Entergy

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BVY 03-87

U.S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, DC 20555

Subject: **Vermont Yankee Nuclear Power Station**
License No. DPR-28 (Docket No. 50-271)
Supplement to Third-Interval Inservice Inspection (ISI) Program – Submittal of Relief Request B-5, "Limited Examinations"

Vermont Yankee Nuclear Power Station's (VY) third ten-year interval of the Inservice Inspection Program concluded on August 31, 2003. During this interval, the components identified within Attachment 2 received less than "essentially 100%" examination. Accordingly, pursuant to 10CFR50.55a(g)(5)(iii), relief is requested on the basis that the required "essentially 100%" coverage examination is impractical due to physical obstructions and limitations imposed by design, geometry and materials of construction of the subject components.

Attachment 1 identifies the commitments contained within this letter. Attachment 2 contains Relief Request B-5.

If you have any questions on this transmittal, please contact Mr. Thomas B. Silko at (802) 258-4146.

Sincerely,

James M. DeVincentis
Manager, Licensing

Attachments

cc: USNRC Region 1 Administrator
USNRC Resident Inspector - VY
USNRC Project Manager - VY
Vermont Department of Public Service

A047

Attachment 1

Vermont Yankee Nuclear Power Station

Supplement to Third-Interval Inservice Inspection (ISI) Program – Submittal of Relief Request B-5, "Limited Examinations"

List of Commitments

SUMMARY OF VERMONT YANKEE COMMITMENTS

BVY NO.: 03-87

The following table identifies commitments made in this document by Vermont Yankee. Any other actions discussed in the submittal represent intended or planned actions by Vermont Yankee. They are described to the NRC for the NRC's information and are not regulatory commitments. Please notify the Licensing Manager of any questions regarding this document or any associated commitments.

COMMITMENT	COMMITTED DATE OR "OUTAGE"
NONE	N/A

Attachment 2

Vermont Yankee Nuclear Power Station

Supplement to Third-Interval Inservice Inspection (ISI) Program – Submittal of Relief Request B-5, "Limited Examinations"

Relief Request B-5

LICENSEE/UTILITY NAME – Entergy Nuclear Operations, Inc.
PLANT NAME, UNIT – Vermont Yankee
10-YEAR INTERVAL – Third Interval
REQUEST FOR RELIEF No. B-5

Proposed Alternative
In Accordance with 10 CFR 50.55a(g)(5)(iii)

-- Inservice Inspection Impracticality --

1. ASME Code Component(s) Affected

Code Classes:	1, 2, 3
References:	Subarticle IWB-2500, Subarticle IWC-2500, GL 88-10, NUREG 0313, Code Case N-460
Examination Categories:	B-D, B-F, B-H, B-J, B-K, B-O, C-A, C-C, and C-F-2
Item Numbers:	B3.90, B3.100, B5.10, B8.10, B9.11, B10.10, B14.10, C1.10, C3.10, and C5.51
Description:	Volumetric and Surface Examination Coverage
Component Numbers:	Various, see Table RR-B-5

2. Applicable Code Edition and Addenda

1986 Edition with no Addenda

3. Applicable Code Requirements

Subarticle IWB-2500 states, in part, "Components shall be examined and tested as specified in Table IWB-2500-1." Table IWB-2500-1 requires a volumetric examination or a surface and volumetric examination be performed on the component based on Category and Item Number. The applicable examination area or volume and method required are as shown below from Table IWB-2500-1:

Examination Category	Item Number	Examination Requirements /Figure Number	Examination Method
B-D	B3.90 & B3.100	IWB-2500-7(b)	Volumetric
B-F	B5.10	IWB-2500-8(c)	Volumetric and Surface
B-H	B8.10	IWB-2500-13	Surface
B-J	B9.11	IWB-2500-8(c)	Volumetric and Surface
B-K	B10.10	IWB-2500-15	Surface
B-O	B14.10	IWB-2500-18	Volumetric or Surface

Subarticle IWC-2500 states, in part, "Components shall be examined and pressure tested as specified in Table IWC-2500-1." Table IWC-2500-1 requires a surface examination or a surface and volumetric examination to be performed on the component based on Category and Item Number. The applicable examination area or volume and method required are as shown below from Table IWC-2500-1:

