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PROPOSED METHOD FOR REVIEW OF MARK I, II, AND III POOL DYNAMIC LOADS

In our memos to you of February 25, 1975, April 10, 1975, and April 11, 1975, we provided standard letters concerning pool dynamic loads and relief valve loads. This information has either been sent or will be sent to all applicants/licensees for plants with Mark I, II, and III containments. Recognizing that several RP and TR branches will be involved in the review of these responses from each of the applicants and licensees, and the complex nature of the problem, we have prepared the following recommended procedures to effect these reviews in an efficient manner:

1. We would suggest that one LPM be designated to coordinate the DRL effort for pool dynamic and relief valve load reviews and to facilitate and provide efficient contact between DTR and DRL. Each of the TR branches will have a corresponding designee:

   CSB - R. Cudlin, Pool Dynamics; L. Slegers, Relief Valve Loads
   MEB - S. Hou
   SEB - A. Gluckmann

2. The review of each response should be initiated by a TAR from DRL to DTR and should include SEB, MEB, and CSB.

3. Any additional information requests from MEB, SEB, or CSB should be sent to DRL individually.

4. The final evaluation for each plant will be coordinated by CSB.

5. The following review functions and interfaces will be performed by the designated TR branches:

   a. CSB Review Functions

      (1) CSB will identify those containment structures, piping and components which could be subject to pool dynamic loads.

      (2) CSB will evaluate and determine the acceptability of the selection, quantification, and combination of pool dynamic loads specified for each of the structures, piping and components. This evaluation will be based on appropriate

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experimental data and analyses and the relative magnitude of the pool dynamic load compared to the design basis load for each of the structures, piping, and components.

(3) CSB will evaluate the potential for asymmetric load profiles due to pool dynamic phenomena.

(4) CSB will evaluate the applicant's response to the ACRS' concerns; i.e., that additional analytical models be developed for pressure suppression phenomena to supplement test data.

b. SEB Review Functions

(1) SEB will verify the applicant's determination of the relative magnitudes of pool dynamic loads compared to design basis loads for those structures subject to pool dynamic loads.

(2) SEB will verify that the combinations and values of pool dynamic loads that are approved by CSB have been correctly factored into the structural load combination equations for each structure. SEB will determine the requirement for application of dynamic load factors to the pool dynamic load values.

(3) SEB will evaluate the capability of the affected containment structures to tolerate asymmetric loading profiles.

(4) SEB will conclude as to the adequacy of the structural design of each of the structures which could be subject to pool dynamic loads.

c. MEB Review Functions

MEB will perform functions (1), (2) and (4), as described for SEB as related to piping and components which could be subject to pool dynamic loads.

We would be happy to discuss our recommendations with you.

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R. Cudlin
L. Slegers

POOL DYNAMIC LOADS

Recent developments have indicated that pool dynamic loads may not have been fully considered in the structural design of BWR plants utilizing Mark I and Mark II type containments. In response to this situation we have sent letters to all licensees/applicants for these types of plants requesting that they report on the potential magnitudes of pool dynamic loads and the structural capability of their suppression chamber design to tolerate such loads. We have requested that they provide this information within 60 days and to notify us within 15 days as to their ability or inability to meet such a schedule. We have established an interim time period for assessment of each plant based on our conclusion that pool dynamic loads do not represent an immediate safety concern for Mark I operating plants. This conclusion was reached on the basis of the information provided below which describes the background and current status of our understanding of the problem.

In March of 1974 GE performed a series of "air tests" to scope the range and magnitude of pool dynamic loads for the Mark III design. It was recognized that more definitive tests were required and therefore comprehensive tests in 1/3 scale were initiated in the summer of 1974 and are currently still in progress. Parallel efforts to develop analytical methods for the various pool dynamic phenomena have been undertaken by GE, the NRC's consultants, and by several A/E's.

We have maintained periodic contact with GE regarding the planning and progress of pool dynamics testing and associated analyses. Although the emphasis has been placed on resolution of these concerns for the Mark III design, our discussions with GE have noted that parallel efforts should be directed at evaluation of the Mark I and II containment designs.

In their letters of April 9 and 15, 1975 (A. P. Bray to E. G. Case), and in a meeting on April 10, 1975, GE provided a summary of their actions in this regard. GE has performed a preliminary generic evaluation of pool swell loads for a typical internal structure arrangement of a Mark I containment torus (see figure 1). The structural response analysis was based on pool swell loads extrapolated from Mark III test data, which is currently the only available data base. The resultant load profile, as shown in figure 2, is a pressure pulse of approximately 40 psi and a duration of about 60 milliseconds. Some of the assumptions that GE used to arrive at this profile are listed in the attached figure 3.

