



UNITED STATES  
NUCLEAR REGULATORY COMMISSION  
WASHINGTON, D. C. 20555

OCT 31 1979

MEMORANDUM FOR: S. Varga, Acting Assistant Director for Light Water Reactors, DPM

FROM: R. P. Denise, Acting Assistant Director for Reactor Safety, DSS

SUBJECT: BOARD NOTIFICATION: RUPTURE STRAIN AND FLOW BLOCKAGE MODELS IN PWR LOCA CALCULATIONS

Reference: 1.) Memo to D. B. Vassallo, from R. L. Tedesco, Board Notification: Combustion Engineering Rupture Strain Model in LOCA Calculations, dated February 14, 1979.

2.) Letter to D. F. Ross, Jr., from A. E. Scherer, dated September 18, 1978

The NRC staff has determined that parts of the approved ECCS evaluation models, for all light water reactors, relating to cladding rupture temperature, strain, and flow blockage might, in general, be non-conservative and therefore, might not be in compliance with Appendix K of 10 CFR 50. Section IB of Appendix K states: "To be acceptable the swelling and rupture calculations shall be based on applicable data in such a way that the degree of swelling and incidence of rupture are not underestimated". This matter has been the subject of a previous recommendation of a board notification (Ref. 1) for the Combustion Engineering ECCS model. The staff has recently reviewed all vendor models and compared them to applicable data from ongoing research programs, including the recent Oak Ridge National Laboratory multi-rod burst tests (MRBT). Our evaluation of this information shows that the other models may also not meet the requirements of Section I.B of Appendix K. In accordance with the requirements of NRR Office Letter No. 19, the following information is provided:

1. The Item for Notification

The staff has again reviewed the rupture temperature, strain, and flow blockage components of the various ECCS evaluation models and compared these models to the available data, including the well-characterized recent (MRBT) tests at Oak Ridge. Our evaluation indicates that these components of the various ECCS models may lead to an underestimation

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of the degree of swelling and incidence of rupture in significant portions of the cladding temperature range encountered in LOCA analysis. In particular, rupture strain appears to be underpredicted in all PWR models in the low temperature alpha phase of Zircaloy. Since the rupture, strain, and blockage curves of the models underpredict the data in some areas, these portions of the ECCS models might not be conservative and might not be in compliance with Appendix K of 10 CFR 50 which prohibits underestimation of cladding swelling and incidence of rupture.

We have concluded that it is necessary to seek additional information from licensees and their vendors to determine if these models remain acceptable. Therefore, appropriate licensing boards should be notified of our concern and plans for action.

## 2. Relevance and Materiality

This item is relevant to all LOCA calculations performed in accordance with the CE, Westinghouse, B&W, GE and EXXON evaluation models. Because of the way in which this subject is handled in BWR models, the staff has not yet determined the extent of the problem for those reactors. Studies done in the past for BWR's show that the results are not as sensitive as PWR's to these models. Also parts of the BWR data base are different, and need to be examined in view of their application.

## 3. Significance

The most significant information developed since the issuance of Reference 1 was the recent MRBT results, and the staff assessment of all available data. Previously we expected that relatively small compensating model changes such as those proposed in Reference 2 could off-set the penalty associated with increasing strains and blockages. Evaluation of the new data, which fill in some missing gaps, allowed significant improvement in the understanding of the entire relevant data base. As a result, it is likely that higher strains and/or blockages should be calculated for all the PWR models. Preliminary staff estimations based on sensitivity calculations indicated that the minor model changes previously considered may not be sufficient to compensate for the larger penalties consistent with the new data. However, case specific calculations by applicants and licensees using their applicable evaluation models will be required to determine the effect of the new data on the capability of individual plants to meet the peak cladding temperature requirements of 10 CFR 50.46. We are in the process of preparing more detailed technical information for the applicants and licensees to evaluate and to further assess the significance. We expect to send this information to the applicants, licensees, and appropriate hearing boards and other interested parties in early November.

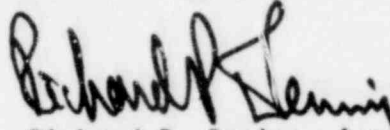
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4. Relation to Projects

This relates to all LOCA calculations performed with the GE, CE, Westinghouse, B&W and EXXON LWR evaluation models. Also, any models derived from these models or the NRC "WREM" model may be affected.

I recommend that appropriate boards be informed of this concern and our plans to follow up with technical discussions with all parties concerned.



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