From: Mahesh Chawla
To: Dale Vincent
Date: 3/17/05 3:13PM
Subject: RAI - "DEVELOPMENT AND QUAL. OF A GOTHIC CONTAINMENT EVAL. MODEL FOR THE PINGP" -WCAP-16219-P (APRIL 2004) TAC NOS: MC4245/ MC4246

To complete the review, the staff has identified, in part, the need for additional information related to the information presented in WCAP-16219-P, "Development and Qualification of a GOTHIC Containment Evaluation Model for the Prairie Island Nuclear Generating Plants," April 2004. Please arrange a telephone conference to discuss the following:

(1) A fog or mist has been observed in the vapor-air boundary layer between a cool surface and a heated bulk air-steam mixture. This mist can contribute to an increase in the sensible heat transfer through the vapor-air boundary layer and, in the GOTHIC model, the diffusion of the mist into the bulk atmosphere can result in a decrease in the containment pressure due to evaporation of the mist.

Although the formation of mist has been observed, for example Mori and Hijikata **(Ref.1)**, its effect on containment pressure and temperature has not been measured. The staff is not aware of any known direct measurements of the formation rate of the mist or of its impact on the heat transfer rate to the surface. In addition, the staff is not aware of any data demonstrating the effect of mist in the vapor-air boundary layer on bulk atmosphere pressure. The GOTHIC 7.0 qualification report **(Ref. 2)**, Section 5.10, discusses verification of this model in terms of comparison with experimental data. However, other codes have compared well with these same data without including this effect. In particular, the NRC CONTAIN 2.0 **(Ref.3)** code compares well with these data. Thus, while mist or fog in the vapor-air boundary layer has been observed under certain circumstances, the quantification of its effect is considered uncertain and not verified to the extent required for a phenomenon with a significant effect on licensing calculations. The staff therefore believes that the mist formation model should not be used for licensing calculations. (See for example, ADAMS accession document ML032681050, September 29, 2003 letter "Kewaunee Nuclear Power Plant - Issuance of Amendment (TAC No. MB6408)", to T. Coutu, Kewaunee Nuclear Power Plant, Nuclear Management Company, LLC, from A.C. McMurtray, NRC.)

Based on a review of the input decks presented in WCAP-16219-P, is appears that NMC proposed to use this mist formation model (and not to use the fog model), in part based on sample calculations presented with the mist formation model active.

For the staff to reconsider the use of the mist formation model for licensing calculations, NMC needs to provided additional information demonstrating that the rate of the formation of the mist and its impact on the bulk containment atmosphere are known and can be quantified. Absent additional information, the staff's previous conclusion that the mist formation model should not be used for licensing calculations will be applied to WCAP-16219-P.

(2) The benchmark case for the main steam line break (MSLB) comparison to the CONTEMPT code uses the approved Uchida model for heat transfer and the approved 8% revaporization. NMC is requesting use of the mist diffusion layer model (MDLM) **(Ref.4)**, with NRC limitations — the diffusion layer model (DLM), as an alternative to the Uchida model with revaporization, for steam line breaks.

For the MSLB licensing evaluation, does NMC plan to use both the accepted DLM model and the 8% revaporization at the same time? (WCAP-16219, Table 3-1 indicates the revaporization fraction is "N/A" for GOTHIC, however the input decks indicate a "default" is being used.) If so, NMC needs to justify the independence of the phenomena in the DLM model and the revaporization fraction used to account for the difference observed in an early containment test facility and the ability of containment codes to predict the experimental results.

(3) The staff would like NMC to provide, in electronic format (CD-ROM, 3.5-in floppy disk), the GOTHIC input models (the *.GTH files) used in WCAP-16219. This would enable the staff to perform its own sensitivity studies and assist us in better understanding GOTHIC.

References:

1. Yasuo Mori and Kunjo Hijikata, "Free Convective Condensation Heat transfer With Noncondensable Gas on a Vertical Surface," Int. J. Heat and Mass Transfer Vol 16 pp 2229-2240

2. GOTHIC Containment Analysis Package Qualification Report Version 7.0 NAI 8907-09 Revision 6 July 2001July

3. Murata, K.K., et al., "Code Manual for CONTAIN 2.0: A Computer Code for Nuclear Reactor Containment Analysis," US NRC NUREG/CR-6533

4.The NRC acceptable form of the mist diffusion layer model (MDLM) is now referred to as the diffusion layer model (DLM) in GOTHIC 7.1 Patch1 (QA), the original MDLM without the boundary layer mist formulation and without the film roughness enhancement.

CC: Edward Throm

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