

JUN 16 1977

MEMORANDUM FOR: E. G. Case, Acting Director  
Office of Nuclear Reactor Regulation

R. B. Minogue, Director  
Office of Standards Development

FROM: Saul Levine, Director  
Office of Nuclear Regulatory Research

SUBJECT: RESEARCH INFORMATION LETTER - 12, MODIFICATIONS TO  
PRESSURE VESSEL FAILURE PROBABILITY PREDICTION

This memorandum transmits the results of the modifications incorporated in the OCTAVIA computer code (Research Information Letter dated February 25, 1977) as discussed in meetings between RES and NRR and as referenced in the letter (Case to Levine, dated March 24, 1977). The modifications involve:

1. The capability to handle residual stresses. Coding was incorporated in OCTAVIA to handle residual stresses which can be a constant or can vary with flaw size.
2. An upper limit to be imposed on the toughness. Coding was incorporated to allow the user to impose an upper bound on the toughness.

and

3. The capability to handle uncertainties in the toughness. The OCTAVIA code was modified to calculate the 95% and 5% confidence bounds on the toughness as derived from the basic HSST data (ORNL-TM-4914). The best fit to the data was also updated based on regression analyses. The user also has the option of inputting his own confidence bounds or best fit.

The draft reports which are enclosed describe the above modifications and sensitivity studies which have been made on the effects of these modifications. The Surry 1 vessel has been re-evaluated with the modified versions of OCTAVIA and the median pressure vessel failure probabilities are shown in Tables 1 and 2. Table 1 is for a copper content of 0.25% which was used as the present copper content in Surry 1; Table 2 is for a reduced copper content of 0.1%. Figure 1 is a plot associated with Table 1.

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From Table 1, the median failure probability is  $5 \times 10^{-7}$  per vessel years for an operating temperature of  $110^\circ$  and the current age of Surry taken to be approximately 2.5 years; the failure probability increases to  $3 \times 10^{-5}$  per vessel year after 40 years. These numbers compare with  $6 \times 10^{-7}$  per vessel year for 2.5 years and  $3 \times 10^{-5}$  per vessel year after 40 years reported in the previous OCTAVIA Research Information Letter. Table 2 shows the 1 to 2 order of magnitude reduction in failure probability due to reduced copper content. The effect of copper content is similar to that in the previous OCTAVIA calculation. For the input data used, the modified OCTAVIA results generally agreed within a factor of 2 with the previous results from OCTAVIA.

Original Signed by  
Saul Levine

Saul Levine, Director  
Office of Nuclear Regulatory  
Research

Enclosures:

1. Calculation of Pressure Vessel Failure Probabilities for Surry 1
2. Sensitivity Studies on Residual Stress and Toughness Limits
3. The OCTAVIA Computer Code: PWR Reactor Pressure Vessel Failure Probabilities Due to Operationally Caused Pressure Transients

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Refers to RES MC#1277.

RECORD NOTE: \*See previous yellow for concurrence. 2nd page retyped in Dir. Off.

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