LIMITATIONS ON THE APPLICABILITY OF HIGH-EXPLOSIVE CHARGES FOR SIMULATING NUCLEAR AIRBLAST

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The flow fields that result form nuclear and high explosive (HE) detonations are qualitatively alike but quantitatively different. Consequently, care must be exercised in carrying over conclusions drawn from measurements of HE tests to nuclear explosions. The usefulness of HE explosions for simulating nuclear airblast is predicated on the fact that after reaching ca. 5-6 times the initial radius the flow-filed looks like that produced by a point source and produces shock overpressures similar to those in the nuclear case. Numerical simulations of airblast phenomena have been carried out using one- and two-fluid Flux-Corrected Transport hydrocodes in one and two dimensions. The principal differences in the free-field solutions are the presence in the HE case of contact discontinuity between air and HE products and of backward-facing shock behind it.

Temperatures in the nuclear fireball are initially three orders of magnitude higher; correspondingly, the density minimum at the center of the fireball is much broader and deeper. When the blast wave in a nuclear
height-of-burst (HOB) situation undergoes regular reflection from the ground only one peak develops in the overpressure, and the reflected wave propagates upward rapidly through the hot underdense fireball. In the HE case part of the upward-moving reflected wave is reflected downward at the contact surface, producing a second pressure peak on the ground, while the shock transmitted through the contact surface propagates slowly upward.

After transition to Mach reflection other differences appear. At late times following shock breakaway the nuclear fireball, unlike the HE along its lower edge below HOB. The vortices (both forward and reverse) are stronger and form earlier. This has important consequences for fireball rises and for dust entrainment and transport to high altitudes.