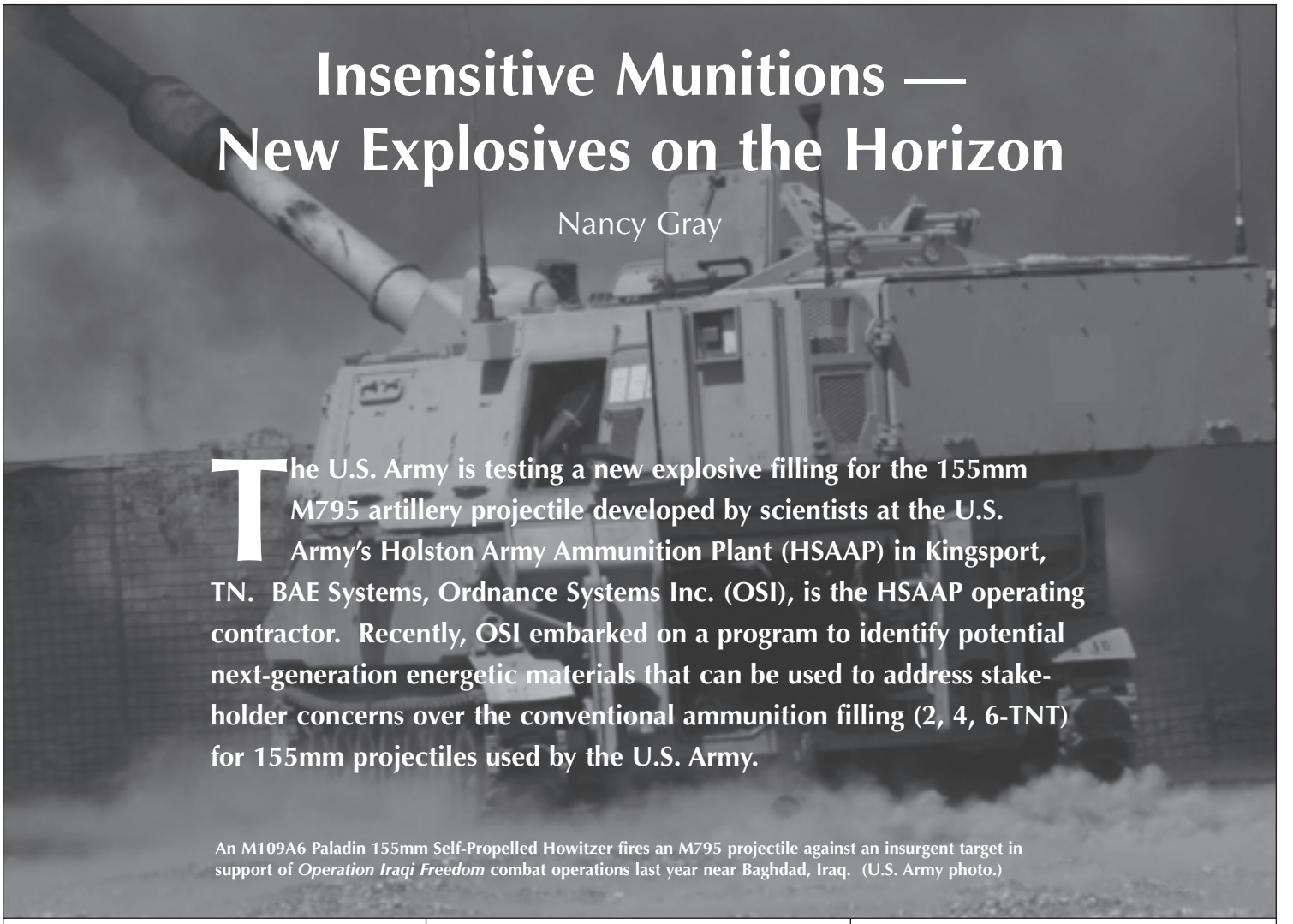
Insensitive Munitions — New Explosives on the Horizon

Nancy Gray



The U.S. Army is testing a new explosive filling for the 155mm M795 artillery projectile developed by scientists at the U.S. Army's Holston Army Ammunition Plant (HSAAP) in Kingsport, TN. BAE Systems, Ordnance Systems Inc. (OSI), is the HSAAP operating contractor. Recently, OSI embarked on a program to identify potential next-generation energetic materials that can be used to address stakeholder concerns over the conventional ammunition filling (2, 4, 6-TNT) for 155mm projectiles used by the U.S. Army.