Examination Category	Item Number	Examination Requirements / Figure Number	Examination Method
C-A	C1.10	IWC-2500-1(a)	Volumetric
C-C	C3.10	IWC-2500-5(a) and (b)	Surface
C-F-2	C5.51	IWC-2500-7(a)	Surface & Volumetric

4. Reason for Request

Pursuant to 10 CFR 50.55a(g)(5)(iii), relief is requested on the basis that the required "essentially 100%" coverage examination is impractical due to physical obstructions and limitations imposed by design, geometry and materials of construction of the component.

Relief is requested from performing a complete coverage examination of the entire volume or area required. Entire volume or area required is defined by ASME Section XI Code Case N-460 titled "Alternative Examination Coverage for Class 1 and Class 2 Welds, Section XI, Division 1." Code Case N-460 states in part, "...when the entire examination volume or area cannot be examined...a reduction in examination coverage...may be accepted provided the reduction in coverage for that weld is less than 10%."

The NRC through, Information Notice 98-42 titled "Implementation of 10 CFR 50.55a(g) Inservice Inspection Requirements," termed the reduction in coverage of less than 10% to be "essentially 100 percent." Information Notice 98-42 states, in part, "The NRC has adopted and further refined the definition of 'essentially 100 percent' to mean 'greater than 90 percent'...has been applied to all examinations of welds or other areas required by ASME Section XI."

Relief is requested from performing an examination of "essentially 100%" of the required volume or area as applicable for the identified components in Table RR-B-5.

Note: Category B-A reactor pressure vessel shell welds (Item Nos. B1.11, B1.12 and B1.30) are not listed in Table RR-B-5. A relief request was submitted for coverage limitations of this augmented examination of the reactor pressure vessel shell welds in a letter from Vermont Yankee to USNRC[1], dated January 23, 1997. The NRC issued an SER[2], dated February 18, 1999, related to that submittal.

5. Proposed Alternative

The statistical basis provided below demonstrates that a reduction in coverage does not affect the ability to confidently detect potential degradation mechanisms. With an earlier design coupled with

[1] VYNPC Letter to USNRC, BVY 97-15, "Augmented Examination of the Reactor Pressure Vessel Shell Welds," dated January 23, 1997.

[2] USNRC Letter to VYNPC, NVY 99-16, "Augmented Examination of the Reactor Pressure Vessel Shell Welds at Vermont Yankee Nuclear Power Station (Tac No. M99389)," dated February 18, 1999.

the examinations complete to the extent practical and results evidencing no unacceptable flaws present, the underlying objectives have been met. Additionally, a VT-2 examination performed on the subject components during system pressure test per examination category B-P each refueling outage and category C-H each period provides additional assurance that the structural integrity of the subject components is maintained.

Basis for Use

Vermont Yankee obtained a Construction Permit on July 7, 1967. Vermont Yankee's piping systems and associated components were designed and fabricated before the examination requirements of ASME Section XI were formalized and published. Since this plant was not specifically designed to meet the requirements of ASME Section XI, literal compliance is not feasible or practical within the limits of the current plant design.

Physical obstructions imposed by design, geometry and materials of construction are typical of vessel appurtenances, biological shield wall, insulation support rings, structural and component support members, adjacent component weldments in close proximity, unique component configurations (valves and pumps), and dissimilar metal weldments.

As a minimum, all components received the required examination(s) to the extent practical with regard to the limited or lack of access available. The examinations conducted confirmed satisfactory results evidencing no unacceptable flaws present, even though "essentially 100%" coverage was not attained. Vermont Yankee has concluded that if any active degradation mechanisms were to exist in the subject welds, those degradations would have been identified in the examinations performed. The basis for this conclusion derives from the statistical approach put forth in Appendix A of this request. The statistical approach concludes that even for large reductions in coverage, the reduction in degradation detection confidence is insignificant.

