump wears and the clearances open, the performance will gradually change. No limiting value for either flow or discharge pressure was provided and sudden performance degradation is not expected. These expanded ranges will allow degrading conditions to be identified and provide assurance that the Fuel Oil Transfer Pumps will be capable of fulfilling their safety function.

3.4.3 Licensee's Proposed Alternative Testing

The licensee stated:

BVPS-1 proposes the use of the expanded limits [shown in paragraph 3.4.2 above] for test acceptance criteria in lieu of the test acceptance criteria specified in Table ISTB-5300-1. Testing will be performed per 1OST-36.1 and 2 (Diesel Generator Monthly Tests) using expanded ranges for flow and discharge pressure during the Comprehensive tests and for flow during the Group B tests. Extensive hardware changes would be required in order to comply with the requirements of Table ISTB-5300-1 with little or no enhancement or compensating increase to the quality of the tests or the ability to detect pump degradation. These expanded ranges will allow degrading conditions to be identified without needlessly declaring the pumps inoperable and provide assurance that the Fuel Oil Transfer Pumps will be capable of fulfilling their safety function.

3.4.4 Staff Evaluation

The licensee requested relief for diesel fuel oil transfer pumps 1EE-P-1A, 1EE-P-1B, 1EE-P-1C, and 1EE-P-1D from the ASME Code-specified acceptance criteria for pressure and flow rate on the basis that conformance with these requirements is impractical. The licensee proposed to test the pumps per 1OST-36.1 and 2 (Diesel Generator Monthly Tests) using expanded ranges for flow and discharge pressure as summarized in the table in Section 3.4.2 above.

The discharge pressure range for these pumps is 6.8 to 13 psig, and the discharge pressure has historically varied by as much as 1 psig from one test to the next, and between 1 to 2 psig over the course of a year. Flow rate for these pumps ranges from 9 to 13.3 gpm, and the flow rate varies by 1 to 1.5 gpm from one test to the next and between 1 to 1.5 gpm over the course of a year. In this situation, the ASME Code limits are too restrictive, and therefore, impractical to apply.

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

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

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

3.4.5 Conclusion

Based on the above evaluation, the NRC staff has concluded that compliance with the ASME Code requirement for test acceptance criteria is impractical for the diesel fuel oil transfer pump testing, and considering the burden on the licensee if the ASME Code requirement is imposed, relief is granted from the ASME Code requirement and the alternative is imposed, pursuant to 10 CFR 50.55a(f)(6)(i). The relief granted is authorized by law and will not endanger the common defense and security and is otherwise in the public interest, giving due consideration to the burden upon the licensee if the ASME Code requirement was imposed on the facility. The relief is granted for the fourth 10-year IST program interval of BVPS-1.

3.5 <u>Relief Request No. PRR6</u>

3.5.1 Code Requirements/Components Affected

The licensee requested relief for the boric acid transfer (BAT) pumps 1CH-P-2A and 1CH-P-2B from the flow rate determination and recording requirements of the ASME OM Code, ISTB-5121, “Group A Test Procedure,” and ISTB Table-3000-1, “Inservice Test Parameters.”

3.5.2 Licensee’s Basis for Request

The licensee stated:

> Testing the [BAT] Pumps using the emergency boration flow path is impractical during power operation because it would inject water with higher concentration of boric acid into the Reactor Coolant System [RCS], which would result in a reactivity transient and subsequent reactor shutdown. Therefore, the Code-required quarterly testing is performed using an alternate test loop. The pumps are Group A tested quarterly through RO-1CH-ORBA-1(2), the restricting orifices in the minimum flow fixed resistance recirculation lines. However, there are no installed flow instruments in these recirculation lines. Because of the restricting orifices, the flow is assumed to be fixed and at its reference value. Delta-P and vibration are then measured and compared to the acceptance criteria.
>
> NUREG-1482, Rev.1, Section 5.9, "Pump Testing Using Minimum Flow Return Lines With or Without Flow Measuring Devices", in part states; In cases where only the minimum flow return line is available for pump testing, regardless of the test Interval, the staffs position is that flow instrumentation that meets the requirements of Subsection ISTB-3500 should be installed in the minimum flow return line. Installation of this (Cont.) instrumentation is necessary to provide flow rate measurements during pump testing so that this data can be evaluated with the measured pump differential pressure to monitor for pump hydraulic degradation. The guidance provided in GL 89-04, Position 9 still applies.
>
> Since a full flow loop exists that can be easily instrumented and utilized only during certain plant operating modes, the guidance provided in GL 89-04, Position 9, for non-instrumented minimum flow paths shall be followed during the quarterly Group A test.
>
> Position 9 of GL 89-04 states that, "In cases where flow can only be established through a non-instrumented minimum flow path during quarterly pump testing and a path exists at cold shutdowns or refueling outages to perform a test of the pump under full or substantial flow conditions, the staff has determined that the increased interval is an acceptable alternative to the Code requirements, provided that pump differential pressure, flow rate, and bearing vibration measurements are taken during this testing and that quarterly testing also measuring at least pump differential pressure and vibrations is continued."
>
> In accordance with Position 9 of the GL 89-04, the pumps have also been tested through their full-flow recirculation flow paths through [HCV-1CH-110(105)], at a refueling frequency. For the full-flow recirc test, the flow is measured by a portable ultrasonic flow meter that has been "wet-flow" calibrated to within the ±2% accuracy required by Table ISTB-3500-1.
>
> In order to install the flow meters, however, the insulation on the piping must be

removed and the heat trace elements must be moved away from where the transducers and tracks will be installed. Moving the heat trace elements places stresses on them, which increases the probability of failure of the heat trace elements. The heat tracing on the boric acid piping is needed to support system operability. Therefore, it is impractical to test the pumps quarterly and at a cold shutdown frequency. A review of past test results has shown that this combination of quarterly Group A testing and refueling frequency Comprehensive testing is capable of assessing pump performance and detecting degradation.

The use of the portable ultrasonic flow meter and full-flow recirc flow path was considered for the quarterly test. It was determined, however, that use of the full-flow recirc line was impractical for quarterly testing. Testing quarterly using the temporary ultrasonic flow meter would lead to the increased probability of failure of the heat trace elements and to increased dose for the laborers who remove/reinstall the insulation and the technicians who install the flow meters.

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

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

3.5.3 Licensee's Proposed Alternative Testing

The licensee stated:

Perform the quarterly Group A test through a fixed-resistance noninstrumented minimum-flow recirculation line assuming flow to be constant and measuring delta-P in 1OST-7.1(2) (Boric Acid Transfer Pump Operational Tests) and perform the full flow Comprehensive test at least once every 2 years, through a larger recirculation line, using a portable ultrasonic flow meter in 1OST-7.13(14) (Boric Acid Transfer Pump Full-Flow Tests).

Separate vibration reference and acceptance criteria values will be used for the different test conditions of the recirc and full-flow tests.

3.5.4 Staff Evaluation

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

The licensee’s proposed alternative is consistent with the NRC staff’s Position 9, outlined in NRC GL 89-04, except for the time (i.e., cold shutdown or refueling outages) of performance of the full flow test. In Position 9 of GL 89-04, the NRC staff stated, “In cases where flow can only be established through a non-instrumented minimum-flow path during quarterly pump testing and a path exists at cold shutdowns or refueling outages to perform a test of the pump under full or substantial flow conditions, the NRC staff has determined that the increased interval is an acceptable alternative to the ASME Code requirements provided that pump differential pressure, flow rate, and bearing vibration measurements are taken during this testing and that quarterly testing also measuring at least pump differential pressure and vibration is continued.”

The quarterly test can be performed through a non-instrumented full-flow recirculation line. However, Position 9 of GL 89-04 does not address on-line testing through a non-instrumented full-flow recirculation line. The test using a full-flow recirculation line requires the installation of a portable ultrasonic flow meter to determine the system flow rate. Installation of the portable flow meter requires removal of the piping insulation and movement of the heat trace elements away from where the transducers and tracks will be installed. Moving the heat trace elements places stresses on them, which increases the probability of failure of the heat trace elements. Permanently installing the flow meters would require a design change to the plant and the purchase of additional flow instrumentation. Therefore, it is impractical to test the pumps through the full-flow recirculation line quarterly and at cold shutdown frequency.

While performing the Group A test through a fixed-resistance mini-flow recirculation line, the flow may be assumed to be fixed at its reference value, and then delta-P and vibration can be measured and compared to the acceptance criteria. Performing a comprehensive pump test at least once every 2 years through a larger recirculation line is consistent with the full-flow test outlined in Position 9 of GL 89-04. Therefore, the NRC staff finds that the licensee’s proposed IST alternative to test the BAT pumps: (1) quarterly through a fixed-resistance minimum flow recirculation line, measuring pump differential pressure and vibration and (2) once at least every 2 years (while on-line or during shutdown conditions) through a larger full-flow recirculation line, measuring pump differential pressure, flow rate (using a portable ultrasonic flow meter), and vibration, as described in Relief Request No. PRR6, provides an adequate method to assure operational readiness of the pumps.

3.5.5 Conclusion

Based on the above evaluation, the NRC staff has concluded that compliance with the ASME Code requirement for testing is impractical for the BAT pumps, and considering the burden on the licensee if the ASME Code requirement is imposed, relief is granted from the ASME Code requirement and the alternative is imposed, pursuant to 10 CFR 50.55(f)(6)(i). The relief granted is authorized by law and will not endanger the common defense and security and is otherwise in the public interest, giving due consideration to the burden upon the licensee if the ASME Code requirement was imposed on the facility. This alternative is authorized for the fourth 10-year IST program interval of BVPS-1.

3.6 Relief Request No. PRR-7

3.6.1 Code Requirements/Components Affected

The licensee requested relief from ISTB-3400, "Frequency of Inservice Tests," and Table ISTB-3400-1, "Inservice Test Frequency," which require Group A pumps to be tested on a quarterly frequency. Relief was requested for the following pumps:

RHR pump 1RH-P-1A
RHR pump 1RH-P-1B

3.6.2 Licensee's Basis for Request

The Residual Heat Removal (RHR) Pumps are in a standby condition during power operation, and are not required to be in service until the Reactor Coolant System (RCS) temperature is ≤ 350F and RCS pressure is ≤ 430 psig. Therefore, they are not exposed to operational wear except when the RCS is at low temperature and pressure and the RHR System is in operation for normal shutdown cooling.

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 2235 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 prevent 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 (caution tagged). 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 overpressurization. Major plant and system modifications would be needed to allow quarterly Group A testing of the RHR pumps according to ASME OM Code requirements.

In addition, although overpressure precludes testing of the RHR pumps, they are also located inside containment. Testing at power, subsequent to system modification, would require test personnel to make a containment entry in order to monitor pump operation. Since radiation levels and air temperature inside containment are higher than normal during power operation, this would involve higher radiological dose rates and heat stress risks to plant personnel. This presents a working environment for station personnel that is not considered practicable for quarterly surveillance testing on a routine basis while on-line.

Based on the above, compliance with the ASME OM Code test frequency requirement for Group A pump tests is impractical. Testing is only possible during a surveillance interval frequency of cold shutdown and refueling.

3.6.3 Licensee's Proposed Alternative Testing

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

3.6.4 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 they have determined that quarterly testing of the RHR pumps is impractical. As such, the licensee has proposed an alternative to the requirements that would test the RHR pumps during cold shutdown or refueling outages, but not more than once every 92 days. For a cold shutdown or refueling outage that extends longer than 3 months, the pumps will be tested every 3 months in accordance with Table ISTB-3400-1. In the instance of an extended outage, a Group A test may be performed; otherwise, a comprehensive test will be performed each refueling.

The RHR pumps are low-pressure (600 psig design pressure) pumps which 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 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.

3.6.5 Conclusion

Based on the above evaluation, the NRC has concluded that compliance with the Code requirement for testing is impractical for the RHR pumps, and considering the burden on the licensee if the Code requirement is imposed, relief is granted from the Code requirement and the alternative is imposed, pursuant to 10 CFR 50.55a(f)(6)(i). The relief granted is authorized by law and will not endanger the common defense and security and is otherwise in the public interest, giving due consideration to the burden upon the licensee if the Code requirement was imposed on the facility. This alternative is authorized for the fourth 10-year IST program interval of BVPS-1.

3.7 Relief Request No. PRR8

3.7.1 Code Requirements/Components Affected

ISTB-3300, "Reference Values"

ISTB-3300(a) requires that initial reference values shall be determined from the results of testing meeting the requirements of ISTB-3100, "Preservice Testing," or from the results of the first inservice test.

