March 5, 2004

Mr. Michael Kansler
President
Entergy Nuclear Operations, Inc.
440 Hamilton Avenue
White Plains, NY 10601

SUBJECT: SAFETY EVALUATION OF RELIEF REQUESTS FOR THE FOURTH 10-YEAR INTERVAL OF THE INSERVICE INSPECTION PROGRAM - VERMONT YANKEE NUCLEAR POWER STATION (TAC NOS. MB8349 THROUGH MB8358)

Dear Mr. Kansler:

By letter dated April 1, 2003, as supplemented on January 12 and February 18, 2004, Entergy Nuclear Vermont Yankee, LLC and Entergy Nuclear Operations, Inc. (Entergy), submitted 10 requests for relief from the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code (Code), Section XI requirements for the Vermont Yankee Nuclear Power Station (VYNPS). The subject relief requests are for the fourth 10-year inservice inspection (ISI) interval at VYNPS, which began on September 1, 2003.

The U.S. Nuclear Regulatory Commission staff has completed its review of the relief requests as documented in the enclosed Safety Evaluation (SE). Our SE concludes the following:

1) With respect to Relief Request Nos. ISI-02, ISI-05, ISI-07, ISI-08, ISI-10, and ISI-11, the proposed alternatives will provide an acceptable level of quality and safety. Therefore, the proposed alternatives are authorized pursuant to Section 50.55a(a)(3)(i) of Title 10 of the *Code of Federal Regulations* (10 CFR) for the remainder of the fourth 10-year ISI interval.

2) With respect to Relief Request Nos. ISI-03, ISI-04, and ISI-09, the proposed alternatives will provide an acceptable level of quality and safety. Therefore, the proposed alternatives are authorized pursuant to 10 CFR 50.55a(a)(3)(i) for the remainder of the fourth 10-year ISI interval, or until ASME Code Cases N-652, N-663, and N-613-1, respectively, are approved for general use by reference in Regulatory Guide (RG) 1.147. After that time, if the licensee wishes to continue to use these ASME Code Cases, the licensee must follow the conditions and limitations, if any, specified in the RG.

Relief Request No. RR-PT-1 was withdrawn by Entergy's submittal dated February 18, 2004.

All other ASME Code, Section XI requirements for which relief was not specifically requested and approved in these relief requests remain applicable, including third-party review by the authorized Nuclear Inservice Inspector.

If you have any questions regarding this matter, please contact the VYNPS Project Manager, Mr. Richard B. Ennis, at (301) 415-1420.

Sincerely,

/RA/

Darrell J. Roberts, Acting Chief, Section 2
Project Directorate I
Division of Licensing Project Management
Office of Nuclear Reactor Regulation

Docket No. 50-271

Enclosure: Safety Evaluation

cc w/encl: See next page

If you have any questions regarding this matter, please contact the VYNPS Project Manager, Mr. Richard B. Ennis, at (301) 415-1420.

Sincerely,

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SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELATED TO RELIEF REQUESTS FOR THE

FOURTH 10-YEAR INTERVAL OF THE INSERVICE INSPECTION PROGRAM

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 April 1, 2003, as supplemented on January 12 and February 18, 2004, Entergy Nuclear Vermont Yankee, LLC and Entergy Nuclear Operations, Inc. (Entergy or the licensee), submitted 10 requests for relief from the American Society of Mechanical Engineers Boiler and Pressure Vessel Code (ADME Code), Section XI requirements for the Vermont Yankee Nuclear Power Station (VYNPS). The subject relief requests are for the fourth 10-year inservice inspection (ISI) interval at VYNPS, which began on September 1, 2003.

2.0 REGULATORY REQUIREMENTS

The ISI of the ASME Code Class 1, 2, and 3 components is to be performed in accordance with Section XI of the ASME Code and applicable edition and addenda as required by Title 10 of the *Code of Federal Regulations* (10 CFR) Section 50.55a(g), except where specific written relief has been granted by the U.S. Nuclear Regulatory Commission (NRC or Commission) pursuant to 10 CFR 50.55a(g)(6)(i). Pursuant to 10 CFR 50.55a(a)(3), alternatives to the requirements of paragraph (g) may be used, when authorized by the NRC, if the licensee demonstrates that: (i) the proposed alternatives would provide 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.

Pursuant to 10 CFR 50.55a(g)(4), ASME Code Class 1, 2, and 3 components (including supports) must meet the requirements, except the design and access provisions and the pre-service examination requirements, set forth in the ASME Code, Section XI, “Rules for Inservice Inspection of Nuclear Power Plant Components,” to the extent practical within the limitations of design, geometry, and materials of construction of the components. The regulation requires that inservice examination of components and system pressure tests conducted during the first 10-year interval, and subsequent intervals, complies with the requirements in the latest edition and addenda of Section XI of the ASME Code incorporated by

reference in 10 CFR 50.55a(b) 12 months prior to the start of the 120-month interval, subject to the limitations and modifications listed therein. The applicable ASME Code of record for the fourth 10-year ISI interval at VYNPS is the ASME Code, Section XI, 1998 Edition with Addenda through 2000.

3.0 RELIEF REQUEST ISI-02

As discussed in the licensee's submittal dated April 1, 2003, Relief Request ISI-02 proposed the use of ASME Code Case N-560 as an alternative to ASME Section XI, Category B-J for examination of piping welds.

3.1 Components Affected

ASME Code Section XI, Class 1, Table IWB-2500-1, "Examination Category B-J, Pressure Retaining Welds in Piping," lists the examination requirements for Category B-J welds. The ASME Code requires examination of 25% of circumferential butt welds (or socket welds or branch connections).

3.2 Licensee Request for Re-approval

The licensee's request for relief was approved in an NRC letter dated November 9, 1998, to use ASME Code Case N-560, as augmented by Electric Power Research Institute (EPRI) TR-106706, as an alternative to the requirements of ASME Code Section XI, Class 1, Table IWB-2500-1. The ASME Code of record for the third 10-year ISI interval at VYNPS is the ASME Code, Section XI, 1986 Edition. The ISI ASME Code of record for the fourth 10-year ISI interval, starting September 1, 2003, is the 1998 Edition through 2000 Addenda. The licensee performed a comparison of the two editions of the ASME Code and listed the applicable changes. The licensee stated that the changes do not affect the use of ASME Code Case N-560, as augmented by EPRI TR-106706, at VYNPS.

3.3 Changes to the Applicable ASME Code Section

For Examination Category B-J, the differences between the 1986 Edition (third interval) and the 1998 Edition with Addenda through 2000 (fourth interval) are as follows:

1) The requirement for examination of longitudinal welds has been eliminated, except as noted in Notes (4), (5), and (6) at the intersections of circumferential welds.

2) Note (1)(c) clarifies which Category B-J dissimilar metal welds are included (no technical change).

3.4 NRC Staff Evaluation

For Category B-J welds of ASME Code Section XI, Class 1, the ASME Code requires examination of 25% of circumferential butt welds (or socket welds or branch connections). In a letter dated November 9, 1998, the NRC staff approved the licensee's request for relief to use ASME Code Case N-560 as augmented by EPRI TR-106706 as an alternative to the ASME

Code requirements pursuant to 10 CFR 50.55a(a)(3)(i) on the basis that the alternative provided an acceptable level of quality and safety. The alternative allows the use of a risk-informed program to select not less than 10% of Category B-J piping welds.

The licensee implemented the program with the approved relief request during the remainder of its third 10-year interval and requested to continue its implementation in the fourth interval. The staff reviewed the changes to the applicable ASME Code section. The first change involves an elimination of the requirement for examination of longitudinal welds. Since there are no longitudinal welds in the Category B-J population at VYNPS, the staff finds that this change does not affect the use of the previously approved relief request. The second change made clarification regarding which Category B-J dissimilar metal welds are included. Since there is no technical change, it does not affect the use of AMSE Code Case N-560 at VYNPS.

Based on the above, the staff agrees that the changes in the ASME Code Section XI in the 1998 Edition with Addenda through 2000 have no effect on the use of the previously approved relief request. ASME Code Case N-560, as augmented by EPRI TR-106706 specifically to VYNPS, is still applicable.

3.5 Conclusion

The NRC staff finds that the changes in the ASME Code, Section XI in the 1998 Edition with Addenda through 2000 have no effect on the use of ASME Code Case N-560, as augmented by EPRI TR-106706 at VYNPS, and that the alternative authorized for the third 10-year ISI interval is still applicable for the fourth 10-year ISI interval. The staff concludes that the licensee's proposed alternative, approved previously, continues to provide an acceptable level of quality and safety. Therefore, pursuant to 10 CFR 50.55a(a)(3)(i), the staff authorizes the proposed alternative for the remainder of the fourth 10-year ISI interval at VYNPS.

4.0 RELIEF REQUEST ISI-03

As discussed in the licensee's submittal dated April 1, 2003, Relief Request ISI-03 proposed the use of ASME Code Case N-652 as an alternative to ASME Code Section XI, Categories B-G-1, B-G-2, and C-D for examination of bolting.

4.1 Components Affected

ASME Code Section XI, Class 1, Examination Category B-G-1, Code Item Nos. B6.120, B6.150, B6.160, and B6.170; Examination Category B-G-2, Code Item Nos. B7.10, B7.40, B7.50, B7.60, and B7.70; and Examination Category C-D, Code Item No. C4.20.

4.2 ASME Code Requirements

ASME Code Section XI, Category B-G-1, Code Item Nos. B6.120, B6.150, B6.180, and B6.210 requires volumetric examination of bolts and studs in heat exchangers, piping, pumps, and valves regardless of whether the bolts or studs are examined in place or removed.

For ASME Code Section XI, Category B-G-1, Code Item Nos. B6.150, B6.180, and B6.210,

volumetric examinations of bolting on heat exchangers, pumps, and valves are limited to components selected for examination under Examination Categories B-B, B-J, B-L-2, and B-M-2.

ASME Code Section XI, Category B-G-1, Code Item Nos. B6.150, B6.160, and B6.170; Category B-G-2, Code Item No. B7.50; and Category C-D, Code Item No. C4.20 require inspection of 100% of bolts and studs at each bolted connection in piping selected for examination under Code Categories B-J and C-F.

ASME Code Section XI, Category B-G-2, Code Item Nos. B7.10, B7.40, B7.50, B7.60, and B7.70 require visual examination of all Class 1 bolts, studs, and nuts, two inches and less in diameter in place under tension, when the connection is disassembled, or when the bolting is removed.

