From: Peter Tam
To: Dosa, John J; Steven Leonard
Date: 4/8/04 11:25AM
Subject: Draft RAI on Your 9/19/03 Letter re. NMP1 RPV Flaw Evaluation (TAC MC0930)

John:

Our reviewer, Simon Sheng, completed review of the subject submittal and would like to discuss with you the draft questions below. Please call me to set up a conference call for this purpose (presumably when you are relatively free from Unit 2 refueling activies).

The flaw evaluation methodology in Appendix A of Section XI of the ASME Code does not consider cladding stresses. You have the option to (1) demonstrate that the impact due to cladding stresses on the acceptability of the detected reactor pressure vessel closure head flaw according to the Section XI requirements is insignificant, or (2) answer the following questions to support your modified flaw evaluation methodology:

1. Pages 4 and 5 of the Structural Integrity Report SIR-03-036, Rev. 0, describe an approach of calculating the applied stress intensity factor (K) due to cladding stresses for a surface flaw on the inside surface of the reactor pressure vessel. Provide the cladding stress distribution from 1 inch beneath the clad-vessel interface to the clad surface under the limiting load condition. Further, provide the values for the parameters used in this cladding stress calculation: modulus of elasticity, the coefficient of thermal expansion, the stress-free temperature, the inner diameter (ID) surface temperature, and the Poisson's ratio of the cladding and the coefficient of thermal expansion of the base metal.

2. The NRc staff could not verify that Equation (1) is from Tada and Paris's handbook. Provide the derivation of this equation and its related function m(x).

3. The basis underlying Equation (4) is not given on Page 4 of the Structural Integrity report.

3a. Provide a better definition of Kl min. As indicated by Equation (1), Kl is a function of only the crack depth. Your definition of Kl min as "minimum Kl in base material" without relating to a specific crack depth is misleading.

3b. Provide the basis for the use of a correctional factor (a/amin) in Equation (4) for flaws greater than amin.

4. It is stated on Page 5 of the Structural Integrity report, "To calculate the surface stress intensity factor, the cladding stress intensity factor (obtained by Equations 1 and 5 above) for a flaw depth equal to the thickness of the cladding (with the same aspect ratio as the deeper flaw being evaluated) is determined. It is then modified based on the ratio between the membrane stress intensity correction factors for the surface (using the Raju/Newman, Mm) and the crack tip (using the Appendix A, Mm)." It is not clear how you can build up your approximation for a "deeper surface flaw" from a fracture model for a surface flaw touching the interface of clad and base metal; nor it is clear that the subsequent modifications will bridge the disconnect. Justify your approach based on principles in Elasticity and apply your approach to examples with exact solutions to demonstrate that your approach is valid.

5. Revise the definition of flaw eccentricity on Page 7 of the Structural Integrity report. Since you bracket "e/t" by "absolute signs," describing the flaw eccentricity as "negative if toward inner vessel wall" is not necessary. When characterizing flaws close to ID as the current case, the flaw eccentricity should be described as "negative if toward outer vessel wall."

6. It was stated on Page 11 of the Structural Integrity report, "Reference [10] documents the stresses from the revised bolting procedure evaluation to be 5.6 ksi on the outside surface and 1.5 ksi on the inside surface at the flaw location." Provide the reason for the revision of the bolting procedures and the change (the delta) of the stresses caused by the use of the revised bolting procedures in lieu of the old procedures.

The sole purpose of this e-mail is to prepare you and others for the proposed conference call. The e-mail does not formally requrest for addition information, nor does it formally convey an NRC staff position.

Peter S. Tam, Senior Project Manager
Project Directorate I-1
Division of Licensing Project Management
Office of Nuclear Reactor Regulation

e-mail: pst@nrc.gov Tel.: 301-415-1451

CC: Chia-Fu Sheng

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From:	Peter Tam
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