BLASTWAVE DUSTY BOUNDARY LAYER MODELING

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Uncertainties in nuclear blast wave effects in the low to moderate overpressure regime center largely on the precursed shock flowfield attendant to non-ideal airblast (NIAB). Of particular interest for NIAB flows are the complex fluid/surface interaction phenomena related to dusty boundary layer processes. Such processes are dominated by turbulent mixing and by 2 phase flow interaction effects.
The entrainment of soil into the blast wave boundary layer flow is recognized as an important and complicated phenomenon controlled by the interfacial forces exchanged between the air and ground. the state-of-the art of fluid solid interactions analysis, for a solid which is frangible at relatively low stress levels, cannot at present treat the process of air infiltration and particle entrainment. Consequently, computational approaches and dust sweep-up assessment analyses require an entrainment model which provides a boundary condition for the more manageable but noneless difficult 2-phase flow analysis of the blast wave environment.

SIAC has applied its 2-phase model MAGIC to the study of dust boundary layer dynamics. A dust entrainment model was developed which is based on the assumption that the entrainment rate is controlled by the turbulent mixing velocity. Turbulent closure is effected in the model via a 2-equation dynamic turbulence model. 2-phase flow effects are considered by including Lagrangian particles trajectories for en ensemble of representative particles which interact and couple to the gas flow through momentum, energy and mass exchange. Model simulations of dusty shock tube experiments have been made with highly promising results. The model along with comparative simulation results with laboratory and engineering scale boundary layer data will be discussed.