

# PRECISION-GUIDED MUNITIONS FOR BCT COMMANDERS

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The objective of U.S. military kinetic operations always has been to defeat the enemy while minimizing risks to friendly forces, casualties among the innocent population, and undesired collateral damage. Today, more than any era in the past, we have technologies to achieve that objective across the spectrum of conflict. Even successful stability and nation-building operations have brief spikes of intensity, calling for rapid, pinpoint lethality.

Force commanders require, and have asked for, precision indirect-fire capabilities, and the field artillery is committed to providing these capabilities — tactical precision-guided munitions (PGMs), which allow commanders to turn defeat into victory, save lives, and minimize collateral damage.

In his survey of corps, division, and brigade combat team (BCT) commanders, MG Peter M. Vangjel, chief of Field Artillery and commanding general of Fort Sill, Okla., reported that maneuver commanders' fire support priority was precision. The field artillery has been working diligently to answer the call.

The commander of ground forces in the highly successful surge in Iraq during 2007, then LTG Raymond T. Odierno, commander, Multinational Corps-Iraq (MNC-I), endorsed the effectiveness of the relatively new 155mm Excalibur and guided multiple-launch rocket system (GMLRS) unitary PGMs, "...they were *extremely* effective. In fact, GMLRS and Excalibur were my brigade commanders' weapons of choice."



*A Soldier fires an Excalibur round  
from the M777A2 during a  
mission in Afghanistan.*

SGT Henry Selzer

We have entered a remarkable era of all-weather, all-terrain precision effects, available to maneuver commanders 24/7, with Excalibur, GMLRS unitary, and the near-future nonline-of-sight launch system (NLOS-LS) precision attack missile (PAM), projected to be fielded in FY12.

### Six Meters and Closing

Indirect-fire PGMs are proving to be more accurate than the 10 meters required of a PGM. Excalibur and GMLRS test results and combat records of their impacts catalogue their accuracy to within a six-meter radius of intended targets, bringing us closer than ever to the ideal “one-round, one-hit” capability.

As the enemy was being cleared out of Baghdad during the 2007 surge, many ran north to Baqubah in the Multinational Division-North (MND-N) area of operations. MAJ Jack E. Vantress, S3, 5th Battalion, 20th Infantry (5-20 IN), the lead task force during Operation Arrowhead Ripper in Baqubah, discussed in an e-mail, on 17 December 2007, Excalibur’s precision and how the task force achieved its desired effects on a two-story building. “We fired two rounds nearly simultaneously... Excalibur’s accuracy was such that the second round entered the building at the same point of impact as the first, thereby achieving the desired penetration to the first floor.”

Employed in conjunction with other joint firepower assets, Excalibur gives the enemy no way out. In July 2007, two Excalibur rounds were fired on a house containing top al-Qaida leader Abu Jurah and 14 other insurgents in Arab Jabour, south of Baghdad. An AH-64 Apache helicopter attacked a vehicle, and as insurgents fled from the rubble, an F-16 dropped two 500-pound bombs to destroy a house three of the fleeing insurgents had entered. The enemy never had a chance.

COL David B. Haight, commander of the 3rd BCT, 10th Mountain Division, recently deployed his brigade to Afghanistan. Before he deployed, he ensured his fires battalion had the capability to fire Excalibur. “In June 2008, I went to the Fires Conference at Fort Sill and received a briefing on Excalibur’s global positioning system accuracy. With Excalibur’s pinpoint accuracy, I can put one round into the bad guys’ exact location and take them out while

causing minimum collateral damage and safeguarding the Afghan populace. Excalibur was *exactly* what we needed.

“We had identified an operational need for Excalibur, so we made the case for M777A2s in the brigade to fire the round—M777s are not organic to IBCTs [infantry BCTs]. FORSCOM [Forces Command] approved the request for the capability and resourced us with 12 M777 howitzers, which our 4-25 FAR [4th Battalion, 25th Field Artillery Regiment] quickly trained and certified on. The M777 has the added advantage of being lighter than the M198 and is very mobile; we can move it around the Afghan battlefield, sling-loaded under a helicopter to fire Excalibur.”

