

March 7, 2006

MEMORANDUM TO: Terence L. Chan, Chief  
Piping & NDE Branch  
Division of Components Integrity, NRR

FROM: Donald G. Naujock, Materials Engineer **/RA/**  
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SUBJECT: SUMMARY OF PUBLIC MEETING HELD NOVEMBER 8 & 9, 2005,  
WITH EPRI- PDI REPRESENTATIVES (TAC NO. MC8313)

On November 8 & 9, 2005, the staff participated in a public meeting with representatives from the Electric Power Research Institute (EPRI) - Performance Demonstration Initiative (PDI) program at the EPRI Non-Destructive Examination Center, 1300 W. T. Harris Boulevard, Charlotte, NC. EPRI provides PDI's business operations and technical support. PDI is a nuclear power industry initiative established to develop and administer the qualification requirements of Appendix VIII, "Performance Demonstration for Ultrasonic Examination Systems," Section XI of the American Society of Mechanical Engineers, *Boiler and Pressure Vessel Code* (Code) and to develop and administer the demonstrations and qualifications of ultrasonic examinations of butt welds that are associated with other EPRI programs. The purpose of the meeting was to discuss PDI's approach for implementing selected aspects of Appendix VIII and associated items. The subjects discussed were the status of reactor pressure vessel and piping performance demonstrations, analysis of the performance data for trends, proposed actions affecting Appendix VIII, and the inspectability of cast austenitic piping. These meetings are a continuation of formal dialog between NRC and the industry on PDI's implementation of Appendix VIII and other nondestructive testing aspect of mutual interest. 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 meeting participants and agenda are listed in Enclosures 1 and 2 respectively. Handouts provided at the meeting are included as Enclosures 3 through 9.

10 CFR 50.55a

Three final regulatory guides addressing ASME Code Cases were noticed in the *Federal Register* on September 29, 2005, (70 FR 56938-56939); Regulatory Guide (RG)1.84, Revision 33, "Design, Fabrication, and Materials Code Case Acceptability, ASME Section III;" RG 1.147, Revision 14, "Inservice Inspection Code Case Acceptability;" and RG 1.193, Revision 1, "ASME Code Cases Not Approved for Use." The drafts of RG 1.84, Revision 34; RG 1.147, Revision 15; and RG 1.193, Revision 2 are scheduled for issuance for public comment in the first quarter of 2006.

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### Status of Reactor Pressure Vessel

PDI presented an update of their reactor pressure vessel (RPV) program which is summarized in Enclosure 3, "PDI RPV Issues and Update." The RPV program is a mature program for qualifications with single and dual transducer techniques. New procedure and personnel qualifications are occurring with the phased array ultrasonic testing (UT) technique for automatic and manual applications. The manual qualifications rely on real time observations and loses some of the advantages of phased array that are available with post-processing of recorded data, such as enhancing images, analyzing individual angles, and adjusting focal depths.

A concern was expressed that the phased array technique used during qualifications may have limitations in some field applications. The phased array technique is qualified with all of the angles in the array interrogating the examination volume. In field applications, scanning restrictions may limit the number of angles interrogating the examination volume. According to ASME Code, the volume not examined by the angles used during the performance demonstration should be considered in the coverage calculation. The concern is how important are all the angles in the phased array for determining coverage. This concern was to alert meeting participants of a potential new issue with phased array. No action is contemplated for this item.

### Status of Piping and Bolting

PDI presented an update of their Piping and Bolting Program which is also a mature qualification program. The program status is summarized in Enclosure 4, "PDI Piping & Bolting Program Update." Besides implementing Appendix VIII testing requirements for the U.S. nuclear industry, PDI provided technical expertise and testing services to foreign countries, such as Korea, Japan, Spain, and Switzerland. No action items.

### Status of Dissimilar Metal Welds

PDI provided an update of their dissimilar metal weld (DMW) program which is summarized in Enclosure 5, "Dissimilar Metal Weld Program Update." PDI has developed a 3-day training class for examination of DMWs. The class discusses the background of typical cracks and crack locations and the implementation of UT parameter issues, such as probe selection, procedure review, and hands on training. The training is to prepare personnel for the DMW performance demonstration and subsequent field examinations.

