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Date: 4/22/04 12:18PM
Subject: NRC document - Application of ASME Section XI Rules to J-weld-2004.doc

Tom and Bob,

Attached is the white paper that presents Entergy's position on why relief for the J-weld remnant is not needed. As we discussed in our telephone conversation yesterday, you may docket this paper. Please let me know if you have any questions.

- docket 50-313
- PM is T Alexion.

Thanks!

Guy

<<Application of ASME Section XI Rules to J-weld-2004.pdf>>

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Application of ASME Section XI Rules to J-weld Remnant after Installing the Framatome Repair Configuration on Reactor Vessel Head Penetrations

Background:

- ANO-1, Unit 1 is committed to ASME Section XI, 1992 Edition, with portions of the 1993 Addenda (as it applies to pressure testing including the deletion of Examination Category B-E).

- The proposed repair modifies the configuration by removing a portion of the CRDM nozzle, relocating a new pressure boundary weld into the head bore that abandons a portion of the original J-weld (J-weld remnant) leaving it attached to the reactor head. The J-weld remnant performs no function other than being integral to the head. Prior to the modification, the J-weld is not specifically classified by ASME Section XI (Code) and is only considered in Examination Category B-P under Item No.B15.10 as part of the overall reactor vessel. As such, it is included as part of the VT-2 visual examination scope when the reactor vessel is pressure tested. There are no specific inspection/examination requirements specified for the J-weld. After the modification, the remaining weld material is no longer considered a weld covered by IWB-2500 and is treated as base material like the reactor vessel.

- Historically, this repair has been supported by two generic relief requests:

  - One addresses the use of ambient temperature temper bead welding (e.g., ANO1-R&R-005).

  - One addresses a weld anomaly that may occur in the new pressure boundary weld and postulated flaws in the J-weld remnant (e.g., ANO1-R&R-006).

History:

The two generic relief requests that have been historically used to support the described repair configuration seem to have evolved from the repair's initial use. The initial approach taken by the industry to address the J-weld may have fostered the belief that relief was needed from the Code rules when a flaw was discovered. There are two thoughts that help explain how the industry came to the point of requesting relief on the J-weld remnant.

1. In the initial campaign, significant efforts were being expended to examine the J-weld, characterize flaws, and determine acceptance. In this stage of the Alloy 600 initiative, licensees were struggling with how the Code interfaced with the effort especially since it was being applied to a weld that is not examined by the Code and no clear criteria was available to determine its acceptance. However, once they identified a flaw in the J-weld with the non-Code required NDE, licensees were bound to comply with the rules of IWA-4000 for its removal, repair, or replacement. As discussed below, they could be misled to apply the rules of IWB-3000. However, in reality they should have determined that the

Code does not provide any analytical evaluation criteria for a partial penetration vessel weld.

2. The other factor that could have led the industry to seek relief for the J-weld remnant could be the Edition/Addenda of the Code being used at the specific facility. It is in the later Edition that significant clarification has been provided.

So initially, the industry was using an approach that:

1. Attempted to address the discovery of flaws identified with examinations that were not required by the Code, and

2. Attempted to follow rules that are written for examinations that are required by the Code.

This approach was further complicated because once discovered, the Code rules for removing a flaw did apply. This led the licensee back to rules that were only applicable to examination results provided by Code required examinations (IWB-2500). However, now that the industry has moved away from examining the J-weld before the modification or its remnant after the modification, it becomes significantly clearer. Therefore, it is appropriate to reconsider the need for the relief request as applied to postulated hypothetical flaws.

Discussion:

The following information evaluates compliance with the Code as they apply to the J-weld remnant.

Inputs:

a) As applied to the modification, Code rules do not require any examination or inspection of the J-weld before or after the modification is installed.

b) As revised NRC Order EA-03-009 (the Order) is implemented, there are no examinations or inspections being performed on the J-weld at ANO-1 since the CRDM is being ultrasonically examined in accordance with the requirements of Section IV.C(5)(b)(i) of the Order.

Section II.A of Relief Request ANO1-R&R-006, Revision 0 references the Code requirements that were considered to be applicable and for which relief was sought.

The relief request stated:

> **II. Code Requirements**
>
> A. ASME Section XI (pertaining to the J-groove weld remnant)
>
> Paragraph IWA-4310 requires in part that "Defects shall be removed or reduced in size in accordance with this Paragraph." Furthermore, IWA-4310 allows that "...the defect removal and any remaining portion of the flaw may be evaluated and the component

accepted in accordance with the appropriate flaw evaluation rules of Section XI." The ASME Section XI, IWA-3300 rules require characterization of flaws detected by inservice examination.

Paragraph IWB-3420 requires the characterization of flaws in accordance with the rules of IWA-3300.

Subparagraph IWB-3142.4 allows the use of analytical evaluation to demonstrate that a component is acceptable for continued service. It also requires that components found acceptable for continued service by analytical evaluation be subject to successive examination during the next three inspection periods.

Paragraph IWB-3613 establishes acceptance criteria to be used for evaluating flaws in areas where bolt-up loads play a significant role (i.e., the RPV-to-head interface). IWB-3613(b) requires the use of a safety factor of $\sqrt{10}$ (3.16) to determine the stress intensity factor (SIF) of a flaw during normal operating conditions.

