

September 8, 2005

MEMORANDUM TO: Terence L. Chan, Chief  
Piping Integrity & NDE Section  
Materials and Chemical Engineering Branch  
Division of Engineering

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SUBJECT: SUMMARY OF PUBLIC MEETING HELD MAY 24 & 25, 2005, WITH  
EPRI- PDI REPRESENTATIVES (TAC NO. MC6431)

On May 24 & 25, 2005, the staff participated in a public meeting with representatives from the Electric Power Research Institute (EPRI) - Performance Demonstration Initiative (PDI) program at the Georgia Power Company, 241 Ralph McGill Boulevard NE, Atlanta, Georgia. 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 Supplement 10 specimens and qualifications; the status of PDI sponsored ASME Code activity; expansion of Supplement 10 for site specific configurations; expansion of the Appendix VIII concept for other applications; and discussion on analyzing performance demonstration data. 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 Attachments 1 and 2 respectively. Handouts provided at the meeting for selected items in the agenda are included as Attachments 3 through 10.

I. Status of PDI Piping Demonstration Program

PDI presented a brief discussion on Supplement 10, "Dissimilar Metal Weld Qualifications." The discussion is summarized in Attachment 3, "Dissimilar Metal Weld Qualifications."

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The attachment summarizes the industry's progress in successfully detecting and characterizing flaws in dissimilar metal welds (DMW). On rough inside diameter surface conditions, eddy current testing (ET) may be necessary in conjunction with ultrasonic testing (UT) to length size flaws. To date, only examinations for circumferential flaws performed from the outside diameter (OD) with automated UT equipment have been qualified for depth sizing. No manual UT techniques are qualified for depth sizing DMWs from the OD, and no manual or automated UT techniques are qualified for depth sizing DMWs from the inside diameter (ID).

UT development is continuing to resolve the difficulties associated with examinations performed on weld configurations with rough surface conditions and depth sizing. The techniques and their limitations used to detect circumferential flaws also apply to axial flaws with some adjustments for rotating the scanning direction 90E.

Attachment 4, "PDI Piping & Bolting Program Update," summarizes the changes, current issues, and future efforts of the PDI program. The changes are security of performance demonstration data on computer hard drives and moving toward a paperless environment. Current issues are modifications to qualified equipment and the controlling of PDI transducers loaned to licensees. Future issues to be addressed are: how to meet the UT needs recommended by the Material Research Program (MRP), MRP-139, "Butt Weld Inspection and Evaluation Guideline," and the qualification of personnel for weld overlays down to 2-inch diameter piping.

At the NRC/EPRI-PDI meeting of June 4 & 5, 2003, PDI presented a white paper with empirical data supporting the concept that when manufacturers modified their equipment, they would also change the equipment model or series identification. Recently, PDI identified a piece of equipment that was modified by the manufacturer but yet retained the same model identification as the previous qualified unmodified equipment. The modification affected the equipment's essential variables. According to Section XI, Appendix VIII, VIII-4000, if changes are made to the equipment that affect the essential variables, the equipment must be requalified. This recent example is of concern because ASME Code permits using the same identified equipment without verification of essential variables. However, changes in essential variables affect the acoustic responses which could result in missed detection or characterization of safety significant flaws.

PDI is currently undertaking the task of preventing equipment modified in such a manner from reaching the field via ASME Code Section XI, Appendix VIII, VIII-4110. PDI will send a letter to all equipment manufacturers that are referenced in procedures qualified through the PDI program with the intent of notifying the manufacturers that any modification affecting the equipment's essential variables listed in Section XI, Appendix VIII, VIII-4000, must be accompanied with a corresponding change to the model or series identification. PDI indicated that they would make available to the NRC the contents of their letter and any responses from equipment manufacturers.

## II. Status of PDI Vessel and Nozzle Demonstration Program

Attachment 5, "PDI - Reactor Pressure Vessel," summarizes the NDE activities associated with reactor pressure vessel (RPV) examinations that are occurring in 2005. Besides the generic procedure for using fixed angle transducers to examine the RPV, PDI has developed a generic

procedure for manual RPV examinations using a phased array UT technique. Other phased array UT techniques are scheduled for performance demonstration later this year.

