

October 12, 2005

Mr. Alexander Marion, Senior Director  
Engineering/Nuclear Generation Division  
Nuclear Energy Institute  
1776 I Street, NW, Suite 400  
Washington, D.C. 20006-3708

Dear Mr. Marion:

In your letter dated July 27, 2005, you provided EPRI Materials Reliability Program Report MRP-139, Rev. 0, *Materials Reliability Program: Primary System Piping Butt Weld Inspection and Evaluation Guideline*, to the Nuclear Regulatory Commission (NRC) for information. You indicated that the Nuclear Energy Institute (NEI) was not requesting approval of MRP-139, but would appreciate staff comments on the document. On August 4, 2005, a public meeting was held between NRC and representatives from NEI and MRP during which an overview of the report was given and general staff observations were provided.

The NRC staff has since completed its review of MRP-139. Overall, MRP-139 represents a step forward in addressing inspection requirements for Alloy 600/82/182 butt welds in the primary system. However, the NRC has identified portions of the document which should be clarified and enhanced. Enclosed are the NRC staff's comments and recommendations resulting from the August 4 meeting and the review of MRP-139. My staff and I look forward to continuing our discussions on these issues.

Sincerely,

***/s/RA by Michael Mayfield/***

Michael E. Mayfield, Director  
Division of Engineering  
Office of Nuclear Reactor Regulation

Enclosure: As stated

cc: Jim Riley, NEI  
Christine King, EPRI

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Nuclear Regulatory Commission (NRC) Questions and Comments to Materials Reliability  
Program Report MRP-139, "PRIMARY SYSTEM PIPING BUTT WELD INSPECTION AND  
EVALUATION GUIDELINE"

The staff has reviewed MRP-139 and provides the following comments and recommendations, as applicable:

General Comments:

- Section 1.3 of MRP-139 addresses the primary water stress corrosion cracking (PWSCC) safety issue and states that no changes to the current American Society of Mechanical Engineers (ASME) Code are required. As discussed at the August 4<sup>th</sup>, 2005 public meeting, the NRC considers this issue to be safety significant. Even though there has not been an event that would warrant shutting down pressurized water reactors (PWRs), there is enough documented evidence of leakage and cracks/flaws to support the position that current ASME Code inspection requirements are not sufficient for managing PWSCC. In recognition of this, we recommend that the industry consider developing a plan for codification of inspection and evaluation guidelines including flaw evaluation methodologies, inspections, inspection schedules, and mitigation techniques. Comments 21-24 discuss the staff concerns in more detail.
- Table 6-1 permits the use of approved alternative examination programs for several categories of welds. The staff understands "approved alternatives" to mean alternatives to Code requirements which the NRC has previously approved. Approved alternatives may include risk-informed inservice inspection (RI-ISI) programs. RI-ISI may lead to certain dissimilar metal (DM) welds never being inspected after the post-mitigated inspection. The NRC believes that use of RI-ISI for stress-improved welds is inappropriate since experience does not yet exist to demonstrate that stress improvement (SI) will be fully effective. The NRC believes more experience with SI of DM welds in PWRs is warranted before these welds are incorporated in RI-ISI programs. Comment 25 discusses the staff concern in more detail.
- MRP-139 appears to specify only visual inspections for welds in piping less than 4" nominal pipe size (NPS). Experience with PWSCC has shown that visual examinations (VT) alone are not an adequate tool. The staff recommends that volumetric examinations and mitigation be considered in addition to VT examinations. Comment 16 discusses the staff concerns in more detail.
- MRP-139 lacks clarity and specificity with respect to how to address welds that are considered uninspectable. The staff recommends that MRP-139 be revised to be more explicit concerning its direction to make these welds inspectable. Comments 3, 4, 7 and 11 discuss the staff concerns in more detail.
- MRP-139 does not address the subject of regulatory interaction with licensees. Comments 4 and 26 discuss the staff concern in more detail.

