VALIDATION OF EXPLOSION CONTAINMENT CODES: ANALYSIS OF BARE RIGID MODELS IN THE COVA PROGRAMME

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SUMMARY

The UKAEA and the JRC Ispra are engaged in a collaborative experimental and theoretical programme for the development and validation of explosion containment codes. The experiments are well instrumented tests aimed at providing high quality data on stresses, strains and loads occurring when a well-characterized energy source is located within a containment vessel partially filled with water. The data are presently being used to validate Lagrangian and Eulerian finite difference codes, the purpose of this being to demonstrate

— that the assumptions made in the numerical formulation of the physical equations are adequate,
— that the properties of materials and components are correctly chosen.

In this paper the results concerning the validation of hydrodynamics in simple bare charge experiments are discussed. The tests were performed with cylindrical rigid bare containments having the scaled dimensions of a pool and loop type LMFBR in which two types of energy sources namely the high explosive "Composition B" and a low density explosive specially developed by UKAEA, were fired. Two cover gas volumes were investigated for each tank dimension. Numerical results have been obtained with the finite difference explicit Lagrangian codes ARES (INTERATOM), ASTARTE (UKAEA) and REXCO-H Release 2 (from ANL and modified by JRC Ispra) as well as with the finite difference Eulerian code SEURBNUK being jointly developed by UKAEA and JRC Ispra.

Experimental and numerical results are compared on pressure and impulse histories at twenty points located on the vessel bottom, wall and roof. Pressure wave arrival times are also considered with special emphasis on roof impact times. The heights of the sharp pressure peaks were not considered in this evaluation because experimental results are affected by the limited frequency response of the recording equipment and numerical values are strongly influenced by the choice of the mesh-size and numerical damping parameters. This omission is justified by the fact that containment loading from a pressure peak is much more dependent on its time-integral than on the value of the peak pressure.

The pressure and impulse time curves obtained from the experiments are compared with those from calculations. On the floor and walls of the tank it is shown that in general there is a good qualitative agreement on the pressure records. For these records quantitative comparisons have been made of the impulse values separating out the effect of the various waves wherever possible. Agreement is reasonable at all positions except close to the axis on the floor where there appear to be significant differences in the impulse magnitude of the reflected waves. Reasons for these differences are discussed.

On the roof the computed pressure records are significantly spikier than the experimental ones though in many cases the impulse values are in good agreement with the experimental ones. In addition to any effect arising from the discrete distribution of mass imposed by the finite difference schemes used in the various computer codes a further possible reason for the nature of the calculated roof pressure records is the inadequacies of modelling the constitutive relation for water in a cavitated state. Preliminary studies have been done using more sophisticated models than those used in the original calculations. These models are described and results obtained after incorporation of these models in the various codes are presented.