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

August 28, 2013

Site Vice President
Entergy Nuclear Operations, Inc.
Vermont Yankee Nuclear Power Station
P.O. Box 250
Governor Hunt Road
Vernon, VT 05354

SUBJECT: VERMONT YANKEE NUCLEAR POWER STATION – RELIEF REQUESTS FOR FIFTH 10-YEAR INSERVICE TESTING PROGRAM INTERVAL (TAC NOS. MF0622, MF0623, MF0624, MF0625)

Dear Sir or Madam:

By letter dated February 1, 2013 (Agencywide Documents and Access Management System (ADAMS) Accession No. ML13039A027), as supplemented by letters dated May 1, 2013 (ADAMS Accession No. ML13127A076) and June 6, 2013 (ADAMS Accession No. ML13162A399), Entergy Nuclear Operations, Inc. (Entergy or the licensee) requested relief from, and proposed alternatives to, certain inservice testing (IST) requirements of the American Society of Mechanical Engineers *Code for Operation and Maintenance of Nuclear Power Plants* (OM Code) for its fifth 10-year IST program interval for the Vermont Yankee Nuclear Power Station (VYNPS). The program included Pump Relief Requests RR-P01, RR-P02 and Valve Relief Requests RR-V01 and RR-V02.

The NRC staff has determined that the licensee has adequately addressed all of the applicable regulatory requirements for each Relief Request. Relief Request RR-V01 is authorized pursuant to 10 CFR 50.55a(a)(3)(ii) on the basis that compliance with Code requirements would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety. Relief requests RR-V02 and RR-P02 are authorized pursuant to 10 CFR 50.55a(a)(3)(i) on the basis that they provide an acceptable level of quality and safety. Relief Request RR-P01 is granted pursuant to 10 CFR 50.55a(f)(6)(i) based on the impracticality of performing testing in accordance with the Code requirements. Granting relief is authorized by law and will not endanger life or property or the common defense and security, and is otherwise in the public interest giving due consideration to the burden upon the licensee that could result if the requirements were imposed on the facility. The Relief Requests are authorized for the fifth 10-year IST program interval at VYNPS. The details of the staff's review are included in the enclosed safety evaluation.

Sincerely,

Douglas V Pickett for

Robert H. Beall, Acting Branch Chief
Plant Licensing Branch I-1
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket No. 50-271

Enclosure: Safety Evaluation

cc w/enclosure: Distribution via ListServ

UNITED STATES
NUCLEAR REGULATORY COMMISSION
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SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

FOR RELIEF REQUESTS RELATED TO THE FIFTH 10-YEAR

INSERVICE TESTING PROGRAM INTERVAL

ENTERGY NUCLEAR VERMONT YANKEE, LLC AND

ENTERGY NUCLEAR OPERATIONS, INC.

VERMONT YANKEE NUCLEAR POWER STATION

DOCKET NO. 50-271

1.0 INTRODUCTION

By letter dated February 1, 2013 (Agencywide Documents and Access Management System (ADAMS) Accession No. ML13039A027), as supplemented by letters dated May 1, 2013 (ADAMS Accession No. ML13127A076), and June 6, 2013 (ADAMS Accession No. ML13162A399), Entergy Nuclear Operations, Inc. (Entergy or the licensee) requested relief from, and proposed alternatives to, certain inservice testing (IST) requirements of the American Society of Mechanical Engineers (ASME) *Code for Operation and Maintenance of Nuclear Power Plants* (OM Code) for its fifth 10-year IST program interval for the Vermont Yankee Nuclear Power Station (VY or VYNPS). The program included Pump Relief Requests RR-P01, RR-P02 and Valve Relief Requests RR-V01 and RR-V02.

In RR-P01, the licensee requested relief from the frequency requirements specified in paragraph ISTB-3400 and Table ISTB-3400-1 of the ASME OM Code for service water pumps P-7-1A, P-7-1B, P-7-1C, AND P-7-1D.

In RR-P02, the licensee proposed an alternative to the ASME OM Code requirements of paragraph ISTB-5123(e) for the high pressure coolant injection (HPCI) main pump/booster pump combination P44-1A/B. Specifically, the licensee requested to use a modified vibration velocity (V_V) acceptance criteria specified in Table ISTB-5121-1 of the ASME OM Code.

In RR-V01 and RR-V02, the licensee proposed an alternative for various check valves in lieu of the exercising requirements as specified by paragraph ISTC-3522(c) of the ASME OM Code.

2.0 REGULATORY EVALUATION

The regulations in Title 10 of the *Code of Federal Regulations* (10 CFR) 50.55a(f), "Inservice Testing Requirements," requires, in part, that IST of certain ASME Code Class 1, 2, and 3

components must meet the requirements of the ASME OM Code and applicable addenda, except where alternatives have been authorized pursuant to paragraphs (a)(3)(i) or (a)(3)(ii).

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

The regulations in 10 CFR 50.55a(f)(5)(iii) states, in part, that licensees may determine that conformance with certain code requirements is impractical and that the licensee shall notify the Commission and submit information in support of the determination.

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

The VYNPS fifth ten-year IST interval begins on September 1, 2013 and is currently scheduled to end on August 31, 2023.