ISTB-3300(d) requires that reference values shall be established at a point(s) of operation (reference point) readily duplicated during subsequent tests.

ISTB-3300(f) requires that all subsequent test results shall be compared to these initial reference values or to new reference values established in accordance with ISTB-3310, ISTB-3320, or ISTB-6200(c).

ISTB-5120, "Inservice Testing" (Centrifugal Pumps, Except Vertical Line Shaft Centrifugal Pumps)

ISTB-5121(e) and ISTB-5123(e), "Group A Test Procedure and Comprehensive Test Procedure," require that all deviations from the reference values shall be compared with the ranges of Table ISTB-5100-1 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-5100-1. For example, if vibration exceeds either $6V_r$, or 0.7 in/sec, the pump is in the required action range.

ISTB-5220, "Inservice Testing" (Vertical Line Shaft Centrifugal Pumps)

ISTB-5221(e) and ISTB-5223(e), "Group A Test Procedure and Comprehensive Test Procedure," require that all deviations from the reference values shall be compared with the ranges of Table ISTB-5200-1 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-5200-1. For example, if vibration exceeds either $6V_r$, or 0.7 in/sec, the pump is in the required action range.

ISTB-5320, "Inservice Testing" (Positive Displacement Pumps, Except Reciprocating)

ISTB-5321(e) and ISTB-5323(e), "Group A Test and Comprehensive Test Procedure," require that all deviations from the reference values shall be compared with the ranges of Table ISTB-5300-1 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-5300-1. For example, if vibration exceeds either $6V_r$, or 0.7 in/sec, the pump is in the required action range.

Note: BVPS-1 has no reciprocating positive displacement pumps in the IST Program.

Table 1

Pump No.	Description	Class	Group A or Group B	Speed (rpm)
1-CH-P-2A	Boric Acid Transfer Pump	3	A	3510/ 1765
1-CH-P-2B	Boric Acid Transfer Pump	3	A	3510/ 1765
1-EE-P-1A	Diesel Generator Fuel Oil Transfer Pump	3	B	1150

1-EE-P-1B	Diesel Generator Fuel Oil Transfer Pump	3	B	1150
1-EE-P-1C	Diesel Generator Fuel Oil Transfer Pump	3	B	1150
1-EE-P-1D	Diesel Generator Fuel Oil Transfer Pump	3	B	1150
1-FW-P-3A	Motor Driven Auxiliary Feedwater Pump	3	B	3580
1-FW-P-3B	Motor Driven Auxiliary Feedwater Pump	3	B	3580
1-QS-P-4A	Chemical Injection Pump	2	B	1170
1-QS-P-4B	Chemical Injection Pump	2	B	1170
1-QS-P-4C	Chemical Injection Pump	2	B	1170
1-QS-P-4D	Chemical Injection Pump	2	B	1170
1-RH-P-1A	Residual Heat Removal Pump	2	A	1200
1-RH-P-1B	Residual Heat Removal Pump	2	A	1200
1-WR-P-1A	River Water Pump	3	A	1185
1-WR-P-1B	River Water Pump	3	A	1185
1-WR-P-1C	River Water Pump	3	A	1185

3.7.2 Licensee's Basis for Request

The above pumps in the BVPS-1 IST Program have at least one vibration reference value (Vr) that is currently less than 0.05 in/sec. A small value for Vr produces a small acceptable range for pump operation. The ASME OM Code Acceptable Range limit for pump vibrations from Table ISTB-5100-1, Table ISTB-5200-1, and Table ISTB-5300-1 for both the Group A test and Comprehensive test is $\leq$ 2.5 Vr. Based on a small acceptable range, a smooth running pump could be subject to unnecessary corrective action if it exceeds this limit. ISTB-6200(a), "Corrective Action - Alert Range", states; If the measured test parameter values fall within the alert range of Table ISTB-5100-1, Table ISTB-5200-1, or Table ISTB-5300-1, as applicable, the frequency of testing specified in ISTB-3400 shall be doubled until the cause of the deviation is determined and the condition is corrected.

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

In order to avoid unnecessary corrective actions, a minimum value for Vr of 0.05 in/sec is proposed. This minimum value would be applied to individual vibration locations for those pumps with reference vibration values less than 0.05 in/sec. Therefore, the smallest ASME OM Code Acceptable Range limit for any IST pump vibration location would be no lower than 2.5 times Vr, or 0.125 in/sec, which is within 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 location for which the pump would be inoperable would be no lower than 6 times Vr, or 0.300 in/sec.

ASME XI, Table IWP-3100-2, "Allowable Ranges of Test Quantities", specifies a vibration Acceptable Range limit of 1.0 mil for a displacement reference value _<0 .5 mils. In velocity units, a displacement reference value of 0.5 mils is equivalent to 0.047 in/sec for an 1800 rpm pump and 0.094 in/sec for a 3600 rpm pump.

The effective minimum reference value proposed (0.05 in/sec) for smooth running pumps is roughly equal to the ASME XI IWP reference value for an 1800 rpm pump and more conservative than the reference value for a 3600 rpm pump. Without this relief, the ASME XI Acceptable Range limit for some extremely smooth running pumps is reduced by as much as a factor of 10.

In addition to the requirements of ISTB for IST, the pumps in the BVPS-1 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/or 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: a Condition Report (CR) initiated, increased monitoring to establish a rate of change, review of component specific information to identify cause, and removal of the pump from service to perform maintenance.

All pumps in the IST Program will remain in the BVPS-1 PdM program even if certain pumps have very low vibration readings and are considered to be smooth running pumps.

Using the provisions of this relief 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. Using the provisions of this relief request as an alternative to the vibration acceptance criteria ranges specified in Table ISTB-5100-1, Table ISTB- 5200-1, or Table ISTB-5300-1 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.

3.7.3 Licensee’s Proposed Alternative Testing

The licensee stated:

In lieu of applying the vibration acceptance criteria ranges specified in Table

ISTB-5100-1, Table ISTB-5200-1, or Table ISTB-5300-1, as applicable, smooth running pumps with a measured reference value below 0.05 in/sec for a particular vibration measure location will have subsequent test results for that location compared to an Acceptable Range limit of 0.125 in/sec and an Alert Range limit of 0.300 in/sec (based on a minimum reference value of 0.05 in/sec). These proposed ranges shall be applied to vibration test results during both Group A tests and Comprehensive tests.

In addition to the Code requirements, all pumps in the BVPS-1 IST Program are included in and will remain in the BVPS-1 PdM program regardless of their smooth running status.

3.7.4 Staff Evaluation

The ASME OM Code, paragraph ISTB-3540, requires that for centrifugal pumps, vibration measurements shall be taken in a plane approximately perpendicular to the rotating shaft in two approximately orthogonal directions on each accessible pump-bearing housing. Measurement shall also be taken in the axial direction on each accessible pump thrust bearing housing. The paragraph requires that for vertical line shaft pumps that the vibration measurements be taken on the upper motor-bearing housing in three orthogonal directions including the axial direction. The paragraph requires that for reciprocating pumps, vibration measurements shall be taken on the bearing housing of the crankshaft, approximately perpendicular to both the crankshaft and line of plunger travel. These measurements are required to be compared with the ASME OM Code vibration acceptance criteria as specified in Table ISTB-5100-1, Table ISTB-5200-1, or Table ISTB-5300-1, as applicable, to determine if the measured values are acceptable.

Table ISTB 5100-1, Table ISTB-5200-1, or Table ISTB-5300-1 states that, if during an inservice test, a vibration measurement exceeds 2.5 times the previously established reference value (V_r), the pump is considered in the alert range. The frequency of testing is then doubled in accordance with paragraph ISTB-6200(a), until the cause of the deviation is determined and the condition is corrected and the vibration level returns to the acceptable range level. Pumps whose vibration is measured as greater than 6 times V_r are considered to be in the required action range, and must be declared inoperable until cause of the deviation has been determined and the condition is corrected. Per ISTB-3300, 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-5100-1, Table ISTB-5200-1, or Table ISTB-5300-1, 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 ASME OM Code Subgroup on pumps has tried numerous times to implement an ASME OM Code change to establish test requirements for a class of pumps, defined as smooth-running. These requirements focused on selecting a minimum vibration to be specified in the proposed ASME OM Code change that would assign the minimum reference values. The ASME OM Code committees have not reached a consensus on the appropriate minimum reference value and on whether this approach would be sufficient to determine degradation in safety-related pumps during testing. In addition, the ASME OM Code committees have discussed what other types of pump monitoring activities should be included as compensatory requirements for the testing of smooth-running pumps.

A few plants have been previously authorized to use the smooth-running pump methodology as described above. At one particular plant, the minimum reference value was 0.1 in/sec. However, a pump bearing at this plant experienced significant degradation even though the vibration was below the minimum reference value in the proposed alternative. Had the current ASME OM Code requirements been in place, the bearing vibration level for this pump would have exceeded the alert range. The degradation was discovered during vibration monitoring for a PdM program. After this occurrence, it was clear to the NRC staff that a simple minimum reference value method alone would not be sufficient to determine pump degradation.

The licensee's proposed alternative testing combines the minimum reference value method with a commitment to monitor all the pumps in the IST program with 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-5100-1, Table ISTB-5200-1, or Table ISTB-5300-1 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 predictive monitoring program for all IST program pumps (Table 1) considered important to safe and reliable plant operation. The licensee states the BVPS-1 PdM program goes beyond the IST requirements for pumps. The program includes bearing temperature trending, oil sampling and analysis, and thermographic analysis. The licensee states 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 increased monitoring to establish the rate of degradation, review of component-specific information to identify cause, and removal of the pump from service to perform maintenance. The proposed alternative is consistent with the objective of IST, which is to monitor degradation in safety-related components.

As described above, the NRC staff finds that the alert and required action limits specified in the relief 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 licensee's proposed alternative will provide an acceptable level of quality and safety.

3.7.5 Conclusion

Based on a review of the information provided by the licensee and the above evaluation, the NRC staff has concluded that the licensee's proposed alternative provides adequate indication of pump performance and an acceptable level of quality and safety. Therefore, the alternative to the vibration requirements of ISTB-3300, Table ISTB-5100-1, Table ISTB-5200-1, or Table ISTB-5300-1 of the OM Code is authorized pursuant to 10 CFR 50.55a(a)(3)(i) based on the alternative providing an acceptable level of quality and safety. This alternative is authorized for pumps listed in Table 1 above for the fourth 10-year IST program interval of BVPS-1.

3.8 Relief Request Nos. PRR9 and PRR10

3.8.1 Code Requirements/Components Affected

ISTB-5122 requires that the test parameters in Table ISTB-3000-1 be determined and recorded during Group B quarterly tests. Flow rate is one of the test parameters listed in Table ISTB-3000-1. Section ISTB-3510(a) requires that instruments used for testing be accurate within the specifications in Table ISTB-3500-1. Table ISTB-3500-1 requires that the flow rate be accurate to within ± 2% of the actual flow rate.

The licensee requested relief from the requirement in ISTB-5122 that requires flow rate to be determined and recorded during the Group B quarterly test of AFW pumps 1FW-P-3A, 1FW-P-3B, and 1FW-P-2.

3.8.2 Licensee's Basis for Request

The recirculation flow paths for AFW pumps 1FW-P-3A, 1FW-P-3B, and 1FW-P-2 are not equipped with flow instrumentation that meet the accuracy requirement in Table ISTB-3500-1. Therefore, without system modifications, the flow rate cannot be measured during Group B quarterly testing of the AFW pumps. Section ISTB-5122 states that system resistance may be varied to achieve the reference point. System resistance is not varied during the Group B AFW pump quarterly tests. The flow rate in each recirculation flow path should remain the same for each test because the resistence in each recirculation flow path is fixed. The fixed flow rate in each recirculation path will be the reference point during the Group B quarterly test, and differential pressure across each pump will be measured by instrumentation that meets the requirements of Table ISTB-3500-1. Flow instrumentation that meets the ASME OM Code requirements is not necessary for the AFW pump Group B quarterly test because the flow rate does not have to be adjusted to obtain the reference point. System resistance would be varied and an instrumented flow path would be available to measure and record pump flow rate during the biennial comprehensive pump test for each AFW pump.

3.8.3 Licensee's Proposed Alternative Testing

The licensee proposed to not determine and record the flow rate during the Group B quarterly test of AFW pumps 1FW-P-3A, 1FW-P-3B, and 1FW-P-2.

