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U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

ATTENTION: MR. T. R. QUAY

SUBJECT: BASES FOR AP600 PCS DBA MASS TRANSFER CORRELATION BIASES

Dear Mr. Quay:

During the August 16, 1995, meeting between Westinghouse and the Containment Systems and Severe Accident Branch, Westinghouse took an action to provide a discussion on the bases for the mass transfer correlation biases used for the AP600 containment design basis analyses. Attachment 1 to this letter provides the requested bases.

The Westinghouse Electric Corporation copyright notice is also attached.

Please contact John C. Butler on (412) 374-5268 if you have any questions concerning this transmittal.

Brian A. McIntyre, Manager
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/nja

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Attachment to Westinghouse Letter NTD-NRC-95-4570

Bases for Mass Transfer Correlation Biases

The WGOTHIC evaluation model used to predict the AP600 containment pressure during design basis accidents is a bounding model. The initial conditions, boundary conditions, and dominant transport models in the code (condensation and evaporation mass transfer) bound the actual values in a way that biases the predicted pressure towards higher values. The subject of this report is to document the logic by which the mass transfer models were bounded.

The mass transfer correlations selected for use on AP600 were compared to data from both separate effects and integral effects tests in Reference 1. The data comparisons were presented in the form of predicted Sherwood numbers to measured Sherwood Numbers. (The Sherwood number is a dimensionless group based on the mass transfer coefficient, as defined in Reference 1). The comprisons show the correlations underpredicted the data with mean predicted-to-measured values of 0.936 for evaporation and 0.984 for condensation. Thus, the selected correlations exhibit an underprediction of the mean data.

The correlations can be further biased such that even the data points that are most over predicted with the nominal correlation are bounded, and the remainder of the data set is underpredicted. That is, the biased correlation bounds all the data. This can be expressed as:

$$C \frac{P}{M} \leq 1$$

where:

C is the bias factor

P is the predicted mass transfer coefficient value

M is the measured mass transfer value

Thus, the value for C can be determined from the most overpredicted data point as:

$$C \leq \frac{M}{P}$$

The evaporation test data are plotted in Figure 1 (Figure 4.2-1, Reference 1) and have a peak value of P/M = 1.191. Thus the value of the bias factor for the evaporating data is C = 0.840. By multiplying the evaporation mass transfer correlation by this factor, the correlation is made to be a bounding correlation.

The condensation test data are plotted in Figure 2 (Figure 4.3-3, Reference 1) and have a peak value of P/M = 1.491. This particular value lies somewhat above the bulk of the data and corresponds to a single elevation on the LST, while five other simultaneous measurements at different elevations in the same test produced lower P/M values. This peak value is considered anomolous. Consequently, the next highest value, P/M = 1.347 was selected for evaluating the bias factor. Thus the value of the bias factor for the evaporating data is C = 0.742. By multiplying the condensation mass transfer correlation by this factor, the correlation is made to be a bounding correlation.

References:

1. R. P. Ofstun, "Experimental Basis for the AP600 Containment Vessel Heat and Mass Transfer Correlations", WCAP-14326, March 31, 1995, Westinghouse Electric Corporation.

