FLUID STRUCTURE INTERACTION EFFECTS ON SRV LOADINGS FOR
THE MARK I CONTAINMENT

Lawrence Livermore Laboratory performed several sets of analyses for the Engineering Branch to study the effects of torus wall flexibility on ramshead SRV loadings in the Mark I containment. These studies included both two and three dimensional fluid structure coupled models. The results showed that for the bubble pressure loads used as input, increased torus wall flexibility reduced the applied pressure at the torus wall with larger reductions seen in the two dimensional model.

Further studies by Livermore were performed using simulated t-quencher loadings developed by the Containment Systems Branch. The results of this study were similar to the previous results showing decreased wall pressure loadings with increased wall flexibility. Torus shell maximum deflections provided by Livermore for the different pulse durations showed increased deflections for increased pulse durations. Based on these results we have concluded the fundamental frequency of the Livermore model is low compared to the input pulse and the response is governed by the impulse. Since the effect of the fluid is an added inertia to the structure, the Livermore results are showing that for input pulses of short duration compared to the system fundamental frequency the fluid inertia can significantly reduce the pressure felt by the wall.

A comparison of the Livermore results for the extended FSI study to the results of the in plant t-quencher tests at Monticello shows the Livermore results over predict the observed displacements by an order of magnitude indicating the Livermore model is far more flexible than the actual torus. This fact was pointed out in the Livermore report for the two dimensional model. Since the Monticello test results measured a bubble frequency of approximately 6-7 Hz when the peak shell pressure occurred and a predominant free shell vibration frequency of about 16 Hz, the maximum response at Monticello should be approximately equal to the response to a statically applied pressure. From the Bechtel torus shell analysis for a pressure equal to 6.7 psi the maximum shell deflection should be about .02". Based on the results from Monticello, the estimated shell deflections were .013 to 0.18 inches which corresponds to the Bechtel calculated static deflection.

The conclusion based on the test results at Monticello is that the FSI effects were not significant in reducing the applied wall pressure. However, the results of the Livermore analysis demonstrate the FSI effects become important for structures loaded with dynamic loadings that have short durations compared to the structural natural frequency.

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