NRC Staff Issues with the Proposed Site-Specific Mock Up Process

NRC/PDI Meeting
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Site Specific Mockup Process What is it? How is it used?

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- As PDI does not have mockups to cover every plant configuration, the site specific mockup (SSMU) process was developed
- At the September 11, 2012 public meeting it was stated that approximately 150 welds were examined using unencoded site-specific procedures
- Implementation guidance provided by PDI to industry via "Dissimilar Metal Weld Mock-Up Criteria, Rev A"
- Dissimilar Metal Weld Mock-Up Criteria, Rev A is limited in applicability to Supplement 10 welds

Regulatory Issues with SSMU Process

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- There is no allowance for the SSMU process in either Supplement 10 and ASME Code
- Some procedures developed using the SSMU process do not meet ASME Code, Section XI, Appendix VIII Supplement 10 requirements
  - Appendix VIII Supplement 10 provides a process for changing essential variables
  - While the SSMU process provides some technical justification for modifying a procedure, it is not a part of ASME Code or 10CFR50.55a
- A Code Case, Rulemaking, or Code Change will be required for the SSMU process to allow for limited changes in essential variables

Two Categories of SSMU Procedures

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- All SSMU procedures are modified versions of procedures that have passed Appendix VIII Supplement 10 blind testing
- There appear to be two types of SSMU procedures
  - SSMU optimized procedures that **do not** change any essential variables
  - SSMU modified procedures that **do** change essential variables
- It is not known how many SSMU procedures fall in to each these categories

What is an Essential Variable?

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- Article VIII-2000 requires procedures to have a list of essential variables
- The minimum list of essential variables is described in Appendix VIII 2100 includes, but is not limited to
  - Nominal inspection angle
  - Probe model number
  - Number, size, shape, and configuration of active elements
  - Number, size, shape, and configuration of wedges or shoes
  - Nominal frequency or the center frequency
  - Bandwidth or waveform duration as defined in VIII-4000
  - Scan pattern

Tolerances in Essential Variables

- Using VIII-4100 a probe may be substituted based on the following tolerances:
  - (1) propagation mode is the same
  - (2) measured angle, ± 3 deg
  - (3) center frequency for search units with bandwidths less than 30%, ±5%
  - (4) center frequency for search units with bandwidths equal to or greater than 30%, ±10%
  - (5) waveform duration, ±1⁄2 cycle or 20%, whichever is greater (measured at −20 dB), or bandwidth, ±10%

How to Handle these cases?

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- If no essential variables are changed outside of the allowed tolerances of the procedure and those spelled out in Appendix VIII then no regulatory action is required
- If essential variables *have* been changed in the SSMU process, there are two methods to allow the use of the modified SSMU procedure
  - Pass a blind Supplement 10 Personnel test as per Section XI Appendix VIII Supplement 10 4.0 (d)
  - Submit a relief request and receive approval via a safety evaluation from the NRC staff

What is the NRC staff Looking for in a Generic SSMU Process?

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- If a Code Case or other changes are to be made formalizing the SSMU process, the following elements will need to be addressed
  - Open Test Design
    - Number and types of flaws
    - Locations of flaws
    - Sizes of flaws
    - Acceptance Criteria
  - Limits on Changes to Essential Variables
  - Mockup Quality Assurance
  - Modeling of UT Sound Fields
  - Third Party Review
  - Provide a copy of Technical Justification to NRC Staff (not for review or approval)

Industry proposal to strengthen the site specific mockup criteria

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- At the September 11, 2012 public meeting, industry provided high level info on revisions intended to strengthen SSMU criteria
- Some positive changes have been suggested
- The requirements for the mockups such as flaw quantity and size remains essentially unchanged from original requirements
- The acceptance criteria are vaguely written
- There is no required third party review for the technical justification
- This revised process could, in the NRC Staff's opinion, still allow unacceptable site specific mockup procedures to be used

Open Testing

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- Designing a rigorous open test is a complex process with many pitfalls
- One should be able to demonstrate the ability of a procedure to discriminate between flawed and unflawed regions
- A direct comparison between the signal to noise ratio and other aspects of the Appendix VIII-qualified procedure and the modified procedure is recommended

Number of Flaws

- Requirements with respect to quantity, size, type, and locations of implanted flaws in the mockups need to be well-defined
  - One flaw in each orientation is insufficient as one flaw cannot cover a range of sizes, angles, or locations
  - Using only small flaws or one flaw location does not cover the range of possibilities in the field

Mockup Quality Assurance

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- Flaw implantation methods may leave artifacts in the test blocks
  - Damage caused by implantation process
  - “Bonus” flaws
  - Improperly induced flaws
  - Fabrication flaws unrelated to flaw implantation
- Test blocks need to be examined to assure that the true state information is correct

Limits on Allowable Changes

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- Changes to essential variables should be kept to a minimum
  - Modify wedge or focal laws, not the transducer
  - Same frequencies
  - Same aperture
- Changes to essential variables would need to be justified
- This was addressed in the September 11 public meeting

Acceptance Criteria

- Designing a robust acceptance criteria for open testing is challenging
  - It is possible that blind testing is simpler than open testing
- Predetermined and defensible acceptance criteria need to be developed prior to testing

Modeling

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- The SSMU procedure would greatly benefit from modeling that compares the Appendix VIII qualified procedure to the modified procedure
- This modeling should show that the ultrasonic fields and possibly indication responses are the same for each procedure for different flaw sizes and orientations
- This modeling will also help identify issues with search unit designs
- Modeling will not identify poorly-driven search units

Third Party Review

- A third party review is a powerful quality assurance tool to ensure compliance with Appendix VIII. If Appendix VIII criteria are not met, follow on actions, such as regulatory review, would be required

Conclusions

- The staff agrees that there is likely a need for site-specific mockups; however, this process must comply with the ASME Code requirements and/or 10CFR50.55a
- SSMU procedures that do not change any essential variables from the Appendix VIII-qualified procedures require no regulatory approvals or additional actions
- Until a method is included in an NRC approved Code edition, SSMU Procedures with modified essential variables need either:
  - A blind Supplement 10 personnel test in order to comply with Appendix VIII requirements
  - Alternately, a Safety Evaluation would be required to use a procedure with modified essential variables
- A Code Case or Code Change would be required to allow the use of SSMU procedures to change essential variables in the future
  - The staff proposed that the ASME Code include a site specific mock-up process at the November ASME Code Meetings in Phoenix