Attachment 6, "RPV Nozzle Update," summarizes the NDE activities occurring in 2005 for the vessel-to-nozzle welds and nozzle inner radius examinations. PDI developed a generic procedure (PDI-UT-11) for manual nozzle inner radius examinations, developed modeling software for plotting flaws in the nozzle inner radius, and developed a tool for accurately measuring the transducer location and skew for nozzle inner radius examination.

### III. Open Items from the October 19 & 20, 2004

PDI has established a criterion for the surface smoothness needed for an effective UT inspection. The surface smoothness is a 1/32-inch (0.75 mm) maximum gap between the component's surface and the bottom of the transducer to be used for an examination. This criterion is PDI's definition for the term "flush" found in PDI documents. This criterion applies to both detection and sizing. This maximum gap applies everywhere the transducer must be positioned for inspecting the required volume. PDI will include the surface smoothness definition in their procedure updates, as they occur. The item is closed.

To determine the representativeness of the inside and outside surfaces conditions of PDI's test specimens with the surface conditions found in the field, PDI requested that utilities perform profilometry measurements during DMW examinations and provide these measurements to PDI. Although the examinations may extend over a 10-year period, a large population of the DMWs and corresponding profilometry data will be gathered over the next several refueling cycles. PDI will evaluate the profilometry data to assess the representativeness of the PDI test specimens. Preliminary data provided by licensees identified differences between as-built surface conditions and those of the PDI test specimens. PDI is in the process of designing and procuring additional test specimens to address these configuration differences. PNNL is also interested in the profilometry data for the purpose of procuring a representative test specimen for evaluating various ultrasonic testing (UT) techniques. PDI indicated that they would seek permission from participating utilities to share their profilometry data with PNNL. PDI also mentioned that their training samples could be provided to PNNL after this summer because most of the personnel would have completed the testing for the fall outages season.

PDI is gathering plant-specific DMW configuration and fabrication information, such as counterbores, weld root and crown conditions, cladding, weld buttering, remnant welds, adjacent welds, and weld repairs. The data will help address NRC concerns that a configuration is unique to a particular plant as opposed to occurring multiple times across several plants, the degree to which site specific applications are cited, and the non-uniform application of site specific criteria. PDI indicated that they would continue gathering the necessary information.

After gathering the DMW configuration data, PDI indicated that they would review and update their procedure, "Dissimilar Metal Weld Mock-Up Criteria," as needed. The PDI procedure is to demonstrate UT inspectability of weld configurations that were not included in the Supplement 10 performance demonstration test set. The PDI site specific procedure provides for narrowing the scope and essential variable ranges of the qualified Supplement 10 procedure. Therefore, no requalification is necessary with the PDI site specific procedure.

The PDI database for vessel performance demonstrations (Supplements 4, 5, 6, and 7) has been reviewed for quality and any inappropriate data was either corrected or removed. The database can be queried now for RPV and RPV nozzle examinations. However, data retrieval is performed with customized programming. The data output contains indicators that have changed over time which necessitate interpretation by PDI personnel familiar with the input data.

Attachment 7, "Development of Enhanced Statistical Analysis Capabilities of Performance Demonstration Qualification Data," provides the status of PDI's efforts toward improving the data retrieval of the pipe performance demonstration database. The NRC provided PDI with a list of variables of interest in a letter dated March 15, 2005. PDI indicated that its database will include most of the variables of interest listed in NRC's letter. The variables identified in the NRC letter not included are: specific UT techniques such as phased array, computer focusing and equipment essential variables such as transducer specifics, and factors contributing to false or missed detection. PDI expects to have the revised pipe database completely operational for Supplement 10 performance demonstrations data retrieval by the end of 2005 and for Supplements 2 and 3 performance demonstrations data retrieval by the end of 2006. The storage of data from Supplements 8 and 11 performance demonstrations were not discussed.

#### IV. Status of Code Coverage Calculation Procedure

This item is being considered by the ASME Code at the Working Group on Inspection of Systems and Components. No Action is necessary.

#### V. 10 CFR 50.55a

The NRC staff is completing the technical bases to endorse the 2004 Edition in a proposed rule. The schedule for publication of the proposed rule has not been determined.

Regulatory Guide 1.147, Revision 14, "Inservice Inspection Code Case Acceptability," and Regulatory Guide 1.193, Revision 1, "ASME Code Case No Approved for Use," are scheduled for publication July/August 2005.