PDI is evaluating utility supplied data of as-welded configurations with the configurations of their test specimens to verify the representativeness of their test specimens. As a result of the evaluation, PDI has identified the need for additional DMW test specimens and is in the process of acquiring more DMW specimens.

PDI personnel have requested licensees to provide profilometry data they recorded during DMW examinations from the inside diameter. The data collected during the UT examination are used to determine weld areas that cannot be effectively examined because of surface roughness, and in evaluating the representativeness of the PDI test specimens used for qualifying procedures and personnel. PDI will continue collecting and reviewing the data. PNNL is also interested in the profilometry data because the data can assist them in designing

representative DMW test specimens. Although this data is available, it can only be viewed with vendor specific software. Action: NRC/PNNL will coordinate viewing the profilometry data with the licensee that own the data and the vendor who recorded the data.

PDI has received surface condition data for welds containing Inconel that are examined from the outside diameter. The data is taken with a feeler gage and the profile is traced on to paper. PDI has been reviewing the tracings and providing recommendation to licensees on the kind actions necessary for effective UT examinations. The kind of actions being recommended are: site specific mock-ups, transducer selections, alternative UT techniques, weld surface grinding, and/or configuration modifications (such as a pre-emptive weld overlay).

PDI rewrote their generic procedure PDI-UT-10, Revision B, "Generic Procedure for the Examination of Dissimilar Metal Welds." The major procedure changes are presented in Enclosure 5, "PDI-UT-10 Revision B." The changes are: removing depth sizing from the procedure, clearly identifying the qualification limitations, providing criteria for contour search units, providing criteria for selecting search units, providing alternate calibration blocks to use with some of the selected search units, and clearly describing surface requirements. A separate generic procedure is being developed for depth sizing DMWs.

#### Status of Weld Overlay

PDI has procured small diameter overlay specimens for expanding the qualification range from 4-inch nominal pipe diameter to 2-inch diameter pipe. PDI also rewrote their generic procedure PDI-UT-8, Revision D, "Generic Procedure for the Examination of Weld Overlaid Similar and Dissimilar Metal Welds." The major procedure changes are presented in Enclosure 6, "PDI-UT-8, Revision D." The changes are summarized as: expanding the scope down to 2.0-inch diameter piping, adding a Table for transducer selection, using different calibration blocks for refracted longitudinal and contoured transducers, and adding criteria for examinations of tapered surfaces and non-standard overlays. The new procedure was qualified to ASME Section XI, Appendix VIII, Supplement 11."

PDI is extending the qualification of personnel previously qualified to Supplement 11 by adding-on performance demonstration for 2-inch diameter weld overlaid pipe. The add-on has the same number of flaws in the 2-inch diameter test specimens as would normally be used in test sets selected for the diameter range and wall thickness range of the procedure. This concept is analogous to a person being qualified for a single diameter pipe. The ASME Code is silent on this point for Supplement 11 qualifications. Examples of the acceptability of the add-on concept are Supplement 12, Supplement 14, and the intergranular stress corrosion cracking qualification of personnel. The NRC staff asked if the add-on concept should be formalized in the ASME Code. Action: PDI will assess the applicability of formalizing the add-on concept in the ASME Code.

#### Examination of Cast Austenitic Piping

The Pacific Northwest National Laboratory (PNNL) representative gave a presentation titled, "Assessment of Cast Stainless Steel Piping Inspection, PNNL Research Activities Update," Enclosure 8. PNNL used 1970s vintage centrifugally cast, (approximately) 3-inch through-wall thick, austenitic pipe specimens to identify the cast microstructure and to assess its inspectability with low frequency (1 mHz and 500 kHz) UT transducers. From this data, PNNL

was able to reliability detect and length size cracks 20% through-wall and greater on the far-side of the weld. PNNL was unable to get tip diffraction signals from flaws on the far-side, thus none of the flaws were sized for depth. Because of test specimen design and non-blind testing conditions, PNNL could not assess the probability of making false calls. PNNL is nearing completion with their examinations of the limited number of available cast austenitic pipe specimens.