For surface examinations, Vermont Yankee calculated the coverage percentage based on the area that was examined within the required coverage area divided by the required surface area to be inspected. For volumetric (invariably ultrasonic) examinations, VY elected to use the following method to calculate coverage. The required examination volume was calculated. The examination was performed in accordance with an approved ultrasonic procedure that met the governing Code requirements. The approved procedure requires a number of angles and a number of beam directions for each angle. For each angle/beam direction combination the volume interrogated by that beam was calculated (within the required coverage volume). Then that value was divided by the required examination volume to determine a percentage of coverage for each angle/beam-direction combination. Then those required angle/beam-direction coverage percentages were averaged to determine an overall composite coverage. For example, prior to invoking Appendix VIII, ASME Section V, Article 4 required 0°, 45°, and 60° search units for examining vessel welds from the OD of the vessel. The 45° and 60° search units are each required to be scanned in four orthogonal directions. Therefore, a total of nine angle/beam-directions are required and a coverage percentage is calculated for each of those nine angle/beam-direction combinations. Then those nine values are averaged to determine the overall composite coverage. (Note: Since Appendix VIII was invoked for vessel welds, the required number of angle/beam-direction combinations now depends on the qualified procedure, and thus the calculation would be different.) There are many other ways to calculate volumetric coverage, and it may be that using other calculation methods, more ultrasonic exams may have fallen above or below the 90% coverage threshold. The calculation method is of relative unimportance however, when one considers the statistical relevance (see Appendix A, "Statistical Significance of Limited Coverage").

Usually, a change in the NDE procedure will not make a dramatic change in the amount of coverage. Also, typically, the original NDE procedure is optimized to perform the test with the greatest amount of confidence in the results. When a change is made to the procedure to achieve greater coverage, usually compromises in the NDE technique must be made. Further, since the implementation of Appendix VIII, it is not permissible to change ultrasonic techniques in order to attain more coverage because the UT technique would then not be qualified. It is more important to be confident in the results that are obtained, rather than to compromise the technique to obtain a little more coverage. As can be seen in Appendix A, "Statistical Significance of Limited Coverage," unless the coverage increase is quite dramatic, the impact is not really significant.

For the most part, Vermont Yankee did not select alternative welds when coverage was limited on the scheduled weld. A sample plan implies a certain amount of random choice in the selection of welds for examination – unless there are more conservative ways to select the sample, such as selecting high stress points or welds where industry experience indicates that damage mechanisms are more likely. This is why for Category C-F-2, terminal end welds are singled out; they are more typically high stressed. The reason for interferences is usually independent of the flaw mechanism. However, there may be cases where this is not true. For example, valve-to-pipe welds and pump-to-pipe weld geometries may inhibit coverage. But, these welds may actually have higher stresses because of their configurations. In these cases, if alternative welds were selected, the sample of higher stressed welds in the population would be diluted. If alternative welds are chosen, the selection randomness decreases. Flaw mechanisms associated with test limitations may be missed. It may be better to accept the limited coverage than to select alternative welds.

There is Code precedent for allowing limited coverage due to inaccessibility. ASME Section XI allows certain Class 1 and Class 2 welds to be exempt based on the criteria that they are inaccessible. Paragraphs IWB-1220(c), IWB-1220(d), and IWC-1223 exempt welds that are inaccessible due to control rod drive penetrations, because they are encased in concrete, are buried underground, or are encapsulated by guard pipe. The Code recognizes that examination of these welds is not possible and, therefore, that a Relief Request would not be necessary. The same logic applies to portions of welds that are inaccessible and where examination of those portions of welds is not possible.

The statistical study in Appendix A, "Statistical Significance of Limited Coverage," makes the interesting point that the Code and the industry implicitly accept a certain number of flaws in a population of welds by accepting one or more of the following: 1) a sample inspection plan, 2) a reduction of up to 10% in coverage, and/or 3) a probability of detection of any one flaw of less than 100% (80% in the examples). This is not surprising when one considers that the ISI program is spread over ten years. If no flaws were acceptable, 100% of the safety related components in the plant would have to be inspected every day.

The impact that a reduction of coverage would have is not significant when one takes the above implicit assumptions into account.

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.