4.3 Licensee's Proposed Alternative

The licensee proposed the following alternative:

> Bolting will be selected and examined in accordance with Code Case N-652. Specifically:
>
> 1. In accordance with Code Case N-652, Category B-G-1, Note 2, a surface examination of bolts and studs in heat exchangers, piping, pumps, and valves may be substituted for volumetric examination when the bolts or studs are removed.
>
> 2. In accordance with Code Case N-652, Category B-G-1, Note 4, volumetric examinations may be conducted on one heat exchanger, one pump, or one valve among a group of heat exchangers, pumps, or valves that are similar in design, type, and function. In addition, when the component to be examined contains a group of bolted connections of similar design and size, such as flanged connections, examination may be conducted on one bolted connection among the group.
>
> 3. In accordance with Code Case N-652, Category B-G-1, Note 6; Category B-G-2, Note 3; and Category C-D, Note 4, examination of flanged piping bolting may be limited to one connection of a group of connections similar in design, size, function, and service.
>
> 4. In accordance with Code Case N-652, Category B-G-2, Note 1, bolting will only be examined when a connection is disassembled or the bolting is removed. (Effectively, the alternative only applies to piping bolting.)

4.4 Licensee's Basis for Proposed Alternative

The licensee's basis for the proposed alternative is as follows:

> The service experience of bolting throughout the industry is exemplary. Degradation is only associated with leakage and other provisions address examination of bolting at leaking connections.
>
> 1. New notes (Note 2 of Category B-G-1 and Note 5 of Category C-D in Code Case N-652) were added to Categories B-G-1 and C-D to allow surface examination to be substituted for volumetric examination when bolting is removed for the examination. This recognizes that bolting failures initiate from the OD [outside diameter] surface and that a surface exam is an acceptable technique for detection of such defects.
>
> The existing examination methods require volumetric examination of removed bolting greater than two inches, even when surface examination is at least an equal, and possibly a more appropriate, examination.
>
> Code Case 307-2, in which examination of the borehole surfaces of bolts and studs was eliminated, demonstrates that cracking initiates on the outside surfaces of bolts and studs. For this reason, a qualified surface examination meeting the acceptance standards of IWB-3515 would provide at least the sensitivity for flaw detection that an end shot ultrasonic examination would provide on bolts and studs that have been removed for examination. Consequently, when bolts or studs are removed for examination, either a surface or volumetric examination should be allowed.
>
> 2. Note 3 of Section XI Category B-G-1 was changed (Note 4 in Code Case N-652 Category B-G-1) to require heat exchangers, pumps, and valves to be grouped based on design, type, and function, and then one component among the group to be volumetrically examined during the interval. In addition, if the component selected for examination included more than one bolted connection, then only one of those bolted connections is required to be examined. The note was also revised to apply only to volumetric examination as a new note was added to address visual examination of bolting for heat exchangers, pumps, and valves. Reference to examination of bolting for piping was also removed as a new note was added to address this.
>
> Previously, the Code only required bolting for heat exchangers, pumps and valves to be examined when the component was selected for examination under Categories B-B, B-L-2, or B-M-2. These Categories require the components to be selected for examination only when the component is disassembled. There appears to be no technical justification to tie volumetric examination of bolting to component disassembly. This change makes the Class 1 requirements for volumetric examination of bolting on these type components identical to the existing Class 2 requirements.

Under existing Section XI examination rules, Category B-G-1 volumetric examination of bolted connections in heat exchangers, pumps, and valves is required only when the major component is disassembled for maintenance, repair, or volumetric examination. This is inconsistent with, and actually less stringent than, the requirements of Category C-D, wherein volumetric examination of a sample of bolted connections in vessels, pumps and valves is required regardless of whether the component is disassembled for maintenance or repair.

Therefore, even though bolting inspection will be performed under a sample program (one connection of like connections), the change made by Code Case N-652 is more restrictive in that it will require examination of Category B-G-1 bolting regardless of whether the connection is disassembled.

3. A new note (Note 6 in Code Case N-652, Category B-G-1) was added in Category B-G-1 to clarify the requirements for examination of flange bolting in piping systems. It requires examination of one bolted connection among a group of bolted connections that are similar in design, type, function, and service.

A new Note 3 was added in Code Case N-652, Category B-G-2 to clarify the requirements for examination of flange bolting in piping systems. It requires examination of one bolted connection among a group of bolted connections that are similar in design, type, function, and service.

Note 2 of Category C-D was editorially revised to clarify the language. No technical changes were made to this note.

Note 3 of Category C-D was revised to clarify the requirements for examination of flange bolting in piping systems. It requires examination of one bolted connection among a group of bolted connections that are similar in design, type, function, and service.

The current code requires examination of bolting for piping when the component is selected for examination under Categories B-J or C-F, which is very difficult to comprehend. For bolting Categories B-G-1 and B-G-2, the existing notes require the examination of bolted connections in piping to be tied to components selected for examination under piping examination Category B-J. For bolting Category C-D, examination of bolted connections in piping is tied to piping examination Category C-F. These notes are confusing since it is difficult to limit examination of flange bolting in piping based on the piping welds selected for examination.

Therefore, even though bolting inspection will be performed under a sample program (one connection of like connections), the change made by Code Case N-652 is more restrictive in that it will require examination of piping bolting regardless of when the piping is selected under other Categories.

4. Note 1 of Category B-G-2 was revised to state that visual examination of bolting is required only when the connection is disassembled or removed.

   Note 2 of Category B-G-2 was revised to clarify that visual examination of bolting for vessels, pumps, and valves is required only when the component is examined under Category B-B, B-L-2, or B-M-2. Reference to examination of bolting for piping was also removed as a new note (Note 6 in Code Case N-652) was added to address this.

   The existing Section XI requires visual examination of this bolting when the component is "selected" for examination. Note 1 for Category B-G-2 of Code Case N-652 clarifies that examination is only required when the component is disassembled. It also clarifies that examination of any given bolted connection is required only once during the interval.

   The existing Section XI Category B-G-2 Note 1 states that bolting may be examined in place under tension, when connection is disassembled, or when bolting is removed. This revision recognizes the fact that visual examination on bolting in place and under tension is not meaningful. Furthermore, the existing Section XI Category B-G-2 rules for piping do not tie the examination to disassembly of the connection as they do for heat exchangers, pumps, and valves.

   Unlike volumetric examination, performing visual examinations of bolting while in place and under tension does not provide any meaningful information on the integrity of the bolting. Typically, the only portion of the bolting visible is the nuts and stud ends or the bolt head. Also, the only real degradation mechanism for flange bolting occurs when the connection is leaking. All Class 1 piping is subjected to a leakage test after each refueling outage and IWA-5000 already requires leaking flanges to be partially disassembled and the bolting to be examined for degradation. Performing a visual examination of bolting in place and under tension once every 10 years adds little value. This requirement is also inconsistent with the Class 1 rules for visual examination of bolting associated with heat exchangers pumps and valves, wherein the examination is tied to disassembly of the component. For these reasons it is more appropriate to tie the examination of bolted connections in piping to disassembly of the flange.

   Compliance with the proposed alternatives described above will provide an adequate level of quality and safety for examination of the affected welds, and will not adversely impact the health and safety of the public.

4.5 NRC Staff Evaluation

The licensee requests use of ASME Code Case N-652 as an alternative to the ASME Code-required volumetric examination of bolts and studs in heat exchangers, piping and pumps for ASME Code Section XI Category B-G-1 items; and as an alternative to the ASME

Code-required visual examination of bolts and studs in heat exchangers, piping and pumps for ASME Code Section XI Category B-G-2 items.

1. ASME Code Section XI, Category B-G-1, Code Item Nos. B6.120, B6.150, B6.180, and B6.210.

The ASME Code requires volumetric examination of bolts and studs in heat exchangers, piping, pumps, and valves regardless of whether the bolts or studs are examined in place or removed. The licensee proposed to perform such inspections with a surface examination instead of the ASME Code-required volumetric examination when bolts or studs are removed.

Industry experience shows that degradation such as corrosion and cracking will likely initiate from the OD surface of a bolt or stud. For such degradation, the use of surface inspection techniques is essentially as effective as volumetric techniques. A qualified surface exam meeting the acceptance standards of IWB-3515, as specified in ASME Code Case N-652, will provide the sensitivity of flaw detection in studs and bolts as required by the ASME Code using volumetric methods. OD initiated degradation, when detectable by volumetric methods such as ultrasonic testing (UT), would also be detectable by a surface examination, such as dye penetrant testing (PT). Therefore, the proposed alternative will provide an acceptable level of quality and safety.

2. ASME Code Section XI, Category B-G-1, Code Item Nos. B6.150, B6.180, and B6.210.

Under the ASME Code requirement, volumetric examinations of bolting on heat exchangers, pumps, and valves are limited to components selected for examination under Examination Categories B-B, B-J, B-L-2, and B-M-2. These Categories require the components to be selected for examination only when the connection is disassembled or when the bolting is removed. However, there is no technical basis to associate volumetric examination to component disassembly.

As an alternative specified in ASME Code Case N-652, Category B-G-1, Note 4, volumetric examinations may be conducted on one heat exchanger, one pump, or one valve among a group of heat exchangers, pumps, or valves that are similar in design, type, and function. In addition, when the component to be examined contains a group of bolted connections of similar design and size, such as flanged connections, examination may be conducted on one bolted connection among the group.

According to the ASME Code requirement, volumetric examination of the bolts and studs will only be performed when the major components are disassembled for maintenance and repairs. Using the ASME Code Case as an alternative, volumetric examination of the bolts and studs will be performed under a sample program. Since bolts and studs are grouped under similar conditions, such as design, type, and function, if degradation in a bolt were to occur, it would likely also take place in other bolts under similar conditions, and the sampling examination would detect the degradation. The staff finds that the requirements as specified in the ASME Code Case should effectively detect degradation in a manner that allows for timely corrective action. Therefore, the alternative will provide an acceptable level of quality and safety.

3. ASME Code Section XI, Category B-G-1, Code Item Nos. B6.150, B6.160, and B6.170; Category B-G-2, Code Item No. B7.50; and Category C-D, Code Item No. C4.20.

The ASME Code requires inspection of 100% of bolts and studs at each bolted connection in piping selected for examination under ASME Code Categories B-J and C-F. This, in fact, tied bolting inspections to the selection of piping components for examination based on pipe welds.