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

3.0 TECHNICAL EVALUATION

3.1 Pump Relief Request RR-P01

3.1.1 Code Requirements

The ASME OM Code, paragraph ISTB-3400, "Frequency of Inservice Tests," states that, "An inservice test shall be run on each pump as specified in Table ISTB-3400-1 which notes that Group A and Group B tests shall be performed quarterly, and comprehensive tests (CPTs) shall be performed biennially. The applicable Code Edition and Addenda is OM-2004 Edition through OMb-2006 Addenda

3.1.2 Specific Relief Requested

The licensee requested relief from the frequency requirements specified in paragraph ISTB-3400 and Table ISTB-3400-1 for Service Water (SW) pumps P-7-1A, P-7-1B, P-7-1C, and P-7-1D. These SW pumps are Group A pumps.

3.1.3 Licensee's Basis for Relief

As stated by the licensee in its February 1, 2013, submittal:

> The four SW pumps are two-stage, vertical line shaft centrifugal pumps that are submerged in, and take suction from, the Connecticut River. They supply all the station SW system requirements. The station SW system is a dual header system comprising two parallel headers each containing two pumps. The two parallel headers supply both the turbine and reactor auxiliary equipment, including the residual heat removal SW system. A header interconnection is provided downstream of the pumps. Normally, the valves in the interconnecting line are open, permitting any of the pumps to supply the cooling water to both headers and to balance system operation. In addition, a cross-tie is provided to the non-nuclear safety station fire protection system. This 12-inch cross-tie valve is normally closed, with a one-inch cross-tie and a restricting orifice providing pressurization of the fire protection system header.
>
> The SW pumps at VY are not provided with individual pump flow indication. Furthermore, the SW headers are not provided with flow indication that could be used to determine pump flow. During normal operations, individual SW pump flow rate cannot be fixed or directly measured. It is therefore not possible to operate the SW pumps at the fixed reference value required for a Group A test.
>
> Sufficient straight sections of piping are required to measure flow rate accurately, through the use of either permanently or temporarily installed instrumentation, such as non-intrusive flow measurement devices. The only sufficiently long straight sections of piping in each of the two parallel headers are buried between the intake structure and the entrance to the reactor building. Use of this piping is considered impractical because these sections of the two parallel headers are buried piping.
>
> Based on the above, significant redesign and modification of the SW system would be required to obtain direct measurement of pump flow. Such redesign and modification would be costly and burdensome to VY.
>
> The SW system has a test flow loop, which is connected to the fire protection system header. This permits testing individual pumps, one at a time. However, this test loop does not provide SW flow to heat loads. Rather, the flow is discharged to the intake structure. The SW cross-tie valves must be shut, one SW subsystem is aligned to provide cooling water, and the other SW subsystem is aligned to the test loop. In the subsystem aligned to the test loop, one pump is stopped and the other is the pump under test. Therefore, to test one pump, it is necessary to provide all SW cooling loads with one subsystem, comprising two SW pumps. During approximately 7 months of the year, Connecticut River water temperatures preclude this method when the plant is operating, due to elevated heat sink temperatures and heat removal capacity. Therefore, this test loop cannot be regularly used for quarterly testing each quarter.

Testing during the remaining 5 months (approximately November through March) is impractical due to equipment concerns, personnel safety, and scheduling difficulty. Since the SW pump test requires taking each SW subsystem out of service, the test must be inserted into the 13-week schedule at a time that does not have an adverse impact on other scheduled work.

The process of realigning the SW system, isolating one subsystem, testing the off-line subsystem, unisolating the tested subsystem, realigning the SW system, isolating the other subsystem, testing the second subsystem, and recovery to the normal operating configuration takes more than a full shift in favorable weather. The test loop and instrumentation taps are outdoors on the SW pump room roof. If the weather is below freezing, the test loop requires installation of a temporary shelter with temporary power and heating due to instrumentation icing and personnel safety concerns associated with severe cold weather. Therefore, any scheduled test would be weather dependent, potentially disrupting the scheduled work week. The test would then have to be delayed or rescheduled for a subsequent week in another 13-week schedule.

Therefore, scheduled testing on-line is impractical due to equipment concerns, plant loads, personnel safety, and scheduling difficulties.

The burden imposed by compliance with the [ASME OM] Code requirement would be a redesign of the SW system to provide a flow element and sufficient straight piping runs downstream of each SW pump. This system redesign would be so extensive that it could not be accomplished within the building that currently houses the SW pumps, since these straight piping runs would have to be approximately 12 feet long (10 pipe diameters for 14-inch pipe). This redesign would still NOT accommodate single point testing due to varying weather dependant plant loads and the required header cross-tie operation.

3.1.4 Licensee's Proposed Alternative

As stated by the licensee in its February 1, 2013, submittal:

A review of the historical test data for these pumps indicated that these pumps are highly reliable and have not been susceptible to frequent or unanticipated failures. Plant operating experience has shown that the performance of the SW pumps degrades slowly over an extended period due to normal system wear. During the 3rd Ten-Year IST Interval, one SW pump was replaced, disassembled, and inspected each operating cycle, with each pump being replaced and inspected at least once every six years. The results of those inspections and replacements demonstrated that the service life of a SW pump is consistently greater than six years, and that pump performance can be reliably trended and predicted using data gathered during pump capacity testing performed each refueling outage. During the 4th Ten-Year IST Interval, SW pump inspection/rebuild was returned to a 6 year periodicity to coincide with the 6 year scheduled PMs to preclude schedule perturbation and additional

unavailability for rebuilds [and the SW pumps are replaced when the periodic testing indicates that replacement is prudent.] Therefore, scheduled inspection/replacement of SW pumps will be on a 6 year fixed interval for this Relief Request.