3.8.4 Staff Evaluation

AFW pumps 1FW-P-3A, 1FW-P-3B, and 1FW-P-2 are categorized as Group B pumps in accordance with the requirements in ISTB-1200 and ISTB-2000. Table ISTB-3400-1 requires that Group B pumps be tested quarterly and biennially. Requirements for the quarterly test are less rigorous than the requirements for the comprehensive test. Quarterly Group B AFW pump tests are normally performed when the plant is operating. Comprehensive AFW pump tests are performed biennially during an outage, shutdown, or startup. Paragraph ISTB-5122 and Table ISTB-3000-1 state that quarterly tests shall be conducted with the pumps operating at a specified reference point.

Each recirculation flow path used for AFW pumps 1FW-P-3A, 1FW-P-3B, and 1FW-P-2 is a fixed resistance flow path. There is no flow instrumentation installed in the flow path. The NRC staff considers the installation of flow instrumentation to be an undue burden when compared to the limited benefits gained by the results of the quarterly pump tests. During the performance of the quarterly pump testing, pump differential pressure will be measured and trended. This provides a reference value for differential pressure that can be duplicated during subsequent tests. Pump flow rate will not be varied, measured, or recorded during the performance of the quarterly AFW pump testing. This methodology provides for the acquisition of repeatable differential pressure during AFW pump Group B quarterly testing, which is an adequate means of providing reasonable assurance of the operational readiness of the pumps. The performance of pump tests using a noninstrumented recirculation flow path is an acceptable alternative per Position 9 of GL 89-04, provided that comprehensive pump testing is also performed biennially. Biennial comprehensive testing requires that AFW pump differential pressure and flow rate be measured and evaluated together to determine pump hydraulic performance.

3.8.5 Conclusion

Based on the above evaluation, the NRC staff has concluded that the licensee’s proposed alternatives to the ASME OM Code testing requirements for the AFW pumps are authorized pursuant to 10 CFR 50.55a(a)(3)(ii), on the basis that complying with the specified ASME OM Code requirements results in hardship or unusual difficulty without a compensating increase in the level of quality and safety. The licensee’s proposed alternatives provide reasonable assurance of the operational readiness of the pumps. The alternatives are authorized for the fourth 10-year IST program interval of BVPS-1.

3.9 Relief Request No. PRR11

3.9.1 Code Requirements/Components Affected

The licensee requested relief from ISTB-3100(b), ISTB-5210(a) and ISTB-3300(e)(1) of the ASME OM Code.

> ISTB-3100, "Preservice Testing," ISTB-3100(b) requires preservice testing of vertical line shaft pumps to be performed in accordance with ISTB-5210, "Preservice Testing." ISTB-5210(a) states that in systems where resistance can be varied, flow rate and differential pressure shall be measured at a minimum of 5 points. If practicable, these points shall be from pump minimum flow to at least pump design flow. A pump curve shall be established based on the measured points. At least one point(s) shall be designated as the reference point(s).
>
> ISTB-3300, "Reference Values," ISTB-3300(e)(1) requires reference values to be established within ± 20% of pump design flow rate for the comprehensive test.

Relief was requested for the following pumps:

1RS-P-1A and 1RS-P-1B, Inside Recirculation Spray Pumps (Code Class 2)

1RS-P-2A and 1RS-P-2B, Outside Recirculation Spray Pumps (Code Class 2)

3.9.2 Licensee’s Basis for Request

The recirculation spray system at the Beaver Valley Power Station Unit No. 1, is designed to recirculate water from the containment sump through coolers to spray containment after a Containment Isolation Phase B signal (CIB) and predetermined time delay. The time delay in starting the recirculation spray pumps allows the containment sump to fill, thereby ensuring adequate NPSH is available for the pumps and to avoid pump operating difficulties due to vortexing. The sump is filled with water from the quench spray system and water from ruptured lines or vessels in the reactor coolant system. Recirculation spray system operation is required during post accident conditions for heat removal to reduce containment pressure to less than 50 percent of the peak calculated pressure for the LOCA within 24 hours after the postulated accident. During the recirculation phase of safety injection, the outside recirculation spray pumps may be manually aligned to provide containment sump water to the high head safety injection pumps. The water is injected into the reactor coolant system for core cooling. The outside recirculation spray pumps are used in this application only when the low head safety injection pumps are unavailable.

The four recirculation spray pumps receive their suction supply from the containment sump. Two pumps are located inside containment and two pumps are located outside containment. The water from the sump is recirculated through recirculation spray coolers where it is cooled by the river water system. The cooled water is then used to spray the containment via four recirculation spray headers and the cycle repeats itself for an extended period after the design basis accident.

The piping configuration for the inside recirculation spray pumps (1 RS-P-1A and 1 B) consists of the pumps receiving suction directly from the containment sump and discharging via ten-inch lines to the recirculation spray coolers. From the coolers, the water flows to the containment spray headers via 12-inch lines. The pump discharge piping is provided with a four-inch recirculation test line which returns flow to the containment sump and is utilized only during pump testing. Locked shut manual isolation valves normally isolate the non-Code four-inch recirculation test line. A spectacle flange is provided in the pump discharge piping to isolate flow to the spray headers during pump testing.

The piping configuration for the outside recirculation spray pumps (1RS-P-2A and 2B) is similar to that of the inside recirculation spray pumps. However, the outside recirculation spray pumps receive their suction from a pump pit, which is provided inventory from 12-inch cross connect lines from the containment sump. The pumps' suction is located below the level of the containment sump. The cross-connect/suction and discharge lines are provided with normally open motor operated valves, which receive an automatic signal to open upon generation of a CIB. In addition, a spectacle flange is provided in the pump discharge piping, which is used to isolate flow to the spray headers during pump testing. The pumps' discharge piping is provided with a six-inch branch connection to the high head safety injection pump suction. To facilitate pump testing, provisions exist for recirculation from the outside recirculation spray pumps discharge to the pump casing. A local flow indicator (FI-1RS-157A, B) is provided in the four-inch recirculation line. When testing the pumps with water the associated spectacle flange must be rotated, the suction and discharge isolation valves closed, and the pump filled with an external supply of primary grade water.

Due to the restrictions associated with the existing piping configuration, ±20% of the design flow rate cannot be achieved through the 4-inch recirculation test line for either set of pumps.

Prior to initial startup, the inside and outside recirculation spray pumps for Unit No. 1 were subject to long term full flow testing. This testing was performed in 1972 as follows:

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

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

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

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

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

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

3.9.3 Licensee’s Proposed Alternative Testing

As an alternative to measuring at least five points for the preservice test over a range from pump minimum flow rate to at least pump design flow rate as required by ISTB-3100(b) and ISTB5210(a), the five points will be obtained within approximately 41 percent of the design flow rate and within approximately 38 to 40 percent of the maximum required accident flow rates. Should a baseline curve be required, the manufacturers curve would be used in conjunction with the pump minimum operating point curves and the points obtained would be reconciled to the manufacturers curve to provide assurance of acceptable pump operation.

The proposed alternative to ISTB-3100(b) and ISTB-5210(a) provides an acceptable level of quality and safety.

As an alternative to testing within 20 percent of the design flow rate during the comprehensive test, as required by ISTB-3300(e)(1) and ISTB-3430, the reference values will be established within approximately 41 percent of the design flow rate (3500 gpm) and within approximately 38 to 40 percent of the maximum required accident flow rates.

The proposed alternative to the requirements specified in ISTB-3300(e)(1) and ISTB-3430 provides an acceptable level of quality and safety and would provide reasonable assurance that the pump would be able to perform its function as well as providing sufficient indication of any potential degradation occurring to the pumps.

Testing will be conducted as follows:

The test circuits identified in Attachment 1 will be used to satisfy preservice testing requirements.

The inside recirculation spray pumps shall have a dike constructed in the containment sump encompassing the pump suction and four-inch recirculation test line return. Sufficient inventory will be provided to establish stable flow conditions through the four-inch recirculation test line. Temporary test instrumentation, of required accuracy, shall be installed as required, in the pump test circuit.

The outside recirculation spray pumps shall be tested by establishing the hydraulic test circuit in a solid condition. Flow shall be recirculated through the pump casing while measuring flow with flow indication provided in the four-inch recirculation test line. Temporary pressure instrumentation shall be utilized at the pumps' suction.

Pump vibration will be measured and recorded in accordance with the criteria specified in the Code. In addition, vibration spectral analysis will also be performed which is a more accurate method of detecting mechanical degradation or changes than that of the traditional inservice test vibration requirements.

The inside and outside recirculation spray pumps have a design flow rate of 3500 gpm with varying maximum required accident flow rates. The table below shows the maximum required accident flow rates for each pump and the range of values within which test flows are established.

The minimum test flow rate for recirculation spray pump 1R-P-1A is 38 percent less than the maximum required accident flow rate of 3320 gpm. This percentage of the maximum required accident flow rate is specified for recirculation spray pump 1R-P-1A and the percentages for other recirculation spray pumps are listed in the table below.

Pump ID	Accident Flow	Test Flow	Percent of Accident Flow
1RS-P-1A	3320 gpm	2050-2075 gpm	-38%
1RS-P-1B	3370 gpm	2050-2075 gpm	-39%
1RS-P-2A	3385 gpm	2040-2060 gpm	-40%
1RS-P-2B	3340 gpm	2040-2060 gpm	-39%

Presently, the inservice test reference flow rates are typically established with the existing test circuit in the range of 2040 to 2075 gpm. The low reference flow rates result from restrictions due to the small four-inch recirculation line and the limited volume of water in the test circuit.

With the restrictions described, the highest flow rate that can be measured while maintaining stable test conditions is within approximately 41 percent of the 3500 gpm design flow rate and within approximately 38 to 40 percent of the maximum required accident flow rates.

In the 2040 to 2075 gpm range of the head curve for these pumps, the curve is not flat but well sloped. [Refer to figures PRR11-3 to PRR11-6]. Therefore, as performance degrades due to internal recirculation caused by increasing internal pump clearances, the differential pressure will measurably decrease for a given reference flow rate.

To be within 20 percent of pump design flow rate on the low end requires a minimum reference flow rate of 2800 gpm. To be within 20 percent of the maximum required accident flow rate would require minimum reference flow rates ranging from 2656 to 2708 gpm, depending on the pump being tested. For the reasons previously stated, reference flow rates are procedurally controlled within a range of 2040 to 2075 gpm, which is not within the 20 percent of the design flow rate required during the comprehensive test.

Testing at near design flow rate conditions is important for pumps with characteristic head-flow curves that are flat or gently sloping in the low flow region (little change in developed head with increasing flow rate). In the low flow region, increasing internal flow rates, as a result of internal wear, are difficult to detect. Pumps with the flat portion of the curve at low flow rates should be tested at or near design conditions to determine if increasing internal recirculation flow rates have degraded pump performance to the point where design performance cannot be met. This situation does not apply to the inside and outside recirculation spray pumps if they are tested within approximately 41% of the design flow rate when considering the slope of the curve. Testing at the proposed reference flow rates will detect degradation since the pump head-curve is well sloped at the point of testing.

In addition to the aforementioned tests, the inside and outside recirculation spray pumps are included in the [BVPS-1 PdM] Program. All pumps have spectral vibration data obtained each refueling outage. The outside recirculation spray pumps are subject to periodic oil sample analysis. The bearings associated with the inside recirculation spray pumps are grease lubricated. These activities are beyond that required by [Subsection] ISTB and further provide assurance as to the ability to detect pump degradation. Also, as a preventive maintenance activity, the pumps' mechanical seals are replaced every seventh refueling outage.

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

Historically, the pumps have demonstrated excellent performance during surveillance testing. The only corrective maintenance recorded for the pumps was associated with inside recirculation spray pump 1RS-P-1A. As a result of a failed surveillance test on March 23, 2000, during the thirteenth maintenance and refueling outage, the pump was disassembled for inspection and overhaul. A piece of lumber was found lodged in the pump impeller. The resulting Condition Report determined that the wood had been left in the pump suction since initial startup and became unlodged during the surveillance test. A post-maintenance test was performed and acceptable results were obtained on March 31, 2000. Additional corrective maintenance for 1RS-P-1A includes the repair of pump seal leakage detected during surveillance testing performed in 1993. Following impeller replacement on March 31, 2000, a five point pump curve was obtained between 1376 gpm and 2077 gpm. Although the new pump curve was below the manufacturer's curve, it generally followed the shape of the manufacturer's curve. Based on this, it was expected that the new pump's performance would continue to follow the shape of the manufacturer's curve at higher flows and also provide adequate margin above the MOP [Minimum Operating Point] Curve at higher flows. Pump operation since the new impeller was installed has continued to be satisfactory at its tested flow rate of approximately 2050 gpm.

