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REPLY TO
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BVY 97-15

United States Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, DC 20555

References: (a) License No. DPR-28 (Docket No. 50-271)
(b) Letter, VYNPC to USNRC, BVY 96-105, dated September 10, 1996
(c) Letter, VYNPC to USNRC, BVY 96-118, dated October 9, 1996
(d) Letter, USNRC to VYNPC, NVY 96-159, October 11, 1996

Subject: Augmented Examination of the Reactor Pressure Vessel Shell Welds

In Reference (b), Vermont Yankee provided its plans for inspection of the reactor pressure vessel shell welds at Vermont Yankee Nuclear Power Station. During the Fall, 1996 refueling outage Vermont Yankee performed that inspection in accordance with the requirements of 10 CFR 50.55a(g)(6). Vermont Yankee noted in Reference (b) that required coverage of all welds may not be achieved and that Vermont Yankee would submit a relief request as appropriate following completion of the inspection. The purpose of this letter, therefore, is to provide, in accordance with 10 CFR 50.55a(g)(6)(ii)(A)(5), information which supports Vermont Yankee's determination that the examination coverage achieved, although less than that required, constitutes an alternative which provides an acceptable level of quality and safety.

Enclosure A provides a detailed report of ultrasonic coverage achieved for each weld. Enclosure B provides drawings of the reactor vessel, including interferences which limited coverage. Enclosure C details the method used to calculate the ultrasonic coverage.

We trust the information provided is acceptable; however, should you have any questions or require additional information, please contact this office.

Sincerely,
VERMONT YANKEE NUCLEAR POWER CORPORATION

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Drawings located in CF

ENCLOSURE A
EXPLANATION OF ULTRASONIC COVERAGE

Because of restricted clearance between the biological shield wall and the vessel outside diameter, it was necessary to perform the required ultrasonic examination from the inside of the reactor vessel. Only two vendors provide this service. Vermont Yankee contracted ABB Combustion Engineering Nuclear Operations in conjunction with Southwest Research Institute to perform this ultrasonic examination. The examination was performed during the Fall, 1996, refueling outage in September, 1996.

Vermont Yankee used Appendix VIII qualified ultrasonic techniques rather than the conventional ultrasonic technique that is specified in Regulatory Guide 1.150 and ASME Section V, Article 4, referenced by ASME Section XI, IWA-2232(a). Appendix VIII is not invoked in the 1986 Edition of Section XI. The superior alternative examination which was demonstrated in accordance with Appendix VIII was approved for use by the Vermont Yankee Authorized Nuclear Inservice Inspector under the provisions of ASME Section XI, IWA-2240.

The examination revealed only seven recordable indications, only one of which exceeded the ASME Section XI, IWB-3511, acceptance criteria. That flaw was reported to the NRC in Reference (c) and was accepted in Safety Evaluation Report Reference (d).

10 CFR 50.55a(g)(6) states that "essentially 100%" of each vessel shell weld shall be examined. "Essentially 100%" is defined as "more than 90% of the examination volume of each weld." The Vermont Yankee reactor vessel contains five circumferential and eight vertical shell welds within the scope of 10 CFR 50.55a(g)(6). For three of the horizontal welds and six of the vertical welds, 90% coverage was not achieved. Table A-1 gives examination coverage achieved for each of the reactor vessel shell welds.

Since there are no vessel features in the unexamined regions that are significantly different from those in the examined regions, and since the interferences which limited examination coverage do not affect flaw susceptibility, Vermont Yankee has concluded that the examination results achieved are representative of the weld characteristics in the unexamined regions. Therefore, Vermont Yankee has determined that the examination coverage achieved constitutes an alternative which provides an acceptable level of quality and safety per 10 CFR 50.55a(g)(6)(ii)(A)(5).

Table A-1

Weld	Code Item	Coverage	Interferences
CD (Circ)	B1.30	90%	guide rods
D1 (Vert)	B1.12	99%	steam dryer support bracket
D2 (Vert)	B1.12	96%	steam dryer support bracket
DE (Circ)	B1.11	90%	guide rods
E1 (Vert)	B1.12	51%	feedwater sparger, core spray piping header, offset between upper and lower tool configurations
E2 (Vert)	B1.12	53%	feedwater sparger, core spray piping header, offset between upper and lower tool configurations
EF (Circ)	B1.11	69%	guide rods, core spray piping down-comers, core shroud lifting lugs, surveillance specimen holders and brackets
F1[1] (Vert)	B1.12	65%	jet pump riser brackets
F2[1] (Vert)	B1.12	65%	jet pump riser brackets
FG[1] (Circ)	B1.11	68%	guide rods, core spray piping down-comers, core shroud lifting lugs, surveillance specimen holders and brackets
G1[1] (Vert)	B1.12	45%	recirc inlet pipe, jet pump instrumentation L-bracket
G2[1] (Vert)	B1.12	45%	recirc inlet pipe, jet pump instrumentation L-bracket
GH (Circ)	B1.11	0%	jet pump instrumentation L-brackets
ALL		64%	

NOTE (1) "Beltline" welds.