Once per Cycle, typically during each refueling outage when plant loads are minimized, a head-flow curve will be generated in accordance with ISTB-5210, and the pump CPT will be performed in accordance with ISTB-5223. This will provide information so that the performance of the pump can be compared to the previous head curve data to project and predict pump operation life inclusive of mission time. Overall peak and full spectrum vibration measurements will be also taken at each of the points used to generate the head curve to provide additional operational information.

On a quarterly basis, a surveillance will be performed by measuring pump differential pressure, motor vibration, and motor amps. The data will be compared to the degree possible with the head-flow curve and vibration measurements and amps obtained during the previous 5-point test.

The SW pumps are in the VY oil analysis program, described in station procedure DP 0213. Lube oil samples are taken quarterly from each SW pump and sent to an independent laboratory for analysis. A complete analysis of the oil is performed, including wear particles, lubricity, additives, water, dirt (silicon), and oxidation. In addition, the oil in the SW pumps was changed to synthetic oil (SHC 630), due to the superior performance and service life of the synthetic oil.

As stated by the licensee in its May 1, 2013, submittal:

> "...vibration readings are obtained and compared to the value at the ~2700 gallons per minute test point on the 5-point curve. Also, ...differential pressure (d/p) is determined by measuring discharge pressure minus the temperature-corrected, bay level measured, correlated pressure. Comparison of the differential pressure to the 5-point test is somewhat subjective, since it is affected by varying the number of operating pumps, plant loads, and cross-tied header operation. Motor amps are a measure of pump load and are conservatively compared to the quarterly vibration measurement and d/p measurement.

3.1.5. NRC Staff Evaluation of RR-P01

Table ISTB-3400-1 notes that Group A and Group B tests shall be performed quarterly, and CPTs shall be performed biennially. The ISTB-5121(b) requires that for Group A tests, 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 its reference value.

The four SW pumps P-7-1A, P-7-1B, P-7-1C, and P-7-1D are two-stage vertical line shaft centrifugal pumps that are submerged in and take suction from the Connecticut River. There is no installed flow measurement instrumentation in the pump discharge piping. It is also impractical for the licensee to install flow instrumentation for the pumps, or use temporary non-intrusive flow measuring devices, because there are no sufficient straight lengths of piping to ensure a region of flow stability. Significant system redesign and modifications would be necessary to permit repeatable flow rate measurements.

For the SW pumps, which are classified as Group A pumps, the ASME OM Code requires that a Group A test be performed quarterly and a CPT be performed biennially. Table ISTB-3000-1 requires that during the Group A test and CPT, differential pressure, flow rate, and vibration shall be measured.

The licensee states that during each refueling outage the CPT will be performed in accordance with ISTB-5223 and meet the acceptance criteria of Table ISTB-5221-1. In addition the motor amps will be measured and recorded. The VY refueling outage cycle is 18 months. Therefore, VY will be performing a CPT more often than required by the ASME OM Code (every 18 months instead of every two years) and is, thus, acceptable.

The SW pumps are not provided with individual pump flow indication. Furthermore, the SW headers are not provided with flow indication that could be used to determine individual pump flow. During normal operation, individual SW pump flow rate cannot be fixed or directly measured. Therefore, it is not possible to operate the SW pumps at a fixed reference value required for a Group A test. Since it is possible that SW pump differential pressures measured during quarterly testing will vary appreciably due to changes in system demand, similar variation in pump vibration can be expected. In order to assess pump vibration conditions against ASME OM Code criteria, variable vibration data must be acquired for a broad range of differential pressure conditions. The licensee states that during refueling outages, head-flow curves will be generated, and a CPT will be performed. This will provide information so that performance of the pump can be compared with the quarterly test data and the data from the previous refueling outage head-flow curves. Overall peak and full spectrum vibration measurements will also be taken at each of the points used to generate the head-flow curve to provide additional operational information. In this way, a correlation between pump vibration versus differential pressure can be developed each refueling outage to permit quarterly vibration testing even though the vibration testing might not be at the ASME OM Code-prescribed reference hydraulic condition. Pump motor amps, which are a measure of pump load, will also be measured and compared to quarterly vibration and differential pressure measurements.

The SW pumps are in the VY oil analysis program. A complete laboratory analysis of the oil will be performed that will identify signs of pump degradation.

The licensee stated that each SW pump will be inspected and rebuilt, as required, or replaced, at least once every six years. This is the same inspection/replacement schedule that has been successfully used during the fourth 10-year IST interval. It is the NRC staff's understanding that pump inspections and rebuilds or replacements will be based on performance, and inspections and rebuilds or replacements occur generally around a six year frequency.

The licensee submitted capacity test data, vibration test data, and amperage test data for the four SW pumps for the period between 2003 and 2013. The data indicates that pumps P-7-1A, P-7-1C, and P-7-1D have been operating in the acceptable range during that time period. Pump P-7-1B operated in the alert range for vibration in the first half of 2005, after which vibration levels returned to normal levels and the pump operated in the acceptable range for the rest of the ten-year period.