6. Duration of Proposed Alternative

Relief is requested for the third ten-year interval of the Inservice Inspection Program for Vermont Yankee, which began September 1, 1993 and concluded August 31, 2003.

TABLE RR-B-5

COMPONENTS WITH LESS THAN "ESSENTIALLY 100%" COVERAGE

Section XI Category & Item No.	Component System & Number	Component Description	Condition Limiting Coverage	Exam & Coverage Percent
B-D B3.90	RPV N1A	Vessel-to-Nozzle (Recirculation)	Nozzle, radius blend, & weld configuration	UT 50.4%
B-D B3.90	RPV N1B	Vessel-to-Nozzle (Recirculation)	Nozzle, radius blend, & weld configuration	UT 50.4%
B-D B3.90	RPV N2A	Nozzle-to-Vessel (Recirculation)	Nozzle, radius blend, & weld configuration	UT 51.6%
B-D B3.90	RPV N2B	Nozzle-to-Vessel (Recirculation)	Nozzle, radius blend, & weld configuration	UT 51.6%
B-D B3.90	RPV N2C	Nozzle-to-Vessel (Recirculation)	Nozzle, radius blend, & weld configuration	UT 51.6%
B-D B3.90	RPV N2D	Nozzle-to-Vessel (Recirculation)	Nozzle, radius blend, & weld configuration	UT 51.6%
B-D B3.90	RPV N2E	Nozzle-to-Vessel (Recirculation)	Nozzle, radius blend, & weld configuration	UT 51.6%
B-D B3.90	RPV N2F	Nozzle-to-Vessel (Recirculation)	Nozzle, radius blend, & weld configuration	UT 51.6%
B-D B3.90	RPV N2G	Nozzle-to-Vessel (Recirculation)	Nozzle, radius blend, & weld configuration	UT 51.6%
B-D B3.90	RPV N2H	Nozzle-to-Vessel (Recirculation)	Nozzle, radius blend, & weld configuration	UT 51.6%
B-D B3.90	RPV N2J	Nozzle-to-Vessel (Recirculation)	Nozzle, radius blend, & weld configuration	UT 51.6%
B-D B3.90	RPV N2K	Nozzle-to-Vessel (Recirculation)	Nozzle, radius blend, & weld configuration	UT 51.6%
B-D B3.90	RPV N3A	Vessel-to-Nozzle (Main Steam)	Nozzle, radius blend, & weld configuration	UT 51.6%
B-D B3.90	RPV N3B	Vessel-to-Nozzle (Main Steam)	Nozzle, radius blend, & weld configuration	UT 51.6%
B-D B3.90	RPV N3C	Vessel-to-Nozzle (Main Steam)	Nozzle, radius blend, & weld configuration	UT 51.6%
B-D B3.90	RPV N3D	Vessel-to-Nozzle (Main Steam)	Nozzle, radius blend, & weld configuration	UT 51.6%
B-D B3.90	RPV N4A	Nozzle-to-Vessel (Feed Water)	Nozzle, radius blend, & weld configuration	UT 63.3%
B-D B3.90	RPV N4B	Nozzle-to-Vessel (Feed Water)	Nozzle, radius blend, & weld configuration	UT 63.3%
B-D B3.90	RPV N4C	Nozzle-to-Vessel (Feed Water)	Nozzle, radius blend, & weld configuration	UT 63.3%
B-D B3.90	RPV N4D	Nozzle-to-Vessel (Feed Water)	Nozzle, radius blend, & weld configuration	UT 63.3%
B-D B3.90	RPV N5A	Nozzle-to-Vessel (Core Spray)	Nozzle, radius blend, & weld configuration	UT 67.1%
B-D B3.90	RPV N5B	Nozzle-to-Vessel (Core Spray)	Nozzle, radius blend, & weld configuration	UT 67.1%

TABLE RR-B-5
(Continued)