Upon further consideration, it is Entergy's position that relief from the 1992 Edition of the Code is not required for the following reasons:

1. The portion of ANO1-R&R-006 that addresses the J-weld remnant is based on the assumption of a hypothetical flaw since neither the Code nor the Order require an examination of the J-weld either before or after the modification. Postulating a flawed J-weld is not done because of any requirements of the Code, but rather because we recognize that the J-weld remnant material is susceptible to PWSCC. The rules of IWA-4000 for repair and replacement, and the rules contained in IWB-3000 for acceptance standards do not apply to hypothetical flaws. Therefore, how hypothetical flaws are evaluated to determine their potential effect on the acceptability of the reactor head for operation is an obligation under 10 CFR 50 Appendix B rather than the Code.

   Even though neither the Code nor the Order require assessment of the J-weld remnant, it is appropriate to recognize that the material is susceptible to PWSCC and is subject to cracking during operation. However, because this evaluation is not required by the Code, the method of evaluation is subject to engineering discretion.

   Using the Code as guidance, the rules of IWB-3000 are first considered. But it is clear that those rules, including the requirements of IWB-3600, were written for those specific items that required preservice or inservice examination in accordance with IWB-2500. Specifically, IWB-3131 clearly indicates that only the examinations required by IWB-2500 shall be evaluated by comparing the examination results with the acceptance standards specified in Table IWB-3410-1. Additionally, IWB-3132 - *Acceptance,* provides four methods for accepting examination results but, again, specific to those examinations required by IWB-2500. Finally, IWB-3610(a) states in part, "A flaw that exceeds the size of allowable flaws defined in IWB-3500 may be evaluated by analytical procedures such as described in Appendix A." There are no allowable flaw sizes defined in IWB-3500 for a partial penetration J-weld (the configuration prior to the modification) nor are there criteria for a J-weld remnant, which is the configuration after the modification.

In summary, there are no Code rules that require the evaluation of a hypothetical flaw; the requirements of IWB-3000 and specifically IWB-3600 only apply to configurations that are examined in accordance with IWB-2500 and whose allowable flaw size is described in IWB-3500.

However, realizing the responsibility of the licensee to ensure safe operation of the reactor and recognizing the potential for cracks in the J-weld remnant, it is appropriate to perform an evaluation. Since the rules of IWB-3000 are not applicable, it is imperative to understand the basis for ensuring reactor safety before selecting an appropriate evaluation method. 10 CFR 50, Appendix G provides specific fracture toughness requirements of the ferritic pressure-retaining materials of the reactor coolant system. In this regulation, it is mandatory to evaluate the reactor vessel and establish pressure and temperature limits to protect against vessel fracture during operation, test conditions, and operational occurrences. 10 CFR 50 Appendix G requires the limits to be at least as conservative as limits obtained by following the methods of analysis and margins of safety of Appendix G of ASME Section XI. ASME Section XI Appendix G provides methods of analysis to evaluate hypothetical flaws that may exist within a reactor vessel. These methods are used to determine the operational limits to ensure that such flaws would not result in failure.

2. Other references in the relief request implicate the necessity to comply with IWA-3300 for flaw characterization. The relief request states in part "The ASME Section XI, IWA-3300 rules require characterization of flaws detected by inservice examination."

   Again, what is being considered is a hypothetical flaw rather than an actual flaw detected during inservice examination. When IWA-3300 is taken in full context of IWA-3000, it is clear that these rules relate to the discovery of flaws during those examinations required by IWB-2500, IWC-2500, and IWD-2500 when performed as an inservice inspection.

3. The final incorrect implication of Code rules for which relief has been sought is a reference to IWB-3142.4. This reference would lead the reader to believe that successive examinations are required for three periods when flaws are accepted by analytical evaluation. This misinterpretation has been discussed with the NRC Staff on previous occasions with agreement that the requirement for successive examinations is only a Code requirement when the flaw is detected during the performance of examinations required by IWB-2500.

   IWB-2420 establishes the parameters for performing successive examinations. It first indicates that the sequence of examinations established in the first interval be repeated in the following interval. It continues to recognize that components accepted by analytical evaluation in accordance with IWB-3132.4 or IWB-3142.4 shall have their sequence adjusted to include successive examinations during the next three periods and, after verifying that the evaluated flaw remains unchanged, the item may return to its original schedule (i.e., that required by IWB-2500).

To summarize, the path through the Code only reaches IWB-3132 or IWB-3142 if flaws are discovered during the examinations required by IWB-2500. While it has been an industry practice to also use the guidance of IWB-3000 to evaluate flaws discovered outside of IWB-2500 examinations, the rule is not a requirement, and therefore relief from rules that are being used as guidance is not required. In addition, there are no rules within the discussion of successive examinations for hypothetical flaws that have been postulated for the purpose analysis.

Conclusion:

While it is often convenient to apply rules of the Code to conditions/situations that are outside the specific scope of the Code or its specific content, it is not necessary to request relief when the Code is being used as guidance and it cannot be complied with in total. Relief Request ANO1-R&R-006 has confused the Code requirements with good practice for using the guidance of the Code when addressing situations not specifically addressed by the Code. However, just because the Code does not address all situations that may arise, it does not excuse the licensee from the responsibility to ensure that component design and safety bases are maintained.

Since the Code does not require examination of the J-weld remnant or provide rules in IWB-3600 for evaluating hypothetical flaws in the J-weld remnant, it is the responsibility of the licensee to ensure appropriate selection of evaluation criteria. This criterion is located in 10 CFR 50 Appendix G which refers to ASME Section XI Appendix G. The criterion of ASME Section XI Appendix G provides a method of analysis consistent with existing analysis that provides for safe operation of the reactor vessel with hypothetical flaws.

Based on the information presented above, it is Entergy's position that NRC approval to use ASME Section XI Appendix G to evaluate the J-weld remnant is not required.

Entergy has evaluated the J-weld remnant against the criteria of ASME Section XI Appendix G with acceptable results.