Excalibur has become a joint and combined effort as both the U.S. Marines and Canadians are using it in theater. In September 2005, 3rd Battalion, 13th Field Artillery (FA), 214th FA Brigade, fired GMLRS in support of MNC-I for the first time in combat during Operation Restoring Rights at Tal Afar and the next day during Operation Sayaid in the Al Anbar Province. In Tal Afar, eight GMLRS destroyed two insurgent strongholds and killed 48 insurgents from 50 kilometers away. In the Al Anbar Province, six rockets destroyed a bridge frequently used by insurgents.

COL Kenneth J. Lull, former commander, 169th Fires Brigade, Colorado Army National Guard, and the Force FA Headquarters, MND-N, 25th Infantry Division, Iraq, reported experiences with GMLRS during Operation Arrowhead Ripper. “We shot more than 100 GMLRS in support of 3-2 SBCT [3rd Stryker BCT, 2nd Infantry Division, attached to the 25th Infantry Division] in a two- to three-week period — a *magnificent* round.”

Aided by unmanned aerial vehicles (UAVs), combat observation lasing teams (COLTs), forward observers (FOs), joint terminal attack controllers (JTACs), and other detection assets, precision strike suite-special operations forces (PSS-SOF) software can be used to locate the target *precisely* enough to fire PGMs quickly. PSS-SOF has been incorporated into forward observer software (FOS) and rapidly determines three-dimensional grid coordinates accurately enough to employ PGMs against time-sensitive targets (TSTs) or targets in support of troops in contact.

MAJ Vantress commented in an e-mail, dated 17 December 2008, on the impact PGMs and PSS-SOF had on his task force operations during Operation Arrowhead Ripper, “For both PGMs, our biggest combat multiplier was PSS-SOF. Used in combination with UAVs and FOS, we cut down the delivery time immensely. We loaded PSS-SOF in all our fire support Stryker variants to allow the forward fire support teams to quickly gain fidelity from their observers. Simply put, GMLRS and Excalibur were our weapons of choice in the close urban fight. They saved countless lives...while allowing us to maintain the momentum.”

This speaks not only to precision, but also to responsiveness.

Precision is the “coin of the realm” at the BCT and below. With Excalibur organic to BCTs, PGM allows small unit commanders to gain overmatch and a decisive advantage. In Operation Iraqi Freedom (OIF), MLRS or high-mobility artillery rocket system (HIMARS) “packages” have supported BCTs with GMLRS — also very responsively.

### Minimum Collateral Damage

Precision munitions mean more than just accuracy of impact and effects on the intended target; PGMs provide precise effects with minimum collateral damage in the target areas. Commanders can safely employ Excalibur, GMLRS, and, beginning in FY12, PAM, in appropriate circumstances, close to troops in contact for immediate fire missions. These munitions reduce troop standoff distances, giving commanders options such as entering a building to collect time-sensitive intelligence just seconds after the building is engaged.

COL Lull, in an e-mail dated 18 November 2008, shared his experiences with employing Excalibur in Iraq, “We fired 17 Excalibur rounds for the 3-2 SBCT when it cleared Baqubah of insurgents in intense combat during Operation Arrowhead Ripper. In one mission, we fired Excalibur on a known enemy safe house. Although it did not level the building, it killed everyone in the building without harming children who were playing outside in front of the house next door about 30 yards away. Excalibur is an *incredible* round. I called MNC-I and asked for every Excalibur

round I could get my hands on.”

In his e-mail dated 16 December 2008, BG Stephen J. Townsend, commander, 3-2 SBCT, Operation Arrowhead Ripper, discussed employing GMLRS to detonate improvised explosive devices (IEDs) in Baqubah. The alternative was to uncover and destroy the deep-buried IEDs (DBIEDs) or houseborne IEDs (HBIEDs) with successive shots *manually* emplaced by an explosive ordnance disposal (EOD) team: “Our pre-assault intel proved quite accurate — that we faced up to 175 DBIEDs and also booby-trapped houses, or HBIEDs, in Baqubah. By the time we were done, we had recorded more than 200 emplaced IEDs inside the city and about 41 rigged houses.