Section XI Category & Item No.	Component System & Number	Component Description	Condition Limiting Coverage	Exam & Coverage Percent
B-D B3.90	RPV N6A	Nozzle-to-Vessel (Head Spray)	Nozzle, radius blend, & weld configuration	UT 52.5%
B-D B3.90	RPV N6B	Nozzle-to-Vessel (Head Spray)	Nozzle, radius blend, & weld configuration	UT 52.5%
B-D B3.90	RPV N7	Vessel-to-Nozzle (Head Vent)	Nozzle, radius blend, & weld configuration	UT 49.1%
B-D B3.90	RPV N8A	Vessel-to-Nozzle (Jet Pump Instr.)	Nozzle, radius blend, & weld configuration	UT 65.9%
B-D B3.90	RPV N8B	Vessel-to-Nozzle (Jet Pump Instr.)	Nozzle, radius blend, & weld configuration	UT 65.9%
B-D B3.90	RPV N9	Vessel-to-Nozzle (CRD – Capped)	Vessel, radius blend, & weld configuration	UT 61.6%
B-D B3.90	RPV N10	Nozzle-to-Vessel (SLC)	Vessel, radius blend, & weld configuration and support skirt	UT 42.8%
B-D B3.100	RPV N10-IR	Nozzle Inner Radius (SLC)	Support skirt	UT 88.3%
B-F B5.10	RPV N6A-SE	Nozzle-to-Safe-end (Head Spray)	Flange bolting & surface depression	UT 58%
B-F B5.10	RPV N6B-SE	Nozzle-to-Safe-end (Head Spray)	Flange bolting	UT 89.9%
B-H B8.10	RPV Support Skirt	Bottom Head-to-Support Skirt	OD of weld inaccessible due to biological shield wall and insulation	PT 50%
B-J B9.11	Core Spray CS4B-MF5	Valve-to-Pipe	Valve configuration (one-sided exam)	UT 38.6%
B-J B9.11	RHR RH28-12	Pipe-to-Valve	Valve configuration (one-sided exam)	UT 82.5%
B-J B9.11	RHR RH29-10	Valve-to-Elbow	Valve configuration (one-sided exam) & branch connection obstruction	UT 82.1%
B-J B9.11	RHR RH32-8	Valve-to-Pipe	Valve configuration (one-sided exam) & OD surface configuration	UT 73.8%
B-K B10.10	Recirc RR-89,90	8 Lug Welds	Pipe clamp on bottom of shear lugs	PT 77.8%
B-O B14.10	CRD 02-27HF	CRD Housing-to-Flange	Two 1" diameter support rods	UT 85.2%
B-O B14.10	CRD 02-27SH	CRD Housing-to-Flange	Two 1" diameter support rods	UT 85.2%
B-O B14.10	CRD 26-03HF	CRD Housing-to-Flange	Two 1" diameter support rods	UT 85.2%
B-O B14.10	CRD 34-39HF	CRD Housing-to-Flange	Two 1" diameter support rods	UT 85.2%
C-A C1.10	RHR A-HTEX10-4	RHR Heat Exch. Shell-to-Flange	Flange geometry & 12 welded attachments	UT 80.2%
C-C C3.10	RHR A-RHR-CC-4	RHR Heat Exch. Welded Support	Limited access between shell and floor	MT 80.1%
C-F-2 C5.51	Condensate CT27-S30	Pipe-to-Valve	Valve configuration	UT 84.5%

<u>TABLE RR-B-5</u>
(Continued)

Section XI Category & Item No.	Component System & Number	Component Description	Condition Limiting Coverage	Exam & Coverage Percent
C-F-2 C5.51	Feedwater FW-17-S5	Valve-to-Pipe	Valve configuration (one-sided exam)	UT 79.8%
C-F-2 C5.51	RHR RH3D-S206	Valve-to-Pipe	Weld OD profile configuration (limited circumferential scan)	UT 79.0%
C-F-2 Augmented	RCIC RC3-S15	Pipe-to-Valve (0.280" thick)	Valve configuration	UT 80.5%
NUREG 0313	RWCU CU54-16	Pipe-to-Flange (Class 3)	Flange configuration	UT 57.3%

Appendix A

Statistical Significance of Limited Coverage

Certain Code Categories require a sample inspection. A typical population of Category B-J or C-F welds is several hundred welds. The sample size for B-J welds was 25% (prior to the implementation of Code Case N-560) and the sample size for C-F is 7.5%. The historical reasoning for choosing these sample sizes is not well known, however, it is presumed that if the numbers are based on statistical arguments, the percentages are not extremely rigid.

