From: Thomas Alexion
To: DAVANT, GUY H
Date: 7/31/03 9:46AM
Subject: **CORRECTED SUBJECT LINE - 2ND RAI - NOZZLE THREADS - ANO-2**

Guy,

Attached is a second RAI on the nozzle threads relaxation request. Note that this RAI only applies to ANO-2.

Tom

CC: BENNETT, STEVE A; N. Kaly Kalyanam

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Subject:	**CORRECTED SUBJECT LINE - 2ND RAI - NOZZLE THREADS - ANO-2**
Creation Date:	7/31/03 9:46AM
From:	Thomas Alexion
Created By:	TWA@nrc.gov

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Options	
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Second Request for Additional Information
Entergy Letter CNRO-2003-00020 on Nozzle Threads Relaxation Request
Arkansas Nuclear One, Unit 2

1. Provide the stress-strain curves for penetration tube, J-groove weld, and vessel head used in your finite element method (FEM) analysis; justify the applicability of these stress-strain curves to your CEDM nozzle assembly. Test data should be provided to justify the use of either an elastic-perfectly plastic model or a strain hardening model for the Alloy 600 nozzle material in your FEM analysis.

2. Describe the input loads (pressure, forces, imposed displacements, imposed temperature differences, imposed interference, etc.) that were used to generate the FEM stress results shown in Figures 5 to 11 of Enclosure 3. Details should be given regarding the generation of welding induced residual stresses and your consideration of the residual stresses in the through-wall axial flaw analysis.

3. The proposed alternative calls for UT examination of the CEDM nozzles from two inches above the J-groove weld to 1.544 inches above the bottom of the nozzle. However, in your fracture mechanics analysis described on page 37 of Enclosure 3, the flaw length is assumed to be 0.5 inch for the through-wall axial flaw. Since you have no information on the end portion (1.544 inches long) of the CEDM nozzles, the only indisputable assumption for a postulated axial flaw is a flaw of 1.544 inches long originated from the nozzle end. Revise your results using this indisputable assumption for the flaw. To reflect the assumption of an end flaw in the CEDM nozzle, you need to revise your stress intensity factors.

4. On page 42 of Enclosure 3, you reported that for ANO-2 the free-span nozzle length is 2.48 inches and the un-inspected length is 1.764 inches. Therefore, the available flaw growth length is 0.716 inch (2.48-1.764 inches). Please recall that the length of 1.764 inches was derived on page 14 of Enclosure 3 to reflect the difference of 0.22 inch between the free-span lengths from FEM model (2.70 inches) and ANO-2 measurement (2.48 inches). To calculate the available flaw growth length correctly, you should use either FEM model dimensions (2.7-1.764 inches) or actual dimensions (2.48-1.544 inches). Both would give you 0.936 inch. You may need this longer available flaw growth length to prepare your response to Question No. 3.

5. It is mentioned on pages 38 and 39 of Enclosure 3 that both pressure on flaw faces and the membrane stress have been considered for the through-wall flaw analysis. Describe the nature of this membrane stress (e.g., the "hoop stress" caused by internal and external pressure on the nozzle, or residual stresses).

6. The crack growth amplitude α of 2.67×10^{-12} that you used in the PWSCC growth rate equation is appropriate when all parameters are expressed in metric systems. However, it is suggested in Attachment 15 to Appendix II of Enclosure 5 that the metric system was used for the threshold stress intensity factor K_{th} (Mpa√m, page 4) in the calculation, while English systems were used for the stress intensity factor K (ksi√in, page 1), temperatures T and T_{ref} (°F, page 2), thermal activation energy Q_g (kcal/mole, page 2), and universal gas constant R (kcal/mole-°R, page 3). Provide one example showing the actual PWSCC growth rate calculation that was executed by using Mathcad.