February 17, 2010

MEMORANDUM TO: Timothy R. Lupold, Chief
Piping and NDE Branch
Division of Component Integrity
Office of Nuclear Reactor Regulation

FROM: Carol A. Nove ***/RA/***
Piping and NDE Branch
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SUBJECT: SUMMARY OF MARCH 11-12, 2009 VISIT TO THE ELECTRIC POWER RESEARCH INSTITUTE NONDESTRUCTIVE EVALUATION CENTER TO DISCUSS EXAMINATION OF OPTIMIZED WELD OVERLAYS

On March 11-12, 2009, Mr. Ted Sullivan and Ms. Carol Nove of the Division of Component Integrity (DCI) and Mr. Michael Anderson of Pacific Northwest National Laboratory (PNNL) visited the Electric Power Research Institute (EPRI) Nondestructive Evaluation (NDE) Center to discuss the nondestructive examinations of optimized weld overlays (OWOLs). The DCI and PNNL staff met with Mr. Carl Latiolais and Mr. Ronnie Swain of the EPRI NDE Center and Mr. Terry McAlister, Materials Reliability Program Inspection Issue Task Group Chairperson. The objective of this meeting was to gain an in-depth technical understanding of industry's proposed approach to ultrasonic examination of OWOLs in the field and to formulate preliminary regulatory conclusions on the adequacy of the proposed approach. The proposed approach for qualification of OWOL examinations will closely follow the requirements of the American Society of Mechanical Engineers Boiler and Pressure Vessel Code, Appendix VIII, Supplement 11, *Qualification Requirements for Full Structural Overlaid Wrought Austenitic Piping Welds*, resulting in previously qualified, Supplement 11 procedures being extended to address the expanded examination volume required for OWOLs.

Enclosed are the notes from this meeting.

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DATE	02/17/2010	01/27/2010	01/27/2010

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March 11-12, 2009, EPRI Visit to Discuss Examinations of Optimized Weld Overlays

Objective

To gain an in-depth technical understanding of industry's proposed approach for qualification of UT examination of Optimized Weld Overlays (OWOLs) and to formulate preliminary regulatory conclusions on the adequacy of the proposed approach.

Topics for Discussion/Data Review

1. Physical characteristics of OWOL mockups
   - How were the mockups made?
     With welding and materials consistent with what is used in the plants

   - Were cast materials used in any mockups?
     Yes, centrifically cast safe-ends in the surge and shutdown cooling mockups, and static cast in the reactor coolant pump (RCP) mockup

   - Compare OWOL mockups to full structural weld overlay (FSWO) mockups.
     Less than FSWO thickness, flaws ranging down to the outer 50% of the original weld/base material volume versus FSWO which have flaws ranging in the outer 75% of the original materials
     The original FSWO mockups are 2", 4", 6", 12", 28" piping, plus some additional special configurations (pzr spray, drain lines)
     The new mockups will expand the FSWO thickness up to 36" piping and will include optimized weld overlays (with the expanded exam volume) on a portion of the mockup.

   - What do the mockups represent?
     Surge line, Shutdown Cooling, and RCP

   - How representative are the mockups? How representative are the acoustic properties of the mockups with cast safe ends to the acoustic properties in the field?
     The RCP mockup properties may be somewhat different from the plants because the casting is static, where the plant joints may have centrifically cast safe-ends. The other two mockups should be the same as in the plants. There is also a possibility that the grain structures of the castings are different, depending on the vintage of the cast used in the plants.

   - Are there configurations being considered by industry for applying OWOLs that the examination mockups don't represent?
     Yes, however these mockups are considered by Performance Demonstration Initiative (PDI) to be the worst cast configurations that are being considered. Additional mockups are planned of differing configurations, however all configurations will not likely be covered by the mockups.

ENCLOSURE

2. Physical relationship between OWOL mockups and Supplement 11 FSWO mockups
   - What characteristics do OWOL and FSWO mockups share?
     The characteristics are in all ways similar with the exceptions below.

   - Differences?
     The height of the flaws, the thickness of the overlay, and the use of cast material on the safe ends.

   - Are they a reasonable extension of Supplement 11 mockups?
     Yes, because they are actual configurations found in the plants.