As an alternative according to ASME Code Case N-652, Category B-G-1, Note 6; Category B-G-2, Note 3; and Category C-D, Note 4, examination of flanged piping bolting may be limited to one connection of a group of connections similar in design, size, function, and service. The inspection is performed under a sample program. Bolts and studs are grouped under similar conditions, such as design, type, and function. If degradation were to occur in any bolts, it would likely also take place in other bolts under similar conditions. An inspection under the sampling program should detect any significant degradation in a manner that allows for timely corrective action. Therefore, the proposed alternative will provide an acceptable level of quality and safety.

4. ASME Code Section XI, Category B-G-2, Code Item Nos. B7.10, B7.40, B7.50, B7.60, and B7.70.

The ASME Code requires visual examination of all Class 1 bolts, studs, and nuts, two inches and less in diameter, in place under tension, when the connection is disassembled, or when the bolting is removed.

AMSE Code Case N-652, Note 1 for Category B-G-2 clarifies that examination is only required when the component is disassembled or the bolting is removed. It also clarifies that examination of any given bolted connection is required only once during the interval.

Under the AMSE Code requirement, visual examinations may be performed on bolts and studs when they are still in place and under tension. Visual examination of bolting while in place and under tension does not provide any meaningful information on its structural integrity, since the only portion of the bolting visible is the nuts and stud ends or the bolt head; degradation on the bolting surface may be missed. As an alternative specified in AMSE Code Case N-652, Category B-G-2, Note 1, bolting will only be examined when a connection is disassembled or the bolting is removed. Since visual examination of the bolting surface when the component is disassembled or removed is more likely to detect any degradation, if it exists, the proposed alternative provides an acceptable level of quality and safety.

4.6 Conclusion

The NRC staff concludes that the licensee's proposed alternatives will provide an acceptable level of quality and safety. Therefore, pursuant to 10 CFR 50.55a(a)(3)(i), the use of the proposed alternative as described in the licensee's letter dated April 1, 2003, is authorized for the remainder of the fourth 10-year ISI interval at VYNPS, or until AMSE Code Case N-652 is approved for general use by reference in Regulatory Guide (RG) 1.147. After that time, if the licensee wishes to continue to use ASME Code Case N-652, the licensee must follow the conditions and limitations, if any, specified in the RG.

5.0 RELIEF REQUEST ISI-04

As discussed in the licensee's submittal dated April 1, 2003, Relief Request ISI-04 proposed the use of ASME Code Case N-663 as an alternative to ASME Code Section XI, Class 1, Categories B-F, C-F-1, and C-F-2 for surface examinations.

5.1 Components Affected

ASME Code Section XI, Class 1, Examination Categories B-F, C-F-1, and C-F-2, Code Item Nos. B5.10, C5.11, C5.41, C5.51, and C5.81, pressure retaining dissimilar metal welds in reactor vessel nozzle-to-safe-end butt welds 4-inch nominal pipe size (NPS) and larger; pressure retaining circumferential welds and branch connection welds in austenitic stainless steel or high alloy piping 4-inch NPS and larger; and pressure retaining circumferential welds and branch connection welds in carbon or low alloy steel piping 4-inch NPS and larger.

5.2 ASME Code Requirements

IWB-2500-1, Examination Category B-F, Item No. B5.10, and IWC-2500-1, Examination Category C-F-1 and C-F-2, Item Nos. C5.11, C5.41, C5.51 and C5.81 state that surface examination of essentially 100% of each weld requiring examination must be performed. All Category B-F welds 4-inch NPS and larger require surface examination. Of the total population of non-exempt Category C-F-1 and C-F-2 piping welds greater than a 4-inch NPS, 7.5%, but not less than 28 welds, require surface examination.

5.3 Licensee's Proposed Alternative

The licensee proposed the following alternative:

> Surface examination of the subject welds (Categories B-F, C-F-1, and C-F-2 4-inch NPS and larger) shall be conducted in accordance with Code Case N-663. All areas of the subject welds identified as susceptible to outside surface attack shall be surface examined during the Vermont Yankee Fourth Ten-Year Interval in accordance with Code Case N-663. [Code Case N-663 also includes Category B-J, but Vermont Yankee will examine Category B-J in accordance with Relief Request ISI-02.]

5.4 Licensee's Basis for Proposed Alternative

The licensee's basis for the proposed alternative is as follows:

> The subject item numbers in ASME Section XI require a volumetric and/or surface exam on selected piping welds to ensure that generic degradation mechanisms are not active on either the inside diameter (I.D.) or the outside diameter (O.D.). However, these welds are selected using a deterministic set of requirements that are un-informed as to any possible degradation mechanisms. ASME Code Case N-663 provides an alternative to the current ASME Section XI requirements for defining the number and location of surface examinations for piping components.

The ASME Section XI Task Group on ISI Optimization, Report No. 92-01-01, *Evaluation of Inservice Inspection Requirements for Class 1, Category B-J Pressure Retaining Welds in Piping*, dated July 1995, concluded (with 50 units responding with a total of 9333 welds inspected) only 2 welds (0.02%) were found to have flaws detected by Section XI surface examinations. These flaws were determined to be fabrication-induced. In parallel with the above, several risk-informed Code cases have been developed for use on piping welds (e.g., ASME Code Cases N-560, N-577, and N-578). One of the methods for risk-informing piping examinations is via use of EPRI TR-112657, Rev. B-A, *Revised Risk-Informed Inservice Inspection Evaluation Procedure (NRC SER [safety evaluation report] dated 10/28/99)*. Table 4-1, *Summary of Degradation-Specific Inspection Requirements and Examination Methods*, of the EPRI report lists the required degradation mechanisms to be evaluated in Class 1, 2, and 3 piping. It also identifies the risk-informed examination method required for each of these degradation mechanisms. The only degradation mechanism that requires a surface examination is O.D. chloride cracking. These two initiatives led ASME to investigate the value of surface examinations.

Code Case N-663 incorporates lessons learned from the risk-informed initiatives and industry examination experience into Section XI by requiring that an evaluation be conducted to identify locations, if any, where a surface examination would be of benefit from a generic piping degradation perspective. The results of this evaluation identify where O.D. degradation is most likely to occur by reviewing plant-specific programs and practices, and operating experience. If the potential for degradation is identified, Code Case N-663 defines examination techniques, volumes, and frequencies. As such, implementing Code Case N-663 will identify appropriate locations for surface examination, if any, and eliminate unnecessary examinations.

Other ASME Section XI examination requirements for the subject piping welds, including volumetric examinations and pressure testing, will continue to be performed. Examination requirements for other components, including Class 1 piping less than NPS 4, will continue to meet all Section XI requirements and are not subject to this request.

Code Case N-663 was approved by the ASME Boiler and Pressure Vessel Code Committee on September, 17, 2002, but has not yet been included in the most recent listing of NRC approved code cases provided in Revision 12 of Regulatory Guide 1.147, “Inservice Inspection Code Case Acceptability – ASME Section XI Division 1.”

5.5 NRC Staff Evaluation

The proposed use of AMSE Code Case N-663 by the licensee to replace the ASME Code Section XI required surface examinations for piping welds of Categories B-F, C-F-1, and C-F-2 is consistent with the approved underlying EPRI and Westinghouse methodologies on risk-informed ISI contained in TR-112657, Revision B, “Revised Risk-Informed Inservice Inspection Evaluation Procedure” and WCAP-14572, Revision 1-NP-A, “Westinghouse Owners Group Application of Risk-Informed Methods to Piping Inservice Inspection Topical Report.” Although the two topical reports use different approaches, both have reached their objectives of

identifying the risk-important areas of the piping systems and defining the appropriate examination methods, examination volumes, procedures, and evaluation standards necessary to address the degradation mechanisms of concern and the ones most likely to occur at each location to be inspected.

In regard to the current issue of surface examinations for piping welds of Categories B-F, C-F-1, and C-F-2, all plant-specific risk-informed ISI programs are in accordance with the topical reports' conclusion that the only degradation mechanism that requires a surface examination is OD chloride cracking; consequently, surface examination will be considered only when OD chloride cracking is identified to be the degradation mechanism affecting the structural integrity of the subject piping welds.

AMSE Code Case N-663 provides that "...in lieu of the surface examination requirements for piping welds of Examination Category B-F (NPS 4 and larger), B-J (NPS 4 and larger), C-F-1, and C-F-2, surface examinations may be limited to areas identified by the Owner as susceptible to outside surface attack." The susceptibility criteria are listed in Table 1 of AMSE Code Case N-663 for two types of degradation mechanisms: 1) external (OD) chloride stress-corrosion cracking (SCC); and 2) other outside surface initiated mechanisms. The staff has determined that the surface inspection requirements of ASME Code Case N-663 are acceptable because the inspection requirements defined in the ASME Code case are equivalent to the corresponding inspection requirements approved by the NRC and adopted by using risk-informed ISI programs. Further, the ASME Code case requires that licensees conduct a plant-specific service history review to identify other mechanisms (e.g., thermal fatigue or mechanical fatigue) that can result in outside surface attack and to include plant-specific processes and programs that minimize chlorides and other contaminants. Therefore, the alternative provides reasonable assurance that the proposed inspections will not lead to degraded piping performance when compared to the existing performance levels.

5.6 Conclusion

Based upon the review of the information provided by the licensee in support of its request for relief, the NRC staff concludes that the use of ASME Code Case N-663 for Class 1 and 2 surface examinations, in lieu of the specified ASME Code requirements, will provide an acceptable level of quality and safety. This conclusion is based on the fact that inspection requirements defined in ASME Code Case N-663 are equivalent to the inspection requirements adopted by plants employing risk-informed ISI programs, and because the licensee will be required to conduct a plant-specific service history review to identify mechanisms (e.g., chloride-induced SCC as well as fatigue) that will cause outside surface attack upon subject plant components. Therefore, pursuant to 10 CFR 50.55a(a)(3)(i), the licensee's proposed use of ASME Code Case N-663 is authorized for the remainder of the fourth 10-year ISI interval for VYNPS, or until ASME Code Case N-663 is approved for general use by reference in RG 1.147. After that time, if the licensee wishes to continue to use ASME Code Case N-663, the licensee must follow the conditions and limitations, if any, specified in the RG.

6.0 RELIEF REQUEST ISI-05

As discussed in the licensee's submittal dated April 1, 2003, Relief Request ISI-05 proposed alternative requirements to ASME Code Section XI, Appendix VIII, Supplement 10, for examination of dissimilar metal welds.

6.1 Components Affected

Pressure-retaining piping welds subject to examination using procedures, personnel, and equipment qualified to ASME Code Section XI, Appendix VIII, Supplement 10 criteria.