Based on the above discussion, the NRC staff concludes that it is impractical to perform a quarterly Group A test of SW pumps P-7-1A, P-7-1B, P-7-1C, and P-7-1D in accordance with the ASME OM Code requirements without significant design modifications. The CPT and evaluation of flow rate, differential pressure, and vibration on a refueling outage frequency in accordance with the Code acceptance criteria will allow an adequate assessment of the pumps' operational readiness. The licensee will perform a CPT every 18 months. Quarterly measurement of pump vibration data, including spectral analyses, will be assessed against the ASME OM Code criteria to the extent possible, using variable reference values determined from differential pressure measurements. Motor amps will be measured and compared to previous test data. In addition, the results of previous inspections every refueling outage and the inspection and rebuilding, or the replacement, of the SW pumps every six years demonstrated that the service life of a SW pump is considerably greater than six years and that pump performance can be reliably trended and predicted using data gathered during the CPT each refueling outage. Additionally, the SW pumps are in the VY oil analysis program, ensuring that a lube oil analysis will be performed quarterly for each pump.

3.1.6 Conclusion

As set forth above, the NRC staff determines that granting relief pursuant to 10 CFR 50.55a(f)(6)(i) is authorized by law and will not endanger life or property or the common defense and security, and is otherwise in the public interest giving due consideration to the burden upon the licensee that could result if the requirements were imposed on the facility. Furthermore, the staff concluded that the testing performed to the extent practical provides reasonable assurance of the operational readiness of SW pumps P-7-1A, P-7-1B, P-7-1C, and P-7-1D. Accordingly, the NRC staff concludes that the licensee has adequately addressed all of the regulatory requirements set forth in 10 CFR 50.55a(f)(5)(iii). Therefore, the NRC staff grants the proposed relief for SW pumps P-7-1A, P-7-1B, P-7-1C, and P-7-1D at VY for the fifth 10-year IST program interval, which begins on September 1, 2013 and is scheduled to end on August 31, 2023.

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

3.2 Pump Relief Request RR-P02

3.2.1 Code Requirements:

The ASME OM Code, paragraph ISTB-5123, "Comprehensive Test Procedure," requires that comprehensive tests (CPT) shall be conducted with the pump operating at a specified reference point. The test parameters shown in Table ISTB-3000-1 shall be determined and recorded as required by this paragraph.

The ISTB-5123(e) requires that all deviations from the reference values shall be compared with the ranges of Table ISTB-5121-1 and corrective actions taken as specified in ISTB-6200. The vibration measurements shall be compared to both the relative and absolute criteria shown in the alert and required action ranges of Table ISTB-5121-1.

The ISTB-6200, "Corrective Action," specifies corrective actions required if test parameter values fall within the alert range or required action ranges of Table ISTB-5121-1.

Table ISTB-3000-1, "Inservice Test Parameters," notes that test parameters for Group A tests, Group B tests, and CPTs shall be determined and recorded.

Table ISTB-5121-1, "Centrifugal Pump Test Acceptance Criteria," defines the required acceptance criteria for centrifugal pumps for Group A Tests, Group B Tests, and CPTs.

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

3.2.2 Specific Relief Requested

The licensee proposed an alternative to the ASME OM Code requirements of paragraph ISTB-5123(e) for the high pressure coolant injection (HPCI) main pump/booster pump combination P44-1A/B. Specifically, the licensee requested to use a modified vibration velocity (V_V) acceptance criteria specified in Table ISTB-5121-1 at the main pump turbine side horizontal and vertical vibration points I-3, O-3 and main pump gear box side horizontal vibration point I-4. The remaining high pressure and booster pump vibration points will be evaluated in accordance with the ASME OM Code requirements.

3.2.3 Licensee's Basis for Relief

The licensee states that HPCI main/booster pump P44-1A/B has the safety function to provide (1) adequate core cooling and reactor vessel depressurization following a small break loss of coolant accident, and (2) reactor pressure control during reactor shutdown and isolation.

> The HPCI pump has a notable history regarding analysis and resolution of high vibration issues. During the 1985-1987 timeframe, vibration consultants with specialized equipment were used to identify phase angles, natural and resonance frequencies, etc.... The root cause of the higher vibration levels was determined to be a 2nd order acoustical resonance in the piping connecting the low pressure (LP) and high pressure (HP) pumps, and the presence of a structural resonance at the 2nd order in the horizontal direction on the HP pump.
>
> These resonance conditions are design related and have existed since initial pump installation. The HPCI Booster pump impeller was modified in 1989, based on the consultant's recommendations to reduce the 2nd order vibration levels; however, the overall peak levels remained higher than the Table ISTB-5121-1 acceptable range of 0.325 in/sec. Vermont Yankee concluded that these high

levels did not indicate pump mechanical degradation and do not represent phenomena that could prevent the pump from performing its intended function. NRC approved IST Program Relief Request RR-P04 in 1993 which permitted the overall peak vibration acceptable range to be expanded to 0.675 in/sec. VY reviewed the overall peak values and determined that the acceptable range limit can be lowered from 0.675 to 0.575 in/sec.

This lower acceptance value is the result of continuing efforts to reduce the vibration levels on this complex system (i.e., turbine, HP pump, gearbox, and booster pump combination). This lower acceptance value (0.575 in/sec) was incorporated into a revised relief request which was renumbered as Relief Request RR-P02 for the fourth 10-year interval IST program.

The licensee requested relief on the basis that its proposed alternative would provide an acceptable level of quality and safety. This relief request RR-P02 is similar to previously approved relief request RR-P02 authorized by NRC for the fourth 10-year Interval IST program.