An M109A6 Paladin 155mm Self-Propelled Howitzer fires an M795 projectile against an insurgent target in support of *Operation Iraqi Freedom* combat operations last year near Baghdad, Iraq. (U.S. Army photo.)

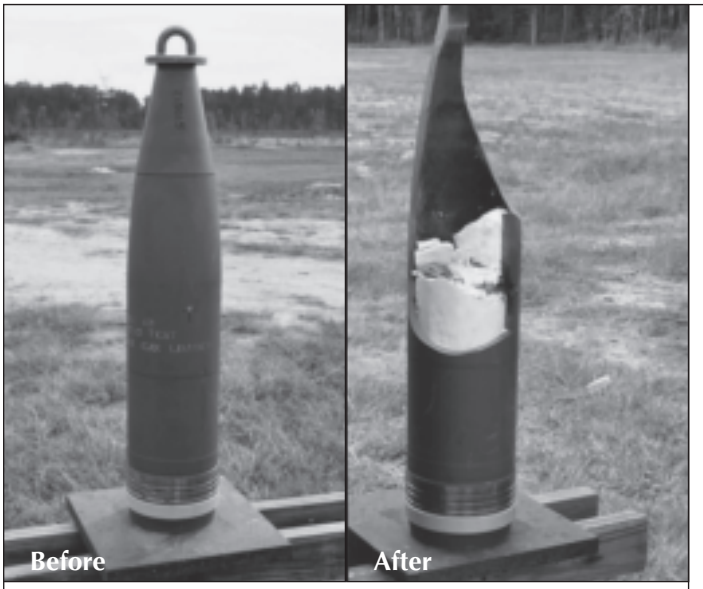
The main issue with TNT as a filling for modern projectiles is that the explosive behaves violently if subjected to an accidental stimulus, such as being involved in a fire. In addition, TNT-loaded ammunition is susceptible to attack by enemy fire. For example, .50-caliber armor-piercing bullets can penetrate a TNT-loaded projectile, causing a devastating reaction. High-speed fragments and even the Rocket Propelled Grenade-7 shaped charge weapon system provoke a similar, violent response from TNT-loaded 155mm projectiles.

Over the years, there have been many initiatives to make TNT safer. For example, mixing TNT with other nonexplosive additives to "desensitize" the explosive and make it less violent (and sensitive) when subjected to unplanned stimuli. One major consequence of these approaches is that when TNT is diluted with nonexplosive additives, such as wax or other inert organic materials, the resultant system energy is reduced, which renders the ammunition less effective. The current state-of-the-art shows that while TNT can be made safer, it can never be completely safe. Even the best attempts to make a safe TNT-based explosive filling fail to fully meet the Army's stringent testing requirements for insensitive ammunition.

A motor pool fire at the Camp Doha, Kuwait, compound in July 1991, involving an M992 ammunition carrier loaded with 155mm artillery projectiles, resulted in the destruction or damage of 102 vehicles. Forty-nine people were injured and 3 Soldiers were killed. Losses exceeded $15 million. That's why PM CAS, OSI and HSAAP have partnered to produce OSX-CAN, an insensitive munition that is entering qualification testing as a potential TNT replacement in M795 munitions. (U.S. Army file photo.)

