ASSESSMENT OF FLUID LOSSES THROUGH TRS TOP VENTS ON SIMULATED BLAST WAVES IN BLAST SIMULATORS

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The simulation of both thermal and blast effects of nuclear explosions in large blast simulators involves the installation of one or more thermal radiation sources (TRSs) in the simulator channel, just ahead of the test
object. Each TRS unity may consume up to 5 kg/m3 of aluminum powder and 5 kg/m3 of liquid oxygen per second, and the resultant hot reaction products should be removed from the test channel before the simulated blast wave arrives at the test section, or the large accumulation of the hot reaction products will adversely affect the simulated wave profile. Reaction product removal is usually accomplished by means of openings or ports in the top of the channel, and these ports are normally equipped with ejectors to enhance the removal performance. If these ports are left open during the passage of the simulated blast wave, then some Mass momentum and energy are lost from the main channel flow, and the quality of the blast simulation can be degraded. These losses and their effects on the quality of simulation are studied numerically and presented in this paper.

A two-dimensional quasi-steady model for Mass, momentum and energy losses through ports in the channel walls by means of jets with angular and contraction effects is formulated. This model is incorporated as a subunit in the random-choice method (RCM) for solving one-dimensional unsteady flows.

The RCM is then used to predict flows in a large blast simulator which produces a decaying wave profile having both positive and negative phases. Computations are compared for the two cases with and without flow losses through side ports, to highlight the differences. The change in positivephase overpressure impulse is also determined, because it provides a quantitative measure of the effects of Mass, momentum and energy losses through the ports. These comparisons are performed for a number of different total port area settings from relatively small to large, and the degradation in quality of the simulation is discussed.