3.2.4 Licensee's Proposed Alternative

To allow for practicable vibration monitoring of the HPCI main/booster pump P44-1A/B, the following alternative vibration acceptance criteria are proposed to be used for vibration points I-3, O-3 and I-4. In addition, a full spectrum analysis will be performed during each quarterly test and the following criteria will be used:

Test Parameter	Acceptable Range	Alert Range	Required Action Range
V_v	$\leq 2.5\ V_r$ but not > 0.575 in/sec	> 2.5 V_r to and including 6 V_r but not > 0.70 in/sec	> 6 V_r or > 0.70 in/sec

3.2.5 NRC Staff Evaluation of RR-P02

The ISTB-5123, "Comprehensive Test Procedure," requires that CPT shall be conducted with the pump operating at a specified reference point. The test parameters shown in Table ISTB-3000-1 shall be determined and recorded as required by this paragraph. The ISTB-5123(e) requires that all deviations from the reference values shall be compared with the ranges of Table ISTB-5121-1 and corrective actions taken as specified in ISTB-6200. The vibration measurements shall be compared to both the relative and absolute criteria shown in the alert and required action ranges of Table ISTB-5121-1. The ISTB-3540(a) requires that for centrifugal pumps, measurements shall be taken in a plane approximately perpendicular to the rotating shaft in two orthogonal directions on each accessible pump bearing housing. The Code further states that the measurement also shall be taken in the axial direction on each accessible pump thrust bearing housing.

The HPCI main/booster pump P44-1A/B has a notable history regarding analysis and resolution of high vibration issues. The root cause of the high vibration levels was determined to be a 2nd order acoustical resonance in the piping connecting the low pressure (LP) and high pressure (HP) pumps, and the presence of a structural resonance at the 2nd order in the horizontal direction on the HP pump. These resonance conditions and high vibration levels are design related and have existed since initial pump installation. Although significant improvements were made to the HPCI system including modification of pump impellers, vibration levels at certain locations have remained higher than the acceptable range of 0.325 in/sec. As such, the licensee proposes to use the modified acceptance criteria of 0.575 in/sec as specified in the table above for the Main Pump Turbine Side Horizontal and Vertical Vibration Points I-3, O-3 and Main Pump Gearbox Side Horizontal Vibration Point I-4. The remaining HPCI High Pressure and Booster pump vibration points will be evaluated in accordance with the acceptance criteria specified in Table ISTB-5121-1.

The licensee has performed extensive analysis of this pump installation and determined that the high vibration levels occurred at the vibration points I-3, O-3 and I-4 were due to effects of acoustical and structural resonance. Based on the operating experiences, these high vibration levels did not indicate pump mechanical degradations and do not represent phenomena that could prevent the pump from performing its intended function. In addition, the vibration readings from quarterly tests as well as CPTs of the past 10 years on the HPCI pump have been relatively stable. At Vibration Points O-3 and I-4, the vibration remained very close to the ASME OM Code Acceptable Range Limit of 0.325 in/sec. At Vibration Point I-3, the vibrations for CPTs remained below 0.5 in/sec, and stayed well within the ASME OM Code-Required Action Range Limit of 0.7 in/sec. The stable vibration readings, although slightly higher than the Alert Range limits but lower than Required Action Range limits, adequately demonstrate that the HPCI main/booster pump has been operable.

In addition to performing the ASME OM Code-required test with slightly higher Alert Range limits, a full spectrum analyses is performed during each quarterly test. A spectrum analysis measures a narrow vibration band width over a wide frequency range and would indicate the frequency and magnitude of vibration peaks. This spectrum analysis would identify specific problems with bearings and other pump mechanical components, and provides a more complete evaluation of the pump's condition than the Code-required vibration measurements. Therefore, the NRC staff finds that the licensee's proposed alternative including a full spectrum analysis provides an acceptable level of quality and safety.

3.2.6 Conclusion

As set forth above, the NRC staff determined that the proposed alternative RR-P02 provides an acceptable level of quality and safety. Accordingly, the NRC staff concludes that the licensee has adequately addressed all of the regulatory requirements set forth in 10 CFR 50.55a(a)(3)(i) for request RR-P02 and is in compliance with the ASME OM Code requirements. All other ASME OM Code requirements for which relief was not specifically requested and approved in the subject request remain applicable. Pursuant to 10 CFR 50.55a(a)(3)(i), the NRC staff authorizes alternative request RR-P02 for the VYNPS fifth 10-year IST program interval, which begins on September 1, 2013 and is currently scheduled to end on August 31, 2023.

3.3 Valve Relief Request RR-V01

3.3.1 Code Requirements:

The ISTC-3522(c) "Category C Check Valves", states that "If exercising is not practicable during operation at power and cold shutdowns, it shall be performed during refueling outages."

3.3.2 Specific Relief Requested

Alternative testing is requested for the following valves:

Table 1

Valve Number	System	ISTC-1300 Category	Safety Class
V14-33A	Core Spray (CS)	C	2
V14-33B	CS	C	2
V10-36A	Residual Heat Removal (RHR)	C	2
V10-36B	RHR	C	2

3.3.3 Basis for Relief

The licensee states that the request proposes an alternative to the referenced ASME OM Code requirement on the basis that complying with the ASME OM Code requirements results in unusual hardship or difficulty and that the proposed alternative provides an equivalent level of safety and quality.