3.9.4 Staff Evaluation

The inside recirculation spray pumps supply water from the containment sump to the spray headers to remove heat and reduce containment pressure to less than 50% of the peak calculated pressure for a LOCA within 24 hours after the postulated accident. The outside recirculation spray pumps provide containment sump water to the high head safety injection pumps to inject water into the RCS for core cooling. There are two inside recirculation pumps. The test loop for the inside recirculation pumps consists of a 10-inch discharge line feeding into a 4-inch recirculation line, which feeds back to the pump sump. The test loop for the outside recirculation pumps also consists of a 4-inch recirculation line; however, the recirculation from the outside recirculation pumps discharges to the pump casing. Pump design flow cannot be established using these test loops because of the 4-inch recirculation line size. Also, the discharge piping was not designed to be temporarily reconfigured so that pump design flow can be achieved.

The licensee stated that prior to initial startup, the inside and outside recirculation spray pumps were subject to long term full flow testing. To perform the full flow test, 780 spray nozzles were

replaced with plugs, temporary connections were made between the nozzle headers and containment sump. Sufficient water was then added to the containment sump so that a recirculation spray pump could recirculate water through its respective spray header.
The startup test also served to completely flush the system to remove any particulate matter, which could potentially plug the spray nozzles at a future time. Upon completion of the test, water was drained from each recirculation cooler, pump, header and sump. The temporary connections between the head and sumps were removed and the spray nozzles were reinstalled.

The licensee stated, “Re-establishing this full flow test loop fo the purpose of periodic design flow rate testing would require a similar modification every two years.” The licensee also states that the spray headers are inaccessible without a significant amount of scaffolding. Even if the nozzles were accessible, plugging 780 spray nozzles, installing temporary piping, running the full-flow test, and returning the system to its original operable configuration would cause hardship to the licensee. Replacement of the 4-inch recirculation test line with a line of sufficient size to accommodate design flow rate testing would also cause hardship.

As an alternative to measuring at least five points for the preservice test over a range of pump minimum flow rate to at least pump design flow rate as required by ISTB-3100(b) and ISTB-5210(a), the licensee proposes to obtain the five points within 41% of the design flow rate and within approximately 38 to 40% of the maximum required accident flow rate. The low reference flows are limited due to the size of 4-inch recirculation line.

As an alternative to testing within 20% of the design flow rate during the comprehensive test as required by ISTB-3300(e)(1), the reference values will be established within approximately 41% of the design flow rate (3500 gpm) and within approximately 38 to 40% of the maximum required accident flow rate.

The licensee stated, “The inside and outside recirculation spray pumps have a design flow rate of 3500 gpm with varying maximum required accident flow rates.” For the reason stated above, the reference flows are established in the range of 2040 to 2075 gpm, which is not within 20% of design flow. Testing at design flow is important because the reduction in total developed head (TDH) increases as the pump flow increases. If testing data at lower flow rates is used as an indicator of pump hydraulic performance deterioration at the design flow of the pump, it would lead to a misrepresentative conclusion. Testing at design flow is especially important for pumps with head-flow curves that are flat or gently sloping in the low flow region (pump whose developed head changes little with increasing flow). In the low flow region, increasing internal flow rates, as a result of internal wear, are difficult to detect. Pumps with the flat curves at low flows should be tested at or near design conditions to determine if increasing internal recirculation flows have degraded pump performance to the point where design performance cannot be met. However, at within 41% of design flow of the inside and outside recirculation spray pumps, the head curves are not flat but well sloped. Testing at the proposed reference flow rates will detect degradation since the TDH changes noticeably with increase in flow.

Similar relief requests were granted for the North Anna Station recirculation spray pumps (Reference 3.9.6.1) and the Seabrook Station containment spray pumps (Reference 3.9.6.2). The typical pump shutoff, test and design/accident head-flow data for North Anna Station, Seabrook Station and BVPS-1 are summarized in the table on Figure PRR11-7. Based on these head-flow data, the typical pump head-flow curves for the three plants were plotted for comparison purposes. As can be seen from the figure, the curves for the three plants have similar shape and are well sloped (The developed head at the test flow rate for BVPS-1 is 20% below the pump shut off head). Therefore, testing at the reference flows for BVPS-1 will detect pump degradation because pump curve is well sloped at the point of testing.

As discussed above, testing at a lower flow may lead to underprediction of pump degradation at the design flow. Therefore, additional monitoring or maintenance should be included to compensate the limitation of testing at lower flow. The licensee states that the inside and outside recirculation spray pumps are also included in the BVPS-1 PdM program. All pumps will have spectral vibration data obtained each refueling outage. The outside recirculation spray pumps are subject to periodic oil sample analysis. The bearings associated with the inside recirculation spray pumps are grease lubricated. These activities are beyond that required by Subsection ISTB and provide further provide assurance as to the ability to detect pump degradation. Also, as a preventive maintenance activity, the pumps' mechanical seals are replaced every seventh refueling outage. If measured parameters are outside the normal operating range or are determined by analysis to be trending toward a degraded state, the licensee will take appropriate actions. These actions may include monitoring of additional parameters, review of component-specific information to identify cause and removal of the pump from service to perform corrective maintenance.

The licensee also stated, "Historically, the pumps have demonstrated excellent performance during surveillance testing." Corrective maintenance recorded for the pumps was associated with inside recirculation spray pump 1RS-P-1A in 2000. The failed surveillance test was caused by a piece of lumber lodged in the pump impeller. A post-maintenance test was performed and acceptable results were obtained. Additional corrective maintenance for 1RS-P-1A includes the repair of pump seal leakage detected during surveillance testing performed in 1993.

Based on a review of the provided pump curves and information regarding the BVPS-1 PdM program, the NRC staff finds that the alternative provides reasonable assurance of the operational readiness and compliance with the specified ASME OM Code requirement would result in hardship without a compensating increase in the level of quality and safety.

3.9.5 Conclusion

Based on the above evaluation, the NRC staff has concluded that the licensee's proposed alternative to the ASME OM Code testing requirements for the inside and outside recirculation spray pumps is authorized pursuant to 10 CFR 50.55a(a)(3)(ii), on the basis that complying with the specified ASME OM Code requirements results in hardship without a compensating increase in the level of quality and safety. The licensee's proposed alternative provides reasonable assurance of the operational readiness of the pumps. The alternative is authorized for the fourth 10-year IST program interval of BVPS-1.

3.9.6 References

1. Safety Evaluation of Relief Requests Associated with the Third 10-year Interval Inservice Testing Program for Pumps and Valves for North Anna Power Station, Units 1 and 2 (TAC Nos. MB2221 and MB2222), January 1, 2002 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML020070461).

2. Seabrook Station, Unit No. 1 - Relief from ASME Code Operations and Maintenance Code ISTB 4.3(e)(1) Ten-year Interval Inservice Test for Containment Spray Pumps CBS-P9A and CBS-P9B (TAC No. MB6676), May 30, 2003 (ADAMS Accession No. ML031070510).

