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REPLY TO
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BVY 96-105

United States Nuclear Regulatory Commission
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References: (a) License No. DPR-28 (Docket No. 50-271)
(b) Letter, VYNPC to USNRC, BVY 92-55, dated April 5, 1992
(c) Letter, USNRC to VYNPC, NVY 92-67, dated April 17, 1992
(d) Letter, VYNPC to USNRC, BVY 93-112, dated October 6, 1993

Subject: Augmented Examination of the Vermont Yankee Reactor Pressure Vessel Shell Welds

The purpose of this letter is to provide Vermont Yankee's plans for inspection of the reactor pressure vessel (RPV) shell welds at Vermont Yankee Nuclear Power Station during our refueling outage which began September 6, 1996. These plans were discussed with NRC Staff at a meeting on July 25, 1996 and in a telecon on September 6, 1996. This letter also provides Vermont Yankee's plans for addressing weld inspection coverage anticipated during these examinations.

10 CFR 50.55a(g)(6)(ii)(A) requires Vermont Yankee and all other nuclear power plants to conduct a periodic augmented examination of the RPV shell welds in accordance with ASME Section XI. ASME Section XI provides the requirements for ultrasonic examination of RPV welds in IWA-2232. The 1986 Edition (with no addenda) of ASME Section XI is the code of record for Vermont Yankee. In addition, Regulatory Guide 1.150, Revision 1, invokes ASME Section XI and provides supplementary requirements.

Vermont Yankee has contracted ABB Combustion Engineering Nuclear Operations and Southwest Research Institute to perform the required examinations using state-of-art ultrasonic techniques. The ultrasonic techniques and procedures that will be used have been qualified by Southwest Research Institute and consist of two parts. One part uses the Performance Demonstration Initiative (PDI) technique and the other part uses a supplemental technique for certain near volume examinations where clad conditions present unique examination difficulties.

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The use of the PDI-qualified procedures satisfies Code requirements and results in an examination that is more sensitive to detect/size flaws than the Code prescribed techniques. Vermont Yankee intends to use the PDI-qualified ultrasonic technique in lieu of the conventional ultrasonic technique prescribed by Regulatory Guide 1.150 and ASME Section V, Article 4, referenced by ASME Section XI, IWA-2232(a).

In 1992, Vermont Yankee observed cracks in the Vermont Yankee Nuclear Power Station RPV cladding. At that time the cladding was examined and the crack condition determined to be acceptable since all of the cracks are contained within the cladding material and do not encroach on the base metal vessel material. Vermont Yankee's evaluation, including a description of the nondestructive investigation and a metallurgical and fracture mechanics evaluation, was evaluated and reported in Reference (b). The NRC provided their evaluation of Vermont Yankee's assessment and conclusions in Reference (c). Vermont Yankee performed a follow-up examination during the 1993 refueling outage and reported the results in Reference (d). Even though the clad cracking discovered during the 1992 and 1993 examinations did not encroach on the ASME Section XI, IWB-2500 required volume, Vermont Yankee committed in Reference (d) to perform follow-up inspections in the spirit of ASME Section XI, IWB-2420(b). Vermont Yankee's examination of the reactor vessel shell weld during our 1996 refueling outage will satisfy our commitment to perform subsequent examinations of the vessel cladding.

Vermont Yankee manufactured a mockup that duplicates the Vermont Yankee reactor vessel and includes the cracked clad condition. The mockup also simulates flaws which penetrate through the cladding into the base material. These "target" flaws were arranged such that they were located among the so-called "shadowing" clad cracks that are completely contained in the cladding. Vermont Yankee determined that the PDI techniques are not consistently capable of detecting flaws in the near surface (within one inch) region of the cladding when shadowing cracks are spaced at close intervals. Therefore, for the purposes of this examination, those areas immediately below the clad-to-base metal interface will be considered inaccessible where shadowing cracks are spaced at close intervals. This is anticipated to affect the final weld inspection coverage.