The subject check valves are tested by radiography to verify obturator movement to the closed position upon cessation or reversal of flow. Radiography during a refueling outage subjects an unnecessary number of personnel to radiation exposure and results in access restrictions to several areas of the plant that are normally accessible during refueling outages. This ALARA challenge represents an unusual hardship and difficulty in managing personnel access at a time when an unusual number of workers are onsite to support the outage.

3.3.4 Licensee's Proposed Alternative

This request proposes to test these valves within 60 days prior to each refueling outage, rather than during each refueling outage, as required by ISTC-3522. This alternative provides an acceptable level of quality and safety, since testing occurs at the same frequency (every 18 months) as prescribed by the Code. Testing prior to the outage reduces the ALARA concerns associated with radiography since fewer people will be onsite and access will be easier to manage.

This proposed alternative is requested for the duration of the 5th 10-Year Interval Vermont Yankee IST program currently scheduled to commence September 1, 2013 and end on August 31, 2023.

3.3.5 NRC Staff Evaluation of RR-V01

The valves listed in Table 1 are Safety Class 2 Category C check valves that have a safety function to close. The ASME OM Code ISTC-3510 states, in part, that "Active Category A, Category B, and Category C check valves shall be exercised nominally every 3 months." The ASME OM Code recognizes that some valves cannot be tested at this frequency. Deferral of this requirement is allowed by ISTC-3522(c) which states "If exercising is not practical during operation at power and cold shutdowns, it shall be performed during refueling outages." ASME OM Code ISTC-5221(a)(3) states, in part, that "Check valves that have a safety function in only the close direction shall be exercised by initiating flow and observing that the obturator has travelled at least the partially open position, and verify that on cessation or reversal of flow, the obturator has traveled to the seat. Observations shall be made by observing a direct indicator."

The licensee has evaluated several methods available to meet the requirement of verifying that the obturator has traveled to the seat. The methods evaluated included flow testing, non-intrusive testing such as ultrasonic, magnetic or acoustic, disassembly and inspect, and radiography. The licensee concluded that radiography provides the best method for observing the direct indication that the valve has achieved closure. This relief request is a continuation of a previous request for the fourth IST testing interval (ADAMS Accession No. ML033180469).

The use of radiography on a quarterly interval to satisfy ASME OM Code requirements presents additional challenges such as:

1) Increased radiation exposure due to radiography activity. Estimates on performing the task on a quarterly basis would increase test personnel exposure approximately 400 mrem/year.
2) Extensive test equipment setup and large manpower requirements
3) Potential for unexpected challenges to plant safety systems

The NRC staff agrees that exercising the valves listed in Table 1 nominally every 3 months per ISTC-3510 would not be practical during power operation and that it is more appropriate to exercise during a refueling outage. However, performance of the radiography test during a refueling outage presents new challenges. Radiography during a refueling outage could subject an unnecessary number of personnel to radiation exposure which results in access restrictions to several areas of the plant that are normally accessible during the refuel outage. The ALARA challenge represents an unusual hardship and difficulty in managing personnel access at a time when an unusual number of workers are onsite to support the outage. The licensee proposes to perform the exercise test within 60 days prior to each refueling outage. The testing will occur at the same frequency as recommended by the Code and will reduce the ALARA concerns associated with the radiography testing. The staff finds that the alternative provides reasonable assurance that the valves listed in Table 1 are operationally ready.

3.3.6 Conclusion

As set forth above, the NRC staff determined that the proposed alternative, described in alternative request RR-V01, provides reasonable assurance that valves listed in Table 1 are

operationally ready. Accordingly, the NRC staff concludes that the licensee has adequately addressed all of the regulatory requirements set forth in 10 CFR 50.55a(a)(3)(ii) and is in compliance with the ASME OM Code requirements.

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

Therefore, the NRC staff authorizes the proposed alternative in RR-V01 for the fifth IST interval at VY currently scheduled to begin on September 1, 2013 and end on August 31, 2023.

3.4 Valve Relief Request RR-V02

3.4.1 Code Requirements:

The ISTC-3522(c) "Category C Check Valves", states that "If exercising is not practicable during operation at power and cold shutdowns, it shall be performed during refueling outages."

3.4.2 Specific Relief Requested

Table 2

Valve Number	System	ISTC-1300 Category	Safety Class
SL-13-55A	Reactor Core Isolation Cooling (RCIC)	C	2
SL-13-55B	RCIC	C	2
SL-13-55C	RCIC	C	2
SL-13-55D	RCIC	C	2
SL-14-31A	Core Spray (CS)	C	2
SL-14-31B	CS	C	2
SL-2-62A	Nuclear Boiler (NB)	C	2
SL-2-62B	NB	C	2
SL-2-62C	NB	C	2
SL-2-62D	NB	C	2
SL-2-64A	NB	C	2
SL-2-64B	NB	C	2
SL-2-64C	NB	C	2
SL-2-64D	NB	C	2
SL-2-73A	NB	C	2
SL-2-73B	NB	C	2
SL-2-73C	NB	C	2
SL-2-73D	NB	C	2
SL-2-73E	NB	C	2
SL-2-73F	NB	C	2
SL-2-73G	NB	C	2
SL-2-73H	NB	C	2
SL-2-2-7A	NB	C	2
SL-2-2-7B	NB	C	2

