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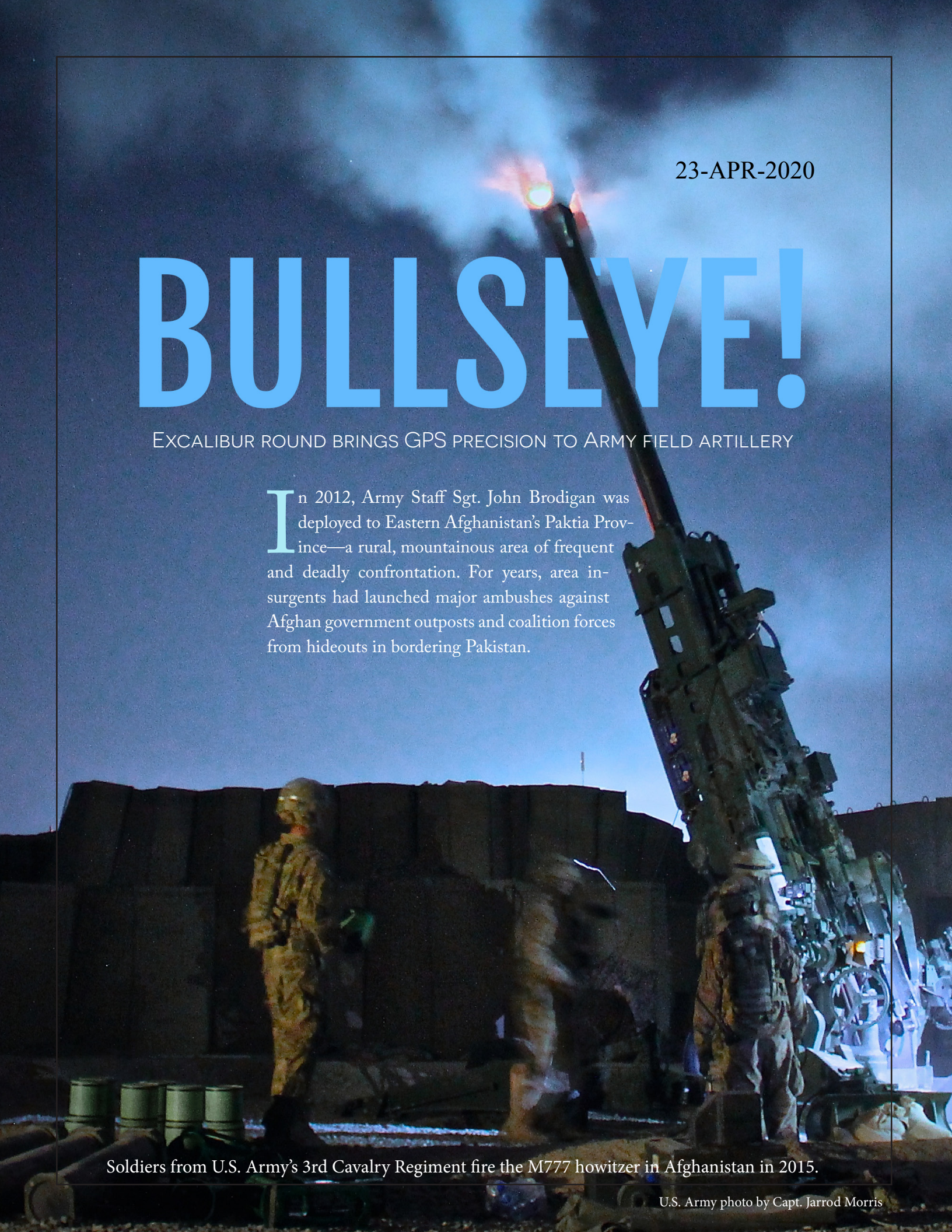
BULLSEYE!

Excalibur round brings GPS precision to Army field artillery

In 2012, Army Staff Sgt. John Brodigan was deployed to Eastern Afghanistan's Paktia Province—a rural, mountainous area of frequent and deadly confrontation. For years, area insurgents had launched major ambushes against Afghan government outposts and coalition forces from hideouts in bordering Pakistan.



Soldiers from U.S. Army's 3rd Cavalry Regiment fire the M777 howitzer in Afghanistan in 2015.

U.S. Army photo by Capt. Jarrod Morris

Brodigan, an Army field artillery data specialist, and his crew from the 25th Infantry Division, fielded an M777A2 howitzer, its 19-foot barrel capable of shelling targets 18 miles away.

