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Modeling of propellant flow and explosively-driven valve for the Large-Bore Powder Gun KIN LAM, Los Alamos National Laboratory — The Large-Bore Powder Gun, with a 3.5-inch bore, is being developed to provide dynamic experiments on physics samples at the Nevada Test Site with impact velocities exceeding 2 km/s. A confinement system is required to seal the target chamber from the gun system to keep it free of hazardous materials from the impact event. A key component of the confinement system is an explosively driven valve (EDV), which uses a small amount of explosive (PBX 9501) to drive an aluminum piston perpendicular to the barrel axis into a tapered hole. The objective of this study is to evaluate the efficacy of the EDV design via computational simulations using models validated with prototype experiments. We first established the gun performance characteristics using an interior ballistics code. Then an energy source model capable of generating the kinematics (i.e., pressure, velocity and displacement profiles) as predicted by the interior ballistic code is used in the hydrodynamics code CTH to calculate the M14 propellant gas expansion as the projectile travels down the gun barrel with the goal of obtaining the lateral (stagnation) pressure load on the EDV piston as it is inserted into the bore. A model of the EDV operation validated against stand-alone experiments is also developed. The gas flow and EDV models are combined to simulate integrated tests as well as the operating conditions specified for qualification. Results from these simulations and those involving design modifications to improve the confinement will be presented.

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