ATTENDANCE SHEET

Subject: Meeting to Discuss Butt Weld Inspection and Evaluation Guidelines — category 2 meeting

Organization: NRC/NEI/PUBLIC INTERESTED GROUPS

DATE: 08/04/05

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Bill Bateman	(301)415-2795	NRR/DE/EMCB
Terence Chan	301-415-2768	NRR/DE/EMCB
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KEITH WICHMAN	3014152785	NRR/DE/EMCB

ATTENDANCE--CONTINUED

Subject: Meeting to Discuss Butt Weld Inspection and Evaluation Guidelines — category 2 meeting

DATE: 08/04/05

NAME (print)	Telephone	Organization Affiliation
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Michael Mayfield	301-415-3298	NRR/DE

ATTENDANCE--CONTINUED

Subject: Meeting to Discuss Butt Weld Inspection and Evaluation Guidelines — category 2 meeting

DATE: 08/04/05

NAME (print)	Telephone	Organization Affiliation
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Materials Reliability Program: Butt Weld I&E Guidelines and Leak Before Break Report

Dana Covill
Co-Chairman, Alloy 600 ITG
Progress Energy

August 4, 2005
NRC Meeting

Meeting Goals

- Present new industry inspection and evaluation guidance for alloy 600/82/182 butt welds (MRP-139)
- Safety is assured
- Demonstrate that MRP-139
  - –Technical ly robust
  - –Mit igation strongly encouraged
  - –Sou ndly based on deterministic and probabilistic analysis
- Basis of LBB remains strong
- **Industry committed to implement MRP-139 under the Materials Initiative (NEI 03-08)**

Agenda

- MRP-139 Overview
- Implementation Requirements
- Implementation Schedule
- Examination Volume
- Volumetric & Surface Examinations
  - Coverage
  - Frequency
- Visual Examination
- Other Alloy 600 locations
- Leak Before Break

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Overview of MRP-139

- MRP-139 provides guidance for the volumetric and visual inspection of dissimilar metal butt welds in PWR primary systems
  - Developed using a structured approach
    - Safety assessment (deterministic and probabilistic)
    - Assessment of margins between onset of leakage and critical crack sizes
  - Review and approval process
    - Third party review
    - Resource assessment
    - Implementation planning
    - Extensive industry review
    - Unanimous approval by the MRP executive committee

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Overview of MRP-139

- Safety Assessment (MRP-113, July 2004) provides technical basis:
  - PWSCC potential limited in extent and severity
  - Temperature affects susceptibility
  - Weld repairs affect susceptibility
  - Not an immediate safety concern
- **Augmented inspections beyond ASME Section XI requirements are the right thing to do**
  - Provides reasonable assurance that the potential for RCS pressure boundary leakage is minimized
  - Assures continued safe operation

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Overview of MRP-139 (cont'd)

- MRP-139 provides Inspection Requirements
  - Monitors condition of DM butt welds
    - Tracks the occurrence of degradation
    - Detects onset of increased initiation as plants age
    - Obtains information on crack growth rates
    - Validates models
  - Increases inspection frequency for earlier detection as compared to current requirements
- MRP-139 has been approved by Executive Committee and will be issued to the PWR Fleet as "Mandatory" under the NEI 03-08 Initiative

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MRP-139 Table of Contents

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Scope of MRP-139

- Applicability
  - Alloy 82/182 butt welds (ASME categories B-F and B-J) in primary system piping in domestic PWRs
    - Welds in piping >1" NPS
      - –Cov ers vast majority considered susceptible
  - Exposed to temperatures at or above cold leg temperature
  - Alloy 82/182 butt welds where mitigation techniques have been applied
- Other Alloy 600/82/182 locations (other sizes, other code categories or lower temperatures) addressed in future industry guidance

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MRP-139 Implementation Requirements

- Sections 1.2, 5, and 6 are "Mandatory" for PWRs
  - Weldments should be made inspectable by the required implementation schedule
- Implement requirements of section 5.1.7 by the required schedule
- Guidelines do not reduce current ASME Code requirements
  - Example: coverage <90% of Code volume requires relief request
- Guidelines will replace applicable requirements in risk-informed inspection programs

