From: Lagally, Hermann O. [lagallho@westinghouse.com]
Sent: Tuesday, July 27, 2010 4:29 PM
To: Taylor, Robert; Murphy, Emmett; Karwoski, Kenneth; Johnson, Andrew
Cc: Lagally, Hermann O.
Subject: Model D5 Contact Pressure for Information
Attachments: D5 Contact Pressure Profiles.doc

Gentlemen:

Application of the square cell model has not yielded the expected results in regard to the SLB:NOP contact pressure ratio for the Model D5. As shown in the preliminary figures in the attached document, the NOP contact pressure exceeds the SLB contact pressure throughout most of the thickness of the tubesheet for all of the radii considered. There are local crossovers as shown on the figures that are typical of the other radii as well. Of note is that the contact pressures are higher than in the WCAP-17072-P for both operating conditions. It is also noted that contact pressure exists circumferentially completely around the tube and over the entire thickness of the tubesheet.

This, of course, raises the issue of the leakage model. The criterion applied, SLB:NOP>1, implies a relationship between loss coefficient and contact pressure, something we have discussed on several occasions. There are two approaches to leakage we are considering:

1. Assume that the loss coefficient is directly proportional to the contact pressure. If one works through the Darcy leakage model with this assumption, the leak rate ratio result is approximately a ratio of viscosity at the respective operating temperatures. The salient factors are the Δp ratio, the viscosity ratio and the contact pressure ratio. This appears to us to be a reasonable assumption because the absolute contact pressures at SLB and NOP conditions are not very much different. Physically it is difficult to imagine that a knee in the loss coefficient vs. contact pressure relationship exists at this local point in the range of contact pressures. Based on our discussions at ANL, I believe we all would expect such a knee to exist in the curve at much higher pressures and/or temperatures as would be expected for severe accidents.
2. An effective flow area can be calculated from our leak rate tests based on a parallel plate flow model. This model is very similar to the Darcy model. It is possible to calculate the flow areas (actually, average gap between tube and collar) required to match the measured leakage for each test specimen at its test condition. If one calculates the contact pressures for the test specimens using the same FEA model used to investigate the slice model issues (no sleeve, only tube in tubesheet collar with the actual test specimen dimensions), it is possible to correlate the contact pressure with the gap size for each test specimen. A good correlation is achieved. Using the correlation between contact pressure and flow area (gap), it is possible to calculate leak rates for both NOP and SLB using the predicted contact pressure as shown on the attached preliminary figures and the leak rate ratio can be developed. This approach was previously included in the cold leg W* submittal for Sequoyah.

This is provided for your information and to support potential discussion during the industry telephone conference scheduled for July 29, 2010.

Regards,

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