MODELING THREE-DIMENSIONAL SHOCK INITIATION OF PBX 9501 IN ALE3D

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ABSTRACT

A recent SMIS (Specific Munitions Impact Scenario) experimental series performed at Los Alamos National Laboratory has provided 3-dimensional shock initiation behavior of the HMX-based heterogeneous high explosive, PBX 9501. A series of finite element impact calculations have been performed in the ALE3D [1] hydrodynamic code and compared to the SMIS results to validate and study code predictions. These SMIS tests used a powder gun to shoot scaled NATO standard fragments into a cylinder of PBX 9501, which has a PMMA case and a steel impact cover. This SMIS real-world shot scenario creates a unique test-bed because (1) SMIS tests facilitate the investigation of 3D Shock to Detonation Transition (SDT) within the context of a considerable suite of diagnostics, and (2) many of the fragments arrive at the impact plate off-center and at an angle of impact. A particular goal of these model validation experiments is to demonstrate the predictive capability of the ALE3D implementation of the Tarver-Lee Ignition and Growth reactive flow model [2] within a fully 3-dimensional regime of SDT.

The 3-dimensional Arbitrary Lagrange Eulerian (ALE) hydrodynamic model in ALE3D applies the Ignition and Growth (I&G) reactive flow model with PBX 9501 parameters derived from historical 1-dimensional experimental data. The model includes the off-center and angle of impact variations seen in the experiments. Qualitatively, the ALE3D I&G calculations reproduce observed "Go/No-Go" 3D Shock to Detonation Transition (SDT) reaction in the explosive, as well as the case expansion recorded by a high-speed optical camera. Quantitatively, the calculations show good agreement with the shock time of arrival at internal and external diagnostic pins. This exercise demonstrates the utility of the Ignition and Growth model applied for the response of heterogeneous high explosives in the SDT regime.