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Implementation Schedule

- By 12/31/07 – evaluate all Alloy 82/182 welds to determine the amount of coverage for axial and circumferential flaws
- Perform first volumetric inspection Alloy 82/182 according to the following schedule
  - By 12/31/07 - all welds associated with the pressurizer and exposed to pressurizer-like temperatures
  - By 12/31/08 - welds $\geq$ 4" NPS and $\leq$ 14" NPS and exposed to temperatures equivalent to the hot leg
  - By 12/31/09 - welds > 14" NPS and exposed to temperatures equivalent to the hot leg
  - By 12/31/10 - welds exposed to temperatures equivalent to the cold leg
  - For welds located within lines that are managed under LBB approval, consider increasing the inspection frequency to the highest frequency for similar sized pipes

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Examination Requirements and Schedule

- Sections 5 and 6 of MRP-139 provide the process for determining
  - NDE method to use for each DM weld
    - Appendix VIII Supplements 10 and 14 for volumetric exams
  - Additional evaluation necessary based on UT coverage
  - Additional evaluation necessary based on alternative NDE method chosen, and
  - Re-examination frequency required for each DM weld

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Examination Volume Description

- Generic description of examination volume
  - The required examination volume is shown by the entire wetted surface within C-D-E-F.
    - Points E and F are 1/4" outboard of the weld (or butter) to base material fusion line as measured on the outer surface of the pipe
  - Data collection beyond the 1/3t requirement can be analyzed to help characterize the condition of the Alloy 82/182 weld

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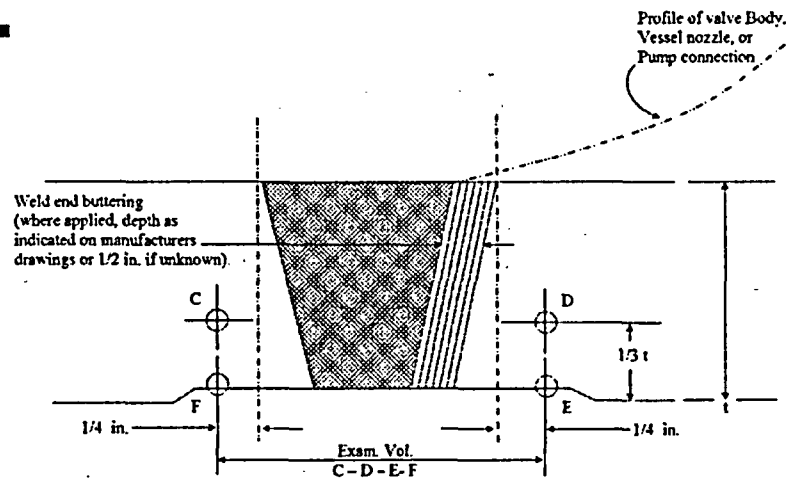
Typical Examination Volume



ALLOY 82/182 DISSIMILAR METAL WELDS
(1/2 in. = 13mm, ¼ in. = 6 mm)

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Crediting Appendix VIII Examinations

- Previous inspections performed in compliance with Appendix VIII can be credited
- Future inspections must be made using the examination volumes presented in MRP-139

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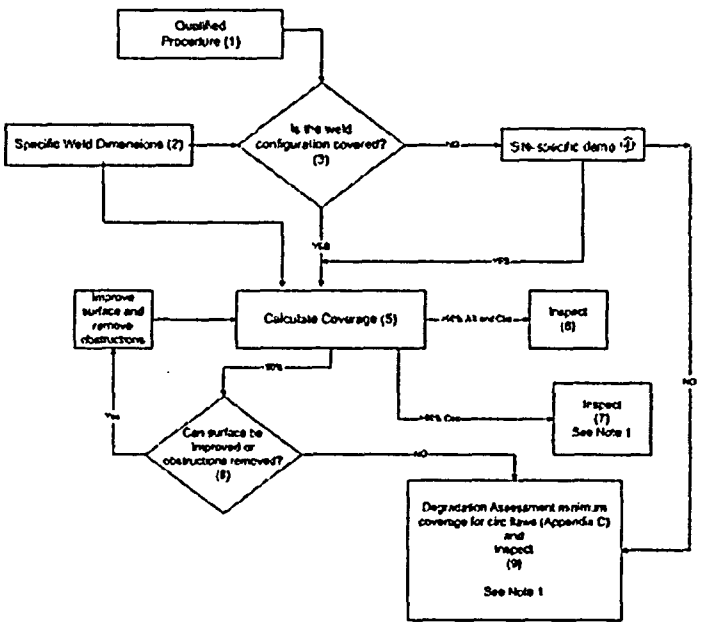
NDE Methodology Procedure: Figure 5-1