Although the pool swell loads have been derived from Mark III data, differences in the Mark I design suggest that the loads are conservative. These are the small free air volumes of the torus and the lower submergence of the vent piping, compared to Mark III plants. The Humboldt and Bodega Bay tests had shown dramatically reduced pool motion with the suppression chamber closed (as during plant operation) as with it open. It is thought that this was the result of air compression effects dampening the pool swell phenomena. The Mark III test program has shown that the range and magnitude of pool swell effects are directly proportional to the

submergence of the vents. The vent submergence for Mark I plants is four feet compared to a value of 7-1/2 feet for Mark III. Therefore, extrapolation of Mark III data, which is representative of deep submergences and a large (open) suppression chamber, to the Mark I design would indicate a degree of conservatism.

The results of the structural analysis showed that some local yielding of the vent header support structures could occur; however, structural failure was not predicted.

MORE DETAIL BY SEB

GE also noted that the Mark I configuration was tested in full scale during the Humboldt and Bodega Bay tests performed between 1958 and 1965, and that the results of these tests verified the adequacy of the primary containment boundary.

Recognizing that the GE analysis is preliminary and that we have not reviewed it in detail, this analysis still represents our best estimate of the problem at this time. We believe the conclusions expressed by GE to be reasonable and therefore acceptable on an interim basis. Although we cannot fully concur with GE that the Humboldt and Bodega Bay tests demonstrated the adequacy of the Mark I structural design, since specific measurements of pool dynamic loads do not appear to have been made, the tests do provide additional confidence that a severe design deficiency does not exist.