Table A-1: Discussion

The coverage calculation method is described in Enclosure C.

For all of the RPV shell welds, no significant additional examination coverage could be achieved without removing reactor vessel internals or by extensively redesigning the manipulator tool. It should be noted that Vermont Yankee and the inspection vendor worked continuously to upgrade the tool to provide the maximum possible coverage of the Vermont Yankee reactor vessel shell welds. It should also be noted that the only other tool performing RPV shell weld examinations from the inside of the vessel would not provide any significant improvement in coverage.

The amount of coverage achieved is directly affected by the proximity of the approach of the probe sled during scanning to vessel internal interferences. At the beginning of the examination, this buffer zone was set at approximately one inch. Following an event where the manipulator tool collided with a specimen holder bracket, the buffer zone was extended to three inches. The specimen holder bracket was inspected and was verified to have suffered no damage, however, the manipulator tool was extensively damaged and it required ten days to retrieve and repair the lower portion of the tool.

Of special note is weld GH for which no examination coverage was achieved. Weld GH is the vessel shell to bottom head weld, the centerline of which is located two inches above the top of the jet pump baffle plate. ABB extensively modified their manipulator to access this weld in preparation for the refueling outage. However, when ABB attempted to fully extend the mast to reach this weld, the jet pump instrumentation L-brackets would not allow the tool probe head to pass. There is an extremely small envelope between those brackets and the vessel shell wall. The tool was pulled out of the vessel and an adjustment of shims at the top of the tool was performed to allow a better angle of approach through this envelope. This additional effort did not correct the interference situation. Rather than risk damaging reactor internals or the inspection tool, it was decided to not make any further attempts to reach this weld. It should also be noted that the other vendor's inspection tool is also not capable of reaching this weld at Vermont Yankee.

We also evaluated what additional ultrasonic coverage of the Vermont Yankee vessel could be obtained by supplementing the internal tool scanning with manual examinations from the OD of the reactor vessel. As supported below, this would not be a significant amount.

The only accessible areas to the reactor vessel OD are those areas above the biological shield wall and through the nozzle windows in the biological shield wall. There is only a twelve inch gap between the shield wall and the vessel OD. This gap is further obstructed by the vessel insulation, insulation brackets and clips, and thermocouple pads. The vessel insulation is stacked from the bottom of the vessel to the top and cannot be removed. In the following paragraphs, the vessel shell welds will be assessed individually for possible additional coverage.

Weld CD is above the top of the biological shield wall and could conceivably be examined from the OD for the small percentage of weld that is not accessible behind the guide rod from the interior. Since 90% of this weld was already examined, it is concluded that the small additional amount of weld that could be examined would not provide significant benefit when weighed against the time and exposure necessary to complete this portion.

Welds D1 and D2 are above the top of the biological shield wall for the portions of the welds that are in the vicinity of the steam dryer support lugs and could conceivably be examined for the small percentage of those welds that are inaccessible from the interior. Since over 90% of these welds has already been examined, it is concluded that the small additional amount of weld that could be examined would not provide significant benefit when weighed against the time and exposure necessary to complete these portions.

Weld DE is below the top of the biological shield wall. There are no nozzle windows in the area of the guide rod interferences. Therefore, no additional examination could be performed on this weld. Also, 90% of this weld was already examined.

Welds E1 and E2 are vertical welds at approximately 105 and 285 , respectively. The core spray nozzle window openings are centered on 90 and 270 , but the edges of the windows only come to about 100 and 280 which are about 10 inches away from each of the weld centerlines. Therefore, no additional examination could be performed on these welds.

There are no nozzle windows within the vicinity of the elevations of welds EF, F1 and F2. Therefore, no additional examination could be performed on these welds.

Weld FG is a circumferential weld at elevation 286.5 feet. The recirc inlet nozzle openings are centered at elevation 282.4 feet, but the tops of the window openings only come to 283.9, which are about 30 inches away from the weld centerline. Therefore, no additional examination could be performed on this weld.

Welds G1 and G2 are vertical welds at 75 and 225 . Each is centered between jet pump pairs and, consequently, each are exactly centered between two recirc inlet nozzles and their respective biological shield wall windows. The two jet pump instrumentation (N-8) nozzle windows are below and vertically aligned with two of the recirc inlet nozzle windows and do not afford any access to welds G1 and G2 either. Therefore, no additional examination could be performed on these welds.

Weld GH is a circumferential weld at elevation 275.5 feet. The jet pump instrumentation (N-8) nozzle windows are centered at elevation 277.7 feet and the bottoms of the windows reach to 275.6 feet, about 1.75 inches above the weld centerline. The bottoms of the two recirc outlet nozzle windows only come to 276.8, still about 13.5 inches away from the weld centerline. An OD examination through the N-8 nozzle windows could conceivably examine a limited cross-section of weld GH. However, these nozzle window openings are very cluttered and, at best, the examination could only be performed for the length of the weld accessible through those two windows, about eight feet total (15% of the total length), and would achieve an estimated

50% of the weld cross-section at best in only one beam direction. An OD examination would be conducted in accordance with ASME Section V, Article 4 (this examination would not have been qualified in accordance with Appendix VIII). Considering that four beam directions are required for scanning in accordance with ASME Section V, Article 4, the weld coverage would only be 50% divided by four, or 12% in cross-section for that eight feet, or less than 2% for the total length of the weld. The jet pump instrumentation nozzles are high dose regions, about 150 mR/hr in the area around the nozzles, and an ALARA estimate for manual ultrasonic examination at these windows, including insulation removal and restoration, protective framework removal and restoration and weld preparation is about 2 manRem. It is concluded that the small additional coverage that might be achieved would not provide significant benefit when weighed against the time and exposure necessary to complete this small extra volume.