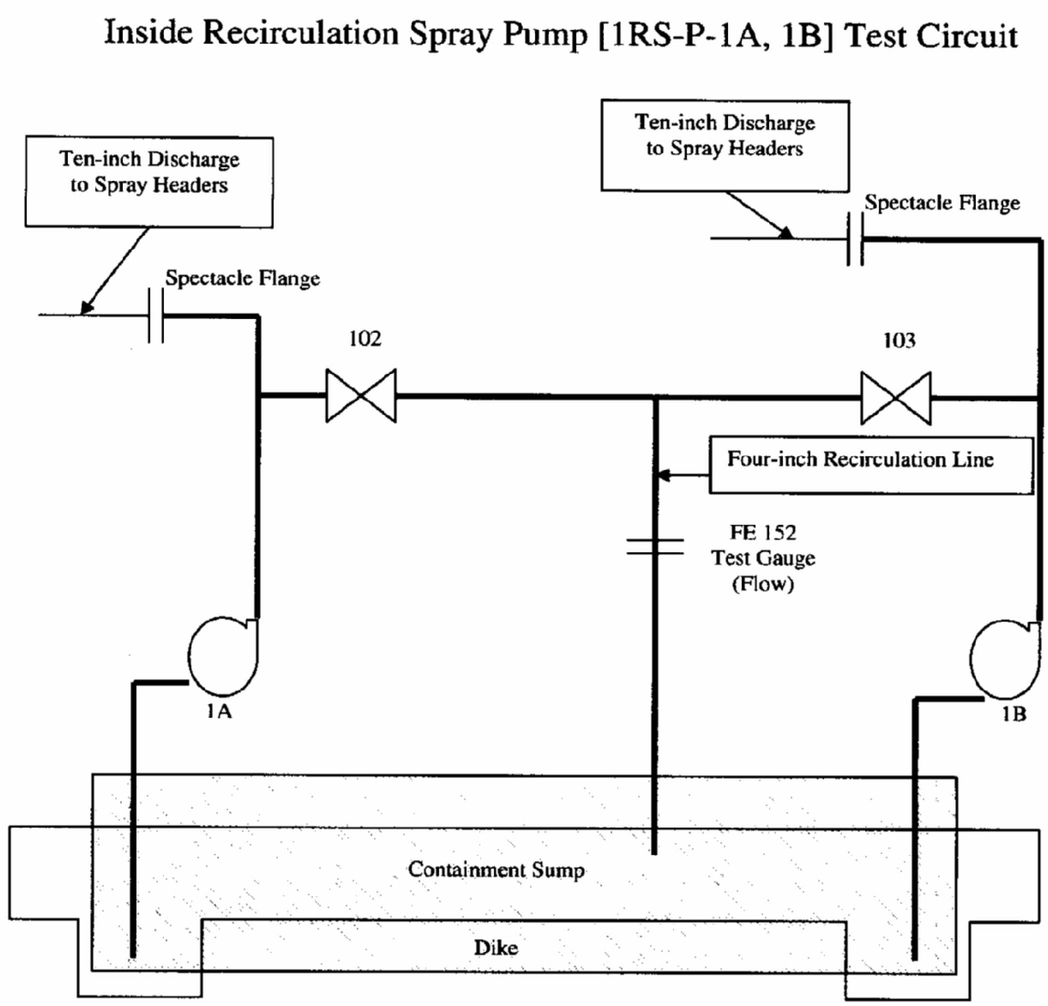


Figure PRR11-1: Inside Recirculation Spray Pump Test Circuit

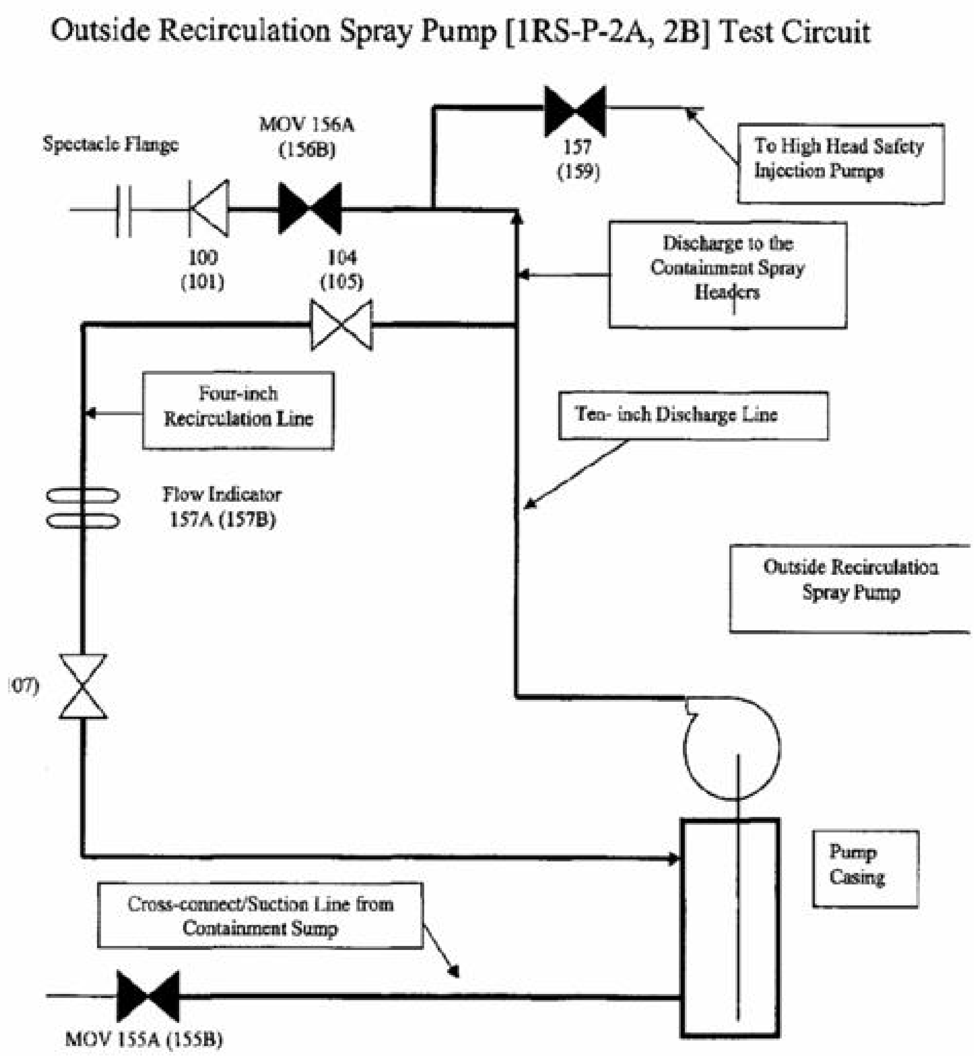
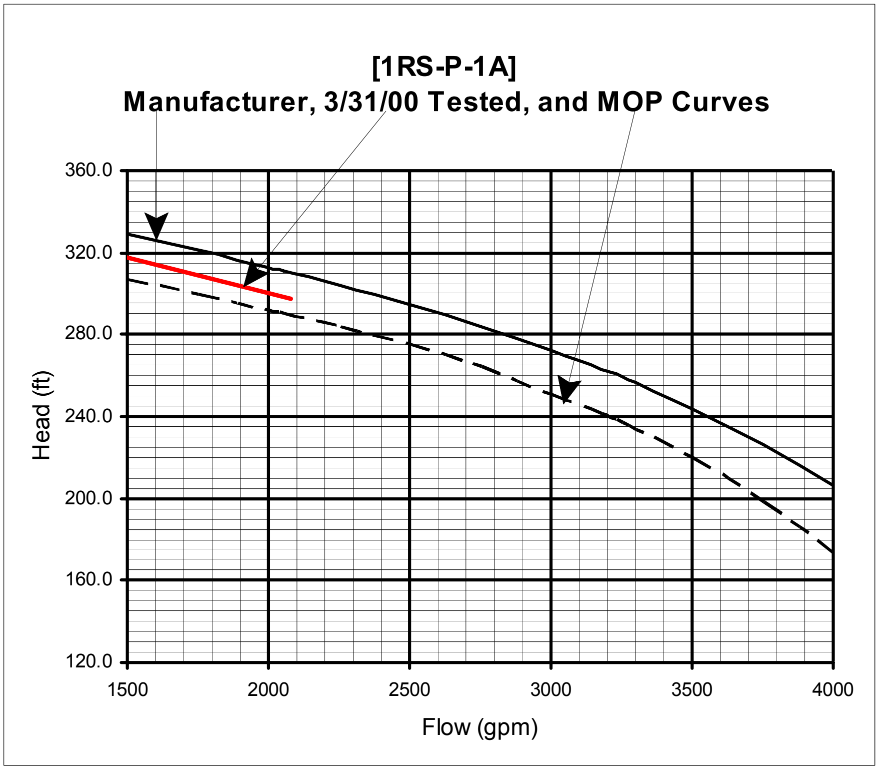


Figure PRR11-2: Outside Recirculation Spray Pump Test Circuit



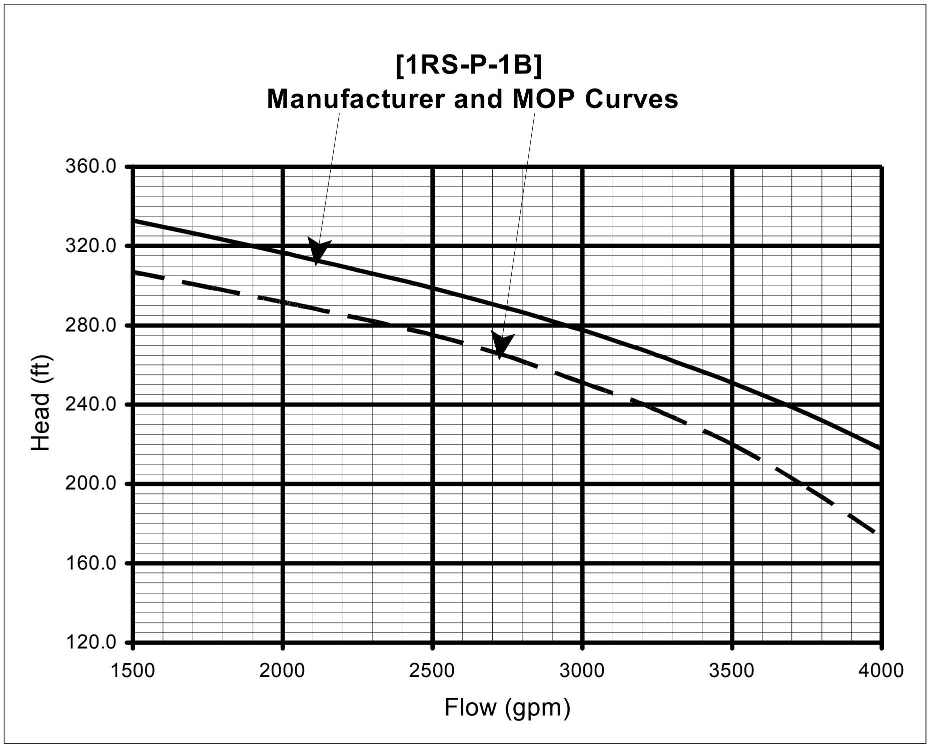
Flow	3/31/00 Pump Curve Head
1376	322.0
1579	317.4
1889	303.5
2065	300.1
2077	297.7

Flow	Manufacturer's Curve Head	MOP Curve Head
1500	329.2	306.9
1750	321.0	299.3
2000	312.7	291.7
2050	311.0	290.2
2250	304.0	283.7
2500	294.6	275.0
2750	284.2	264.2
3000	272.4	251.0
3180	263.0	241.4
3250	259.1	237.0
3500	243.8	220.0
3750	226.3	198.2
4000	206.2	173.0

Figure PRR11-3

MANUFACTURER'S AND PUMP MINIMUM OPERATING POINT (MOP) CURVES

1A Inside Recirculation Spray Pump: 1RS-P-1A

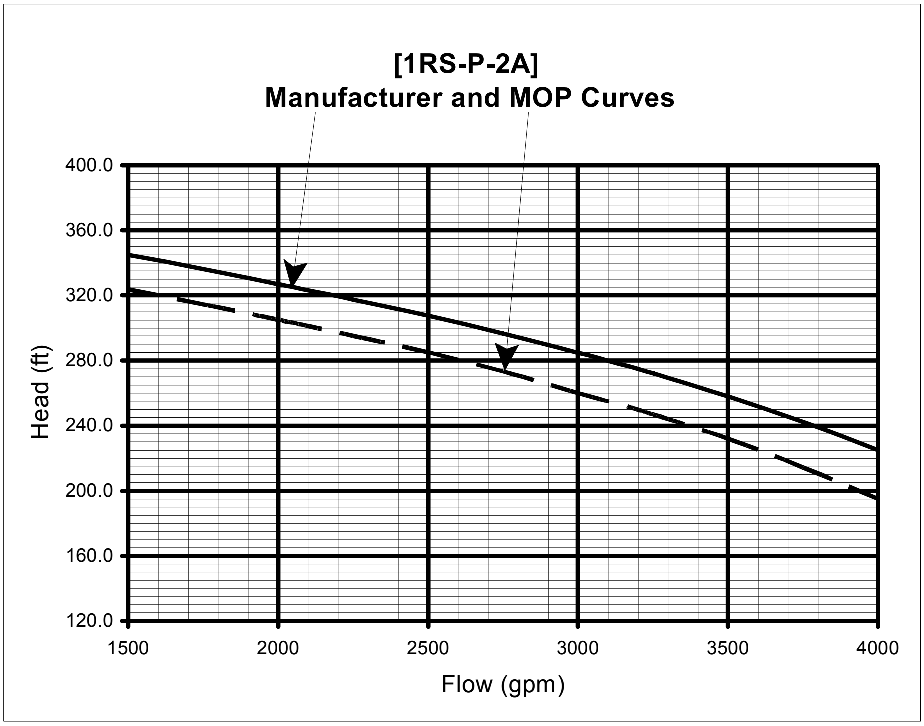


Flow	Manufacturer's Curve Head	MOP Curve Head
1500	332.8	306.9
1750	324.8	299.3
2000	316.6	291.7
2050	314.9	290.2
2250	308.0	283.7
2500	298.7	275.0
2750	288.6	264.2
3000	277.5	251.0
3180	268.6	241.4
3250	265.0	237.0
3500	251.0	220.0
3750	235.3	198.2
4000	217.7	173.0

Figure PRR11-4

MANUFACTURER'S AND PUMP MINIMUM OPERATING POINT (MOP) CURVES

1B Inside Recirculation Spray Pump: 1RS-P-1B

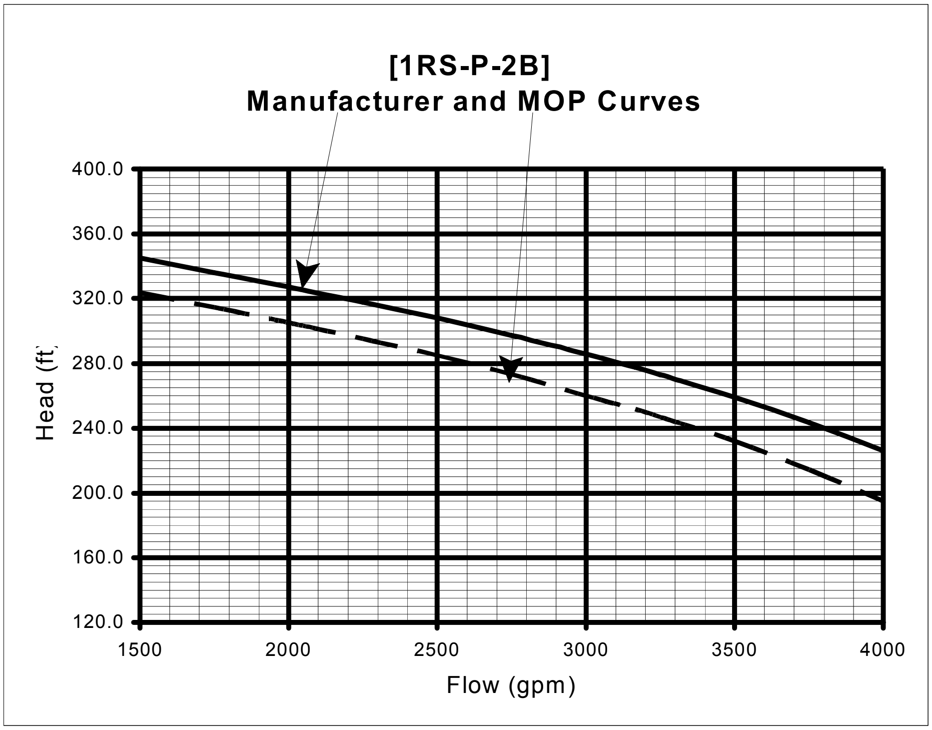


Flow	Manufacturer's Curve Head	MOP Curve Head
1500	345.1	323.7
1750	336.2	314.6
2000	327.0	305.2
2040	325.5	303.6
2050	325.2	303.2
2250	317.5	295.3
2500	307.4	285.0
2750	296.6	273.3
3000	284.9	260.0
3165	276.6	251.7
3250	272.1	246.8
3500	258.0	232.0
3750	242.4	214.3
4000	225.1	195.0

Figure PRR11-5

MANUFACTURER'S AND PUMP MINIMUM OPERATING POINT (MOP) CURVES

2A Outside Recirculation Spray Pump: 1RS-P-2A



Flow	Manufacturer's Curve Head	MOP Curve Head
1500	345.1	323.7
1750	336.2	314.6
2000	327.2	305.2
2040	325.7	303.6
2050	325.4	303.2
2250	317.9	295.3
2500	308.0	285.0
2750	297.4	273.3
3000	285.8	260.0
3165	277.6	251.7
3250	273.1	246.8
3500	259.1	232.0
3750	243.5	214.3
4000	226.1	195.0