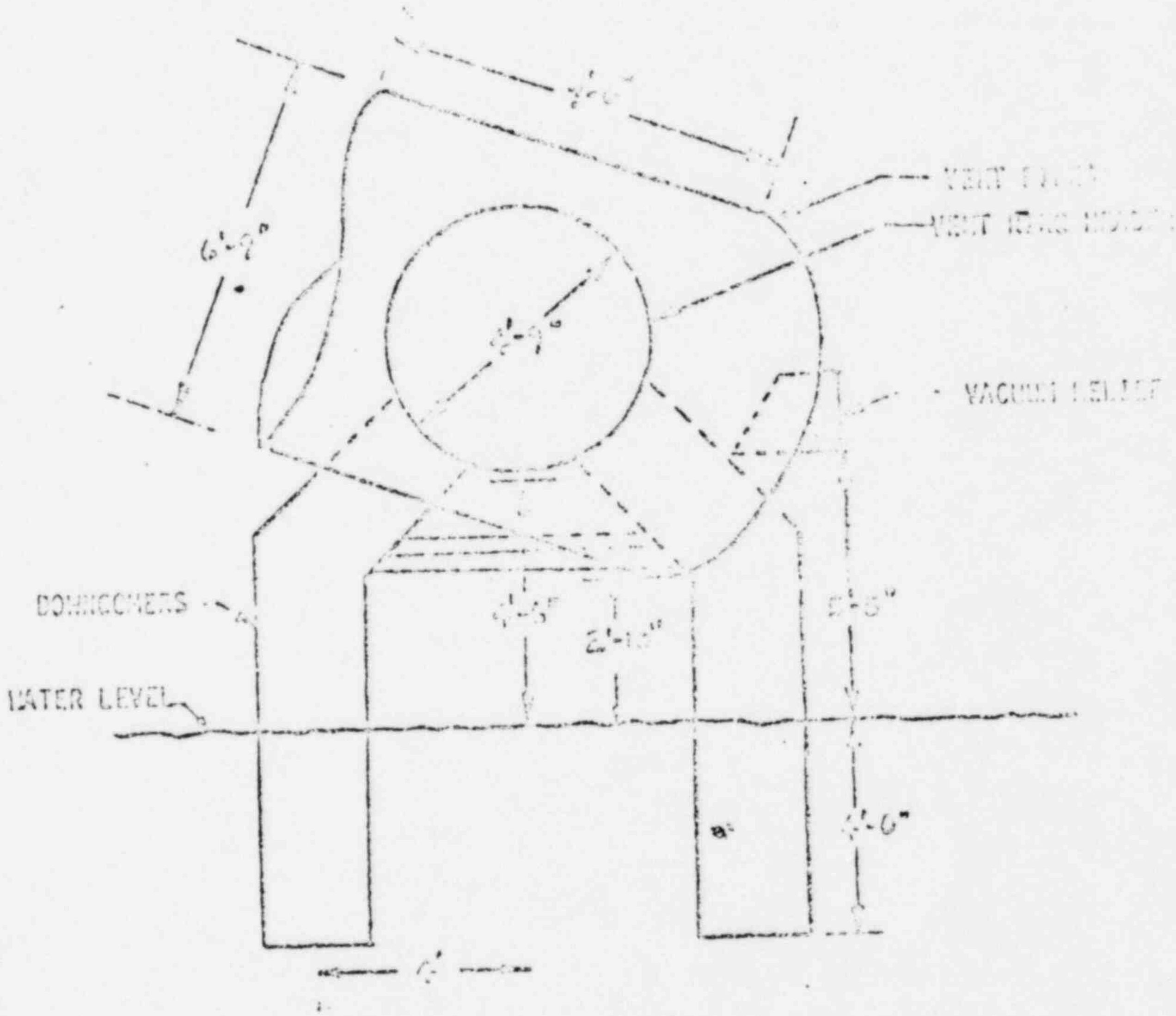
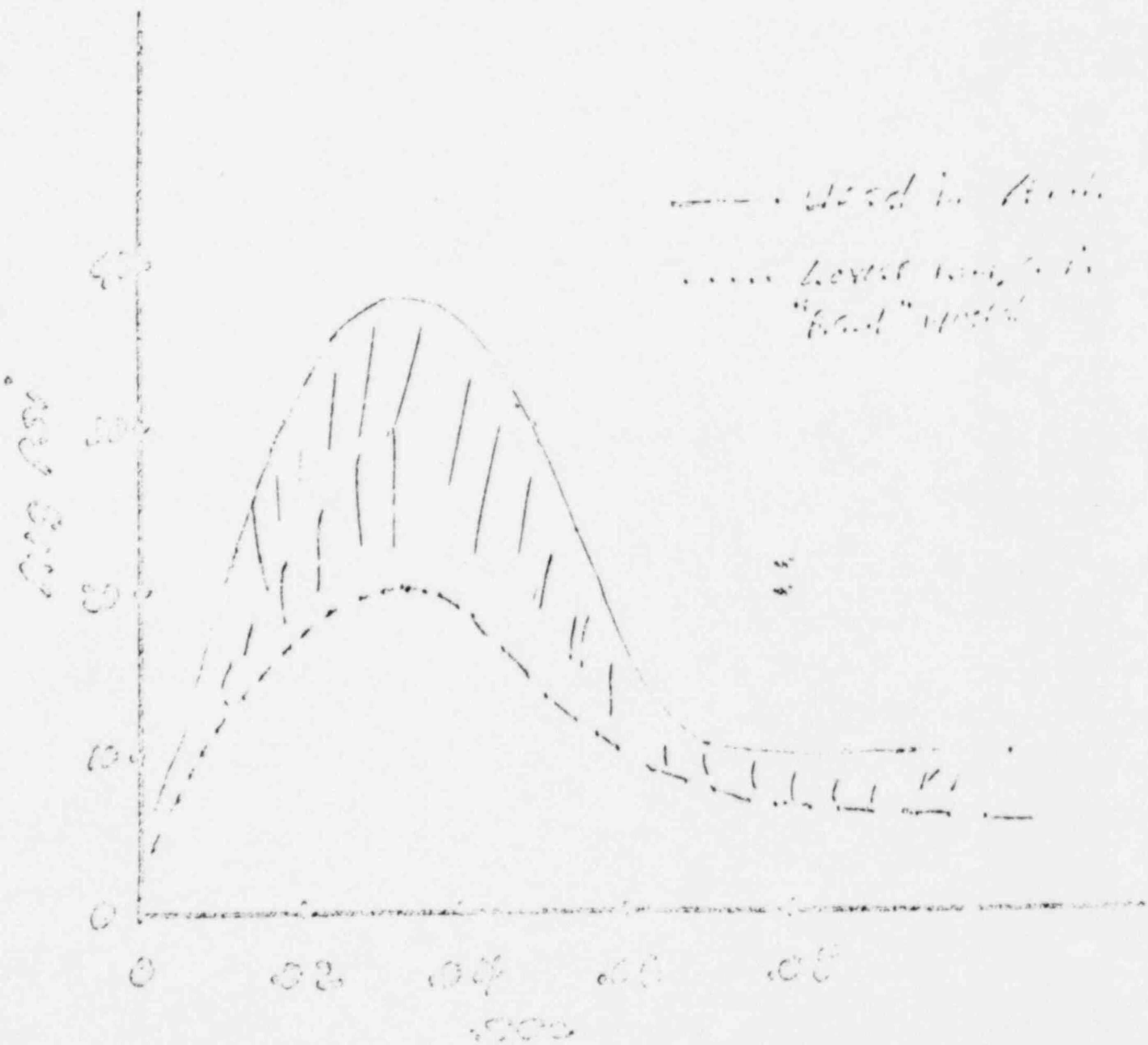


FIGURE 6. MARK I TYPICAL VENT SYSTEM (BROWNS FERRY)



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MARK I HEADER LOAD CONSERVATISMS

BOUNDARY CONDITIONS

ASSUMED ALL AIR CARRY OVER

USED BREAKTHROUGH HEIGHT OF 2 X SUBMERGENCE
BODEGA INDICATED 1.5 X

USED INFINITE OCEAN (SOLID WATER)

1-2' LIGAMENT EXPECTED AT HEADER ELEVATION
PEAK DW PRESSURE CONSERVATISMS

MODEL

CALCULATED LOAD IS 20% HIGHER THAN MEASURED (USING TEST BOUNDARY CONDITIONS)

CONCLUSION: TOTAL CONSERVATISM MAY BE AS HIGH AS FACTOR OF TWO

DAR 4.9.75