6.2 ASME Code Requirements

ASME Code Section XI, Appendix VIII, Supplement 10, includes the following requirements applicable to this relief request:

Item 1 - Paragraph 1.1(b) states, in part, that pipe diameters within a range of 0.9 to 1.5 times a nominal diameter shall be considered equivalent.

Item 2 - Paragraph 1.1(d) states that all flaws in the specimen set shall be cracks.

Item 3 - Paragraph 1.1(d)(1) states that at least 50% of the cracks shall be in austenitic material. At least 50% of the cracks in austenitic material shall be contained wholly in weld or buttering material. At least 10% of the cracks shall be in ferritic material. The remainder of the cracks may be in either austenitic or ferritic material.

Item 4 - Paragraph 1.2(b) states, in part, that the number of unflawed grading units shall be at least twice the number of flawed grading units.

Item 5 - Paragraphs 1.2(c)(1) and 1.3(c) state, in part, that at least 1/3 of the flaws, rounded to the next higher whole number, shall have depths between 10% and 30% of the nominal pipe wall thickness. Paragraph 1.4(b) distribution table requires 20% of the flaws to have depths between 10% and 30%.

Item 6 - Paragraph 2.0, first sentence, states that the specimen inside surface and identification shall be concealed from the candidate.

Item 7 - Paragraph 2.2(b) states, in part, that the regions containing a flaw to be sized shall be identified to the candidate.

Item 8 - Paragraph 2.2(c) states, in part, that for a separate length-sizing test, the regions of each specimen containing a flaw to be sized shall be identified to the candidate.

Item 9 - Paragraph 2.3(a) states that for the depth-sizing test, 80% of the flaws shall be sized at a specific location on the surface of the specimen identified to the candidate.

Item 10 - Paragraph 2.3(b) states that for the remaining flaws, the regions of each specimen

containing a flaw to be sized shall be identified to the candidate. The candidate shall determine the maximum depth of the flaw in each region.

Item 11 - Table VIII-S2-1 provides the false-call criteria when the number of unflawed grading units is at least twice the number of flawed grading units.

6.3 Licensee's Proposed Alternatives and Basis for Proposed Alternatives

The licensee's submittal dated April 1, 2003, stated that the proposed alternatives are based on a forthcoming ASME Code action and were generated from a Performance Demonstration Initiative (PDI) model prepared by the EPRI. The proposed alternatives will be implemented through the PDI Program. The licensee proposed the following alternatives to the ASME Code, Section XI, Appendix VIII, Supplement 10, requirements for VYNPS during the fourth 10-year ISI interval:

Item 1 - The proposed alternative to Paragraph 1.1(b) states:

"The specimen set shall include the minimum and maximum pipe diameters and thicknesses for which the examination procedure is applicable. Pipe diameters within a range of 1/2 in. (13 mm) of the nominal diameter shall be considered equivalent. Pipe diameters larger than 24 in. (610 mm) shall be considered to be flat. When a range of thicknesses is to be examined, a thickness tolerance of ± 25% is acceptable."

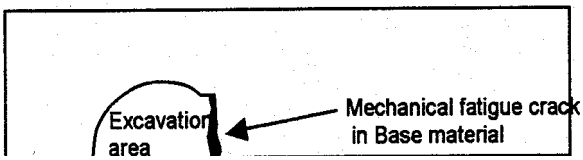
Technical Basis - The change in the minimum pipe diameter tolerance from 0.9 times the diameter to the nominal diameter minus 0.5 inch provides tolerances more in line with industry practice. Though the alternative is less stringent for small pipe diameters, [these small pipes typically] have a thinner wall thickness than larger diameter piping. A thinner wall thickness results in shorter sound path distances that reduce the detrimental effects of the curvature. This change maintains consistency between Supplement 10 and the recent revision to Supplement 2.

Item 2 - The proposed alternative to Paragraph 1.1(d) states:

"At least 60% of the flaws shall be cracks; the remainder shall be alternative flaws. Specimens with [intergranular stress corrosion cracking] IGSCC shall be used when available. Alternative flaws, if used, shall provide crack-like reflective characteristics and shall be limited to the case where implantation of cracks produces spurious reflectors that are uncharacteristic of actual flaws. Alternative flaw mechanisms shall have a tip width of less than or equal to 0.002 in. (.05 mm). Note, to avoid confusion the proposed alternative modifies instances of the term "cracks" or "cracking" to the term "flaws" because of the use of "alternative flaw mechanisms."

Technical Basis - As illustrated below, implanting a crack requires excavation of the base material on at least one side of the flaw. While this

may be satisfactory for ferritic materials, it does not produce a useable axial flaw in austenitic materials because the sound beam, which normally passes only through base material, must now travel through weld material on at least one side, producing an unrealistic flaw response. In addition, it is important to preserve the dendritic structure present in field welds that would otherwise be destroyed by the implantation process. To resolve these issues, the proposed alternative allows the use of up to 40% fabricated flaws as an alternative flaw mechanism under controlled conditions. The fabricated flaws are isostatically compressed which produces ultrasonic reflective characteristics similar to tight cracks.



Item 3 - The proposed alternative to Paragraph 1.1(d)(1) states:

"At least 80% of the flaws shall be contained wholly in weld or buttering material. At least one and a maximum of 10% of the flaws shall be in ferritic base material. At least one and a maximum of 10% of the flaws shall be in austenitic base material."

Technical Basis - Under the current Code, as few as 25% of the flaws are contained in austenitic weld or buttering material. The metallurgical structure of austenitic weld material is ultrasonically more challenging than either ferritic or austenitic base material. The proposed alternative is therefore more challenging than the current Code.

Item 4 - The proposed alternative to Paragraph 1.2(b) states:

"Detection sets shall be selected from Table VIII-S10-1. The number of unflawed grading units shall be at least one and a half times the number of flawed grading units."

Technical Basis - [New] Table VIII-S10-1 provides a statistically based ratio between the number of unflawed grading units and the number of flawed grading units. [Based on information provided by the PDI, t]he proposed alternative reduces the ratio to 1.5 times to reduce the number of test samples to a more reasonable number from the human factors perspective. However, the statistical basis used for screening personnel and procedures is still maintained at the same level with competent personnel being successful and less skilled personnel being unsuccessful. The acceptance criteria for the statistical basis are in Table VIII-S10-1.

Item 5 - The proposed alternative to the flaw distribution requirements of Paragraph 1.2(c)(1) (detection) and 1.3(c) (length) is to use the

Paragraph 1.4(b) (depth) distribution table (see below) for all qualifications.

Flaw Depth (% Wall Thickness)	Minimum Number of Flaws
10-30%	20%
31-60%	20%
61-100%	20%

Technical Basis - The proposed alternative uses the depth sizing distribution for both detection and depth sizing because it provides for a better distribution of flaw sizes within the test set. This distribution allows candidates to perform detection, length, and depth sizing demonstrations simultaneously utilizing the same test set. The requirement that at least 75% of the flaws shall be in the range of 10 to 60% of wall thickness provides an overall distribution tolerance yet the distribution uncertainty decreases the possibilities for testmanship that would be inherent to a uniform distribution. It must be noted that it is possible to achieve the same distribution utilizing the present requirements, but it is preferable to make the criteria consistent.

Item 6 - The proposed alternative to Paragraph 2.0 first sentence states:

“For qualifications from the outside surface, the specimen inside surface and identification shall be concealed from the candidate. When qualifications are performed from the inside surface, the flaw location and specimen identification shall be obscured to maintain a “blind test”.”

Technical Basis - The current Code requires that the inside surface be concealed from the candidate. This makes qualifications conducted from the inside of the pipe (e.g., [pressurized-water reactor] PWR nozzle to safe end welds) impractical. The proposed alternative differentiates between ID and OD scanning surfaces, requires that they be conducted separately, and requires that flaws be concealed from the candidate. This is consistent with the recent revision to Supplement 2.

Items 7 and 8 - The proposed alternatives to Paragraph[s] 2.2(b) and 2.2(c) state[s]:

“... containing a flaw to be sized may be identified to the candidate.”

Technical Basis - The current Code requires that the regions of each specimen containing a flaw to be length sized shall be identified to the candidate. The candidate shall determine the length of the flaw in each region (Note, that length and depth sizing use the term “regions” while detection uses the term “grading units” - the two terms define different concepts and are not intended to be equal or interchangeable). To ensure security of the samples, the proposed alternative modifies the first “shall” to

a “may” to allow the test administrator the option of not identifying specifically where a flaw is located. This is consistent with the recent revision to Supplement 2.

Items 9 and 10 - The proposed alternative to Paragraph[s] 2.3(a) and 2.3(b) state[s]:

“... regions of each specimen containing a flaw to be sized may be identified to the candidate.”

Technical Basis - The current Code requires that a large number of flaws be sized at a specific location. The proposed alternative changes the “shall” to a “may” which modifies this from a specific area to a more generalized region to ensure security of samples. This is consistent with the recent revision to Supplement 2. It also incorporates terminology from length sizing for additional clarity.

Item 11 - The proposed alternative modifies the acceptance criteria of Table VIII-S2-1 as follows:

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TABLE VIII-S2-1
PERFORMANCE DEMONSTRATION DETECTION TEST ACCEPTANCE CRITERIA

Detection Test Acceptance Critera		False Call Test Acceptance Criteria	
No. of Flawed Grading Units	Minimum Detection Criteria	No. of Unflawed Grading Units	Maximum Number of False Calls
~~5~~	~~5~~	~~10~~	~~0~~
~~6~~	~~6~~	~~12~~	~~1~~
~~7~~	~~6~~	~~14~~	~~1~~
~~8~~	~~7~~	~~16~~	~~2~~
~~9~~	~~7~~	~~18~~	~~2~~
10	8	~~20~~ 15	~~3~~ 2
11	9	~~22~~ 17	~~3~~ 3
12	9	~~24~~ 18	~~3~~ 3
13	10	~~26~~ 20	~~4~~ 3
14	10	~~28~~ 21	~~5~~ 3
15	11	~~30~~ 23	~~5~~ 3
16	12	~~32~~ 24	~~6~~ 4
17	12	~~34~~ 26	~~6~~ 4
18	13	~~36~~ 27	~~7~~ 4
19	13	~~38~~ 29	~~7~~ 4
20	14	~~40~~ 30	~~8~~ 5

Technical Basis - The proposed alternative is identified as new Table

[VIII-]S10-1 above. It was modified [from Table VIII-S2-1] to reflect the reduced number of unflawed grading units and allowable false calls. [As provided by the PDI, a]s a part of ongoing Code activities, [Pacific Northwest National Laboratory] PNNL has reviewed the statistical significance of these revisions and offered the revised Table [VIII-]S10-1.