Valve Number	System	ISTC-1300 Category	Safety Class
SL-2-2-8A	NB	C	2
SL-2-2-8B	NB	C	2
SL-2-3-11	NB	C	2
SL-2-3-13A	NB	C	2
SL-2-3-13B	NB	C	2
SL-2-3-15A	NB	C	2
SL-2-3-15B	NB	C	2
SL-2-3-17A	NB	C	2
SL-2-3-17B	NB	C	2
SL-2-3-19A	NB	C	2
SL-2-3-19B	NB	C	2
SL-2-3-21A	NB	C	1
SL-2-3-21B	NB	C	1
SL-2-3-21C	NB	C	1
SL-2-3-21D	NB	C	1
SL-2-3-23A	NB	C	1
SL-2-3-23B	NB	C	1
SL-2-3-23C	NB	C	1
SL-2-3-23D	NB	C	1
SL-2-3-25	NB	C	2
SL-2-3-27	NB	C	2
SL-2-3-31A	NB	C	1
SL-2-3-31B	NB	C	1
SL-2-3-31C	NB	C	1
SL-2-3-31D	NB	C	1
SL-2-3-31E	NB	C	1
SL-2-3-31F	NB	C	1
SL-2-3-31G	NB	C	1
SL-2-3-31H	NB	C	1
SL-2-3-31I	NB	C	1
SL-2-3-31J	NB	C	1
SL-2-3-31K	NB	C	1
SL-2-3-31L	NB	C	1
SL-2-3-31M	NB	C	1
SL-2-3-31N	NB	C	1
SL-2-3-31P	NB	C	1
SL-2-3-31Q	NB	C	1
SL-2-3-33	NB	C	2
SL-2-3-35	NB	C	2
SL-2-305A	NB	C	2
SL-2-305B	NB	C	2
SL-23-37A	High Pressure Coolant Injection (HPCI)	C	2
SL-23-37B	HPCI	C	2

Valve Number	System	ISTC-1300 Category	Safety Class
SL-23-37C	HPCI	C	2
SL-23-37D	HPCI	C	2

3.4.3 Basis for Relief

The valves listed in Table 2 are instrumentation line excess flow check valves (EFCVs) provided in each instrument line process line that penetrates primary containment. The EFCVs are designed to close upon rupture of the instrument line downstream of the EFCV and otherwise remain open.

The EFCVs are required to be tested in accordance with ISTC-3522, which requires exercising check valves nominally every three months to the positions required to perform their safety functions. The ISTC-3522(c) permits deferral of this requirement to every reactor refueling outage.

The EFCVs are classified as ASME Code Category C and are also containment isolation valves. However, these valves are excluded from 10 CFR 50 Appendix J Type C leak rate testing due to the size of the instrument lines and upstream orifice. Therefore, they have no safety-related seat leakage criterion.

These valves cannot be exercised during normal power operation since closing these valves would isolate instrumentation required for power operation. These valves can only be verified to close by leak testing performed during the primary system inservice pressure test performed each refueling outage. This test cannot be performed during cold shutdown since reactor vessel pressurization is required to test the valves.

The EFCVs are simple devices. The major active components are a poppet and spring. The spring holds the poppet open under static conditions. The valve will close upon sufficient differential pressure across the poppet. Functional testing of the valve is accomplished by venting the instrument side of the line. The resultant increase in flow imposes a differential pressure across the poppet, which compresses the spring and decreases flow through the valve. The design back-flow through the VY EFCVs is 1.0 gpm which is the test acceptance criterion.

The EFCVs have been extremely reliable throughout the industry as documented by General Electric Nuclear Energy (GE) Topical Report NEDO-329777-A, "Excess Flow Check Valve Testing Relaxation" (June 2000). In the first 27 years of operation at VY, only one excess flow check valve has failed. VY has evaluated the consequences of a postulated instrument line break without crediting EFCV function and the calculated off-site radiological consequences are sufficiently low and acceptable considering the probability of an instrument line break coincident with the functional failure of the associated EFCV.

3.4.4 Licensee's Proposed Alternative

Vermont Yankee proposes to test a representative sample of EFCVs each refueling outage such that all EFCVs are tested within a 10-year interval. Any failures will be evaluated in accordance with the requirements of the VY Corrective Action Program. This evaluation will include analysis to determine corrective actions, common mode failure, potential expanded sample size, and performance reliability. Performance reliability may require increased test frequency for failed components until two consecutive acceptable tests are achieved.

The proposed alternative is requested for the duration of the 5th 10-Year Interval VY IST program which is scheduled to commence September 1, 2013 and end on August 31, 2023.

3.4.5 NRC Staff Evaluation of RR-V02

The EFCVs are installed on boiling water reactor instrument lines to limit the release of fluid in the event of an instrument line break. Examples of EFCV installations include: reactor pressure vessel level and pressure instrumentation, main steam line flow instrumentation, recirculation pump suction pressure, and RCIC steam line flow instrumentation. The EFCVs are not required to close in response to a containment isolation signal and are not required to operate under post LOCA conditions.

The EFCVs are required to be tested in accordance with ASME OM Code ISTC-3510 which states, in part, that "Active Category A, Category B, and Category C check valves shall be exercised nominally every 3 months." The ASME OM Code recognizes that some valves cannot be tested at this frequency. Deferral of this requirement is allowed by ISTC-3522(c) which states "If exercising is not practical during operation at power and cold shutdowns, it shall be performed during refueling outages." The EFCVs listed in Table 2 cannot be exercised during normal operation because closing these valves would isolate instrumentation required for power operation. These valves can only be tested during a refueling outage. The licensee has proposed an alternative to the required test interval. The proposed change revises the surveillance frequency by allowing a "representative sample" of EFCVs to be tested every refueling outage. The "representative sample" is based on approximately 17 percent of the EFCVs being tested each refueling outage such that each valve is tested at least once every 10 years.

