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U. S. Nuclear Regulatory Commission
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Subject: Arkansas Nuclear One - Unit 2
Docket No. 50-368
License No. NPF-6
Additional Information Related to Proposed License Change For Cycle 14 Risk-Informed Operation (TAC NO. MA8418)

Gentlemen:

On March 9, 2000 (2CAN030003), Entergy Operations submitted a proposed license change to allow risk-informed operation for the remainder of the 14th operational cycle for Arkansas Nuclear One, Unit 2 (ANO-2). Supplemental information in support of the proposed change was submitted on April 11, 2000 (2CAN040005) April 28, 2000 (2CAN040006), May 30, 2000 (2CAN050011), June 20, 2000 (2CAN060015), June 22, 2000 (2CAN060017), June 23, 2000 (2CAN060012 and 2CAN060016), and June 30, 2000 (2CAN060018). Based on several additional interactions with the Staff concerning the proposed change, a discussion on the utilization of burst equations is attached.

Should you have questions concerning the information provided, please contact me.

Very truly yours,

Jimmy D. Vandergrift
Director, Nuclear Safety Assurance

JDV/jjd
attachment

A001

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Framatome Burst Equations Used to Estimate Burst for the ANO-2 Tubing

The following is the burst equation developed by Framatome that is referenced in the EPRI "Steam Generator Degradation Specific Management Flaw Handbook":

Equation 1: $P_B = \Phi * 0.58 (\sigma_\gamma + \sigma_u) t / R_i [1.104 - \{L / (L + 2t)\} h]$

where

Φ = 1.0 for OD cracking
$(\sigma_\gamma + \sigma_u)$ = Yield + Ultimate Material Stress (125,900 psi)
t = Tube wall thickness (0.048 inch)
R_i = Inside radius (0.327 inch)
L = Structural Length
h = Ratio of Degradation Depth to Tube Thickness

The variable value of 1.104 represents the mean value for calculating burst and is used in the deterministic evaluation.

The Aptech model used the following variation of the Framatome equation:

Equation 2: $P_B = \Phi * 0.58 (\sigma_\gamma + \sigma_u) t / R_i [1.0 - \{L / (L + 2t)\} h] + z$

The term z represents a modeling error added in the Aptech model based on pulled tube data. The median value of z is 1082 psi based on a beta distribution. This value was determined by calculating a burst pressure using equation 2 (with z = 0), and comparing them to the actual pulled tube burst pressures. The Aptech model calculated the burst pressures by sampling from the distribution of the modeling errors using the parameters specified above. The material property values were 134 ksi with a standard deviation of 5.27 ksi. The model randomly selected flow stress values using these values with a minimum of 123 ksi and a maximum of 155 ksi, which is a normal distribution. For each flaw, 1000 trials were performed and the mean value of the burst pressure for those 1000 trials was reported.

Correction:

On the previous table that was submitted that listed the burst pressures and calculated pressures based on the Framatome equation, the values for material properties were listed incorrectly. The 134 ksi value should have been designated as the operating temperature value and the 144.5 ksi should have been listed as the room temperature value.