6.4 NRC Staff Evaluation

The licensee proposed to use the program developed by PDI that is similar to the ASME Code requirements. The differences between the ASME Code and the PDI program are discussed below.

Item 1 - Paragraph 1.1(b)

The ASME Code requirement of "0.9 to 1.5 times the nominal diameter are equivalent" was established for a single nominal diameter. When applying the ASME Code-required tolerance to a range of diameters, the tolerance rapidly expands on the high side. Under current ASME Code requirements, a 5-inch OD pipe (4.5 NPS) would be equivalent to a range of 4.5-inch to 7.5-inch nominal pipe diameter. Under the proposed PDI guidelines, the equivalent range would be reduced to a 4.5-inch to 5.5-inch nominal diameter. With current ASME Code requirements, a 16-inch nominal diameter pipe (16-inch NPS) would be equivalent to a range of 14.4 inches to 24 inches. The proposed PDI guidelines would significantly reduce the equivalent range to 15.5-inch to 16.5-inch. The NRC staff considers the proposed alternative to be more restrictive overall than current ASME Code requirements. The NRC staff finds that the proposed alternative will provide an acceptable level of quality and safety and, therefore, is acceptable.

Item 2 - Paragraph 1.1(d)

The ASME Code requires all flaws to be cracks. Manufacturing test specimens containing cracks free of spurious reflections and telltale indicators is extremely difficult in austenitic material. To overcome these difficulties, PDI developed a process for fabricating flaws that produce UT acoustic responses similar to the responses associated with real cracks. PDI presented its process for discussion at public meetings held June 12 through 14, 2001, and January 31 through February 2, 2002, at the EPRI Nondestructive Examination Center, in Charlotte, North Carolina. The NRC staff attended these meetings and determined that the process parameters used for manufacturing fabricated flaws resulted in acceptable acoustic responses. PDI is selectively installing these fabricated flaws in specimen locations that are unsuitable for real cracks. The NRC staff finds that the proposed alternative will provide an acceptable level of quality and safety and, therefore, is acceptable.

Item 3 - Paragraph 1.1(d)(1)

The ASME Code requires that at least 50% of the flaws be contained in austenitic material, and 50% of the flaws in the austenitic material shall be contained fully in weld or buttering material. This means that at least 25% of the total flaws must be located in the weld or buttering material. Field experience shows that flaws identified during ISI of dissimilar metal welds are more likely

to be located in the weld or buttering material. The grain structure of austenitic weld and buttering material represents a much more stringent ultrasonic scenario than that of a ferritic material or austenitic base material. Flaws made in austenitic base material are difficult to create free of spurious reflectors and telltale indicators. The proposed alternative of 80% of the flaws in the weld metal or buttering material provides a challenging testing scenario reflective of field experience and minimizes testmanship associated with telltale reflectors common to placing flaws in austenitic base material. The NRC staff considers the proposed alternative to be more conservative than current ASME Code requirements. The NRC staff finds that the proposed alternative will provide an acceptable level of quality and safety and, therefore, is acceptable.

Item 4 - Paragraph 1.2(b) and Item 11 - Paragraph 3.1

The ASME Code requires that detection sets meet the requirements of Table VIII-S2-1 which specifies the minimum number of flaws in a test set to be five with 100% detection. The current ASME Code also requires the number of unflawed grading units to be two times the number of flawed grading units. The proposed alternative would follow the detection criteria of the table beginning with a minimum number of flaws in a test set being 10, and reducing the number of false calls to one-and-a-half times the number of flawed grading units. The NRC staff has determined that the proposed alternative satisfies the pass/fail objective established for Appendix VIII performance demonstration. The NRC staff finds that the proposed alternative will provide an acceptable level of quality and safety and, therefore, is acceptable.

Item 5 - Paragraphs 1.2(c)(1) and 1.3(c)

For detection and length-sizing, the ASME Code requires at least one third of the flaws be located between 10% and 30% through-the-wall thickness and one-third located greater than 30% through-the-wall thickness. The remaining flaws would be located randomly throughout the wall thickness. The proposed alternative sets the distribution criteria for detection and length-sizing to be the same as the depth-sizing distribution, which stipulates that at least 20% of the flaws be located in each of the increments of 10-30%, 31-60% and 61-100%. The remaining 40% would be located randomly throughout the pipe thickness. With the exception of the 10-30% increment, the proposed alternative is a subset of current ASME Code requirements. The 10-30% increment would be in the subset if it contained at least 30% of the flaws. The change simplifies assembling test sets for detection and sizing qualifications and is more indicative of conditions in the field. The NRC staff finds that the proposed alternative will provide an acceptable level of quality and safety and, therefore, is acceptable.

Item 6 - Paragraph 2.0

The ASME Code requires the specimen inside surface be concealed from the candidate. This requirement is applicable for test specimens used for qualifications performed from the outside surface. With the expansion of Supplement 10 to include qualifications performed from the inside surface, the inside surface must be accessible while maintaining the specimen integrity. The proposed alternative requires that flaws and specimen identifications be obscured from candidates, thus maintaining blind test conditions. The NRC staff considers this to be consistent with the intent of ASME Code requirements. The NRC staff finds that the proposed

alternative will provide an acceptable level of quality and safety and, therefore, is acceptable.

Items 7 and 8 - Paragraphs 2.2(b) and 2.2(c)

The ASME Code requires that the location of flaws added to the test set for length-sizing shall be identified to the candidate. The proposed alternative is to make identifying the location of additional flaws an option. This option provides an additional element of difficulty to the testing process because the candidate would be expected to demonstrate the skill of detecting and sizing flaws over an area larger than a specific location. The NRC staff considers the proposed alternative to be more conservative than current ASME Code requirements. The NRC staff finds that the proposed alternative will provide an acceptable level of quality and safety and, therefore, is acceptable.

Items 9 and 10 - Paragraphs 2.3(a) and 2.3(b)

The ASME Code requires that 80% of the flaws be sized in a specific location that is identified to the candidate. The proposed alternative permits detection and depth-sizing to be conducted separately or concurrently. In order to maintain a blind test, the location of flaws cannot be shared with the candidate. For depth-sizing that is conducted separately, allowing the test administrator the option of not identifying flaw locations makes the testing process more challenging. The NRC staff considers the proposed alternative to be more conservative than current ASME Code requirements. The NRC staff finds that the proposed alternative will provide an acceptable level of quality and safety and, therefore, is acceptable.

The ASME Code also requires that the location of flaws added to the test set for depth-sizing shall be identified to the candidate. The proposed alternative is to make identifying the location of additional flaws an option. This option provides an additional element of difficulty to the testing process because the candidate would be expected to demonstrate the skill of finding and sizing flaws in an area larger than a specific location. The NRC staff considers the proposed alternative to be more conservative than current ASME Code requirements. The NRC staff finds that the proposed alternative will provide an acceptable level of quality and safety and, therefore, is acceptable.

6.5 Conclusion

The NRC staff concludes that the licensee's proposed alternatives to Supplement 10, as administered by the EPRI-PDI Program, will provide an acceptable level of quality and safety. Therefore, the use of the proposed alternatives, as described in the licensee's letter dated April 1, 2003, is authorized for the remainder of the fourth 10-year ISI interval at VYNPS pursuant to 10 CFR 50.55a(a)(3)(i).

7.0 RELIEF REQUEST ISI-07

As discussed in the licensee's submittal dated April 1, 2003, Relief Request ISI-07 proposed the use of Boiling Water Reactor Vessel and Internals Project (BWRVIP) report BWRVIP-75, published in October 1999, as an alternative to Generic Letter (GL) 88-01 for frequency of overlay examinations.

7.1 Components Affected and ASME Code Requirements

ASME Code Section XI, Class 1, Examination Category B-F, Code Item No. B5.10, pressure retaining dissimilar metal welds in vessel nozzles. The ASME Code requires that all welds be examined once within each interval.

7.2 Previous Request Approved by the NRC

The licensee's letter (BVY 00-102) to the NRC dated October 31, 2000, requested approval to use an alternate inspection frequency for Category E Weld Repair Overlays (ASME Code Section XI, Class 1, Examination Category B-F, Code Item No. B5.10, pressure retaining dissimilar metal welds in vessel nozzles) in accordance with BWRVIP-75. BWRVIP-75 allows an inspection schedule of 25% of the weld/weld overlay population every interval when certain guidelines are met. The NRC staff reviewed and approved the request in a letter dated March 22, 2001 (Agencywide Document Access and Management System (ADAMS) Accession No. ML010780133).

7.3 Licensee Request for Re-approval

The licensee stated that neither the ASME Code Section XI, 1986 Edition, nor the ASME Code Section XI, 1998 Edition with 2000 Addenda addresses structural overlays, and that the relief granted for the third 10-year ISI interval is still applicable for the fourth 10-year ISI interval. BWRVIP-75 and the NRC's Safety Evaluation (SE) of BWRVIP-75 are still the current applicable guidance documents for inspection of structurally overlaid components in boiling water reactors (BWRs).

7.4 NRC Staff Evaluation

BWRVIP-75 and the NRC's SE of BWRVIP-75 addressed inspection requirements for Category B-F welds and structurally overlaid components. In the NRC's SE, the staff concluded that licensee-implementation of the guidelines in the BWRVIP-75 report would provide an acceptable level of quality and safety for examination of the safety-related BWR piping welds addressed in the report, and that the report can be used in lieu of the inspection guidance in GL 88-01. The licensee implemented the alternative with the NRC's approval during the remainder of its third 10-year interval, and subsequently requested to continue its implementation in the fourth 10-year ISI interval.

The staff reviewed the applicable ASME Code Section of the 1986 Edition and the 1998 Edition with 2000 Addenda and found that there has been no change between the two editions and addenda that are applicable to structural overlays. The staff also finds that the NRC-approved

guidelines in BWRVIP-75 are still valid, and that the licensee's proposed alternative, approved previously, continues to provide an acceptable level of quality and safety. Therefore, the alternative authorized for VYNPS's third 10-year ISI interval is still applicable for the fourth 10-year ISI interval.