Figure PRR11-6

MANUFACTURER'S AND PUMP MINIMUM OPERATING POINT (MOP) CURVES

2B Outside Recirculation Spray Pump: 1RS-P-2B

	Beaver Valley 1 (Pump 1RS-P-2A)			North Anna			Seabrook (Pump CBS-9B)		
	Shutoff	Test	Design/ Accident	Shutoff	Test	Design/ Accident	Shutoff	Test	Design/ Accident
Flow (gpm)	0	2050	3385	0	1500	3640	0	1900	2808
Total Developed Head (feet)	404.9	325.2	264.5	435	380	290	700	645	560

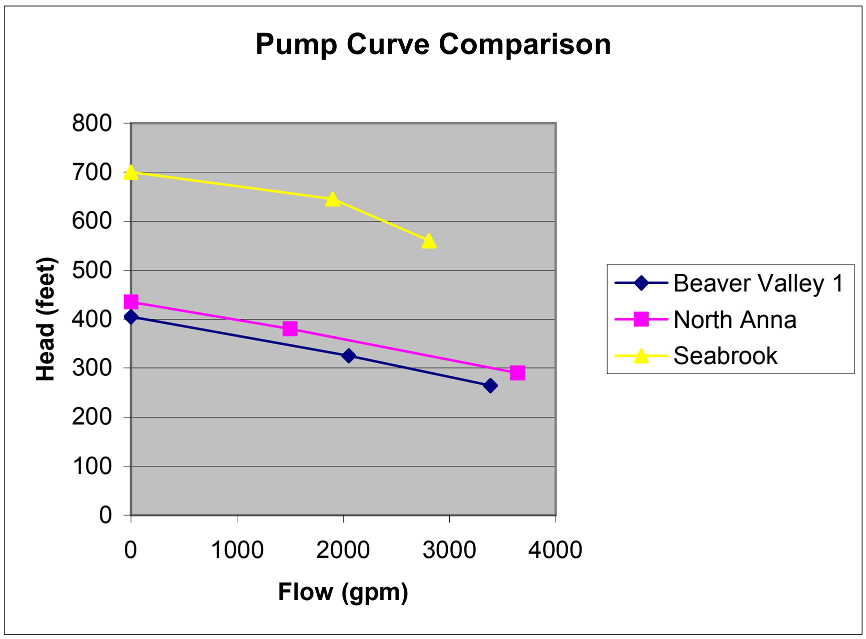


Figure PRR11-7

Comparison of Beaver Valley Unit 1, North Anna, and Seabrook Pump Curves

3.10 Relief Request No. PRR12

3.10.1 Code Requirements/Components Affected

The licensee requested relief from ISTB-3100(a), ISTB-5110(a), and ISTB-3300(e)(1) of the ASME OM Code.

ISTB-3100, "Preservice Testing," ISTB-3100(a) requires preservice testing of centrifugal pumps to be performed in accordance with ISTB-5110, "Preservice Testing." ISTB-5110(a) states that in systems where resistance can be varied, flow rate and differential pressure shall be measured at a minimum of five points. If practicable, these points shall be from the pump minimum flow to at least the design flow. A pump curve shall be established based on the measured points. At least one point shall be designated as the reference point.

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

Relief was requested for the following pumps:

1QS-P-1A, Quench Spray Pump, (Class 2)
1QS-P-1B, Quench Spray Pump, (Class 2)

3.10.2 Licensee's Basis for Request

The quench spray system at the Beaver Valley Power Station Unit No. 1 is designed to provide cold water from the refueling water storage tank (RWST) after a Containment Isolation Phase B (CIB) signal, chemically treat the water and spray containment. This function is required during post accident conditions for heat removal to reduce containment pressure. Containment depressurization is required to eliminate leakage out of containment after a CIB and to ensure containment integrity. The quench spray flow is treated with sodium hydroxide (NaOH) to improve removal of radioactive iodine from the containment atmosphere and to control containment sump pH. The system is provided with two 100 percent capacity redundant trains, each having a design discharge capacity of 2500 gpm. The quench spray pumps are manually stopped when the RWST water level drops below a predetermined level to prevent cavitation. Subsequent to stopping the quench spray pumps, recirculation spray pumps will continue spray flow to the containment.

The piping configuration for the quench spray pumps (1QS-P-1A and 1 B) consists of the pumps receiving suction from the RWST and discharging to the containment through ten-inch lines supplying the quench spray headers. The pumps discharge piping is provided with four-inch recirculation test lines, which by design, are provided for intermittent testing of the quench spray pumps.

Flow testing is performed by opening the locked shut manual isolation valves in the test line thereby allowing a recirculation flow path back to the RWST. Flow instrument FI-1QS-103 is provided in the four-inch recirculation test line and flow instrument FI-1 QS-1 04 is provided in the 1.5-inch branch connection off the four-inch recirculation test line. The 1.5-inch branch connection serves as the RWST test spray header.

The combination of local flow instrumentation provides the ability to measure total flow through the recirculation test line. During the performance of Group B and Comprehensive pump testing, containment isolation valves MOV-1QS-101A and MOV-IQS-101B (as applicable) are de-energized in the closed position to prevent inadvertent discharge of quench spray flow to the containment via the quench spray headers.

Prior to initial startup, the quench spray pumps for Unit No. 1 were subject to long term full flow testing. Temporary connections were made on the quench spray headers and pipe plugs were placed in the spray nozzle sockets and the header drain lines. The quench spray pumps were started and tested, circulating water through the spray header supply lines to the spray headers and out the temporary test connections. This system capability test was conducted to ensure that the system meets flow requirements. It also provided a complete flush of the system to remove any particulate matter, which could conceivably result in plugging of the spray nozzles at a future time. At the completion of this test, the temporary test connections were removed, the pipe plugs were removed and the spray nozzles were installed. The system was then ready for operation. The spray header piping has no remnants of the temporary test connections used to facilitate preoperational full flow testing.

Re-establishing this full flow test circuit for the purpose of periodic design flow rate testing would require similar modification or replacement of the four-inch recirculation test line with a line of sufficient size to pass ±20 percent of the 2500 gpm design flow rate or a minimum flow rate of 2000 gpm. Such hardware modifications would cause a hardship without a compensating increase in the level of quality and safety.

3.10.3 Licensee’s Proposed Alternative Testing

As an alternative to measuring at least five points for the preservice test over a range from the pump minimum flow rate to at least the design flow rate as required by ISTB-3100(a) and ISTB-5110(a), the five points will be obtained over the range of 0 gpm to approximately 1750 gpm. The manufacturer's curve would be used in conjunction with the pump minimum operating point curve and the points obtained would be reconciled to the manufacturer's curve to provide assurance of acceptable pump operation. [Refer to Figures PRR12-2 and PRR12-3] for pump curves. The proposed alternative to ISTB-3100(a) and ISTB-5110(a) provides an acceptable level of quality and safety.

As an alternative to testing within 20 percent of the design flow rate during the comprehensive test, as required by ISTB-3300(e)(1), the reference values will be established within approximately 30 percent of the design flow rate (that is, approximately 1750 gpm). The proposed alternative to the requirements specified in ISTB-3300(e)(1) provides an acceptable level of quality and safety and provides reasonable assurance that the pumps would be able to perform their function as well as providing sufficient indication of any potential degradation occurring to the pumps.

Testing will be conducted as follows:

The test circuits identified in [Figure PRR12-1] will be used to satisfy testing requirements.

The quench spray pumps shall be tested by establishing a recirculation flow path back to the RWST via the four-inch recirculation test line. Temporary pressure instrumentation shall be utilized in the pump suction with sufficient calibrated accuracy to satisfy the ASME OM Code requirements. Differential pressure will be fixed and flow measured.

Pump vibration will be measured and recorded in accordance with the criteria specified in the Code. In addition, vibration spectral analysis will also be performed which is a more accurate method of detecting mechanical degradation or changes than that of the traditional inservice test vibration requirements.

To be within 20 percent of pump design flow rate on the low end requires a minimum reference flow rate of 2000 gpm. Presently the inservice test reference flow rates are established with the existing test circuit at approximately 1750 gpm, when setting differential pressure as the fixed reference value.

Reference flow rates are not within the 20 percent of design flow rate required during the comprehensive test. The test flows are lower than the design flow rate as a result of restrictions due to the small four-inch recirculation line. With the recirculation line restrictions, the highest flow rate that can be measured (approximately 1750 gpm) while maintaining stable test conditions is within approximately 30 percent of the pump design flow rate.

At approximately 1750 gpm, the head curve for these pumps is not flat but well sloped [See figures PRR12-2 and PRR12-3]. Therefore, as performance degrades due to internal recirculation caused by increasing internal pump clearances, the flow rate will measurably decrease for a given reference differential pressure.

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

In addition to the aforementioned tests, the quench spray pumps are included in the BVPS-1 PdM program. All pumps have spectral vibration data obtained each refueling outage and are subject to periodic oil sample analysis. Also, as a preventive maintenance activity, the pumps' mechanical seals are replaced every seventh refueling outage and the pump bearing oil is changed and coupling lubricated every 72 weeks.

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

Historically, the pumps have demonstrated excellent performance during surveillance testing. The only corrective maintenance recorded for the pumps was associated with quench spray pump 1QS-P-1A. Subsequent to the tenth maintenance and refueling outage (in 1995), pump 1QS-P-1A was damaged due to air binding and the rotating element assembly (that is, the impeller) was replaced. The replacement impeller was 10.75 inches in diameter. It was determined that the 10.75-inch impeller was the wrong size since the damaged impeller was 9.85 inches in diameter. The larger impeller resulted in a seven percent increase in the hydraulic data. A successful containment analysis of the DBA conditions with the 10.75-inch pump impeller required that the recirculation spray heat exchanger tube plugging limits be changed from the initial plugging limit of 56 tubes to 20 tubes. In 2001, the recirculation spray heat exchangers had 12 tubes plugged resulting in an eight-tube margin. Therefore, the System Engineering group recommended replacement of the 10.75-inch impeller with a 9.85-inch impeller during fourteenth maintenance and refueling outage (in 2001). Impeller replacement was completed on October 1, 2001 and a five point pump curve was obtained between 600 gpm and 1797 gpm. Although the new pump curve was slightly below the manufacturer's curve, it generally followed the shape of the manufacturer's curve. Based on this, it was expected that the new pump's performance would continue to follow the shape of the manufacturer's curve at higher flows and also provide adequate margin above the MOP Curve at higher flows. Pump operation since the new impeller was installed has continued to be satisfactory at its tested flow rate of approximately 1750 gpm.

3.10.4 Staff Evaluation

The quench spray pumps supply water from the RWST and spray the containment through spray nozzles. The quench spray system is designed to remove energy and heat discharged to the containment following a LOCA or main steam line break to prevent the containment pressure from exceeding design pressure and to reduce and maintain containment temperature and pressure to within acceptable limits. The system is provided with two 100% capacity redundant trains, each having a design discharge capacity of 2500 gpm. The piping configuration for the quench spray pumps consists of the pumps receiving suction from the RWST and discharging to the containment through 10-inch lines supplying the quench spray headers (see Figure PRR12-1). The pumps discharge piping is provided with 4-inch recirculation test lines. Pump design flow cannot be established using these test loops because of the 4-inch recirculation line size. Also, the discharge piping was not designed to be temporarily reconfigured so that pump accident flow can be achieved.

The licensee stated, “Prior to initial startup, the quench spray pumps were subject to long term full flow testing.” To perform the full flow test, spray nozzles were replaced with plugs, temporary connections were made on the nozzle headers. The startup test also served to completely flush the system to remove any particulate matter, which could potentially plug the spray nozzles at a future time. Upon completion of the test, water was drained from each pump and header. The temporary connections and spray nozzle plugs were removed and the spray nozzles were reinstalled.

Re-establishing this full flow test loop for the purpose of periodic design flow rate testing would require a similar modification every 2 years. The licensee also states that the spray headers are inaccessible without a significant amount of scaffolding. Even if the nozzles were accessible, plugging spray nozzles, installing temporary piping, running the full-flow test, and returning the system to its original operable configuration would cause hardship to the licensee. Replacement of the 4-inch recirculation test line with a line of sufficient size to accommodate design flow rate testing would also cause hardship.

As an alternative to measuring at least five points for the preservice test over a range of pump minimum flow rate to at least pump design flow rate as required by ISTB-3100(a) and ISTB-5110(a), the licensee proposes to obtain the five points over the range of 0 gpm to approximately 1750 gpm.

As an alternative to testing within 20% of the design flow rate during the comprehensive test as required by ISTB-3300(e)(1), the reference values will be established within approximately 30% of the design flow rate (test flow rate will be approximately 1750 gpm).