To understand the significance of limited coverage, several examples are presented with conservative assumptions. One initial assumption is that each weld is a separate data point. Another assumption is that if it is desired to find one flaw within a sample of welds, then a larger finite number of flaws must exist in the population to have a certain probability (akin to a level of confidence) of finding at least one flaw. This is implicit from the fact that the Code allows a sample inspection plan. For the sake of argument, assume that a level of confidence of 90% is required. (The following examples use the binomial probability distribution method of determining probabilities.)

A further assumption is that the probability of detecting (POD) any one flaw is 80%. This number is chosen based on Appendix VIII and IGSCC detection qualification acceptance criteria. In actuality, the Appendix VIII acceptance criteria vary between 100% for a small number of flaws (5 flaws) down to 70% for a large number of flaws (20 flaws). The effect of an 80% POD is that in order to assure a 90% chance of detecting at least one flaw in a sample, two flaws must exist in the sample such that there is a 96% (1 - 0.2 x 0.2) chance of detecting at least one of them.

For example, a 25% sample of 400 welds is 100 welds. There must be 20 flaws in the total population in order to assure that there is at least a 90% chance of detecting one of the flaws within the sample, using the binomial probability distribution method and allowing for the 80% POD example. Allowing for POD requires that the probability of two or more flaws occurring in the sample be multiplied by the probability of detecting at least one flaw, given that two exist, i.e. 0.96. The actual probability of detecting at least one of 20 flaws in this example is 92.4%.

What is the effect of limited coverage on several of the sample welds? A more conservative question would be -- what is the effect of not even inspecting several of the sample welds? In the above example, the probability of detecting at least one flaw would only drop a small amount to 90.6% (from 92.4%) if ten welds were dropped completely from the 100-weld sample. The reduced sample size would be 22.5% (90 of 400) rather than 25%.

For a 7.5% sample of 400 welds (or 30 welds), there must be 60 flaws in the total population in order to assure that there is at least a 90% (actually 91.4%) chance of detecting one of the flaws within the sample, allowing for POD. If three of those 30 welds are not even inspected the probability of detecting at least one flaw only drops to 89.1% (from 91.4%). The respective reduced sample size (27 of 400) would be 6.75%.

Even if entire welds are dropped from the sample, the impact is within acceptable limits, as demonstrated in the above examples that the probability of detecting at least one flaw drops only a couple percent when a full 10% of the sample welds are not even inspected.

Actually, a weld examination is not a singular data point. Every scan increment (raster) should be considered a data point for examination of a weld. The portion of weld that is accessible for examination is typically representative of the full weld (the reason for interferences is usually independent of the flaw mechanism). Therefore, the sample of the weld becomes a sample of a larger population within the entire population of welds. The significance of foregoing a number of rasters in one or more welds is even less than foregoing entire welds.

With this viewpoint, even if there is only one weld in the population, a partial coverage examination becomes a sample of that weld. A vessel weld 10 feet long, which requires a 100% examination, may have a total of 240 rasters.

Current Code Case N-460 states that a coverage of 90% is acceptable. This would equate to a 90% sample. In the previous example, for a 90% sample of 240 rasters (216 rasters), there must be a total of six flaws in the total weld length in order to assure that there is at least a 90% (actually 93.4%) chance of one of the rasters detecting at least one flaw within the total weld length (also allowing for POD). If the total coverage drops to 75% (180 rasters), the probability of detecting at least one of those six flaws only drops to 90.3% (from 93.4%).

The previous example assumes that the six flaws are spread randomly along the length and that each flaw is raster size or smaller. A critical flaw size might be long enough such that several scan rasters would impact that flaw. Also, a flaw might be situated such that it overlapped an area of scan interference. This would effectively raise the probability of detection for limited examinations.

Therefore, even for 100% sample inspection plans, a reduction in coverage of what one may initially think is quite severe, may not be statistically significant.