7.5 Conclusion

The NRC staff finds that the conditions supporting the request for relief approved for the third 10-year ISI interval are still valid, and that the alternative authorized for the third 10-year ISI interval is still applicable for the fourth 10-year ISI interval. The staff concludes that the licensee's proposed alternative, approved previously, continues to provide an acceptable level of quality and safety. Therefore, pursuant to 10 CFR 50.55a(a)(3)(i), the staff authorizes the proposed alternative for the remainder of the fourth 10-year ISI interval at VYNPS.

8.0 RELIEF REQUEST ISI-08

As discussed in the licensee's submittal dated April 1, 2003, Relief Request ISI-08 proposed an alternative to ASME Code Section XI, Appendix VIII, Supplement 4, Paragraph 3.2(c) for examination of reactor pressure vessel (RPV) shell welds.

8.1 Components Affected

ASME Code Section XI, Class I, Examination Category B-A, Item B1.10 longitudinal and circumferential shell welds, and B1.20 head welds subject to Appendix VIII, Supplement 4, examination.

8.2 ASME Code Requirements

Supplement 4, Subparagraph 3.2(c), requires that the UT performance demonstration results be plotted on a two-dimensional plot with the measured depth plotted along the ordinate axis and the true depth plotted along the abscissa axis. For qualification, the plot must satisfy the following statistical parameters: (1) slope of the linear regression line is not less than 0.7; (2) the mean deviation of flaw depth is less than 0.25 inches; and (3) correlation coefficient is not less than 0.70.

8.3 Licensee's Proposed Alternative

The licensee proposed using the root mean square (RMS) value of 10 CFR 50.55a(b)(2)(xv)(C)(1) which modifies the depth-sizing criterion of Appendix VIII, Supplement 4, Subparagraph 3.2(a), in lieu of Subparagraph 3.2(c).

8.4 Licensee's Basis for Proposed Alternative

The licensee's basis for the proposed alternative is as follows:

> In a public meeting on October 11, 2000 at NRC offices in White Flint, MD [Reference Meeting Summary - ADAMS Accession No. ML003768853], the PDI identified the

discrepancy between the Subparagraph 3.2(c) and the PDI program. The NRC agrees that Paragraph 10 CFR 50.55a(b)(2)(xv)(C)(1) should have excluded Subparagraph 3.2(c) as a requirement.

The U.S. nuclear utilities created the PDI to implement demonstration requirements contained in Appendix VIII. PDI developed a performance demonstration program for qualifying UT techniques. In 1995, the NRC staff performed an assessment of the PDI program and reported that there were differences between Appendix VIII and the way PDI was implementing the program, but did not take exception to PDI's implementation. The staff requested that the differences between PDI and the Code be resolved.

The solution for resolving the differences between the PDI program and the Code was for PDI to participate in development of a Code case that reflected PDI's program. The Code Case was presented to ASME for discussion and consensus building. NRC representatives participated in this process. ASME approved the Code Case and published it as Code Case N-622, "Ultrasonic Examination of RPV and Piping, Bolts and Studs, Section XI, Division 1."

Operating in parallel with the actions of PDI, the staff incorporated most of Code Case N-622 criteria in the rule published in the Federal Register, 64 FR 51370. 10 CFR 50.55a(b)(2)(xv) was subsequently revised in the Federal Register, 67 FR 187 [60537]. Appendix IV to Code Case N-622 contains the proposed alternative sizing criteria, which has been authorized by the staff. The staff agrees that the inclusion of the statistical sizing parameters of Paragraph 3.2(c) of Supplement 4 to Appendix VII was an oversight.

Compliance with the proposed alternatives described above will provide an adequate level of quality and safety for examination of the affected welds, and will not adversely impact the health and safety of the public.

8.5 NRC Staff Evaluation

As an alternative, the licensee proposed eliminating the use of Supplement 4, Subparagraph 3.2(c), which imposes three statistical parameters for depth-sizing. The first parameter, 3.2(c)(1), pertains to the slope of a linear regression line. The linear regression line is the difference between actual versus true value plotted along a through-wall thickness. For Supplement 4 performance demonstrations, a linear regression line of the data is not applicable because the performance demonstrations are performed on test specimens with flaws located in the inner 15% through-wall. The differences between actual versus true value produce a tight grouping of results which resemble a shotgun pattern. The slope of a regression line from such data is extremely sensitive to small variations, thus, making the parameter of Subparagraph 3.2(c)(1) a poor and inappropriate acceptance criterion. The second parameter, 3.2(c)(2), pertains to the mean deviation of flaw depth. The value used in the ASME Code is too lax with respect to evaluating flaw depths within the inner 15% of wall thickness. Therefore, the licensee proposed to use the more appropriate criterion of 0.15 inch RMS of 10 CFR 50.55a(b)(2)(xv)(C)(1), which modifies Subparagraph 3.2(a), as the acceptance criterion. The third parameter, 3.2(c)(3), pertains to a correlation coefficient. The value of the

correlation coefficient in Subparagraph 3.2(c)(3) is inappropriate for this application since it is based on the linear regression from Subparagraph 3.2(c)(1).

PDI was aware of the inappropriateness of Subparagraph 3.2(c) early in the development of their program. They brought the issue before the appropriate ASME committee which formalized eliminating the use of Supplement 4, Subparagraph 3.2(c) in ASME Code Case N-622. NRC staff representatives participated in the discussions and consensus process of the ASME Code case. Based on the above, the NRC staff believes that the use of the Subparagraph 3.2(c) requirements in this context is inappropriate and that the proposed alternative to use the RMS value of 10 CFR 50.55a(b)(2)(xv)(C)(1), which modifies the criterion of Appendix VIII, Supplement 4, Subparagraph 3.2(a), in lieu of Subparagraph 3.2(c), will provide an acceptable level of quality and safety.

8.6 Conclusion

Based on the discussion above, the staff concludes that the proposed alternative will provide an acceptable level of quality and safety. Therefore, pursuant to 10 CFR 50.55a(a)(3)(i), the use of the proposed alternative as described in the licensee's letter dated April 1, 2003, is authorized for the remainder of the fourth 10-year ISI interval at VYNPS.

9.0 RELIEF REQUEST ISI-09

As discussed in the licensee's supplement, dated January 12, 2004, Relief Request ISI-09 proposed the use of ASME Code Case N-613-1 as an alternative to ASME Code Section XI for examination of RPV nozzle-to-vessel welds.

9.1 Components Affected

ASME Code Section XI, Examination Category B-D, Item B3.90, pressure retaining nozzle-to-vessel welds.

9.2 ASME Code Requirements

ASME Code Section XI, 1998 Edition, 2000 addenda, Figure IWB-2500-7(b) specifies the examination volume for nozzle-to-vessel welds.

9.3 Licensee's Proposed Alternative

In lieu of the requirements of ASME Code Section XI, Figure IWB-2500-7(b), the licensee proposes to use the alternative examination requirements of ASME Code Case N-613-1 and its Figure 2.

9.4 Licensee's Basis for Proposed Alternative

The licensee's basis for the proposed alternative is as follows:

> The examination volume for the reactor vessel pressure retaining nozzle-to-vessel welds extends far beyond the weld into the base metal, and is unnecessarily large. This prolongs the examination time significantly, and results in no net increase in safety, as the area being examined is a base metal region which is not prone to in-service cracking and has been extensively examined before the vessel was put into service, in addition to the first, second, and third interval examinations.
>
> Code Case N-613-1 reduces the examination volume next to the widest part of the weld from half of the vessel wall thickness to one-half (1/2) inch. This removes examination of the base metal that was extensively examined during construction and in three subsequent in-service inspections. This region is not in the high residual stress region associated with the weld; cracks, should they initiate, occur in the high-stressed areas of the weld. These high-stressed areas are contained in the volume that is defined by Code Case N-613-1 and are subject to examination.
>
> Compliance with the proposed alternatives described above in the above items will provide an adequate level of quality and safety for examination of the affected welds, and will not adversely impact the health and safety of the public.

9.5 NRC Staff Evaluation

The licensee requested relief from the UT examination volume requirements specified in Table IWB-2500-1, Examination Category B-D, Code Item B3.90, Figure IWB-2500-7 (b), pertaining to UT examination of full penetration nozzles in vessels. The licensee proposed to use the alternative examination requirements of ASME Code Case N-613-1 and its Figure 2, which allows a reduced examination volume, extending to one-half inch from each side of the widest part of the nozzle-to-vessel weld, in lieu of an examination volume extending to a distance equal to one-half the through-wall thickness from each side of the widest part of the nozzle-to-vessel weld, as required by Figure IWB-2500-7 (b).

The specific weld configuration and revised examination volume are depicted as region A-B-C-D-E-F-G-H within Figure 2 of ASME Code Case N-613-1. All nozzle-to-vessel welds included within the scope of this relief request are of the type depicted in Figure 2 of ASME Code Case N-613-1. The revised examination volume depicted in this sketch extends to one-half inch from each side of the widest part of the nozzle-to-vessel weld and is, therefore, consistent with the licensee's request for the reduced UT examination volume. All other aspects of the UT examination volumes for RPV nozzle-to-vessel welds remain unchanged by the licensee's request.

The acceptability of the reduced UT examination volume is based on prior full volumetric examinations of the welds and base metal, as well as the internal stress distribution near the weld. Prior full volumetric examinations of the nozzle-to-vessel welds cover the full volume of base metal, extending to a distance equal to one-half the through-wall thickness from each side

of the widest part of the nozzle-to-vessel weld, as required by the ASME Code. This base metal region included in the original ASME Code volume was extensively examined during construction, preservice inspection, and prior ISIs (the first, second and third 10-year interval at VYNPS). These examinations all showed the ASME Code volume to be free of unacceptable flaws. The initiation of flaws during plant service in the volume excluded from the proposed reduced examination volume is unlikely because of the low stress in the base metal away from the weld. The stresses caused by welding are concentrated at, or near, the weld. Cracks, should they initiate, occur in the highly stressed area of the weld. These areas are within the volume included in the reduced examination volume proposed by the licensee. The prior full volume examinations of the base metal provide reasonable assurance that these areas are free of unacceptable flaws.

Based on the above discussion, the staff concludes that the proposed alternative to use ASME Code Case N-613-1 and its Figure 2, to reduce the UT examination volume to one-half inch from the widest part of the nozzle-to-vessel weld on each side of the weld crown, will provide an acceptable level of quality and safety.