The quench spray pumps have a design-basis accident (DBA) flow rate of 2500 gpm. For the reasons stated above, the reference flows are established at approximately 1750 gpm, which is not within 20% of design flow. Testing at design flow is important because the reduction in TDH increases as the pump flow increases. If testing data at lower flow rates is used as an indicator of pump hydraulic performance deterioration at the design flow of the pump, it would lead to a misrepresentative conclusion. Testing at design flow is especially important for pumps with head-flow curves that are flat or gently sloping in the low flow region (pump whose developed head changes little with increasing flow). In the low flow region, increasing internal flow rates, as a result of internal wear, are difficult to detect. Pumps with the flat curves at low flows should be tested at or near design conditions to determine if increasing internal recirculation flows have degraded pump performance to the point where design performance cannot be met. However, at within approximately 30% of design flow of the quench spray pumps, the head curves are not flat but well sloped. Testing at the proposed reference flow rates will detect degradation since the TDH changes noticeably with increase in flow.

Similar relief requests were granted for the North Anna Station recirculation spray pumps (Reference 3.10.6.1) and the Seabrook Station containment spray pumps (Reference 3.10.6.2). The typical pump shutoff, test and design/accident head-flow data for North Anna Station, Seabrook Station, and BVPS-1 are summarized in the table on Figure PRR12-4. Based on these head-flow data, the typical pump head-flow curves for the three plants were plotted for comparison purpose. As seen from the figure, the curves for the three plants have similar shape and are well sloped (The TDH at the test flow rate for BVPS-1 is 18% lower than the pump shut off head). Therefore, testing at the reference flows for BVPS-1 will detect pump degradation because the pump curve is well sloped at the point of testing.

The licensee provided pump curves showing flow rate versus the corresponding TDH.
The intent of the curve is to provide trend data on the TDH at each measured flow rate for the

quench spray pumps. The expected result is that at higher flow rates, there is lower pump TDH. This provides an indication that the pumps were tested in an area of the curve where the intent of the comprehensive test would be satisfied.

As discussed above, testing at lower flow may lead to underprediction of pump degradation at the design flow. Therefore, additional monitoring or maintenance should be included to compensate the limitation of testing at lower flow. The licensee stated, “The quench spray pumps are included in the BVPS-1 PdM program.” All pumps will have spectral vibration data obtained each refueling outage and are subject to periodic oil sample analysis. These activities are beyond that required by Subsection ISTB and further provide assurance as to the ability to detect pump degradation. Also, as a preventive maintenance activity, the pumps mechanical seals are replaced every seventh refueling outage and the pump bearing oil is changed and coupling lubricated every 72 weeks. If measured parameters are outside the normal operating range or are determined by analysis to be trending toward a degraded state, the licensee will take appropriate actions. These actions may include monitoring of additional parameters, review of component specific information to identify cause, and removal of the pump from service to perform corrective maintenance.

The licensee also stated, “Historically, the pumps have demonstrated excellent performance during surveillance testing. The only corrective maintenance recorded for the pumps was associated with quench spray pump 1QS-P-1A.” Following replacement of the impeller, a five-point pump curve was obtained between 600 gpm and 1979 gpm. Although the new pump curve was slightly below the manufacturer’s curve, it generally followed the shape of the manufacturer’s curve. Based on this, it was expected that the new pump’s performance would continue to follow the shape of the manufacturer’s curve at higher flows and also provide adequate margin above the minimum operating point curve at higher flows.

Based on a review of the provided pump curves and information regarding the BVPS-1 PdM program, the NRC staff finds that the alternative provides reasonable assurance of the operational readiness and compliance with the specified ASME OM Code requirement would result in hardship without a compensating increase in the level of quality and safety.

3.10.5 Conclusion

Based on the above evaluation, the NRC staff has concluded that the licensee’s proposed alternative to the Code testing requirements for the quench spray pumps is authorized pursuant to 10 CFR 50.55a(a)(3)(ii), on the basis that complying with the specified ASME OM Code requirements results in hardship without a compensating increase in the level of quality and safety. The licensee’s proposed alternative provides reasonable assurance of the operational readiness of the pumps. The alternative is authorized for the fourth 10-year IST program interval of BVPS-1.

3.10.6 Reference

1. Safety Evaluation of Relief Requests Associated with the Third 10-year Interval Inservice Testing Program for Pumps and Valves for North Anna Power Station, Units 1 and 2 (TAC Nos. MB2221 and MB2222), January 1, 2002 (ADAMS Accession No. ML020070461).

2. Seabrook Station, Unit No. 1 - Relief from ASME Code Operations and Maintenance Code ISTB 4.3(e)(1) Ten-Year Interval Inservice Test for Containment Spray Pumps CBS-P9A and CBS-P9B (TAC No. MB6676), May 30, 2003 (ADAMS Accession No. ML031070510).

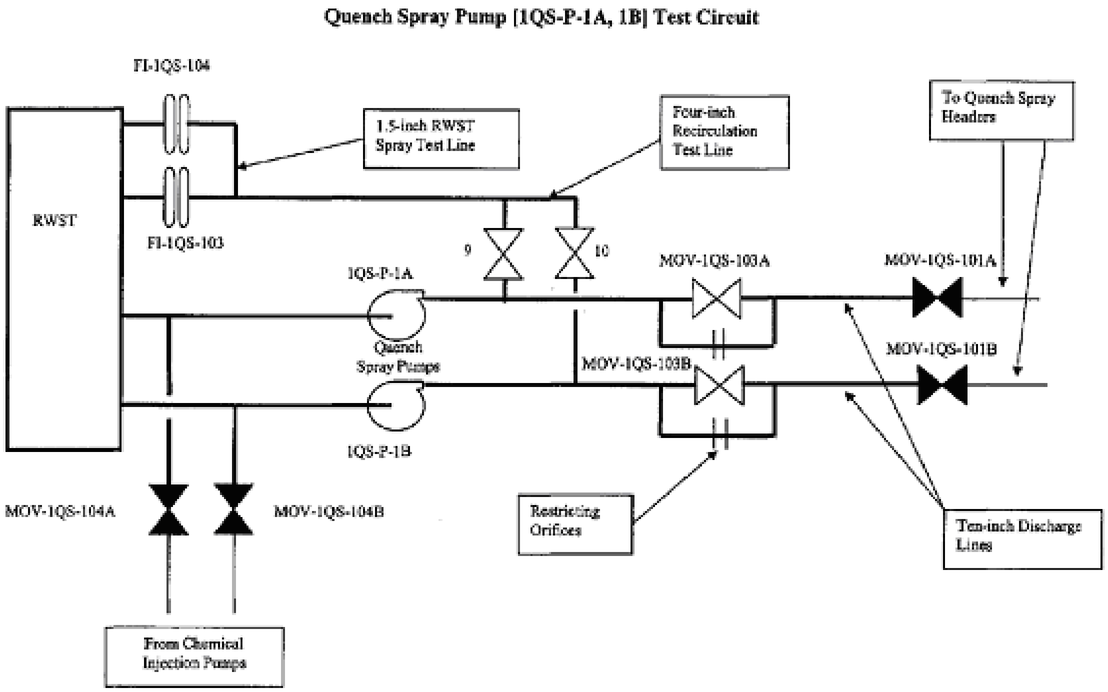
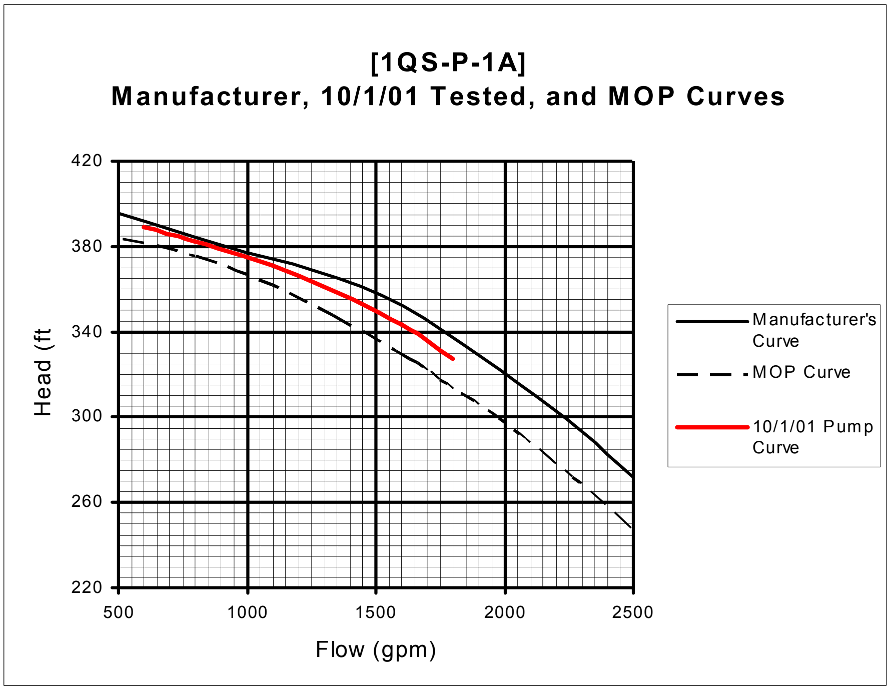


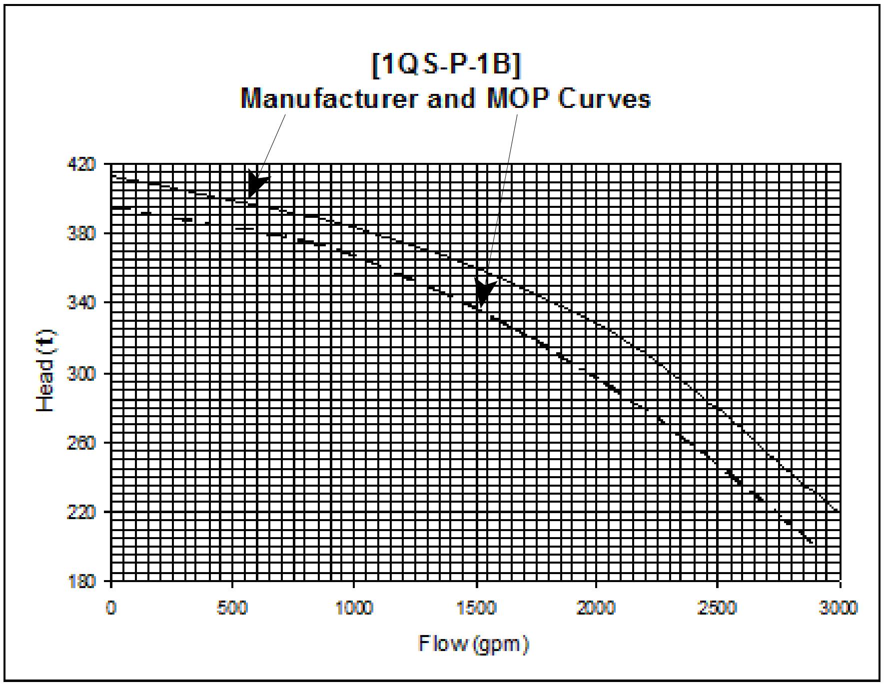
Figure PRR12-1: Quench Spray Pumps Test Circuit



Manufacturer's Curve		MOP Curve	
Flow	Head	Flow	Head
0	414	0	395
803	384	800	375
1522	357	1330	348
2119	310	1630	327
2516	270	1712	321
2597	261	1730	320
2769	240	1830	312
3222	191	1930	303
		2030	294
Tested Curve (10/1/01)		2230	275
Flow	Head	2330	265
600	389.0	2430	254
800	382.1	2530	243
1200	366.1	2630	232
1600	343.1	2730	220
1797	327.6	2893	200

Figure PRR12-2

Manufacturer's and Pump Minimum Operating Point (MOP) Curves
1A Quench Spray Pump (1QS-P-1A)



Manufacturer's Curve		MOP Curve	
Flow	Head	Flow	Head
0	413	0	395
866	388	800	375
1527	359	1330	348
2141	316	1630	327
2496	279	1700	322
2597	268	1730	320
2769	246	1830	312
3181	199	1930	303
		2030	294
		2230	275
		2330	265
		2430	254
		2530	243
		2630	232
		2730	220
		2893	200

Figure PRR12-3

Manufacturer's and Pump Minimum Operating Point (MOP) Curves
1B Quench Spray Pump (1QS-P-1B)

	Beaver Valley 1 (Pump 1QS-P-1A)			North Anna			Seabrook (Pump CBS-9B)		
	Shutoff	Test	Design/ Accident	Shutoff	Test	Design/ Accident	Shutoff	Test	Design/ Accident
Flow (gpm)	0	1750	2500	0	1500	3640	0	1900	2808
Total Developed Head (feet)	414	339	272	435	380	290	700	645	560