To more extensively inspect this near surface volume, when clad cracks are spaced at close intervals, Vermont Yankee and Southwest Research developed a supplemental technique. The intent of this supplemental technique is to improve weld inspection coverage in the near surface volume for beam directions perpendicular to clad cracks where clad crack spacing is at least 1/2 inch but which may be less than that required for the PDI techniques to perform optimally. This supplemental technique is effective for most configurations of clad cracking.

The combination of the PDI and supplemental techniques will be used to interrogate the volume of reactor vessel shell welds. The PDI technique has been demonstrated to satisfactorily examine the total weld volume where no clad cracks exist. Where clad cracking exists, the PDI technique will adequately examine the weld volume where the clad cracks run parallel to the scan direction.

For weld coverage calculation purposes this amounts to approximately 50% of the weld volume. For clad cracks running perpendicular to the scan direction (in any configuration), the PDI technique will also adequately examine the weld volume from one inch below the clad surface to the outside diameter (OD) of the RPV. This amounts to approximately 80% of the total weld volume in that scan direction. Therefore approximately 90% of the total weld volume will be examined by the PDI techniques, even in cases of clad cracking. The supplemental technique will further examine the remaining 10% of the weld volume, except where three or more clad cracks exist in a row spaced 1/4" from each other. The above coverage calculations assume that tool access to the weld is unrestricted.

In addition to the ultrasonic supplemental techniques, Vermont Yankee developed a separate technique to measure clad thickness. It is realized that there are areas where the cladding is thicker than the nominal 3/16 inch. These areas may contain clad cracks which extend through the full clad thickness but which are contained wholly within the clad. In these cases the clad cracks would be deeper than the nominal 3/16 inch. Therefore, following unsuccessful efforts to use ultrasonic or eddy current technology, Vermont Yankee developed a clad thickness measuring technique employing a Hall Effect probe.

The PDI and supplemental ultrasonic techniques and the Hall Effect probe technique were demonstrated using the clad crack block described above on August 22 and 23, 1996. Mr. Peterson of your Region I staff and the Authorized Nuclear Inservice Inspector observed these demonstrations.

The examination coverage requirements of 10 CFR 50.55a(g)(6) state 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." It is anticipated that for some welds, 90% coverage may not be achieved, because the tool may not be able to access sufficient length of each weld or that access restrictions will not allow ultrasonic beams to interrogate the full cross-section of certain portions of welds. The distribution of clad cracks may also affect the volume of weld coverage, as described above. However, until the examination is complete, the final coverage calculations cannot be performed. Following the Fall, 1996, refueling outage Vermont Yankee will submit a relief request as appropriate to address the weld examination coverage achieved.

The NRC has expressed interest in knowing 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. Vermont Yankee has studied this extensively and has concluded that this would not be a significant amount. The results of this study will be included with our final inspection coverage details.

Vermont Yankee intends to further demonstrate the acceptability of the clad cracking condition from the results of the 1996 refueling outage examination and, if necessary, to perform an engineering analysis of those results. This will be accomplished by ultrasonically analyzing a

significant number of the clad cracks. The ultrasonic technique will be able to discriminate and detect flaws that would exceed ASME Section XI, IWB-3500, criteria when adequate spacing of the clad cracks exist. We anticipate that this will be a very large sample of the clad cracks. The analysis of this statistically significant sample of the total population of clad cracks in the vessel will provide high assurance to the analysis of the encroachment of clad cracks into the Code volume. The scope of this assessment will far exceed the effort performed in 1992 and 1993 which was based on a much smaller, but still statistically significant, sample.

Vermont Yankee presented a preview of this information at NRR on March 13, 1996 and the use of the supplemental UT technique at NRR on July 25, 1996.

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

Sincerely,

VERMONT YANKEE NUCLEAR POWER CORPORATION

James J. Duffy

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Licensing Engineer

c: USNRC Region I Administrator
USNRC Project Manager - VYNPS
USNRC Resident Inspector - VYNPS