The licensee's justification for the relief request is based on GE Topical Report NEDO-32977-A "Excess Flow Check Valve Testing Relaxation" dated June 2000. The topical report provided: (1) an estimate of steam release frequency (into the reactor building) due to a break in an instrument line concurrent with an EFCV failure to close, (2) and assessment of the radiological consequences of such a release. The NRC staff reviewed the GE topical report and issued its evaluation on March 14, 2000 (ADAMS Accession No. ML003691722). In its evaluation, the staff found that the test interval could be extended up to a maximum of 10 years. In conjunction with this finding, the staff noted that each licensee that adopts the relaxed test interval program for EFCVs must have a failure feedback mechanism and corrective action program (CAP) to ensure EFCV performance continues to be bounded by the topical report results. Also, each licensee is required to perform a plant specific radiological dose assessment, EFCV failure

analysis, and release frequency analysis to confirm that they are bounded by the generic analyses of the topical report.

The NRC staff reviewed the licensee's proposal for its applicability to GE Topical Report NEDO-32977-A and conformance with approved staff guidance regarding radiological dose assessment, EFCV failure rate, release frequency, CAP, and the proposed feedback mechanism. The staff concludes that the radiological consequences of an EFCV failure are sufficiently low and acceptable, and that the alternative testing, in conjunction with the CAP, provides a high degree of valve reliability and operability. Additionally, a flow restricting orifice is installed just inside the drywell on all but the jet pump instrument lines. The jet pump instrument lines have small diameters and an orifice is not needed. The flow restricting orifice and the jet pump instrument line small tube diameter limit the flow rate leakage to a level where the integrity and functional performance of secondary containment is maintained. The coolant loss in the event of a EFCV failure is well within the makeup capability of reactor coolant supply systems and the potential offsite radiological consequences have been evaluated to be substantially below the limits of 10 CFR 50.67. Therefore, the staff finds that the licensee's proposed test alternative provides an acceptable level of quality and safety.

3.4.6 Conclusion

As set forth above, the NRC staff finds that the proposed alternative described in alternative request RR-V02 provides an acceptable level of quality and safety for valves listed in Table 2. Accordingly, the NRC staff concludes that the licensee has adequately addressed all of the regulatory requirements set forth in 10 CFR 50.55a(a)(3)(i), and is in compliance with the ASME OM Code's requirements.

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

Therefore, the NRC staff authorizes the proposed alternative in RR-V02 for the fifth IST interval at VY currently scheduled to begin on September 1, 2013 and end on August 31, 2023.

Principal Contributors: R. Wolfgang, NRR/DE/EPNB
J. Huang, NRR/DE/EPNB
M. Farnan, NRR/DE/EPNB

Date: August 28, 2013

August 28, 2013

Site Vice President
Entergy Nuclear Operations, Inc.
Vermont Yankee Nuclear Power Station
P.O. Box 250
Governor Hunt Road
Vernon, VT 05354

SUBJECT: VERMONT YANKEE NUCLEAR POWER STATION – RELIEF REQUESTS FOR FIFTH 10-YEAR INSERVICE TESTING PROGRAM INTERVAL (TAC NOS. MF0622, MF0623, MF0624, MF0625)

Dear Sir or Madam:

By letter dated February 1, 2013 (Agencywide Documents and Access Management System (ADAMS) Accession No. ML13039A027), as supplemented by letters dated May 1, 2013 (ADAMS Accession No. ML13127A076) and June 6, 2013 (ADAMS Accession No. ML13162A399), Entergy Nuclear Operations, Inc. (Entergy or the licensee) requested relief from, and proposed alternatives to, certain inservice testing (IST) requirements of the American Society of Mechanical Engineers *Code for Operation and Maintenance of Nuclear Power Plants* (OM Code) for its fifth 10-year IST program interval for the Vermont Yankee Nuclear Power Station (VYNPS). The program included Pump Relief Requests RR-P01, RR-P02 and Valve Relief Requests RR-V01 and RR-V02.

The NRC staff has determined that the licensee has adequately addressed all of the applicable regulatory requirements for each Relief Request. Relief Request RR-V01 is authorized pursuant to 10 CFR 50.55a(a)(3)(ii) on the basis that compliance with Code requirements would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety. Relief requests RR-V02 and RR-P02 are authorized pursuant to 10 CFR 50.55a(a)(3)(i) on the basis that they provide an acceptable level of quality and safety. Relief Request RR-P01 is granted pursuant to 10 CFR 50.55a(f)(6)(i) based on the impracticality of performing testing in accordance with the Code requirements. Granting relief is authorized by law and will not endanger life or property or the common defense and security, and is otherwise in the public interest giving due consideration to the burden upon the licensee that could result if the requirements were imposed on the facility. The Relief Requests are authorized for the fifth 10-year IST program interval at VYNPS. The details of the staff's review are included in the enclosed safety evaluation.

Sincerely,
/ra/ (DPickett for)
Robert H. Beall, Acting Branch Chief
Plant Licensing Branch I-1
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket No. 50-271

Enclosure: Safety Evaluation

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