Enclosure

## **Implementation Schedule and Baseline Inspections:**

1. Section 1.2, "Implementation Schedule," states the following:

"It is important to note that as results from baseline inspections required by this I&E guideline become available, changes to the examination requirements may be needed. For example, depending on the examination results for the hot leg and pressurizer welds, the examination requirements for the cold leg welds may be adjusted."

The effect of residual stresses due to in-process repairs can exacerbate susceptibility for individual welds in a manner that overwhelms the temperature effects. For example, South Texas Project, Unit 1, identified PWSCC in Alloy 182 weld material at cold leg temperatures in the reactor pressure vessel (RPV) lower head, while no flaws have been identified to date in the plant's RPV upper head weld metal which is at a higher temperature. South Texas attributed the susceptibility of the material at the colder temperature to stresses induced during fabrication. The staff recommends that no reduction in cold leg baseline inspections be implemented at a plant due to results from initial hot leg baseline inspections. The staff suggests the section be reworded as follows:

"It is important to note that as results from baseline inspections required by this I&E guideline become available, changes to the examination requirements may be needed. Specifically, examination results for the hot leg and pressurizer welds may identify the need to reduce the time permitted to complete baseline examinations of the cold leg welds."

2. Section 1.2, "Implementation Schedule," item 6 of the guideline schedule states the following:

"For Alloy 82/182 butt welds located within lines that are managed under LBB regulations, utilities should consider increasing the inspection frequency for these locations to the highest frequency for similar size pipes listed above (for example, inspect reactor vessel cold leg 82/182 butt welds by December 31, 2009)."

The staff recommends that the words "should consider increasing" in item 6 of Section 1.2 be replaced with "shall increase" to remove message ambiguity. Baseline inspections for butt welds located within lines managed under leak before break (LBB) regulations should be a priority. Furthermore, the staff recommends that the guidelines specify that LBB welds shall be mitigated and non-LBB welds should be mitigated to reduce their susceptibility.

3. The guidance provided in Section 1.2 pertaining to weldments not inspectable per Section 5.1.5 needs clarification or modification, particularly for the example given in the second paragraph. It should be clarified that baseline inspections will be conducted within the permitted time frame, including welds determined to be uninspectable. If the welds are uninspectable, then the actions necessary to make them inspectable and the

subsequent inspections or compensatory actions will be completed within the stipulated time frame for the baseline inspection. The NRC staff recommends that the guidelines be revised in a number of places (e.g., Sections 1.2, 5.1.7, Table 6-1, and Category H and I) to clearly specify that licensees are required to make such welds inspectable, whether original or full structural weld overlay (FSWO), by the required implementation schedule in Section 1.2. Furthermore, the staff recommends the guidelines be revised to clearly specify that welds modified to be made inspectable will be made inspectable to the extent specified in Section 5.1.5 by qualified Appendix VIII procedures.

4. Comment 3 above relates to welds that are not currently inspectable. To focus our regulatory oversight efforts, the NRC staff recommends that MRP-139 be revised to indicate that licensees will inform the NRC of any welds they conclude cannot be made inspectable by the implementation schedule in the guidelines and their plans to address the issue.
5. MRP-139 does not appear to be clear with regard to the schedule for baseline visual examinations. The MRP letter dated September 12, 2005, clarifies this point but this letter does not indicate that it contains mandatory guidelines. The staff recommends that MRP-139 be revised to clarify this point.
6. Section 1.2 states that "... this section and sections 5 and 6 ... are mandatory requirements for PWR owners." Yet later within this section, it is stated that "Owners also should implement the requirements of Section 5.1.7 by the required schedule." The words "should implement" connote a permissive condition which is not a requirement and appears to be inconsistent with the intent of MRP-139. The staff recommends that this wording be revised to reflect a requirement.

