July 22, 2002

MEMORANDUM TO: Terence L. Chan, Chief
Materials Inspection Section
Materials and Chemical Engineering Branch
Division of Engineering

FROM: Donald G. Naujock, Project Manager ***/RA/***
Section 2
Project Directorate IV
Division of Licensing Project Management
Office of Nuclear Reactor Regulation

SUBJECT: SUMMARY OF PUBLIC MEETING HELD FEBRUARY 7 AND 8, 2002 WITH PDI REPRESENTATIVES (TAC NO. MB3529)

On February 7 and 8, 2002, the staff participated in a public meeting with representatives from the Electric Power Research Institute (EPRI) - Performance Demonstration Initiative (PDI) program at the NRC, Rockville, Maryland. The purpose of the meeting was to discuss PDI's approach for implementing Appendix VIII, "Performance Demonstration for Ultrasonic Examination Systems," Section XI of the American Society of Mechanical Engineers, *Boiler and Pressure Vessel Code* (Code). The subjects discussed were single side reactor pressure vessel (RPV) examinations, status of testing for weld overlays, status of testing for dissimilar metal welds (DMW), and the status of ASME code cases. The meeting is a continuation of formal dialog between NRC and the industry on PDI's implementation of Appendix VIII. The dialog provides opportunities to discuss testing difficulties, review PDI's program methodology for the selected supplements, and address issues regarding the ASME Code. The NRC participants were D. Naujock and S. Doctor (under NRC contract) from Pacific Northwest National Laboratory (PNNL). The meeting participants and agenda are listed in Attachment 1. Handouts provided by PDI for selected items in the agenda are provided in Attachments 2 through 6.

I. <u>Single Side Access</u>

PDI presented viewgraphs in Attachment 2 (untitled) issues pertaining to single side access performance demonstrations for reactor pressure vessel (RPV) welds and inside corner radii (ICR). The major issues are: extension of the RPV through-wall examination thickness, changing the number of allowable false calls to reflect the reduction in scanning directions, and the relation of the beam length to the detection of off-axis flaws. PDI presented their work on extending the RPV wall thickness for examination performed from the outside surface to find flaws on the inside surface. This is a continuation from the last meeting which is in the minutes dated November 29, 2001 that discuss the inability to detect a small flaw which was hidden by an interference shadow. PDI resolved the difficulty by extending the through-wall depth with the aid of an 11 inch thick test specimen. The solution was to use a 60 degree RL probe and the thicker sample in order to demonstrate the procedure.

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A. False Call

PDI identified a disparity with the false call acceptance criteria for single side qualifications versus double side qualifications. The false call statistic was based on the scanned area when it was assumed that a volume of material would be inspected from four directions. When conducting single side examinations, there will be less data for a given volume of material (making it more likely to have a false call) and, since inspecting the volume using half the surface scan area, the number of allowable false calls is also reduced by half. This was considered to be a double penalty. The staff did not take exception to PDI's proposal that the number of false calls should be the same for the inspection of a given volume of material whether this is done with single side or double side qualifications.

PDI intends to initiate a code case and request a Code interpretation at the next ASME Code meeting in Los Angeles, CA at the end of February 2002.

B. Off-Axis Flaws

The generic procedure for manual inspection performed from the inside surface of vessels uses a 60 degree RL that has been demonstrated to work for detecting planar ($\pm$ 10 degree) flaws and a 45°off-axis flaw for thicknesses up to 6.88 inches. To use the procedure for manual inspection performed from the outside surface, PDI performed demonstrations with off-axis flaws oriented in optimum and non-optimum directions. The logic is that the 60°RL technique has demonstrated capabilities of finding planar flaws over a wide range of thicknesses (long metal path) and a variety of flaw sizes. Since the 60°RL technique is the same technique used for finding the 45° off axis flaws, a successful demonstration for off-axis flaws should also be detectable over the same ranges as planar flaws. This is valid as long as the technique is unchanged from the demonstrated thickness (metal path) used for planar flaw demonstrations.

The PDI demonstrations provided acoustic responses for scan sensitivity and distance correction amplitude for side-drilled holes. The responses to the off-axis flaws produced signal-to-noise ratios of 4 to 1 or greater. The scanning was performed on a 3.64 inch thick specimen containing flaws oriented at 45 degrees and extending from both surfaces.

Action has been taken in Code to include off-axis flaws into ASME Section XI, Appendix I, (ASME Action Item: BC01-151).

