From: Marshall David
To: Dave Chrzanowski
Date: 3/14/2008 10:59:02 AM
Subject: Fwd: RAIs for Braidwood Interim SG Tube ARC LAR

Dave,

The purpose of this message is to request responses to the attached RAIs by Monday, 3/24/08. These are the same RAIs that I e-mailed on 3/11, and I had previously requested the 3/24 response date in a telecon with Ken. A call with the technical staff can be arranged should you decide that one is necessary.

When you submit the responses to the Document Control Desk, please send a parallel pdf copy to me and the other NRC staff on this message.

Thanks,
Marshall

>>> Marshall David 3/11/2008 3:35:20 PM >>>
Ken,

Attached are the RAIs for the Braidwood interim ARC license amendment request. These RAIs are similar to those sent to Vogtle (e.g., the same technical issues) and previously Wolf Creek, except for the deletion of plant-specific questions that do not apply to Braidwood.

I propose that we schedule a phone call in the next day or so to ensure mutual understanding of the RAIs.

Thanks,
Marshall

CC: Allen Hiser; Andrew Johnson; Ken Nicely

REQUEST FOR ADDITIONAL INFORMATION

RELATING TO STEAM GENERATOR TUBESHEET
AMENDMENT ON INTERIM ALTERNATE REPAIR CRITERIA

BRAIDWOOD STATION UNIT 2

The NRC staff has the following requests for additional information related to your submittal:

1. Given that the ability of eddy current to size cracks in the weld has not been demonstrated, justify the position in the amendment request that visual inspection of the weld will not be performed unless the eddy current results indicate that a weld flaw is greater than the weld crack acceptance criteria.

2. Visual examinations of the weld will be performed on a best effort basis with inspection systems capable of achieving a resolution similar to the Maximum Procedure Demonstration Lower Case Character Height as discussed in ASME Section XI. Please provide the code edition and addenda that describe this proposed inspection resolution. For visual detection of stress corrosion cracks in other components, a resolution sensitivity sufficient to detect a 1 mil wide wire or crack (as a substitute for a visual examination) has been accepted by the NRC, as described in Title 10 of the Code of Federal Regulations, Part 50.55a(b)(2)(xxi). For the inspection approach to be implemented under this license amendment, provide a description of the performance demonstration process and results that demonstrate the ability to reliably detect flaws with characteristics similar to those that might be expected to be found in these welds.

3. Figure 3-7 (LTR-CDME-08-11 P) needs to provide all geometry details assumed in the weld analysis on pages 7, 9 and 10. (The staff does not understand the assumed weld geometry based on the discussion on pages 7, 9 and 10.) With respect to the equation for S.A. near the top of page 10, what is the parameter whose value is 0.020 and what is the solution for “y”?

4. On page 10, the assumed flaw is said to extend a distance “d” into this “surface.” Does “surface” refer to the outer ellipse or inner ellipse in Figure 3-5? Figure 3-5 suggests it is from the inner ellipse.

5. What was the assumed flow stress for the weld material? What was the basis for selecting this value?

6. LTR-CDME-05-P states that the tube to tubesheet welds were designed and analyzed as primary pressure boundary in accordance with the requirements of Section III of the ASME Code. Please provide a summary of the Code analysis, including the calculated maximum stress and applicable Code stress limit.

7. Regarding the weld repair criterion:

   A detailed stress analysis (e.g., finite element) would be expected to reveal a much more complex stress state than that assumed in the licensee’s analysis, which may impact the likely locations for crack initiation and direction of crack propagation. In addition, the dominant stresses for crack initiation and crack growth may involve residual stresses in addition to operational stresses. Thus, the 35-degree conical “plane” is not the only plane within which cracks may initiate and grow.

One hypothetical crack plane, which appears more limiting than the one assumed by the licensee, is the cylindrical "plane" defined by the expanded tube outer diameter where the weld is in a state of shear. The staff estimates that the required circumferential ligament to resist an end cap load of 2200 lb is greater than 180 degrees (without allowances). Please address these concerns and provide a detailed justification for why the submitted analysis is conservative.

8. The proposed tube and weld repair criteria do not address interaction effects of multiple circumferential flaws that may be in close proximity (e.g., axial separation of one or two tube diameters). Please address this concern and identify any revisions which may be needed to the alternate tube repair criteria and the maximum acceptable weld flaw size.

9. The technical support document for the interim ARC amendment does not make it clear how licensees will ensure they satisfy the accident induced leakage performance criteria. Please describe the methodology to be used to ensure the accident induced leakage performance criteria is met. Include in this response (a) how leakage from sources other than the lower 4-inches of the tube will be addressed (in the context of ensuring the performance criteria is met), and (b) how leakage from flaws (if any) in the lower 4-inches of the tube will be determined (e.g., determining the leakage from each flaw; multiplying the normal operating leak rate by a specific factor).

   [The staff makes two observations here in response to possible industry concerns regarding Item 9.

   First, the staff acknowledges that the ratio of the allowed accident leakage and the operational leakage is 2.5 for Wolf Creek, which is equal to the factor of 2.5 above, while the ratio is 3.5 for Vogtle and 5 for Byron/Braidwood). This is not an atypical situation as is discussed in NRC RIS 2007-20. The operational leakage limit in the technical specifications can never be assumed to ensure that accident leakage will be within what is assumed in the accident analysis, even if the technical specification limit is zero. For example, part through wall flaws in the free span which are not leaking under normal operating conditions may pop through wall and leak under accident conditions. For cracks in the free span which are leaking under normal operating conditions, the ratio of SLB leakage to normal operating leakage can be substantially greater than 2.5 depending on the length of the crack. It is the licensee's responsibility to ensure that the accident leakage limits are met through implementation of an effective SG program, including an engineering assessment of any operational leakage that may occur in terms of its implications for leakage under accident conditions (based on considerations such as past inspection results and operational assessments, experience at similar plants, etc.).