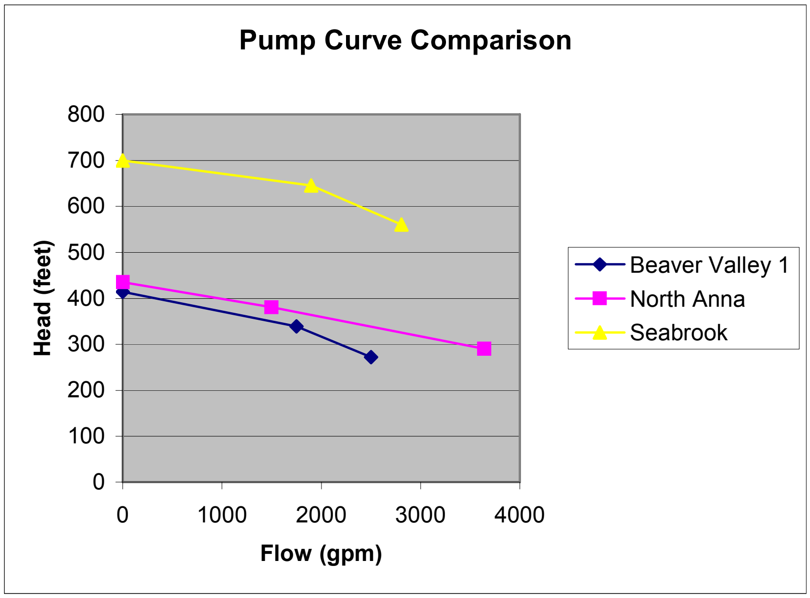


Figure PRR12-4

Comparison of Beaver Valley Unit 1, North Anna, and Seabrook Pump Curves

3.11 Relief Request No. PRR13

3.11.1 Code Requirements/Components Affected

The licensee requested relief from ISTB-3510(a) of the ASME OM Code. ISTB-3510(a) requires that pressure instrument accuracy shall be within ± 0.5% of full-scale for Comprehensive and Preservice Tests. ISTB-3510(a) requires Comprehensive and Pre-service tests instrument accuracy of ± 2% for flow rate and ± 0.5% for pressure. All required accuracies are defined in Table ISTB-3500-1.

Relief was requested for the following pumps:

1WR-P-1A, River Water Pump (Class 3)
1WR-P-1B, River Water Pump (Class 3)
1WR-P-1C, River Water Pump (Class 3)

3.11.2 Licensee's Basis for Request

The BVPS-1 River Water Pumps are vertical line-shaft pumps that receive their suction from a pit that communicates with the Ohio river. Differential pressure is calculated using Pump Discharge Pressure Indicator [PI-1WR-101A, B and C] and the calculated suction pressure using river water elevation from Ohio River Level Recorder [LR-1CW-101], local. The transmitter associated with [LR-1 CW-1 01] 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 is greater than the 0.5% required by Table ISTC-3500-1 when performing a Comprehensive or Preservice test.

Typical Ohio River elevation is between 665 and 667 feet resulting in a small variance between calculated suction pressure when determined by the calculational method provided by the procedure. However, it should be noted that during the spring, river elevations may be higher due to rain. This condition is evaluated with the test results to ensure operational readiness of the pumps.

3.11.3 Licensee's Proposed Alternative Testing

The licensee proposes to use a 0 to 100 psig, 0.1% accurate test pressure gauge in place of the installed discharge pressure indicator. The suction pressure reading over the range of the installed instruments is within 0.504 psig (28 psig x 1.8%). Twenty-eight psig represents the suction pressure on the pump impeller when the river water level instrument is reading at its full scale upper limit. The 0 to 100 psig, 0.1% accurate, test pressure gauge (to be used in place of the installed discharge pressure indicator) provides a discharge pressure reading over the range of the instrument within 0.1 psig. Adding this to the installed 1.8% accurate suction pressure instrument would yield an overall error of 0.604 psig (0.1 psig + 0.504 psig).

When Table ISTB-3500-1 required instrument accuracy of ± 0.5% is applied to the river level readings, the suction pressure reading over the range of the instrument would be expected to be within 0.14 psig (28 psig x 0.5%). Adding this to the allowable 0.5% accurate discharge pressure instrument error would yield an overall worst case (allowed) error of 0.64 psig (0.14 psig + 0.5 psig).

3.11.4 Staff Evaluation

The 1.8% loop accuracy of the calculated suction pressure does not meet the 0.5% accuracy requirement specified in Table ISTB-3500-1. However, the proposed test pressure gauge (0.1% accuracy) is more accurate than the 0.5% accuracy required by Table ISTB-3500-1. The combination of the test pressure gauge maximum error and the calculated suction pressure maximum error is 0.604 psig, which is less than the 0.640 psig maximum allowed error. This combination of gauges is capable of providing an indicated accuracy that is superior to the minimum indicated accuracy that would be allowed by the Code. The reading accuracy achieved from these instruments meet the intent of the Code and yields an acceptable level of quality and safety for comprehensive tests.

3.11.5 Conclusion

Based on the above evaluation, the NRC staff has concluded that the licensee's proposed alternative to the ASME OM Codes accuracy requirements for instruments during pump testing is authorized pursuant to 10 CFR 50.55a(a)(3)(i) on the basis that the alternative provides an acceptable level of quality and safety. The licensee's proposed alternative provides reasonable assurance of the operational readiness of the pumps. This alternative is authorized for the fourth 10-year interval of BVPS-1.

3.12 Valve Relief Request VRR1

3.12.1 Code Requirements

ISTA-3130, "Application of Code Cases," ISTA-3130(b) states, Code Cases shall be applicable to the edition and addenda specified in the test plan.

ISTC-5120, "Motor-Operated Valves," ISTC-5121(a) states; Active valves shall have their stroke times measured when exercised in accordance with ISTC-3500.

ISTC-3700, "Position Verification Testing," states in part, Valves with remote position indicators shall be observed locally at least once every 2 years to verify that valve operation is accurately indicated.

3.12.2 Licensee's Basis for Request

The licensee stated:

NUREG-1482 Revision 1, Section 4.2.5 states in part; As an alternative to MOV stroke-time testing, ASME developed Code Case OMN-1, "Alternative Rules for Preservice and Inservice Testing of Certain Electric Motor-Operated Valve Assemblies in LWR Power Plants," which provides periodic exercising and diagnostic testing for use in assessing the operational readiness of MOVs. Section 4.2.5 further states; The NRC staff recommends that the licensees implement the ASME Code Case OMN-1 as accepted by the NRC (with certain conditions) in the regulations or RG 1.192, as alternatives to the stroke-time testing provisions in the ASME Code for MOVs. RG 1.192 allows licensees with an applicable Code of record to implement ASME Code

Case OMN-1 (in accordance with the provisions in the [RG]) as an alternative to the Code provisions for MOV stroke-time testing, without submitting request for relief from their Code of record. Licensees with a Code of record that is not applicable to the acceptance of this Code Case may submit a request for relief to apply the Code Case consistent with the indicated conditions to provide an acceptable level of quality and safety. The Code of record for BVPS-1 Fourth 10-year IST Interval is OM Code-2001 Edition with Addenda through OMb-2003 and the applicable Code for OMN-1, as stated in RG 1.192, was reaffirmed for OMa-1999.

3.12.3 Licensee's Proposed Alternative Testing

Pursuant to the guidelines provided in NUREG-1482, Revision 1, Section 4.2.5, [the licensee] proposes to implement Code Case OMN-1 in lieu of the stroke-time provisions specified in ISTC-5120 for MOVs. Code Case OMN-1 has been determined by the NRC to provide an acceptable level of quality and safety when implemented in conjunction with the conditions imposed in RG 1.192. BVPS-1 also proposes to implement the provisions specified in ISTC-3700 in conjunction with the MOV diagnostic test frequency in lieu of once every 2 years.

Using the provisions of this relief request as an alternative to the MOV stroke-time testing requirements of ISTC-5120 and position verification frequency of ISTC-3700 provides an acceptable level of quality for the determination of valve operational readiness. Code Case OMN-1 should be considered acceptable for use with ASME OM Code-2001 through OMb-2003 as the Code of record.

3.12.4 Staff Evaluation

The licensee requested relief from ASME OM Code paragraph ISTA-3130(b), which requires that Code Cases be applicable to the edition specified in the test plan. The Code of record at BVPS-1 is the 2001 Edition through 2003 Addenda of the OM Code, and Code Case OMN-1, attached to the 2002 Addenda of the OM Code, expired on March 30, 2004. Per NUREG-1482 Revision 1, Section 2.1.1, an alternative to use Code Case OMN-1 attached to the 2002 Addenda of the OM Code beyond its stated expiration date is required to be authorized by the NRC.

Code Case OMN-1 was reaffirmed in the 2006 Addenda of the ASME OM Code with a new expiration date of November, 2008. Application of ASME OM Code cases is addressed in 10 CFR 50.55a(b)(6) through reference to RG 1.192, which lists acceptable and conditionally acceptable Code cases for implementation in IST programs. RG 1.192, Table 2, conditionally approves the use of Code Case OMN-1 in lieu of provisions for stroke-time testing of motor operated valves in subsection ISTC of the ASME OM Code and references the 1995 Edition up to and including the 2000 Addenda of the Code. This reference does not intend to preclude the use of Code Case OMN-1 with later editions and addenda of the Code.

The licensee has proposed to apply Code Case OMN-1 subject to the conditions contained in Table 2 of RG 1.192. OMN-1 has been recognized as an acceptable alternative to stroke-time testing for assessing the operational readiness of certain motor operated valves. Application of Code Case OMN-1, with the conditions specified in RG 1.192, is also consistent with guidance contained in NUREG-1482 Revision 1, Section 4.2.5. The application of Code Case

OMN-1 provides an acceptable level of quality and safety for the testing of motor operated valves during the licensee's fourth 10-year IST interval.

3.12.5 Conclusion

Based on the above evaluation, the NRC staff has concluded that the licensee's proposed alternative to the ASME OM Code valve stroke-time testing requirements is authorized pursuant to 10 CFR 50.55a(a)(3)(i) on the basis that the proposed alternative provides an acceptable level of quality and safety. The licensee's alternative provides reasonable assurance of the operational readiness of the motor operated valves in the IST program. The alternative is authorized for the fourth 10-year IST program interval of BVPS-1.

4.0 CONCLUSION

Pursuant to 10 CFR 50.55(a)(3)(i), Relief Request Nos. PRR2, PRR4, PRR8, PRR13, and VRR1 are authorized on the basis that the proposed alternatives would provide an acceptable level of quality and safety. Pursuant to 10 CFR 50.55a(a)(3)(ii), Relief Request Nos. PRR9, PRR10, PRR 11, and PRR12 are authorized on the basis that compliance with the specified requirements of the ASME OM Code would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety. Pursuant to 10 CFR 50.55a(f)(6)(i), Relief Request Nos. PRR3, PRR5, PRR6, and PRR7 are granted and alternative requirements are imposed on the basis that the ASME OM Code requirements are impractical for the facility.

5.0 REFERENCES

U.S. Code of Federal Regulations, Domestic Licensing of Production and Utilization Facilities," Part 50, Chapter I, Title 10, "Energy," Section 50.55a, Codes and standards.

U.S. Nuclear Regulatory Commission, "Guidance on Developing Acceptable Inservice Testing Program," GL 89-04, through Supplement 1, April 4, 1995.

U.S. Nuclear Regulatory Commission, "Guidance for Inservice Testing at Nuclear Power Plants," NUREG-1482, Revision 1, June 2004.

Letter, James H. Lash, First Energy Nuclear Operating Company, to NRC, "Beaver Valley Power Station, Unit No. 1 Docket No. 50-334, License No. DPR-66 Inservice Testing Program Ten-Year Update," dated March 28, 2007 (ADAMS Accession No. ML070890491).

Letter, James H. Lash, First Energy Nuclear Operating Company, to NRC, “Beaver Valley Power Station, Unit No. 1 Docket No. 50-334, License No. DPR-66 Response to Request for Additional Information Regarding March 28, 2007 Proposed Alternatives and Relief Requests (TAC Nos. MD5120, MD5121, MD5122, MD5125, MD5128, and MD5130),” dated July 19, 2007 (ADAMS Accession No. ML072040259).

Principal Contributors: Robert J. Wolfgang
Steven G. Tingen
Yuken Wong
Michael D. Orenak
John Huang
Gurjendra S. Bedi

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