C. Nozzle Inner Corner Radius

PDI identified an ambiguity with the critical beam angles associated with Appendix VIII, Supplement 5 for nozzle qualification of ultrasonic techniques to examine the inner nozzle radius from the nozzle outside diameter. The ambiguity is what defines the nominal inspection angle(s) of the sound field; is the nominal inspection angle defined to be that which strikes the flaw, that which strikes the material, or that which is the inspection angle in the Code, or some combination of the above? How are the incident and skew angles for a compound angle verified? What are the key variables that must

be listed in order to uniquely identify the essential variable(s) in the procedure for this application? How are the incident and skew angles verified for each search unit? PDI will address these questions internally and initiate the appropriate actions as needed.

II. Rule Examination Coverage Requirements for Nozzle-to-Vessel Welds

Regarding Appendix VIII, Supplement 7, there is a need for clarification of examination requirements in 10 CFR 50.55a. Specifically, coverage requirements for single side examination for a flaw parallel to the weld from the bore and single side examinations with respect to Supplement 4. As discussed in the rule (64183 *Federal Register*, September 22, 1999, page 51377 and 51397), the NRC staff intended examinations of the vessel welds be performed to 10 CFR 50.55a(b)(2)(xv)(G)(1). The rule specifically states that single side examinations are not permitted for the 15% of the vessel adjacent to the cladding, i.e the inner 15 percent of the vessel shall be examined from four orthogonal directions. However, for nozzle-to-vessel welds, questions were raised on what to do if it is impossible to inspect from four orthogonal directions?

A suggestion was made that if the examinations can be performed in four directions, it should be performed in four directions. Otherwise, examine the weld volume in as may directions as possible but no less than two orthogonal directions using a procedure qualified for single side examinations.

The NRC staff was asked to provide clarification as to the intent of the coverage requirements for nozzle-to-vessel welds. The staff recognized the potential for obstructions to limit nozzle-to-vessel weld examinations. As a result, the coverage criteria in 10 CFR 50.55a(b)(2)(xv)(K) was developed to be use in conjunction with 10 CFR 50.55a(b)(2)(xv)(G). The reasoning is that the nozzle-to-vessel weld is as important as a vessel weld; therefore, it should have the same coverage as a vessel weld, if possible. When vessel coverage is not achievable for a nozzle-to-vessel weld, the examination should be performed to the maximum coverage possible but not less than the progressively reduced coverage described in 10 CFR 50.55a(b)(2)(xv)(K). When the reduced coverage is performed from one side of the weld, the examinations should be performed using personnel and procedures qualified for single side examinations. Although personnel and procedures may qualify for single side examinations, the application of single side in lieu of two sided examinations is not permitted for the inner 15% of the vessel weld and only to the extent permitted by 10 CFR 50.55a(b)(2)(xv)(K) for nozzle-to-vessel welds.

III. Weld Overlay

PDI presented viewgraphs on the status of their weld overlay program in Attachment 3, “Status of PDI Supplement 11 Weld Overlay Program.” Under the old Tri-party agreement between NRC, the Boiling Water Reactor Owners Group, and EPRI, the overlay performance demonstrations were performed on 0.5 inch thick, 12 inch diameter test specimens. With the implementation of Appendix VIII, Supplement 11, the size and wall thickness were expanded to specimens ranging in diameters from 4 to 28 inches and 0.2 to 1.1 inches thick walls. The current PDI qualification program is not consistent with Appendix VIII, Supplement 11 or the newly developed Code Case N-653. However, some small differences still exist between the Code and the PDI program. PDI will initiate changes to Code Case N-653 that would bring the PDI program in compliance with Code. Until the revised code case is issued and endorsed by

the NRC, licensees will have to submit a request for relief to use PDI's approach for meeting Supplement 11.

It was noted that there are no inspection frequency requirements for weld overlays. It was noted in the June 2001 meeting that the frequency for weld overlay inspections were outside the scope of the PDI. There is an action item for PDI to bring this issue up at the next Material Reliability Project (MRP) steering committee meeting. To date, no action has been taken by the MRP.

IV. Dissimilar Metal Welds (DMW)

The inspection of dissimilar metal welds (DMWs) is very challenging because of all the layered coarse grained structures. There are sound field distortions and many signals from both geometric and metallurgical conditions that interfere with the interpretations of the acoustics. In addition, many of the weld configurations limit inspections to an accessible side of the weld (single side examinations). Initial studies have shown that the use of manual and standard automated techniques are not very effective in detecting and sizing through-wall flaws less than 20 %. Further work is in progress at EPRI to develop generic procedures with improved effectiveness.

A. Fabricated Cracks

PDI presented viewgraphs on the status of fabricated cracks in Attachment 4, "Fabrication of Flaws for Weld Dissimilar Metal Weld Examination Samples Utilizing Hot Iso-Static Pressure." The work in progress for the development of hot isostatic pressing (HIP) of notches appears to be quite good. Some development work remains to refine the process for thinner and thicker plates. Once the effects of thickness is established, the procedure will be fully developed and used for selectively installing HIP notches in specimens undergoing fabrication. The critical variable for a fabricated crack is the tightness at the tip of the crack which is 0.002 inch diameter maximum. From the data presented in Attachment 4, the tip diameters consistently satisfied the 0.002 inch maximum criteria.