   Second, the staff is not aware of any operational leakage to date from the tubesheet region for the subject class of plants, and there seems little reason to expect that this situation will change significantly in the next 18 months. Thus, the NRC staff's approach discussed above is not expected to have any significant impact for the licensees requesting relief from the tube repair criteria in the lower 4-inches of the tube.]

10. The proposed "modified B*" approach relies to some extent on an assumed, constant value of loss coefficient, based on a lower bound of the data. This contrasts with the "nominal B*" approach which, in its latest form (as we understand it) is not directly impacted by the assumed value of loss coefficient since this value is assumed to be constant with increasing contact pressure between the tube and tubesheet. Given the amount of time for the staff to review the interim ARC, the staff will not be able to make a conclusion as to whether the assumed value of loss coefficient in the "modified B*" approach is conservative. However, the

staff has performed some evaluations regarding the potential for the normal operating leak rate to increase under steam line break conditions using various values of (l_{NOP}/ l_{SLB}) determined from the "nominal B*" approach (which does not rely on an assumed value of loss coefficient). With these analyses and recognizing the issues associated with some of these previous H*/B* analyses, it would appear that a factor of 2.5 reasonably bounds the potential increase in leakage that would be realized in going from normal operating to steam line break conditions. Please discuss your plans to modify your proposal to indicate that the leak rate during normal operation (for flaws in the lower 4-inches of tube) will increase by a factor of 2.5 under steam line break conditions.

11. The mathematical constant π has been omitted from the first term of the equation near the top of page 8 and the equation at the bottom of page 8. It is not clear if this is a typographical error, or if π has been purposely omitted. If the omission is intentional, please explain.

12. The last term of the equation at the bottom of page 8 includes the parenthetical ($r_o^2 + r_i^2$). The staff believes this should be ($r_o^2 - r_i^2$). It is not clear if this is a typographical error, or if the radii are intentionally being summed. If intentional, please explain why the squared radii should be summed and not subtracted.

13. Explain why it is necessary to subtract A_f (area of the flaw) from $S.A.$ (surface area of the frustum) in the first term of the force balance equation on page 10. (The staff believes this term should be deleted.)

14. Explain the use of the mathematical constant P_i (internal pressure) rather than P ($3\Delta P$ or 4800 psi) in the equations on pages 8 and 10. The explanation on page 11 is not sufficient and appears to the staff to be incorrect.

The NRC staff has the following observations related to your submittal:

A. Your current proposal for modifying the TS is in terms of calendar months. This is inconsistent with the remainder of the steam generator TS inspection requirements which are in terms of effective full power months. In the past, having inspection requirements tied to calendar months has necessitated the need for subsequent amendments in the event of an extended shut-down period.

B. In Section 5.1 1. of Attachment I to your February 25, 2008 letter, there is a discussion concerning the relationship of normal operating leakage and accident induced leakage. In this discussion, you indicate that assuming all normal operating leakage to be from indications below 17 inches from the top of the tubesheet that the accident induced leakage would be less than your accident-induced leakage limit of 0.50 gpm. The NRC staff agrees that it is appropriate to assume all normal operating leakage is from flaws within the tubesheet region (since the source of normal operating leakage will not be known); however, the previous statement is only true when the other sources of accident induced leakage do not contribute more than 0.30 gpm of accident induced leakage (assuming that the normal operating leak rate doubles going from normal operating to accident conditions as is discussed in your submittal). This issue is discussed further under "Issue 5" in Regulatory Issue Summary 2007-20, "Implementation of Primary-to-Secondary Leakage Performance Criteria."

C. In Section 2.0 of Attachment 4 to your February 25, 2008 letter, there is a statement following the structural integrity performance criterion that this criterion is based on ensuring that there is reasonable

assurance that a steam generator tube will not burst during normal operation of postulated accident conditions. Although this statement is true, it is not complete since the criterion is also intended to ensure the tube will not collapse.

D. In the last paragraph of Section 4.1 of Attachment 4 to your February 25, 2008 letter, there is a statement that: "This means that the leakage during accident conditions can increase by no more than 2 to 6 times the leak rate during normal operating conditions for the plants under consideration." This statement is confusing since it implies that the leakage observed during accidents may be six times higher than that during normal operation. We believe the intent of this statement is that the accident induced leakage limit is a factor of 2 to 6 times higher than the normal operating leakage limit for the plants under consideration. With respect to the plants under consideration, the staff notes that the report does not always address Model 51F steam generators (top of page 2 of Attachment 4) although Surry (which has Model 51F steam generators) is referenced in the report. In addition, the report does not reference Indian Point 2 (which has thermally treated Alloy 600 tubing with hydraulic tube expansions).

E. Although arguments were provided regarding the sizing of the circumferential extent of circumferential cracks, it is not clear that this is always the case. If cracks are found and there is more than one operating cycle between inspections, this issue may become important since the depth of flaws deep in the tubesheet may not follow the trends of flaws at other tube locations (i.e., they could be deep over most of their measured circumferential extent).

F. If cracks are found in a steam generator, these locations should be required to be re-inspected during all subsequent inspections (and an assessment of the growth rates (in the circumferential direction) should be provided).

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From: Marshall David

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Braidwood IARC RAIs.doc	46080	3/11/2008 10:53:02 AM

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