New Path Results in a Safer Explosive

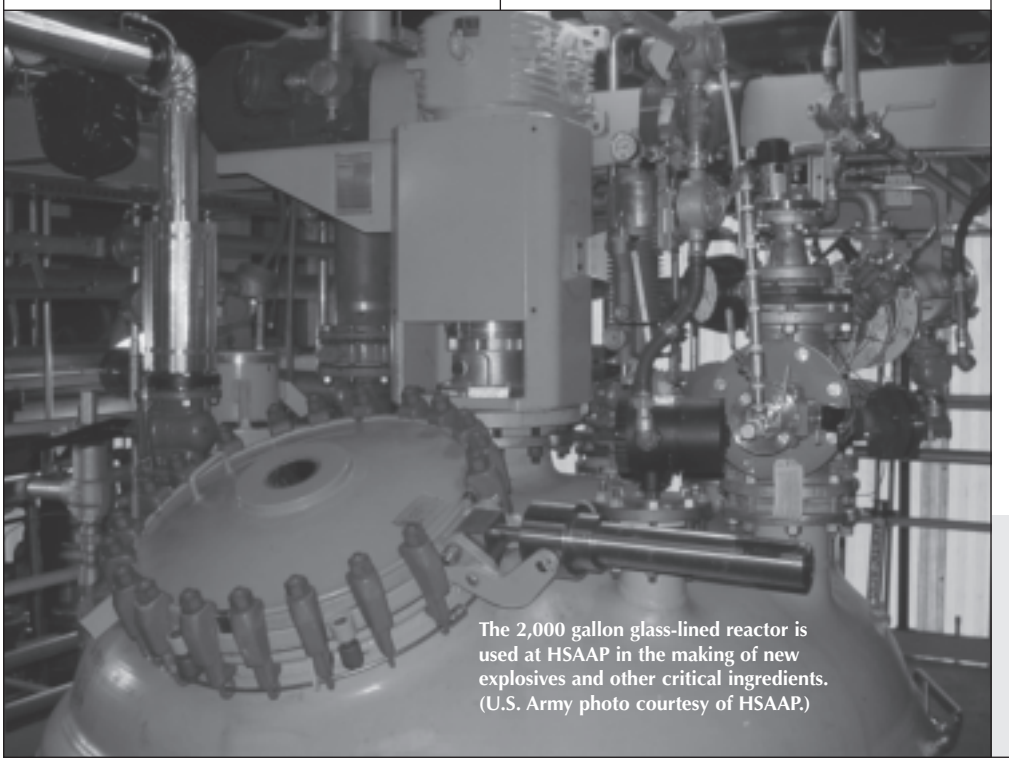
When OSI scientists looked at this problem, they took a different path. Their research suggested that the materials needed to make a safe 155mm artillery explosive were not actually available in large quantities. This left two choices — adopt the conventional approach and try to make a safer TNT-based explosive or



Before: **An inert 155mm M795 artillery projectile moments before being struck by a .50-caliber armor-piercing bullet.** ***After:*** **The same 155mm M795 artillery projectile after being struck by a .50-caliber bullet. Note the white "energetic material" exposed in the damaged shell casing. It is this kind of "accidental stimulus" that renders TNT violent and sensitive. (U.S. Army photos courtesy of HSAAP.)**

find a way to produce the potentially more suitable, but not readily available, insensitive replacement for TNT. OSI chose the second option. Following the completion of a series of strategic programs, OSI had established a capability at HSAAP to manufacture two key ingredients that would become the major components of its 155mm insensitive explosive formulation. The first of these new ingredients was 2, 4-dinitroanisole (DNAN); the second was 3-nitro-1, 2, 4-triazol-5-one (NTO).

OSI manufactures DNAN and NTO in a facility originally designed to destroy explosive materials. From 2000-2001, the U.S. Army established a capability at HSAAP to dispose of energetic ingredients as part of an international peacekeeping effort. This facility employed a 2,000 gallon glass-lined reactor that was used to demonstrate the disposal process, but was then redundant. OSI used the glass-lined reactor as a nucleus for establishing a reconfigurable production facility — one that could be used to make multiple new explosive ingredients, including DNAN and NTO.



The 2,000 gallon glass-lined reactor is used at HSAAP in the making of new explosives and other critical ingredients. (U.S. Army photo courtesy of HSAAP.)

OSI used DNAN, NTO and other ingredients to develop Ordnance Systems Explosive-Common Ammunition Newfill (OSX-CAN). This new explosive was submitted to the U.S. Army's Program Manager Combat Ammunition Systems (PM CAS) as part of an industrywide evaluation program to identify a truly insensitive replacement for TNT in the 155mm M795 ammunition. It was evaluated alongside numerous other candidates in a series of carefully orchestrated tests managed by PM CAS.

The evaluation effort involved systematically testing the candidate explosives loaded into 155mm projectiles against various credible tactical threats such as bullet impact; fragment attack; slow- and fast-heating, sympathetic detonation; and shaped charge attack. OSX-CAN successfully passed all of the insensitive munitions (IM) tests that the explosive was subjected to and was identified as being a "superior choice in all areas" to all other candidates. OSX-CAN was selected as the leading candidate for qualification testing as a TNT replacement in the M795 ammunition.

In developing IM components such as OSX-CAN, HSAAP is ensuring a safer product for warfighters to use and handle, a safer product for transporting and a safer product for manufacturing and storing. The bottom line for OSX-CAN and other IM components being developed at HSAAP is that this ammunition will save lives on and off the battlefield while sustaining the same powerful ability to stop the enemy in its tracks during combat operations.

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