Coverage Assessment
(Figure 5-1, Items 5, 6, and 7)

- Calculated separately for axial and circumferential flaw orientation
- Uses actual weld configuration and the procedure's essential variables
- Inspection considered complete if the average coverage (for axial and circumferential flaws) is > 90% of the required examination volume
  - –If < 90% coverage for axia l flaws, but meet > 90% coverage for circumferential flaws, the examination will be considered acceptable
    - The examination for axial flaws will be completed to achieve the maximum coverage possible
  - –If < 90% coverage for circum ferential flaws, then utilities may attempt to improve the coverage volume (Section 5.1.6)
    - Relief request if required

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Improved Coverage (Figure 5-1 Item 8)

- If outside surface conditions or obstructions limit the coverage to < 90% of the examination volume, evaluate the possibilities for increasing the coverage
  - Re-evaluate examination coverage following implementation of improvements

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Specific Additional Measures for <90% Examination and Configurations Not Currently Addressed in Appendix VIII (Section 5.1.7)

- Implement mitigation actions at the earliest possible RFO for hot leg or pressurizer welds that meet any of the following three conditions
  1. An inability to obtain 90% coverage of the required volume for circumferential flaws
  2. An inability to obtain 90% coverage of the required volume for circumferential flaws AND an inability to improve the examination coverage by modifying the weld
  3. Welds have known cracks
  - Additional monitoring of the weld location for leakage until the weld has been successfully mitigated
    - May include visual examination at every RFO or local leak detection
  - As an alternative to mitigation, modify the weld at the earliest possible RFO to make an examination possible

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Specific Additional Measures for <90% Examination and Configurations Not Currently Addressed in Appendix VIII (Section 5.1.7)

- In the interim before mitigation can be implemented,
  - –Perfor m a volumetric examination at the frequency defined in Table 6-1 for Category D or E
  - –Add itionally, visual examinations of the bare metal shall be performed at the frequency defined in Table 6-2
- Consider augmentation or replacement of the ultrasonic examination with other NDE methods
  - –Demonstrate capabi lity
- Finally, for any area of the pipe that remains unexamined, perform
  - –Degrad ation assessment in accordance with Appendix C and
  - –Includ e justification for interim measures

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Examination Schedules Section 6

- Section 6 provides examination schedules for all primary piping system weldments
- Weldments are categorized
- Scope expansion is applicable if flaws are detected during inspections
- If owners determine that certain weldments are not inspectable before the required RFO per Table 6-1
  - –I mplement a plan to make the weldment inspectable by the required implementation schedule and
  - –I mplement the requirements of section 5.1.7 by the required schedule

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Volumetric Examination Schedules

PWSCC Category	Description of Weldments	Inspected? Cracked?	Inspection Extent and Schedule
A	Resistant Materials	–	Existing Code Inspection Program
B	Non-resistant Mat. Reinforced by full structural weld Overlay	Yes Uncracked	Existing Code Inspection Program
C	Non-Resistant Mat. Mitigated by SI	Yes Uncracked	50% of each mitigation within next 6 years, if no indication continue with existing Code Inspection Program
D	Non-resistant Mat. No SI Pressurizer and Hot Leg ≥4"	– –	100% per period, but no longer than 5 years between exams for pressurizer locations (include surge line nozzle welds near pressurizer) 100% every 5 years for hot leg locations (include surge line nozzle welds near hot leg)
E	Non-resistant Mat. No SI Cold Leg	– –	100% every 6 years

Volumetric Examination Schedules (cont'd)