B. Specimens

PDI presented viewgraphs on the status of specimen fabrication in Attachment 5, "Status of Dissimilar Metal Weld Sample Fabrication." One vendor has been selected to fabricate all of the DMW specimens. The first specimens are to be available in the middle of February and the last ones are to be delivered by June. Presently, PDI is planning on fabricating 6 test sets for demonstration of outside surface procedures and personnel. PDI is fabricating 17 samples to be used for inside surface procedure and personnel testing four of which will be used for practice samples. These four practice samples are main recirculation loop inlet and outlet configurations for Westinghouse units. The current schedule calls for qualification activities to start in September 2002.

C. Examinations

PDI presented viewgraphs on the status of UT examinations of DMW in Attachment 6, "Feasibility of Ultrasonic Examination of Dissimilar Metal Welds." There are concerns about the effectiveness of manual UT because of the complex geometric conditions, the adverse coarse grained material combinations, and the access limitations. All of these factors make the inspection of DMWs very challenging. There were indications that the planned work on these specimens will include advanced techniques such as phased array imaging. The performance level needs to be established because, at this time, it is an unknown. If it is not possible to detect all of the flaws as required by the current version of the Code, the staff and industry will have to come to a consensus on possible solutions.

V. Code Activities

A number of code cases (CC) were discussed. CC N-615 covers the UT examination of the OD surface with a transducer on the ID surface in lieu of performing a surface examination. Using UT as an alternative for a surface examination is not part of the PDI charter. Therefore, PDI has not devoted time towards the development of UT alternatives to surface examinations.

The issue of corrosion resistant cladding (CRC) was discussed. The problem is that the ASME Code, Section XI does not address the examination requirements of CRC. It is excluded from Supplements 2 and 10 and is, thus, not part of Appendix VIII. The examination of CRC is not part of the charter of PDI. However, PDI has initiated Code action to Appendix VIII that identifies welds containing CRC as "in course of preparation". The Code action would require qualification and examination of CRC piping to be performed according to VIII-3110(c).

VI. Old Items

An open issue from the June 2001 meeting was that a white paper was to be developed to support the case that UT of stainless steel and of Inconel are equivalent. Nothing was presented at this meeting so this remains an open item with the action for PDI to prepare and present this information at a future meeting.

PDI stated that both Supplements 5 and 7 can be implemented on the schedule stipulated in 10 CFR 50.55a(g)(6)(ii)(c). For the implementation of Supplement 10, the schedule is going to be very tight. The plan is to shut down all piping qualification activities from September through December in order for all the staff at the EPRI NDE Center to focus on getting procedures and personnel through the Supplement 10 qualification process. PDI estimates that an automated procedure qualification will take a minimum of 6 weeks to qualify. Presently, PDI has scheduled up to 3 automated qualifications for the latter part of 2002. PDI plans to qualify a manual Generic procedure for Supplement 10 and start personnel qualifications during the same period. PDI has prioritized use of the program based on the earliest needs. However, PDI expressed concerns on the reliability of inspecting dissimilar metal welds. Consequently, it was proposed that the next semiannual meeting be at the EPRI NDE Center July 30 and 31, 2002 (or later in the summer, if necessary) in preparation for the September Code meeting and the start of qualifications in September.

Attachments: As stated:

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PUBLIC MEETING WITH EPRI-PDI, FEBRUARY 7&8, 2002

NAME	TITLE	ORGANIZATION
Donald Naujock	Metallurgist	NRC
Terence Chan	Section Chief	NRC
Andrea Keim	Engineer	NRC
Steve Doctor	Senior Staff Engineer	PNNL
Carl Latiolais	Project Manager	EPRI
Mike Gothard	RPV Project Manager	EPRI
Randy Linden	PDI Vice Chairman	PPC
Jeff Landrum	PDI Project Manager NDE	EPRI
Guy M. Bratton	PDI Chairman	Entergy

MEETING AGENDA

Thursday & Friday, February, 7 & 8, 2002

1. Single side reactor pressure vessel examinations:

    A. Discuss test specimen for off-axis flaws.
    B. Discuss nozzle qualifications.

2. Status of testing program for weld overlay.

3. Status of testing program for dissimilar metal welds.

4. ASME Code activities:

    A. Discuss Code Case N-615 demonstration.
    B. Discuss incorporating Code Case N-552 into Code.
    C. Discuss butt welds adjoining Corrosion Resistant Cladding.
    D. Status of code cases updating Appendix VIII supplements.

ATTACHMENT 1