OAK RIDGE NATIONAL LABORATORY
OPERATED BY MARTIN MARIETTA ENERGY SYSTEMS, INC.

POST OFFICE BOX X
OAK RIDGE, TENNESSEE 37831

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E. G. Arndt
Mail Stop NL-1130SS
Mechanical/Structural Engineering Branch
Division of Engineering Technology
Office of Nuclear Regulatory Research
U. S. Nuclear Regulatory Commission
Washington, D. C. 20555

Dear Gunter:

Letter Report, "Evaluation of a Containment Leak Rate Prediction Methodology"

As part of the "Containment Leak Test Sensitivity Study," a potential approach to the task of predicting the containment leak rate between test intervals was evaluated. The initial approach towards a predictive methodology for the post-testing leak rate was to model the various sources of potential leaks as a continuous time Markov process. For many of the components involved, such as gaskets, etc., such a model would entail estimating the deterioration rate of the specific "wearable" components and utilizing such data to generate the transition rates required by the Markov model. These data could then be used to project the estimated leak rate attributable to each component. The actual as-left Type B and C test data would provide the appropriate normalization for each component contribution. In addition to the leakage attributable to each component, an "unattributable" leakage rate would be postulated to account for this contribution. This value would be derived from successive Type A tests, to obtain both a deterioration rate as well as the current normalization for this component. The sum of all the contributors could then be utilized to predict the total "containment leak rate" for the period subsequent to the last Type A test. Whenever a Type B or C test was performed the data obtained would be utilized to renormalize that component and hence update the overall model. Additionally, it was envisioned that additional potential leak paths that result from either non-deteriorating components which fail catastrophically or catastrophic failure modes of components subject to deterioration could also be included in the model using standard time-dependent failure distributions.

In order to determine the feasibility of such a predictive approach, a review of the available Type A, B, and C leak rate test data was performed with a specific view towards the adequacy for use in such a methodology. In general, it was found that the existing data base is insufficient to support such a predictive methodology. In particular, the most important data inadequacies are in the omission of the as-found test results (necessary to estimate the various deterioration rates required by the methodology), or the omission of the as-left data following repair or replacement (required for the renormalization). In this latter case, the data base may not be available simply due to the fact that no post-repair/replacement test was done since an overall Type A test was to be performed subsequent to the individual component tests. The attached report summarizes the difficulties perceived relative to the data availability necessary to support the proposed methodology.

As indicated in the attached report, certain specific data are required by the proposed methodology regardless of the particular type of containment being evaluated. In particular, even if a single limiting leakage criteria sshould be established for various types of containments, the wide disparity in the types of leakage-relevant components present will require a separate evaluation for each containment.

As a final point, the adequacy of the current 0.25 L_A safety margin to provide a reasonable assurance that actual leakage does not exceed the design value (i.e., 1.0 L_A) was not explicitly addressed by this study. In particular, the difficulty inherent in predicting the actual leak rate behavior between tests precludes any judgement of the adequacy of the current safety margin on an absolute basis. However, based on the results of the Containment Leak Rate Sensitivity Study (NUREG/CR-3539, ORNL/TM-8964), it can be inferred that even if the current margin of 0.25 L_A is not met, small deviations will have a minimal impact on the overall LWR accident risk. It should be emphasized that this insensitivity was determined only with regard to the effect of leak rate variations in relatively severe LWR accient scenarios, and hence this conclusion does not necessarily apply to normal operations.

Please call either myself (FTS: 624-6101) or George Flanagan (FTS: 624-6155) if you have any questions concerning this material. I have also attached another short document to this letter for your information.

Sincerely yours,

T. J. B.

T. J. Burns
Engineering Physics & Mathematics Division

TJB:slr
Attachment

cc: G. F. Flanagan