#### **Mitigation:**

7. Section 5.1.7 states that primary water chemistry additions are recommended as one of the mitigation measures when 90% coverage of the required inspection volume cannot be met. Since there are no primary water chemistry additions to mitigate PWSCC that have been determined to be acceptable at this time, clarification should be provided to reflect this fact as discussed in Section 3 of MRP-139.
8. Categories C and G involve application of SI to a weld. Rather than inspecting a weld first, it is possible that licensees will choose to apply a SI process to a weld and treat the weld as Category C if no indication of cracking is found in the post-SI inspection, and as Category G if indication of cracking is found in the post-SI inspection. Experience with the application of SI to welds with Intergranular Stress Corrosion Cracking (IGSCC) demonstrated that pre-existing cracks could be compressed to the extent that during ultrasonic inspection, they appeared to change size or no longer be evident. This phenomenon could result in improper categorization of a weld, including the possibility that a circumferential flaw may actually exceed the size limits for Category G, i.e., 10% of the circumference and 30% through-wall. The staff recommends adding a description of how the implementation of SI and pre-SI UT examinations under MRP-139 will prevent cases of improper categorization.

### **Examination Requirements:**

9. Section 5.1.5 states that when the examination of axial cracks cannot meet the coverage requirement of 90%, the inspection report needs to identify the limitations of the examination, and the examination is considered complete. However, Note 1 in item 7 of Figure 5.1 refers to Section 5.1.7 for disposition. The staff notes that in Section 5.1.7, there are no additional measures required for inability to obtain 90% coverage of the required volume for axial cracks. The staff concern is that axial flaws can have circumferential cracking as evidenced at V.C. Summer. The staff recommends that guidance be provided for additional measures for such axial cracks.

10. Section 5.1.7 starts with a note stating that, "If an owner obtains NRC approval of a relief request for not being able to obtain 90% coverage of the volume of interest, the owner may meet the conditions of the NRC-approved relief request in lieu of this guideline."

The staff agrees with this comment. However, as worded it may be confused with relief requests obtained from the NRC prior to the issuance of MRP-139. We recommend adding words to clarify this point.

11. Section 5.1.7 includes a sentence which states, "This I&E guideline does not require mitigation, replacement, or local leak detection for DM weld applications with service temperatures below 570° F."

The staff recommends striking this line from the document. Categories B, C, F, and G apply to weldments regardless of operating temperature. Consistent with comments 1 and 3, the staff recommends that the guidelines be clarified to indicate that welds at cold leg temperatures need to be made inspectable.

12. The staff recommends the examination requirements in Table 6-1 be revised to clearly identify what inspections need to be performed (e.g., Appendix VIII, Supplement 10, Supplement 11).

13. The third column of Table 6-1 for Categories D and E has dashed lines in answer to the question about whether the weld has been inspected. The dashed lines appear to conflict with the text in Sections 6.4 and 6.5, which state the weld has been inspected. The staff recommends clarifying this table.

14. The staff recommends deleting the words "or Surface" in the title of Table 6-1 on page 6-13 of MRP-139 since Table 6-1 does not reference any use of surface examinations.

15. Section 6.7, Category G, states the following:

"Additional margins (for flaws larger than 10% of [the] circumference or 30% of the wall thickness) may be demonstrated by performing component-specific analytical or experimental evaluation."

The staff recommends adding a condition that additional margins would only be applicable for one outage. This approach is consistent with GL 88-01 and allows a

licensee sufficient time to plan for a full structural weld overlay during the following outage if an analytical or experimental evaluation supports one outage of continued operation with the SI.

16. Section 6.10.2 states, "In every outage when volumetric examinations are not being performed, PWSCC Category J weldments that are at pressurizer or hot leg temperatures must be visually inspected (bare-metal) until replaced or mitigated. For weldments in piping less than 4" NPS, owners may provide an alternative examination program based on a specific evaluation that includes the consequences and safety assessment of a failure at each Category J weldment."