During discussion, false calls was identified as a major concern in examinations of cast austenitic pipe. The concerns were documented in EPRI Technical Report TR-107481, "Status of the Ultrasonic Examination of Reactor Coolant Loop Cast Stainless Steel Materials," dated March 1998. The UT technique used by PNNL was not being considered at the time of the EPRI report. The NRC staff believes that PNNL may have a valid UT examination technique for reliability inspecting the upper 2/3 weld volume of cast austenitic pipe. The NRC staff asked if now is the time to start developing UT examination criteria for examining the upper 2/3 weld volume. The general opinion of the meeting participants was that development of UT examination criteria for the upper 2/3 weld volume of cast austenitic pipe is premature. However, PNNL's research has revealed a potential technique and should be subjected to the rigor of blind performance demonstrations and round robin tests. Action: PDI will present to the PDI Steering Committee a proposal that builds on the knowledge developed by PNNL.

#### Status of ASME Code Work

PDI presented a brief discussion on the status of proposed non-destructive examination related changes to the ASME Code, Enclosure 9, "ASME Code Activities."

The NRC staff made a comparison of the limitations and modifications listed in the 10 CFR 50.55a(b)(2)(xv) with the 2004 Edition with 2005 Addenda of the ASME Code Section XI, Appendix VIII. The comparison identified the following differences:

Supplement	10 CFR 50.55a(b)(2)(xv) requirement	2004 Edition with 2005 Addenda requirement
Supp. 4, Vessel Inner 15%	(B)(2): Flaws smaller than 50% of IWB-3500 need not be included in the test set	1.1(e)(4): Flaws smaller than IWB-3500 need not be included in the test set
Supp. 6, Vessel Outer 85%	(C)(3): Flaws smaller than 50% of IWB-3500 need not be included in the test set	Table VIII-S6-1, Note 2: Flaws smaller than IWB-3500 need not be included in the test set
Supp. 6, Vessel-to-Nozzle	(E)(4): a minimum of 55% cracks	1.1(e)(1): at least 50% cracks
Supp. 7, Vessel-to-Nozzle examinations from the bore	(K)(1)(i), (ii), (iii): a minimum of 4 flaws must be added to the test set.	3.1: a minimum of 3 flaws added to a test set

Supplement	10 CFR 50.55a(b)(2)(xv) requirement	2004 Edition with 2005 Addenda requirement
Supp. 7, Vessel-to-Nozzle examinations from the bore		3.5: personnel qualified to Supp. 6, single side (Do not have to demonstrate on the additional flaws). No additional personnel qualifications are required.

A proposed action going through the ASME Code committees address all of the differences between 10 CFR 50.55a(b)(2)(xv) and 2004 Edition with 2005 Addenda of the ASME Code Section XI, Appendix VIII except for Supplement 7, Paragraph 3.5 which provides a qualification exemption for Supplement 6 qualified personnel performing Supplement 7 examination. 10 CFR 50.55a(b)(2)(xv) applicable to Supplement 7 is for both procedure and personnel qualifications. The staff believes that there are enough differences between examinations from the nozzle bore and the vessel inside surface to warrant a separate Supplement 7 personnel qualification. This item will be addressed as the proposed Code change moves through the ASME Code committees.

#### May 24 & 25, 2005 Meeting Open Items Not Discussed Above

PDI has established a criterion for the surface smoothness needed for an effective UT examination. The surface smoothness is 1/32-inch (0.75mm) maximum gap between the component's surface and the bottom of the transducer. This definition of surface smoothness has been added to PDI's generic procedures. However, ASME Code has been using a definition for surface smoothness as 1/32-inch per square inch in the proposed Code Case N-740 and Section XI, non-mandatory Appendix Q. The differences in surface smoothness between ASME Code and procedures and personnel qualified under the PDI program may affect examination coverage for transducers with a foot print greater than 1 square inch. Action: PDI will address the difference between definitions for surface smoothness with the ASME Code.

PDI discussed the need for adding to the ASME Code a criterion for essential variables that are not explicitly addressed in Appendix VIII, VIII-2100 but are necessary for producing reliable and reproducible examination results. For instance, the use of profilometry to improve UT performance for examinations performed from the inside surface is a procedure-specific essential variable. The existence of procedure-specific essential variables is not clearly recognized in the ASME Code. Action: PDI will champion a change or clarification to ASME Code that addresses essential variables not specifically mentioned in Appendix VIII, VIII-2100.

