Department of the Navy SBIR/STTR Transition Program

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Topic # N10A-T002

A Multiscale Modeling and Simulation Framework for Predicting After-Burning Effects from Non-Ideal Explosives

Reaction Engineering International

WHO

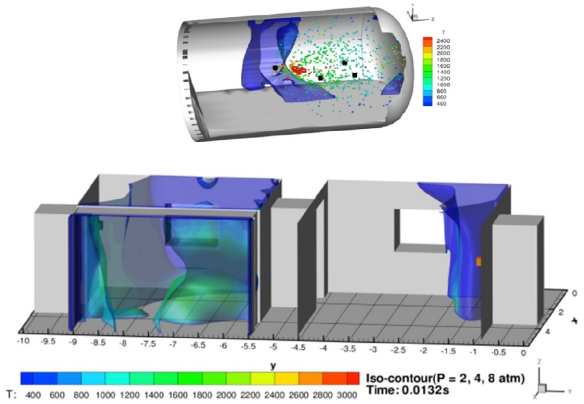
SYSCOM: NAVAIR

Sponsoring Program: Naval Air Warfare Center Weapons Division (NAWCWD) Weapons and Energetics Department (AIR 4.7)

Transition Target: Tomahawk Weapons System Program Office (PMA 280)

TPOC:
(760)939-0685

Other transition opportunities: Defense Threat Reduction Agency (DTRA) Advanced Energetics Program; Army Armament Research, Development, and Engineering Center (ARDEC); Air Force Research Laboratory (AFRL) Munitions Directorate; Department of Energy National Laboratories



Notes: The top image illustrates the systems level validation of modeling of an aluminum (Al) explosive in the Sandia ECF Chamber. The bottom image illustrates JP10 modeling at the Humble Gingko Facility.

WHAT

Operational Need and Improvement: This project involves developing enhanced models of the underlying physics of thermobaric explosives. Better model predictions will reduce costs by limiting the need for expensive testing, and pave the way for producing optimal thermobaric explosive designs and enhanced munition performance. While there are some computational tools that have validated models for specific fuels (e.g. aluminum (Al)) at specific conditions, there are no validated computational tools for multiple fuels (e.g. Al, magnesium (Mg), JP10) to predict the after-burning effect.

Specifications Required: Thermobaric explosive simulations are required with increased accuracy, and with support for multiple fuels. The developed model must also support complex geometries and advanced post-processing.

Technology Developed: The modeling strategy being developed includes several unique features that are important for understanding and predicting the ignition of compressible multiphase flows. These effects include both heterogeneous and homogeneous particle reactions, particle compressibility, and a turbulence modeling approach that naturally includes the effects of group combustion. The modeling will be housed into a new 3D supervisory simulation framework pioneered by REI for examining blast environments that includes support for complex geometries and a variety of explosives.

Warfighter Value: Ultimately, the improved thermobaric modeling capabilities will result in better modeling of munition applications and result in munitions with increased performance and lethality. These enhanced capabilities will provide our warfighters with a competitive advantage.

WHEN

Contract Number: N68335-15-C-0161 **Ending on:** February 14, 2017

Milestone	Risk Level	Measure of Success	Ending TRL	Date
XML Detailed Problem Definition	N/A	Software testing	6	July 2016
Adaptive Mesh Refinement	N/A	Validation with experimental results	6	August 2016
Early Time Explosive Behavior	High	Validation with experimental results	6	December 2016
Droplet Modeling	Med	Validation with experimental results	6	January 2017

HOW

Projected Business Model: REI plans to license the software directly to end users and provide support services.

Company Objectives: REI will meet the specific needs of PMA 280 and become their modeling solution for non-ideal explosives. Subsequently, REI is seeking prime defense contractors and other military programs that could benefit from the enhanced thermobarics modeling software.

Potential Commercial Applications: REI's modeling software can also prove beneficial to defense contractors who are responsible for manufacturing thermobaric explosives and associated munitions. These contractors want the ability for their R&D teams to model thermobarics in order to optimize their behavior and to optimize the design and lethality of munitions using these explosives. REI's model may also be utilized for the mining/demolition industry or for other non-military customers involved in using explosives with non-ideal behaviors.

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