Aerial surveillance detected enemy forces burying a roadside bomb in an urban area not far from Brodigan's firebase. An infantry patrol confirmed the intelligence. Strict limits on collateral damage had long meant sidelining Army and Marine Corps field artillery units in similar situations. A howitzer is a relatively imprecise weapon that can devastate a large area with its high-explosive projectiles.

Fortunately, technology developed by a team of self-described "garage shop engineers," with support from the Navy's Small Business Innovation Research (SBIR) program, is changing when and where field artillery can get in the fight. With GPS-guidance, the M982 Excalibur artillery shell gives Army and Marine Corps brigade commanders a precision-fire option, a capability that has traditionally been the province of higher commands.

Steve Rezonja: "The SBIR program is great. Small companies have the ability to take on projects that bigger companies wouldn't, which helps America be a technological leader, create jobs, and grow the economy."

Without getting into specifics, Brodigan said his crew was cleared to fire.

BOOM! The howitzer roared, and a single Excalibur round left the muzzle at nearly 1,800 miles per hour.

"It hit exactly where it was supposed to," the staff sergeant said. "The accuracy is ridiculous. Field artillery has always been viewed as an area weapon, but this thing makes it a much more precise tool."

The Excalibur's fuse is also adjustable for air burst, point, or delayed detonation. But more important is its circular error probability: about six feet off target. Compare that to the 150-foot miss radius of a standard round.

The Excalibur is considered first-round, fire-for-effect capable, meaning forward observers no longer need to fire multiple bracketing shots before the gun is zeroed in on the target. That accuracy gives field officers the confidence to reduce collateral damage estimates and approve more artillery missions, Brodigan said, which is good for troop morale and mission success.

The 106-pound Excalibur round can also sail out to about 25 miles, doubling the 155-millimeter howitzer's coverage area, using fins that begin gliding at the top of its ballistic arc, according to manufacturer Raytheon.

Those fins are also the business end of the GPS guidance that puts Excalibur rounds on target, and wouldn't work without a state-of-the-art Control Actuation System (CAS) that can withstand the 15,000 Gs of acceleration when fired.

"Having very small, very high power density motors is the key to the CAS's enabling technology," said Steve Rezonja, director of Advanced Programs at General Dynamics' Ordnance and Tactical Systems, which produces the Excalibur's unique CAS.

Rezonja was part of the engineering team at Versatron, a small California company that invented and prototyped the Excalibur's CAS from the Navy's Extended Range Guided Munition program under a 1995 Phase II SBIR contract.

Versatron was founded in 1980 by Al Voigt and John Speicher, who had worked together at General Dynamics in Pomona. By 1985, they had 75 employees and helped develop actuators for the anti-aircraft Stinger missile. They also built a two-person tricycle, called the Vector, which set the land-speed record for human-powered vehicle.

When Versatron was acquired by General Dynamics in 2001, the enabling CAS technology was put into a high-tech production line. Total production to date has reached about 10,000 units, according to General Dynamics.

Photo courtesy Steve Rezonja.

Eric Manton, left, and Steve Rezonja display the Excalibur CAS. Manton was the original program manager that brought the Versatron technology to the Excalibur.

Now that the Excalibur has been combat tested for several years—it was first deployed in 2007—military sales are growing.

Raytheon and co-producer BAE/Bofors reported that "Sweden, Canada, Australia, and the Netherlands have chosen the Excalibur precision-guided projectile to address vital security interests, and several other international partners are finalizing procurement plans."

Raytheon is developing a laser-guided version, the Excalibur S, designed to bypass vulnerability to GPS jamming. Another variant, the Excalibur N5 munition, is being built for naval guns.

"The investment on the government's part has done well," Rezonja said. "The SBIR program is great. Small companies have the ability to take on projects that bigger companies wouldn't, which helps America be a technological leader, create jobs, and grow the economy.

"We're actually working with a few other small businesses, and we're going to do this again with them," Rezonja added. "We're going to take what they've done over the years on various SBIRs and bring it to fruition."

From Staff Sgt. Brodigan's perspective, investment in research like this gives the American warfighter technological advantages that lower casualties and increase success on difficult missions.

"Excalibur is a great form of ingenuity," he said. "I think that's exactly where we need to go with our capabilities—increase range, increase precision."

Versatron, Corp. (General Dynamics, Corp.)
Modernization Priority: General Warfighting Requirements (GWR)
Healdsburg, CA (West Falls Church, VA) • SBIR contract: N00178-95-C-3027 * Agency: Navy * Topic: N93-096, Low Cost Control System Components for Gun Launched Projectiles