#### VI. Status of Code Work

PDI presented a brief discussion on the status of proposed changes to the ASME Code. The discussion is summarized in Attachment 8, "Code Status." PDI is sponsoring a proposed code case that would permit the use of Appendix VIII qualified procedures and personnel for non-Appendix VIII UT applications. The proposed code case has undergone some changes as it progressed through the various Code committees. No action.

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. PDI indicated that they would champion a change or clarification to ASME Code that addresses essential variables not specifically mentioned in Appendix VIII, VIII-2100.

At the June 2003 meeting, the NRC asked for PDI's position on the application of Appendix VIII, VIII-1100(c) and (d) which pertained to the skill level of personnel performing different aspects of an Appendix VIII examination. ASME Code, VIII-1100(d) provides specific tasks that must be performed with Appendix VIII qualified personnel, and VIII-1100(c) provides specific tasks that may be performed by non-Appendix VIII qualified personnel. The jurisdiction of tasks not explicitly identified in either of these two paragraphs is not clear. For example, a specific task that requires knowledge about UT that is not addressed in either paragraph is the holding of the transducer by an individual to scan a pipe. This example was the concern of the ASME Interpretation XI-1-92-39, which permits personnel qualified according to IWA-2300 to perform scanning and physical manipulation of the UT transducer, at the direction of an individual who determines which indications should be recorded and or interpreted. ASME Code has already addressed the concern; this item is complete.

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 during previous meetings regarding the need for PWSCC qualification and re-qualifications 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. If the acoustic response and crack morphology are similar, then the IGSCC re-qualification process would suffice for PWSCC. If the acoustic response and crack morphology are different than IGSCC and other common flaws, the need for PWSCC specific testing and requalifications may be necessary. There are no known comparisons of the acoustic response and crack morphology between IGSCC and PWSCC. PDI stated that PWSCC morphology is discussed in their EPRI report, "Guidelines for Dissimilar Metal Weld Examination and Technical Bases for Qualification." PDI will confirm the title of the EPRI guideline and if the guideline is a proprietary document. 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.

## VII. Revision to PDI Procedures and Program

PDI presented clarifying changes made to UT generic procedure (Attachment 9) PDI-UT-8, "PDI Generic Procedure for the Ultrasonic Examination of Weld Overlaid Austenitic Pipe Welds." None of the changes affect the essential variables thus personnel already qualified to the PDI procedures are not affected. The scope of PDI-UT-8 was expanded to include 2.0-inch diameter pipe and to address tapered and non-standard overlays. For personnel to qualify to the expanded scope, they must pass an add-on blind performance demonstration to their Supplement 11 qualification.

PDI presented changes made to UT generic procedure (Attachment 10) PDI-UT-10, "PDI Generic Procedure for the Ultrasonic Examination of Dissimilar Metal Piping Welds."



PDI-UT-10 was limited to the detection and length sizing of flaws and a different procedure is being developed for depth sizing flaws in DMWs. To address difficulties with detecting flaws in small diameter piping, PDI changed the transducer shape requirements of the procedure for 10-inch diameter and smaller piping from flat or curved transducers to curved transducers. Also, the procedure was simplified by adding the proper focusing depth tables and by refining the requirements for focus transducers. PDI has removed from the generic procedures references to a specific edition of the ASME Code because the performance demonstrations as administered under the PDI program has not changed. The edition of the ASME Code applicable for the various generic procedures will be made available on the PDI web site "EPRIQ."

#### VIII. NRC Issues

The NRC presented seven items for discussion. Four of the items are discussed Section III and VI of this summary. These four items are: the status of updating the PDI performance demonstration database, the application of the surface smoothness criterion, the need for special PWSCC qualifications and re-qualifications, and the examination of site-specific DMW configurations. A summary of the three remaining items follows:

The NRC presented the idea of expanding Appendix VIII, Supplement 11 to address structural weld overlay made with Inconel or ferritic material. PDI is currently using Inconel weld overlay material in Supplement 11 test specimens. PDI believes that the ferritic weld overlays are only being used to address erosion/corrosion wall thinning and do not pose examination difficulties. No action.

