NUCLEAR DUST CLOUD SIMULATION

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A concept for simulating nuclear fireball rise and dust cloud formation is under development at the Weapons Laboratory to provide a capability for testing the effects of dust clouds on the survivâbility/vulnerability of military systems. In this paper the simulation concept is described, the modifications to the CLOUD code used in studying nuclear fireball rise and dust cloud formation (as well as simulation design) are discussed, and we present the results of calculations and small-scale simulation experiments.

Our approach to the simulation of the fireball rise and dust cloud formation at nuclear event is to replicate the important initial conditions of dust pedestal, low-density fireball, equilibrium pressure, and near-zero velocity field that exist in an actual nuclear event a few seconds after detonation. To first order, if the initial conditions are replicated correctly, then the resulting flow fields should also be correctly repli-
cated. These initial conditions will be established by explosively launching a prepared soil bed into the air to simulate the dust pedestal and then a large helium bubble to simulate the fireball region.
The primary non-simulation effect of this concept is that in the nuclear case, fireball cooling through radiation and mixing results in high altitude stabilization of the dust cloud while in the simulation, there is no equivalent mechanism for dissipating buoyancy. The result may be that stabilization does not occur. The results of calculations conducted to specifically address this issue are presented.

Physical effects modeled in CLOUD include buoyancy, moist thermodynamics, decoupled dust, and turbulence. Modifications to CLOUD to permit its use as our primary calculation tool include adding a multimaterial capability, an improved flow computing algorithm suitable for strong density discontinuities, and improved dust modeling which provides conserved momentum and heat transfer between phases.