In summary, the only welds where coverage could be marginally increased from supplemental OD examination would be welds CD, D1, D2, and GH. None of these welds are in the vessel beltline where additional coverage might be more meaningful.

ENCLOSURE B
VERMONT YANKEE REACTOR PRESSURE VESSEL DRAWINGS

Vermont Yankee Drawings

5920-96	General Arrangements
5920-97	Seam Details
5920-103	General Plan
5920-252	Shroud Support
5920-253	Plan of Shroud Support
5920-3773	Vessel and Internals (3 sheets)
5920-3774	Vessel and Internals Plan (3 sheets)
5920-3937	Reactor Building Shield Wall and Trusses

ABB Combustion Engineering Drawings

000394	Reactor Vessel Rollout

ENCLOSURE C
METHOD OF CALCULATING ULTRASONIC COVERAGE

IWA-2500 of Section XI specifies the volume of material to be examined for RPV circumferential and longitudinal RPV welds as 100% of the through-wall thickness (t) of the weld metal and adjacent base metal for 1/2t on either side of the weld fusion lines for 100% of the accessible weld length. Figure C-1 identifies the A-B-C-D Code-required examination volume.

The method for determining ultrasonic examination coverage is tied to the approved ultrasonic examination procedure. The approved procedure specifies the combination of search units, beam angles, and scan directions required to fully cover the examination volume.

Southwest Research Institute PDI-qualified procedure requires that two tandem-beam SLIC 40 search units and two coplanar shear-wave search units (one 45° and one 55°) be used in different combinations to obtain full coverage through various depth regions of the A-B-C-D volume. Figure C-1 shows the three zones of the A-B-C-D cross section having different criteria for effective flaw detection coverage. Figure C-1 also depicts the UT beam profiles through the three depth zones as they affect coverage when a scanning limitation is encountered. Figures C-2 through C-8 are cross-sectional views of each weld showing the beam profiles at each scanning limitation encountered.

Reflectors Oriented Parallel To the Weld

Examination for detection of reflectors oriented parallel to the weld plane is performed with the UT beams directed perpendicular to the weld axis. This examination comprises 50% of the total A-B-C-D cross-sectional examination coverage requirement.

The procedure requires that the inner 1 inch (less clad thickness) of weld metal and adjacent base metal for 1/2t from either side of the weld fusion lines (Zone 1 in Figure C-1) be completely scanned with two SLIC 40 search units in one direction for 100% of the weld length. Zone 1 accounts for 16% of the through-wall thickness.

The midwall volume from 1 inch to 2.25 inches in depth of the weld and base metal (Zone 2 in Figure C-1) must be scanned with any two of the following: the two SLIC 40's or the 45° or 55° shear-wave search units for 100% of the weld length. Zone 2 accounts for 42% of the through-wall thickness.

The outer volume from 2.25 inches in depth to the outside surface of the weld and adjacent base metal (Zone 3 in Figure C-1) must be scanned with both the 45° and 55° shear-wave search units for 100% of the weld length. Zone 3 accounts for 42% of the through-wall thickness.

Reflectors Oriented Transverse To the Weld

Examination for detection of reflectors oriented transverse to the weld plane is performed with the UT beams oriented parallel to the weld axis. This examination comprises 50% of the total examination coverage requirement.

The Zone 1 volume (inner 16%) must be completely scanned with two SLIC 40 search units in one direction for 100% of the weld length.

The Zone 2 volume (middle 42%) must be scanned with any two of the following: the two SLIC 40's or the 45° or 55° shear-wave search units for 100% of the weld length.

The Zone 3 volume (outer 42%) must be scanned with both the 45° and 55° shear-wave search units for 100% of the weld length.

Weld Length Coverage Determination

Examinations for parallel and transverse oriented reflectors were performed in a series of "scan patches" along the length of the weld. This was done to minimize movement of the tool around the circumference of the vessel thus freeing up a vessel azimuth for other in-vessel work. This approach also yields very precise search unit positioning within a given scan "patch". Wherever there is a gap between adjacent scanning patches for the same type of examination (parallel or transverse), the resulting examination limitation must be calculated based on the beam profiles and module "foot print" as they pertain to that specific obstruction. The areas of limited or completely obstructed volumetric coverage are factorially added for each weld and subtracted from the overall weld area examination volume to determine the percent of Code-required examination coverage achieved. The rollout view of the vessel ID in Figure C-9 shows the surface areas accessed by the search unit module for each weld area.

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