Because of the similarities in crack propagation between intergranular stress corrosion cracking (IGSCC) and primary water stress corrosion cracking (PWSCC), the NRC raised a question at previous meetings regarding the need for PWSCC qualification and re-qualification requirements similar to the qualification and re-qualification requirements for IGSCC qualified personnel. Such a qualification depends, in part, on the similarities of the acoustic response and crack morphology of the two stress corrosion cracking mechanisms. There are no known comparisons of the acoustic response and crack morphology between IGSCC and PWSCC.

The NRC is interested in collecting data on PWSCC to assess the need for PWSCC specific qualification requirements. Discussions and data collection for comparisons between IGSCC and PWSCC are continuing. Action: item for PDI and NRC.

At the October 2004 meeting, the NRC presented the subject, "Evaluating the Effectiveness of Performance-Based UT." Since 1994, PDI has been generating and gathering performance demonstration data. Through the years, PDI has made program changes that improve pass rates and testing efficiency. These data are a source of information that is useful for evaluating the effectiveness of Appendix VIII performance-based UT as administered by the PDI program.

The NRC is interested in evaluating the inspectability of weld design and configuration with current technology, the crack morphology and distribution on the POD/sizing, and the equipment and technique selection on the POD/sizing. Action: NRC staff will request from PDI a list of the variables with data entries in the reactor vessel data file and piping data file.

#### Other Items of Interest

Supplement 11 qualifications only address the structural weld overlay and 25% through-wall of the base material. Currently, ASME Code is discussing the application of pre-emptive weld overlay for configuring pipe/pipe fitting surfaces that would allow for more effective UT examinations. The discussion includes expanding the examination volume to include the weld overlay and the adjacent 50% through-wall base material. As long as ASME Code is contemplating such a volume change, there is a need to determine the inspectability of this volume. PDI has not evaluated the inspectability of the change in volume. Action: PDI will propose to the PDI Steering Committee a project for assessing the inspectability of the increased examination volume.

#### Next Meeting

The next semi-annual NRC/PDI meeting is tentatively scheduled for May 23, 2006 at the Brunswick Nuclear Plant Visitors Center.

Enclosures: As stated (9)

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PUBLIC MEETING WITH EPRI-PDI, November 8 & 9, 2005

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Frank Ammirato	EPRI - NDE Center
Mike Anderson	Pacific Northwest National Lab
Darlene Tinley	Tennessee Valley Authority
David Kurek	WesDyne
Richard Fuller	Dominion Nuclear
Carl Latiolais	EPRI - NDE Center
Larry Becker	EPRI - NDE Center
Mike Gothard	EPRI - NDE Center
Randy Linden	PPL Susquehanna
James McArdle	Duke Power Company
Gary Lofthus	Nuclear Management Company
Kevin Hacker	Dominion Nuclear
Sherrie Whiddon	EPRI - NDE Center
Chris Minor	G.E. Nuclear
Steven Mortenson	G.E. Nuclear
Hogo Winterhalter	G.E. Nuclear
Dom Sutton	Southern Nuclear Operating Company
Adam Conti	Framatome
Richard Ford	SSI G.E.
Teresa Donaldson	SSI G.E.
Mike Briley	Entergy



**AGENDA FOR MEETING WITH EPRI - PDI**  
**EPRI NON-DESTRUCTIVE EXAMINATION CENTER, CHARLOTTE, NC**

**November 8 & 9, 2005**

1. Open items from last meeting (May 24 & 25, 2005).
2. Status of PDI Reactor Pressure Vessel Demonstration Program.
3. Discuss rule changes to 10 CFR 50.55a.
4. Status of PDI Piping Demonstration Program.
5. Discuss Ferritic and Austenitic Piping.
6. Status of Dissimilar Metal Weld Program.
7. Status of Training and Discuss Requalification.
8. Status of Code Activities.
9. Discuss Inspection of Cast Steel and Cast Stainless Steel Parts.
10. New issues of mutual interest.
11. Public Comment.
12. Adjourn

ENCLOSURE 2