9.6 Conclusion

The NRC staff finds that the proposed use of ASME Code Case N-613-1 in lieu of the ASME Code-required examination will provide an acceptable level of quality and safety. Therefore, pursuant to 10 CFR 50.55a(a)(3)(i), the staff authorizes the proposed alternative for the remainder of the fourth 10-year ISI interval at VYNPS, or until ASME Code Case N-613-1 is approved for general use by reference in RG 1.147. After that time, if the licensee wishes to continue to use ASME Code Case N-613-1, the licensee must follow the conditions and limitations, if any, specified in the RG.

All other ASME Code, Section XI requirements for which relief was not specifically requested and approved in this relief request remain applicable, including third-party review by the authorized Nuclear Inservice Inspector.

10.0 RELIEF REQUEST ISI-10

As discussed in the licensee's submittal dated April 1, 2003, Relief Request ISI-10 proposed alternative requirements to ASME Code Section XI, Appendix VIII, Supplement 11, for examination of overlaid piping.

10.1 Components Affected

ASME Code Section XI, Class 1, pressure retaining welds in piping, subject o Appendix VIII, Supplement 11, examination.

10.2 ASME Code Requirements

Pursuant to 10 CFR 50.55a(a)(3)(i), the licensee is requesting relief from the weld overlay requirements in the following paragraphs to Section XI, Appendix VIII, Supplement 11:

Paragraph 1.1(d)(1) requires that all base metal flaws be cracks.

Paragraph 1.1(e)(1) requires that at least 20%, but not less than 40%, of the flaws shall be oriented within ±20 degrees of the axial direction.

Paragraph 1.1(e)(1) also requires that the rules of IWA-3300 shall be used to determine whether closely spaced flaws should be treated as single or multiple flaws.

Paragraph 1.1(e)(2)(a)(1) requires that a base grading unit shall include at least 3 inches of the length of the overlaid weld and the outer 25% of the overlaid weld and base metal on both sides.

Paragraph 1.1(e)(2)(a)(3) requires that for unflawed base grading units, at least 1 inch of unflawed overlaid weld and base metal shall exist on either side of the base grading unit.

Paragraph 1.1(e)(2)(b)(1) requires that an overlay grading unit shall include the overlay material and the base metal-to-overlay interface of at least 6 square inches. The overlay grading unit shall be rectangular, with minimum dimensions of 2 inches.

Paragraph 3.2(b) requires that all extensions of base metal cracking into the overlay material by at least 0.1 inches are reported as being intrusions into the overlay material.

10.3 Licensee's Proposed Alternative

In lieu of the requirements of ASME Code Section XI, 1998 Edition, 2000 Addenda, Appendix VIII, Supplement 11, the PDI program, as described in the 3rd column of the Table included with Relief Request ISI-10, shall be used. The relief is for the fourth 10-year ISI interval.

10.4 Licensee's Basis for Proposed Alternative

The licensee’s basis for the proposed alternative is as follows:

> Paragraph 1.1(d)(1), requires that all base metal flaws be cracks. As illustrated [in the submittal], implanting a crack requires excavation of the base material on at least one side of the flaw. While this may be satisfactory for ferritic materials, it does not produce a useable axial flaw in austenitic materials because the sound beam, which normally passes only through base material, must now travel through weld material on at least one side, producing an unrealistic flaw response. To resolve this issue, the PDI program revised this paragraph to allow use of alternative flaw mechanisms under controlled conditions. For example, alternative flaws shall be limited to when implantation of cracks precludes obtaining an effective ultrasonic response, flaws shall be semi-elliptical with a tip width of less than or equal to 0.002 inches, and at least 70 percent of the flaws in the detection and sizing test shall be cracks and the remainder shall be alternative flaws.
>
> Relief is requested to allow closer spacing of flaws provided they didn’t interfere

with detection or discrimination. The existing specimens used to date for qualifications to the Tri-party (NRC/BWROG[Boiling Water Reactors Owners Group]/EPRI) agreement have a flaw population density greater than allowed by the current Code requirements. These samples have been used successfully for all previous qualifications under the Tri-party agreement program. To facilitate their use and provide continuity from the Tri-party agreement program to Supplement 11, the PDI Program has merged the Tri-party test specimens into their weld overlay program. For example: the requirement for using IWA-3300 for proximity flaw evaluation in paragraph 1.1(e)(1) was excluded, instead indications will be sized based on their individual merits; paragraph 1.1(d)(1) includes the statement that intentional overlay fabrication flaws shall not interfere with ultrasonic detection or characterization of the base metal flaws; paragraph 1.1(e)(2)(a)(1) was modified to require that a base metal grading unit include at least 1 in. of the length of the overlaid weld, rather than 3 inches; paragraph 1.1(e)(2)(a)(3) was modified to require sufficient unflawed overlaid weld and base metal to exist on all sides of the grading unit to preclude interfering reflections from adjacent flaws, rather than the [1] inch requirement of Supplement 11; paragraph 1.1(e)(2)(b)(1) was modified to define an overlay fabrication grading unit as including the overlay material and the base metal-to-overlay interface for a length of at least 1 in[.], rather than the 6 sq. in. requirement of Supplement 11; and paragraph 1.1(e)(2)(b)(2) states that overlay fabrication grading units designed to be unflawed shall be separated by unflawed overlay material and unflawed base metal-to-overlay interface for at least 1 in. at both ends, rather than around its entire perimeter.

Additionally, the requirement for axially oriented overlay fabrication flaws in paragraph 1.1(e)(1) was excluded from the PDI Program as an improbable scenario. Weld overlays are typically applied using automated gas tungsten arc welding techniques with the filler metal being applied in a circumferential direction. Because resultant fabrication induced discontinuities would also be expected to have major dimensions oriented in the circumferential direction axial overlay fabrication flaws are unrealistic.

The requirement in paragraph 3.2(b) for reporting all extensions of cracking into the overlay is omitted from the PDI Program because it is redundant to the RMS calculations performed in paragraph 3.2(c) and its presence adds confusion and ambiguity to depth sizing as required by paragraph 3.2(c). This also makes the weld overlay program consistent with the Supplement 2 depth sizing criteria.

The PDI Program omits the phrase “and base metal on both sides,” in paragraph 1.1(a)(1) because some of the qualification samples included flaws on both sides of the weld. To avoid confusion, several instances of the term “cracks” or “cracking” were changed to the term “flaws” because of the use of alternative flaw mechanisms. Additionally, to avoid confusion, the overlay thickness tolerance contained in paragraph 1.1(b), last sentence, was reworded and the phrase “and the remainder shall be alternative flaws” was added to the next-to-last sentence in paragraph 1.1(d)(1).

10.5 NRC Staff Evaluation

The nuclear power industry tasked PDI with the implementation of ASME Code Section XI, Appendix VIII, Supplement 11 performance demonstration program. The PDI program is routinely assessed by the staff for consistency with ASME Code and proposed ASME Code changes. In order to meet the scheduled implementation date of November 22, 2001, specified in 10 CFR 50.55a(g)(6)(ii)(C), PDI evaluated the applicability of using test specimens from an existing weld overlay program[1] for its Supplement 11 performance demonstration program. Their evaluation identified differences with Paragraphs 1.1(e)(1), 1.1(e)(2)(a)(1), 1.1(e)(2)(a)(3), 1.1(e)(2)(b)(1), and 3.2(b). PDI proposed that these paragraphs be changed to permit using the existing weld overlay test specimens.

Paragraph 1.1(e)(1) requires that at least 20%, but not less than 40%, of the flaws shall be oriented within ± 20 degrees of the axial direction. In the PDI program, the flaws satisfy the requirement and specify that the flaws must be in the base metal. This is a tightening of the requirements. Hence, PDIs application of flaw angles to the axial direction is acceptable.

Paragraph 1.1(e)(1) also requires that the rules of IWA-3300 shall be used to determine whether closely spaced flaws should be treated as single or multiple flaws. PDI treats each flaw as an individual flaw and not as part of a system of closely spaced flaws. PDI controls the flaws going into a test specimen set such that the flaws are free of interfering reflections from adjacent flaws. In some cases this would permit flaws to be closer together than what is allowed by IWA-3300, thus making the performance demonstration more challenging. Hence, PDI's application for closely spaced flaws is acceptable.

Paragraph 1.1(e)(2)(a)(1) requires that a base grading unit shall include at least 3 inches of the length of the overlaid weld, and the base grading unit includes the outer 25% of the overlaid weld and base metal on both sides. The PDI program reduced the criteria to 1 inch of the length of the overlaid weld and eliminated from the grading unit the need to include both sides of the weld. The test specimens from the existing weld overlay program have flaws on both sides of the welds which prevents them from satisfying the base grading unit requirements. These test specimens have been used successfully for testing the proficiency of personnel for over 16 years. This is a more challenging test because the individual must locate the flaw on the correct side of the weld. Hence, PDI's application of the 1-inch length of the overlaid weld base grading unit and elimination from the grading unit the need to include both sides of the weld is acceptable.

Paragraph 1.1(e)(2)(a)(3) requires that for unflawed base grading units, at least 1 inch of unflawed overlaid weld and base metal shall exist on either side of the base grading unit. This is to minimize the number of false identifications of extraneous reflectors. The PDI program stipulates that unflawed overlaid weld and base metal exists on all sides of the grading unit and must be free of interfering reflections from adjacent flaws which addresses the same concerns

1. The existing weld overlay program is the industry's response to Generic Letter 88-01 which resulted in a Tri-party Agreement between NRC, EPRI, and the Boiling Water Reactor Owners Group (BWROG), "Coordination Plan for NRC/EPRI/BWROG Training and Qualification Activities of NDE [nondestructive examination] Personnel," July 3, 1984.

as the ASME Code. Hence PDI's application of the variable flaw-free area adjacent to the grading unit is acceptable.

Paragraph 1.1(e)(2)(b)(1) requires that an overlay grading unit shall include the overlay material and the base metal-to-overlay interface of at least 6 square inches. The overlay grading unit shall be rectangular, with minimum dimensions of 2 inches. The PDI program reduces the base metal-to-overlay interface to at least 1 inch (in lieu of a minimum of 2 inches) and eliminates the minimum rectangular dimension. This criterion is more challenging than the ASME Code because of the variability associated with the shape of the grading unit. Hence, PDI's application of the grading unit is acceptable.

Paragraph 3.2(b) requires that all extensions of base metal cracking into the overlay material by at least 0.1 inches are reported as being intrusions into the overlay material. The PDI program omits this criteria. The PDI program requires that cracks be sized to the tolerance specified in the ASME Code which is 0.125 inches. Since the ASME Code tolerance is close to the 0.1-inch value of Paragraph 3.2(b), any crack extending beyond 0.1 inches into the overlay material would be identified by its dimensions. The reporting of an extension in the overlay material is redundant for performance demonstration testing. Hence, PDI's omission of highlighting a crack extending beyond 0.1 inches into the overlay material is acceptable.