   - Why or why not?
     They are simply extensions of FSWOL thickness or extensions of examination volume, but will be used for full qualifications.

3. Capability studies
   - What were the results of detection and sizing in the inspection volumes used?
     All circ flaws in the weld and buttering were detected and sized, successfully, at least from one direction. See next question for limitations.

   - What limitations were found during the capability studies?
     Flaws located in the cast inspection volume were not reliably detected. Axial flaws which were contained in the outer 50% to 75% of the original weld and base material were not reliably detected.

   - Can these limitations be overcome?
     It is unknown at this time.
     For cast volumes, based on the work that has been done to date with available equipment and techniques, it does not appear that available techniques are capable of meeting the requirements of Appendix VIII Supplement 11 for the cast volumes.
     For the 50% to 75% through-wall axial flaws, the current available technology has not had success with consistently detecting and characterizing these flaws.

   - What are the technical reasons that detecting/sizing flaws in the inspection volume was not achieved?
     These are not fully known. Cast materials contain challenging grain structures which are well known to create problems for UT examination. The deeper axial flaws require sound to travel through the weld overlay material and the dendritically shaped cast microstructure of the original piping weld, which seems to create a similar difficulty as that which exists in the cast material. These are only postulated reasons.

   - Discuss the reasons for these limitations in terms of axial versus circumferential detection and sizing capability
     For circumferential flaws, the sound is required to travel through less overall weld material to get to the flaw versus for an axial flaw. Also the grain structure is more favorable when examining for circumferential flaws, than for axial flaws

4. Demonstration versus Qualification
   - Did the Electric Power Research Institute (EPRI) perform a capability demonstration on examining OWOL or did they perform an examination qualification?

     EPRI performed an examination qualification that included detailed fingerprint of all of the samples using equipment and techniques similar to what has been qualified for FSWOL examinations. In addition, various other state of the art conventional and phased array techniques were used.

   - What was the breadth of equipment and procedures used?

     Both conventional and phased array automated techniques were used for the evaluations. These techniques included a variety of frequency and angle combinations. The search units were focused for the examination volume to be examined. Low frequency systems were also evaluated.

   - Were the equipment and procedures used all qualified in accordance with Supplement 11 for FSWOs?

     Yes, additionally evaluations were performed with new state of the art phased array equipment.

   - In terms of the answer to the previous question, what is industry proposing to implement in the field in terms of equipment/personnel/procedures?

     The intent is that previously qualified procedures be expanded to include the new ranges in thickness and the expanded examination volume. The procedures will be qualified in a blind fashion and the required changes needed in the previously qualified procedures will be qualified on the newly fabricated mock-ups. Personnel qualifications will also be expanded in a blind fashion using the same mock-ups. The qualifications will closely follow the requirements defined in Appendix VIII, Supplement 11, but will have to be modified to address the expanded examination volume being qualified. Details of these changes will be included in a request for alternative submittal to the NRC. In addition, the changes will be channeled through the ASME Code in the form of a Code Case coupled with a Code change.

   - What is the technical basis for field implementation of the current status quo?

     There is no intention to simply use the existing techniques for these examinations. As stated above the plan is to qualify all procedures and personnel using the augmented requirements of Supplement 11 prior to deployment.

5. What is the status of vendor qualification planning?

   There is one vendor waiting for EPRI to finish meeting with the NRC so that they can come in and begin the qualification process. EPRI has held them off until the NRC reviewed this process, in case the meeting resulted in additional necessary actions before the qualification could proceed. There is expected to be at least two, and possibly up to four vendors interested in expanding their FSWOL examination procedures to include OWOL configurations.

6. Documentation
   - How did EPRI document its OWOL UT study and the basis for its conclusions?

     EPRI will document all qualification ranges demonstrated on the Performance Demonstration Qualification System documents for both the procedures and personnel that have been successfully qualified. There is one of these documents for every person and every procedure.

7. Future plans
   - What are EPRI's plans over the longer term for performance demonstration qualification of OWOL UT examination?

     EPRI is fabricating additional samples which will be included in the base PDI sample set. The reason for this is that industry will be moving toward this approach in the future. The added samples will allow EPRI to qualify additional personnel and procedures for these types of examinations.