Picatinny Insensitive Munitions (IM) Efforts Paying Dividends

Rene Kiebler and Paul Manz

On Oct. 5, 2009, Picatinny Arsenal, NJ, was honored to host SPC Alan Ng, who was home on mid-tour leave from duty in Afghanistan. Ng, a son of a Picatinny employee, is a mortarman in the 10th Mountain Division. While at Picatinny, he spoke with leaders and engineers from Project Manager Combat Ammunition Systems (PM CAS) and the U.S. Army Armament Research, Development, and Engineering Center (ARDEC) about his experiences with Picatinny-developed munitions.

Shell bodies and separated M783 fuzes from M768 cartridges were recovered from SPC Alan Ng's vehicle after the Sept. 12, 2009, MRAP fire. (Photo courtesy of PM CAS, Picatinny Arsenal.)

On Sept. 12, 2009, a Mine Resistant Ambush Protected (MRAP) vehicle in Ng's convoy was destroyed by a very powerful improvised explosive device (IED). The IED ruptured the vehicle's hull and fuel tank, which engulfed the vehicle interior in flames—to include 16 M768 60mm mortar cartridges that were carried inside the cabin with the 7-man crew. Although several Soldiers were seriously injured in the ambush, all survived. Thanks to the IM features of the M768 cartridges, a much greater disaster was averted.

M768

The M768 incorporates several IM features, including new energetic materials in the fuze and shell body. It also contains a plastic fuze adaptor that melts in an accidental fire, allowing the fuze to separate from the cartridge. This relieves internal pressure and prevents detonation of the explosive fill. After the MRAP had stopped burning, Soldiers who examined the wreckage were amazed to find all of the rounds' shell bodies intact, proving that none of them had gone "high order" in the fire. They also found the remains of the fuzes that had separated from the cartridges as designed, which allowed the PAX-21 explosive fill to burn rather than explode. The team members who developed the M768 were gratified to hear that their hard work paid off for American Soldiers in such a real and dramatic way.

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The M768 cartridge, which received Full Materiel Release in 2006, is one of the early success stories in a larger IM Strategic Plan that Program Executive Office Ammunition (PEO Ammo) is implementing to develop and produce safer ammunition throughout its portfolio. The PEO's PMs have instituted plans of action and milestones for improving IM characteristics for their assigned munitions through improvements in packaging, explosive fills, propellants, and fuzes for all calibers, up to and including 155mm.

PEO Ammo, under the direction of the Army Executive Agent for IM, has long recognized that IM enhances warfighter safety by preventing catastrophic accidents, such as the now-famous fire in Camp Doha, Kuwait, in July 1991 that resulted in 3 deaths and 56 wounded. This incident started with a small heater fire in an artillery resupply vehicle—loaded with propellants and projectiles—that exploded, spreading the fire from vehicle to vehicle. In all, 102 vehicles were destroyed or damaged before the fire was extinguished. In addition, IM promise to reduce the logistics burden imposed by the requirement for large separation distances between highly volatile munitions, both in transit and in storage.

IM Testing and Improvements

Department of the Army Pamphlet 70-3, Army Acquisition Procedures, presents a total systems engineering approach to assist in meeting IM requirements, and specifies IM testing based on *Military Standard 2105C, Hazard Assessment Tests for Non-Nuclear Munitions*. This standard requires subjecting munitions to six very harsh tests:

- Fast cook-off—rapid exposure to a liquid fuel fire.
- Slow cook-off—gradually raising the temperature to above the ignition point.
- Bullet impact.
- Fragment impact.
- Sympathetic detonation—intentionally detonating one munition surrounded by several others.
- Shaped charge jet impact—similar to a rocket-propelled grenade.

Over the last decade, great strides have been made in shell design, propellant and explosive fill formulation, and packaging improvements. For example, the sympathetic detonation and shaped charge tests were once presumed to be impossible to pass, routinely requiring

Shown here is the interior view of the MRAP in Ng's convoy after the Sept. 12, 2009, fire. An unexploded shell body from a M768 cartridge can be seen in the lower left. (Photo courtesy of PM CAS, Picatinny Arsenal.)

SPC Alan Ng (third from left) explained his firsthand experience with the importance of IM to Picatinny M768 team members (left to right) Bill Kuhnle, Roger Wong, Scott Faluotico, Marty Moratz, Pam Ferlazzo, John Niles, Jeff Ranu, and Jeff Smith. (Photo courtesy of PM CAS, Picatinny Arsenal.)

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waivers before new munitions could be materiel released. In 2008, however, the Energetics Branch of PM CAS was nominated for the David Packard Excellence in Acquisition Award for design and explosive fill technology improvements to 155mm artillery projectiles, propellants, and packaging that finally passed all six of these difficult tests.

The maturation and transition of these technologies were dramatically accelerated through the infusion of enabling funds from the Office of the Secretary of Defense (OSD) Technology Transition Office. The Technology Transition Initiative (TTI), established by Congress in 2002, "is intended to accelerate the introduction of new technologies into operational capabilities for the armed forces." The PM CAS/ARDEC team proposed a new IM TNT-replacement explosive fill (called IMX-101) and changes to the M795 projectile to allow pressure relief from the projectile nose. In a highly competitive environment, these were selected by OSD and subsequently received TTI funding. These improvements to the projectile, when coupled with the IM features of the M231, M232, and M232A1 propelling charges and containers, would have almost certainly prevented the Camp Doha disaster.

PM CAS and ARDEC are currently working on a Common Low-Cost IM Explosive Program. Along with support from OSD's TTI, they are leveraging support from the Joint IM Technical Program to accelerate transition of IM solutions to the field. The long-term objective of this program is to develop a single high-explosive fill that can replace TNT and Composition-B in 105mm and 155mm artillery projectiles and 60mm, 81mm, and 120mm mortar cartridges. The new fill must be at least as effective as the more volatile formulations it will be replacing, even though it will be less sensitive to unplanned stimuli. It must be affordable, producible by the current industrial base, and environmentally friendly. Although these requirements may seem insurmountable, in the past, Picatinny Arsenal personnel have risen to such challenges and passed tests once considered impossible. Always focused on providing effective, safe, and reliable weapons to the warfighters they support, their motivation was further enhanced when they heard the aforementioned firsthand feedback from "one of the family" on the importance of providing IM.

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