In addition to the changes for flaw locations, PDI determined that certain Supplement 11 requirements pertaining to location and size of cracks would be extremely difficult to achieve. In an effort to satisfy the requirements, PDI developed a process for fabricating flaws that exhibited crack-like reflective characteristics. Instead of all flaws being cracks, as required by Paragraph 1.1(d)(1), the PDI weld overlay performance demonstrations contain at least 70% cracks with the remainder being fabricated flaws exhibiting crack-like reflective characteristics. The NRC has reviewed the flaw fabrication process, and has compared the reflective characteristics between cracks and fabricated flaws. The NRC found the fabricated flaws acceptable for the application (Reference Meeting Summaries - ADAMS Accession Nos. ML010940402 and ML013330156).

10.6 Conclusion

Based on the above evaluation, the NRC staff has concluded that the proposed alternative to use the PDI program requirements in lieu of Appendix VIII, Supplement 11 will provide an acceptable level of quality and safety. Therefore, pursuant to 10 CFR 50.55a(a)(3)(i), the proposed alternative ISI-10 is authorized for the remainder of the fourth 10-year ISI interval for VYNPS.

11.0 RELIEF REQUEST ISI-11

As discussed in the licensee's submittal dated April 1, 2003, Relief Request ISI-11 proposed the use of Appendix VIII of ASME Code Section XI, as modified by 10 CFR 50.55a(b)(2), for examination of the RPV flange-to-shell weld.

11.1 Components Affected

ASME Code Section XI, Class 1, Examination Category B-A, Code Item No. B1.30, reactor vessel flange-to-shell weld.

11.2 ASME Code Requirements

1998 Edition with Addenda through 2000, Appendix I, Subparagraph I-2110(b) requires that UT of reactor vessel flange-to-shell welds be conducted in accordance with Article 4 of ASME Code Section V, supplemented by the requirements of Table I-2000-1. In addition, RG 1.150, Revision 1, "Ultrasonic Testing of Reactor Vessel Welds During Preservice and Inservice Examinations," serves as regulatory guidance for the UT examination of RPV welds.

11.3 Licensee's Proposed Alternative

The licensee proposed using PDI qualified personnel and procedures to complete the UT of the RPV vessel-to-flange weld in accordance with ASME Code Section XI, 1998 Edition with Addenda through 2000, Appendix VIII Supplements 4 and 6 as required by 10 CFR 50.55a(g)(6)(ii)(C), in lieu of Section V, Article 4 requirements.

11.4 Licensee's Basis for Proposed Alternative

The licensee's basis for the proposed alternative is as follows:

> Federal Register Notice 67 FR 187 [sic, 67 FR 60520], dated September 26, 2002, requires that ASME Section XI, Appendix VIII, Supplement 4, "Qualification Requirements for the Clad/Base Metal Interface of Reactor Vessel", and Supplement 6, "Qualification Requirements for Reactor Vessel Welds other than Clad/Base Metal Interface", be implemented for most of the RPV welds, starting November 22, 2000. Per ASME Section XI, Appendix I, Subparagraph I-2110(b), reactor vessel-to-flange and head-to-flange welds are the only reactor vessel pressure boundary welds not included in Appendix VIII.
>
> During the upcoming ten-year RPV weld examinations [due during the First Period of the Fourth Interval per 10 CFR 50.55a(g)], Vermont Yankee will be employing personnel, procedures, and equipment, demonstrated and qualified by the PDI and in accordance with ASME Code, Section XI, 1998 Edition, with Addenda through 2000, Appendix VIII, Supplements 4 and 6 as amended by the Federal Register Notice 67 FR 187 [sic, 67 FR 60520], dated September 26, 2002 for examination of RPV shell welds.
>
> Appendix VIII was developed to ensure the effectiveness of UT examinations within the nuclear industry by means of a rigorous item-specific performance demonstration. The performance demonstration is conducted on an RPV mockup containing flaws of various sizes and locations. The demonstration establishes the capability of equipment, procedures, and personnel to find flaws that could be detrimental to the integrity of the RPV.

Although Appendix VIII is not a requirement for this weld, the qualification process to Appendix VIII criteria demonstrates that the examination and evaluation techniques are equal or surpass the requirements of Appendix I, Subparagraph 2110(b), ASME Section V, Article 4, and the guidance in RG 1.150.

A comparison between the ASME Section V, Article 4 based UT methods and the procedures developed to satisfy the PDI and Appendix VIII can be best described as a comparison between a compliance-based procedure (ASME Section V, Article 4) and a results-based procedure (PDI/Appendix VIII). ASME Section V, Article 4 procedures use an amplitude-based technique and a known reflector. The proposed alternate UT method was established independently from the acceptance standards for flaw size found in ASME Section XI.

A PDI-qualified sizing method is considered more accurate than the method used in ASME Code, Section V, Article 4. The proposed alternate UT examination technique provides an acceptable level of quality and examination repeatability as compared to the Article 4 requirements.

Vermont Yankee will obtain the examination vendor's Performance Demonstration Qualification Sheet (PDQS), which will attest that their procedure is in compliance with the detection and sizing tolerance requirements of Appendix VIII. The PDI qualification method is based on a group of samples, which validate the acceptable flaw sizes in ASME Section XI. The sensitivity necessary to detect these flaws is considered to be equal to or better than the sensitivity obtained through ASME Section V, Article 4, because sensitivity necessary to detect implanted cracks is generally better than that necessary to calibrate on a machined notch.

The examination and sizing procedures for all potential qualified examination vendors use echo-dynamic motion and tip diffraction characteristics of the flaw instead of the amplitude characteristics required by ASME Section V, Article 4. The search units are required to interrogate the same examination volume as depicted by ASME Section XI, Figure IWB-2500-4 for the shell-to-flange weld joint.

Procedures used for satisfying the requirements of ASME Section V, Article 4 for the UT examination of the RPV-to-flange weld has not undergone such a rigorous demonstration or received the same qualifications as a PDI qualified procedure.

The Vermont Yankee shell-to-flange geometry compares very favorably with the geometry of the PDI qualification specimens. The inside diameter surface (the scan surface) of the shell-to-flange weld and adjacent base material is theoretically a cylinder; there is no taper associated with this joint on the RPV ID at Vermont Yankee. The shell base material thickness (excluding clad) is 5 5/16". The flange thickness (excluding clad) within the extremity of the required examination volume is 10 5/8". Vermont Yankee will require that the vendor's PDQS bound this thickness range. It is expected that an examination will be able to be performed from both the shell and the flange sides of the weld.

The shell-to-flange weld was examined radiographically and ultrasonically as a part of the RPV fabrication. During the second ten-year inservice inspection interval this weld was re-examined. In 1996, the weld was examined by remote automated inspection per 10 CFR 50a(g) during the first period of the third ten-year inservice inspection interval. This last examination was conducted in accordance with Appendix VIII using PDI-demonstrated procedures, even though Appendix VIII was not mandatory at the time.

If Vermont Yankee were to conduct examination of the RPV vessel-to-flange weld in accordance with ASME Section V, Article 4 and RG 1.150, it is expected that the examination would be performed using manual techniques from the vessel OD inside the drywell at the top of the bio-shield wall, and also from the vessel flange mating surface in the reactor refueling cavity. The use of Appendix VIII Supplements 4 and 6 for examination of this weld using remote automated inspection tooling is expected to significantly reduce personnel radiation exposure.

Compliance with the proposed alternatives described above will provide an adequate level of quality and safety for examination of the affected welds, and will not adversely impact the health and safety of the public.

11.5 NRC Staff Evaluation

The 1998 Edition with Addenda through 2000 of Section XI IWA-2232 states, “Ultrasonic examination shall be conducted in accordance with Appendix I.” Subparagraph I-2110(b) of Appendix I requires that ultrasonic examination of head-to-flange welds in a vessel of greater than 2 inches in thickness shall be conducted in accordance with Article 4 of Section V, as supplemented by Table I-2000-1 of this Appendix. Supplements identified in Table I-2000-1 shall be applied. Section V, Article 4, as supplemented by Appendix I, provides a prescriptive-based process for qualifying UT procedures. In lieu of Section XI requirements, the licensee proposed using procedures and personnel qualified in accordance with the performance-based criteria as implemented by the PDI program for the examination of RPVs, Section XI, Appendix VIII, Supplements 4 and 6.

When qualified prescriptive-based UT procedures are applied in a controlled setting containing real flaws in mockups of reactor vessels, and the results are statistically analyzed according to the screening criteria in Appendix VIII of Section XI of the ASME Code, the procedures are equal to, or less effective than, UT Appendix VIII, Supplement 4 and 6 qualified procedures. The performance-based UT is performed with higher sensitivity which increases the chances of detecting a flaw when compared to prescriptive-based Section V, Article 4 requirements. Also, flaw sizing is more accurately determined with the echo-dynamic motion and tip diffraction criteria used by performance-based UT as opposed to the less accurate amplitude criteria for prescriptive-based Section V, Article 4 requirements. Procedures, equipment, and personnel qualified through the PDI program have demonstrated their skill level to detect flaws common to nuclear power plants and have shown high probability of detection levels. This has resulted in an increased reliability of inspections for weld configurations subjected to Appendix VIII.

11.6 Conclusion

Based on the review of the licensee's proposed alternative to use UT procedures and personnel qualified to the 1998 Edition with Addenda through 2000 of Section XI of the ASME Code, Appendix VIII, Supplements 4 and 6 as modified by 10 CFR 50.55a(b)(2)(xv) for the RPV shell-to-flange weld, the staff has determined that the proposed alternative examination with PDI qualified procedures and personnel would provide a better examination than the current ASME Code requirements or the RG 1.150 recommendations. As such, the NRC staff concludes that the proposed alternative will provide an acceptable level of quality and safety. Therefore, pursuant to 10 CFR 50.55a(a)(3)(i), the proposed alternative is authorized for the subject flange-to-vessel weld at VYNPS for the remainder of the fourth 10-year ISI interval.

All other ASME Code, Section XI requirements for which relief was not specifically requested and approved in this relief request remain applicable, including third-party review by the authorized Nuclear Inservice Inspector.

12.0 RELIEF REQUEST PT-1

As discussed in the licensee's submittal dated February 18, 2004, Relief Request PT-1 was withdrawn.

Principal Contributor: Z. Fu

Date: March 5, 2004