PWSCC Category	Description of Weldments	Inspected? Cracked?	Inspection Extent and Schedule
F	Non-resistant Mat. Cracked Reinforced by full structural weld overlay	Yes Cracked	Once in the next 5 years, if no additional indications/growth continue with existing Code Inspection Program for unflawed condition
G	Non-resistant Mat. Cracked Mitigated by SI	Yes Cracked	100% at 2 RFO intervals. If no additional indications/growth after the 2nd examination (4th RFO), continue with existing Code examination program for unflawed condition
H	Non-resistant Mat. Pressurizer and Hot Leg Examination does not meet requirements of Figure 5-1 Item 6 Configuration not addressed in Appendix VIII	No –	Frequency defined in Table 6-1 for Category D to the extent possible. Additional interim requirements as defined in Section 5.1.7.
I	Non-resistant Mat. Cold Leg Examination does not meet requirements of Figure 5-1 Item 6 Configuration not addressed in Appendix VIII	No –	Frequency defined in Table 6-1 for Category E to the extent possible. Additional interim requirements as defined in Section 5.1.7.

Visual Examination Attributes

- Inspection of the bare metal surface of the Alloy 82/182 pipe butt weld and adjacent Alloy 600 components. Perform by
  - –Removin g the insulation, or
  - –Remote visua l examination inside the insulation
- Visual access to the area of interest cannot be compromised by the presence of existing deposits or other factors that could interfere with the examination

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Visual Examination Requirements

PWSCC Category	Description of Weldments	Examination Extent and Schedule
J	Non-resistant Mat Pressurizer and Hot Leg	In the outages when volumetric examinations are not being performed, visual examination every RFO as defined in section 5.2.1 or until mitigated or replaced
K	Non-resistant Mat Cold Leg	Visual examination as defined in section 5.2.1at least once every three (3) RFOs (not counting RFOs when weld is examined volumetrically as one of the three) or until mitigated or replaced. Alternatively, for the RV cold leg, or inlet nozzles ONLY, use deterministic analysis as a basis to allow these nozzle welds to be visually examined once per interval. This option can only be exercised AFTER welds have been UT-examined and fully meet the conditions for being defined as Category E. In RFOs where a UT is performed from the OD, a visual examination is credited. If the UT is performed from the ID, a visual examination may be credited if the 90% examination volume identified in section 5.1.5 was obtained.

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Evaluation Methodologies

- Section 7 summarizes applicable evaluation methodologies per Section XI IWB-3600
  - For these materials, limit load analysis methods are applicable
  - Methodologies can be used for various purposes including
    - disposition of indications found during inspections (surface-connected or embedded flaws)
    - determination of effectiveness of stress improvement processes, and
    - determination of weld overlay design (full structural or stress improvement)

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Inspection of Other Alloy 600 Locations

- Several previously published documents
  - Industry (MRP and CEOG) letters and guidance documents
  - ASME Code Case N-722 - Bare metal visual inspection of A600 locations
    - MRP is evaluating
- MRP will clarify multiple guidance documents

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Leak Before Break Considerations

- Key issues:
  - PWSCC is an active cracking degradation mechanism, although observed pipe cracks have been small and primarily axial
  - PWSCC leakage path is more tortuous than fatigue cracks used in previous LBB evaluations
- Addressed in MRP-140 and presented to staff on March 24, 2005

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LBB Analysis Conclusions

The technical basis for LBB remains strong

- PWSCC observed in Alloy 82/182 butt welds in several plants has been primarily axial in nature
  - Long part-through wall circumferential flaws not likely
- Adequate time between leakage detection and growth to critical flaw size to allow safe shut down
- Adequate margin remains considering alternative leak rate calculation methodologies (flaw morphology)
- Increased plant sensitivity to unidentified leakage
  - Response to leak rates less than 1 gpm (Tech Spec Limits) improved
- Detailed report has been delivered to the NRC for their information

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LBB Additional Considerations

- Increased personnel sensitivity to leak rates since LBB regulation was approved
  - WOG project to standardize leak rates calculations
  - WOG project to determine what action should be taken in response to specific levels of leakage
  - WOG-NRC meeting later this month
- Relevant regulatory documentation needs to be evaluated in light of knowledge and information developed since LBB was approved

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Summary

- Implementation of MRP-139 will minimize the potential for RCS pressure boundary leakage
- MRP-139 requires action if inspections are not effective
- Industry will implement MRP-139 as a "Mandatory" action under the Materials Initiative
- Basis of Leak Before Break remains strong
- Safety is assured
- Mitigation methods are being researched

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