The staff regards the assessment proposed in this paragraph to be unacceptable since it focuses on evaluating consequences of failure rather than preventing failures. Visual examination alone of Category J welds less than 4" NPS is not an acceptable strategy for managing PWSCC. These DM welds are susceptible to PWSCC. To preclude failure of the welds (i.e., loss of leakage or structural integrity), these welds also need to be FSWO or inspected by ultrasonic examinations that are qualified under an Appendix VIII performance demonstration program, and use the scanning requirements of 10 CFR 50.55a(b)(2)(xv)(A)(2). The staff recommends MRP-139 be revised to address this concern, including an appropriate schedule for these actions.

This comment also applies to Category K 4" NPS and smaller welds.

17. Section 5.1.1 states that, "Typically, the volume examined by Appendix VIII procedures is more than the volume required by this I&E guideline." It is not clear why MRP-139 permits volumetric coverage less than that required by the ASME Code. This statement also is inconsistent with Section 1.2 which states that, "These guidelines do not reduce current ASME Code requirements." The staff recommends the text be expanded to identify the circumstances or locations where the reduced inspection volume of MRP-139 may be applied, and discuss the acceptability of the approach.
18. It is not clear whether all of the requirements of the ASME Code, other than those provisions specifically articulated in MRP-139, such as personnel qualification, record keeping, reporting, QA, and sample expansion requirements, will apply to inspections performed under MRP-139. The staff recommends clarifying this issue.

#### **Inspection Intervals:**

19. Section 6.3.1 states, "Weld overlays that do not qualify as a full structural weld overlay (for example, design overlays) and mechanical stress improvement (MSIP™) may introduce additional NDE considerations requiring additional examination preparation." The staff recommends that this statement be clarified.
20. The staff recommends that Section 6.7.2 be modified to be consistent with Section 6.3.2, i.e., that 100% of Category G treated welds shall be volumetrically inspected before returning to service.



### **Flaw Evaluations:**

21. The staff recommends that steps be taken to ensure flaw evaluation methodologies discussed in Section 7 and Appendix C that are not currently part of Section XI, IWB-3600, be codified.
22. Section 7 of the report lacks specificity and does not address some important elements, e.g., the fatigue crack growth rates that should be used for Alloy 82/182 and detailed guidance on the application of Appendix C of the report. The staff recommends that more specific information and guidance be provided in Section 7 and Appendix C to improve its usefulness.
23. In Section 7.1.2, it is stated that, "... a fatigue crack growth calculation must be performed if thermal stresses are sufficient to cause crack growth." It is not clear why stresses from other cyclic loads are not considered. The staff recommends that this section be clarified.
24. One of the provisions of Appendix C of the report is, "... assume that all reported indications, or areas that are not inspected, are through the thickness of the component." Regarding reported indications, it is not clear if this provision is specified because such indications cannot be sized by NDE. For areas that are not inspected, it is not clear if these areas are inaccessible for inspection or uninspectable because current NDE techniques are not adequate. Also, it is not clear what the basis is for requiring the combination of adjacent "growth" circumferential flaws if the ligament between them is less than twice the thickness of the component. The staff recommends that these issues be clarified with more guidance.

### **Welds covered by previous RI-ISI approvals:**

25. Categories C and G allow use of an approved alternative to define the inspection frequency once certain conditions have been met. These conditions include use of resistant materials, reinforcement with a full structural weld overlay, and SI. Approved alternatives include risk-informed ISI relief requests. Such alternatives would lead to some dissimilar metal welds never receiving inservice inspection. The staff considers the provision to allow use of previous risk-informed relief request approvals for Categories C and G to be inappropriate until experience with SI in this application demonstrates its effectiveness. The staff recommends removing this provision from MRP-139.

### **Regulatory Interaction:**

26. The discussion in Section 3.2 on mitigation is at an overview level. The staff would like to be involved with particulars related to application of such measures. For example, FSWO is included under the section of stress improvement. The FSWO is designed to restore the structural integrity of the cracked components and does not rely upon the improvement of residual stress distribution. Consequently, the staff requests that words be added to Section 3.2 that would require licensees to inform NRC of plans to mitigate.