PDI has a large inventory of UT test specimens that are used for different performance demonstrations. With the emphasis on performance demonstrations, the NRC asked if the UT test specimens could be used for performance demonstration performed with eddy current testing (ET). PDI believes that the specimens are UT specific. The specimen design includes inserting oxides in the cracks to prevent the cracks from resealing during fabrication. The cracks give representative acoustic responses for UT but would produce abnormal (enhanced) responses for ET. If there is interest in demonstrating ET capabilities, new mock-ups would be needed. No action is contemplated.

The industry has been welding pads over the J-groove welds used to hold the control rod penetration nozzles and instrument nozzles in the RPV, as well as on the exterior of the lower vessel heads and pressurizer lower heads. The pads are attached to these vessels to mitigate PWSCC. The NRC asked if pads (attachment welds on a pressure boundary) should be included in one of the Appendix VIII supplements. It was stated that the pads were small and are welded to piping that is exempt by the ASME Code from UT examinations, and overlay of partial penetration welds are normally not examined using UT. The consensus at the meeting was that the small diameter sizing exemption should apply also to the weld pad. In the absence of any specific UT requirements in ASME Code, welded pads are not included in the PDI program. No action is contemplated.

Analyzing Information from PDI's Database.

At the last 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 made program changes that improved pass rates and testing efficiency. This data is a source of information that is useful for evaluating the effectiveness of Appendix VIII performance-based UT as administered by the PDI program.

For instance, the performance demonstration results of the initial test attempts and the qualification test (in some cases the initial and qualification test results may be the same) can be statistically analyzed to evaluate the effectiveness of training. The data can be separated by time frames that coincided with changes in training, such as implementation of PDI guided practice, licensee administered practice, self administered practice, and tripling the test set size for procedure demonstrations. The data may show correlations with training intensity, timing of training, and training intensity variations for different qualifications. The statistical analyses could allow one to quantify the effort needed to bring an individual's skills to the level needed for qualification and to make proficiency comparisons. The NRC is interested in evaluating the effectiveness of Appendix VII, the effectiveness of Appendix III and Articles 4 & 5 of Section V, and the value added with multiple Appendix VIII qualifications.

The data is a source for verifying the assumptions associated with the development of the supplements, such as the percent of personnel passing/failing detection, sizing, and false calls.

By statistically analyzing the data and developing crack probability of detection (PDO)/sizing, an understanding can be developed on the effectiveness of detecting and characterizing cracks for different weld configurations such as compound weldments, remnants of earlier welds, sloped and radius welds; for crack locations such as far-side, same or opposite surface from the transducer, and ligaments; for crack morphology such as IGSCC, PWSCC, thermal fatigue and compressed electric discharge machined notches; and for surface conditions such as weld crown, weld shrinkage, components misalignment. The data may show pass/fail correlations for different UT techniques, modeling for inspection, and equipment combinations. The results may be helpful in recognizing conditions that are most challenging to UT examinations. 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.

IX. Other Items of Interest

The NRC has expressed desires for thinking outside the ASME Code requirements to find solutions to UT examinations of cast austenitic material. Recent studies by the PNNL, have shown that ID connected flaws extending 20% through-wall in cast stainless piping can successfully be detected. For piping, ASME Code only requires examination of the inner 1/3 volume. Because of the difficulties in detecting and sizing flaws in the inner 1/3, one could consider expanding the examination volume to include the entire weld region. PNNL will continue evaluating the inspectability of cast austenitic products and sharing the results with the industry. The next step is to work with ASME Code in developing Appendix VIII, Supplement 9. There is no PDI action at this time.

T. Chan

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X. Next Meeting

The next semi-annual NRC/PDI meeting is tentatively scheduled November 8 & 9, 2005 at the office of Florida Power and Light Company, Juno Beach, Florida.

Attachments: As stated (10)

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PUBLIC MEETING WITH EPRI-PDI, MAY 24 & 25, 2005

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**AGENDA FOR MEETING WITH EPRI - PDI**

**GEORGIA POWER COMPANY, 241 RALPH MCGILL BOULEVARD, ATLANTA, GA**

**May 24 & 25, 2005**

1. Status of PDI Piping Demonstration Program.
2. Status of PDI Reactor Pressure Vessel & Nozzle Demonstration Program.
3. Open Items from Last Meeting.
4. Discuss proposed rule changes to the 10 CFR 50.55a.
5. Status of a Code Coverage Calculation Procedure.
6. Revision being made to the PDI procedures and program.
7. Status of Code activities.
8. NRC issues.
9. Public Comment.
10. Adjourn