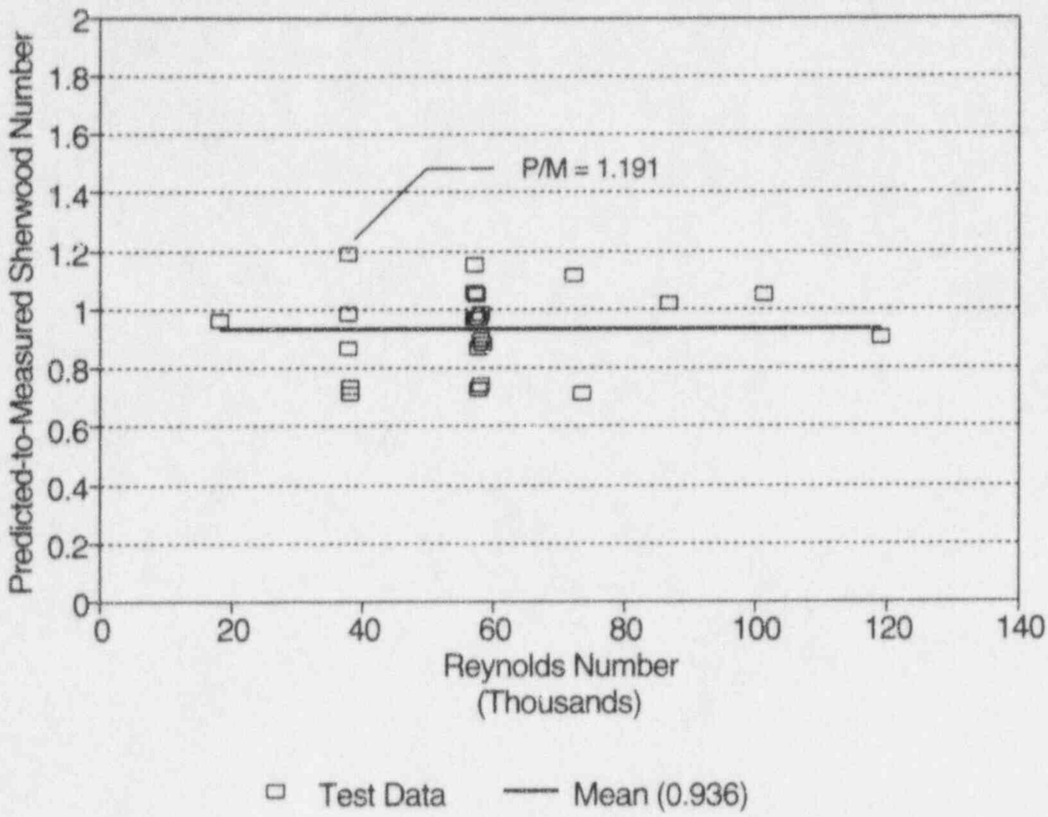

Figure 1 **Predicted-to-Measured Sherwood Numbers for Evaporation as a Function of the Reynolds Number (from Reference 1, Figure 4.2-1)**

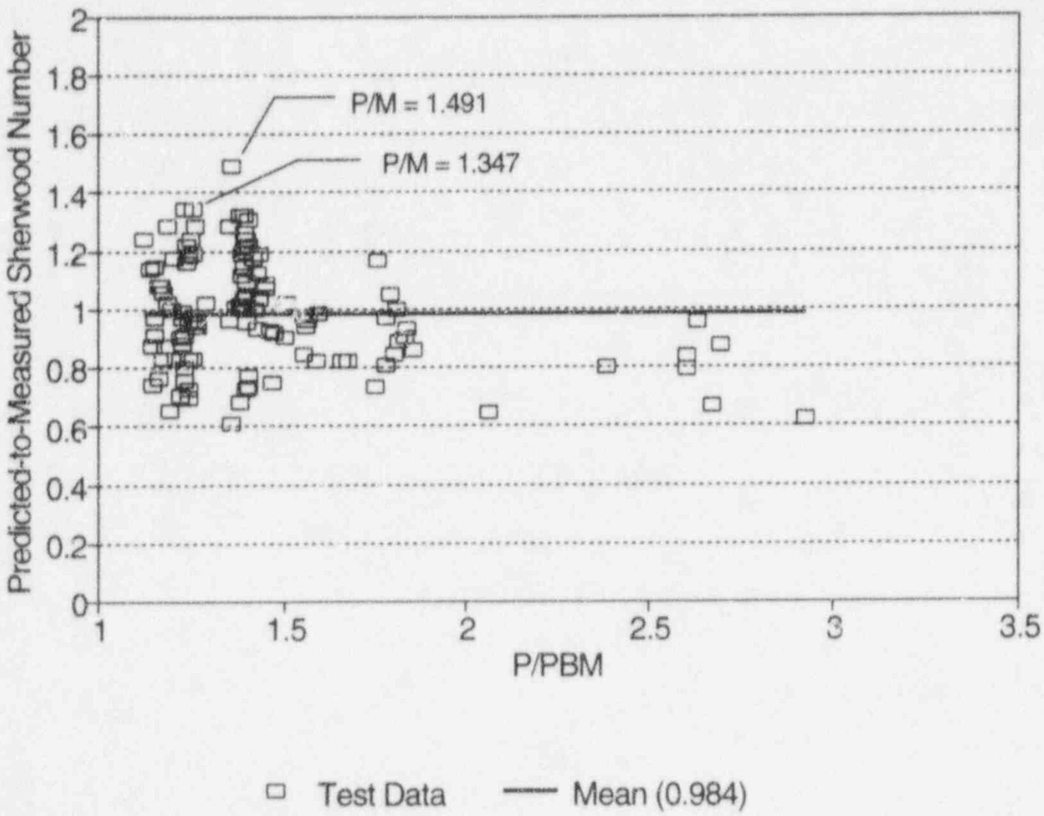

Figure 2 **Predicted-to-Measured Sherwood Numbers for Condensation as a Function of Dimensionless Pressure (from Reference 1, Figure 4.3-3)**