“We were desperate for a solution to the problem of DBIEDs — al-Qaeda had dug in an overlapping network of DBIEDs, the equivalent of a deliberate interlocking minefield in depth. Bottom line: GMLRS worked by neutralizing known and suspected DBIEDs and allowed us to maintain the momentum of our attack with minimum

exposure to our force and minimum collateral damage to the Iraqi infrastructure.”

COL Bruce P. Antonia, former commander, Task Force (TF) 5-20 IN, and his Sykes’ Regulars fought in Baqubah three months before the remainder of 3-2 SBCT joined them in June 2008 for the final assault to clear the city. In an e-mail dated 17 December 2008, he described his ability to shoot GMLRS faster than he could air-drop a bomb on HBIEDs, and the level of comfort they developed with GMLRS’ accuracy and effectiveness, “We were in the midst of clearing a neighborhood when one of my companies came upon a confirmed HBIED. I was on the ground with the company commander when he requested GMLRS to attack the HBIED. Because there was direct-fire contact with the enemy, and I was extremely confident in my commanders and all my FSOs [fire support officers], I immediately agreed to the request. After they called in the fire mission, I asked the company commander exactly where the target was — it was two houses to the west of the one we were

standing in. The testament to GMLRS is that we called it in on a target 50 meters from our own location with great confidence.”

The United Kingdom (UK) has modified 12 of its M270 MLRS launchers to employ GMLRS unitary in Afghanistan. In the past year, the UK has fired more than 300 GMLRS rockets in Afghanistan with the same 98 percent reliability as U.S. missions enjoy.

### Coming Soon: Moving Target Attack

In 2012, PGMs will be organic to BCTs, which will add a long-needed capability, PAM, to attack *moving* targets — a global first.

This U.S. Army-Navy all-terrain, 24/7 missile has an effective range from 500 meters to 40 kilometers. Each of the 15 missiles per PAM container-launch unit (CLU) has an explosive shaped-charge warhead for armored targets with fragmentation for soft targets. PAM is designed to attack armored and lightly armored *moving* and stationary vehicles, small boats, and some bunkers with pinpoint accuracy. Causing minimum collateral damage, it can be employed in urban/complex terrain less than 110 meters from friendly forces.

PAM’s dual-mode seeker, the semi-active laser (SAL) and infrared (IR) heat seeker, can be used separately or in unison for precision target engagement after its GPS navigation has guided the missile to the target area.

Networked and platform-independent,

**XM982 Excalibur** — This is the first GPS-guided, inertial measurement unit (IMU)-aided weapon that can be fired from 155mm platforms, including the M109A6 Paladin, the M777A2 towed howitzer, and the Future Combat Systems Non-Line-of-Site Cannon (FY17).

Excalibur is an extended-range (7.5 to 24 kilometers) unitary round that is all-weather, 24/7, and all-terrain that has been fired in testing and combat with an accuracy of within a six-meter radius of the target.

Excalibur has two special force-protection features: the round only arms itself when within 30 meters of its aimpoint — extra safety for rounds in close support of troops; and the round has a built-in test that exercises in flight. If it detects a problem, it goes into fail-safe mode and flies to a preplanned alternate ballistic impact point (BIP), but does not detonate.

Its 50-pound warhead has a highly concentrated and predictable fragmentation pattern, optimizing it for urban operations and minimizing collateral damage, allowing it to be employed, within 170 meters of friendly troops in combat. Its nonballistic flight trajectory, which terminates in a near-vertical attack angle, along with its precision, produces concentrated lethality to the equivalent of the M107 high-explosive (HE) round.

Its primary target sets are softer targets, artillery and mortar crews, vehicles, and command posts, although Excalibur has been employed successfully against other targets in support of coalition forces. In CENTCOM, Excalibur has been effective against improvised explosive devices, safe houses, mortar crews, footbridges, and other targets.



SPC Derek Miller

*Soldiers with the 2nd Stryker Brigade Combat Team, 25th Infantry Division load an Excalibur round into an M777 during a mission in Baghdad in April 2008.*

PAM is a smart missile. It can acquire specific types of targets in flight and attack them, including moving targets. A missile flies along a nonballistic route to the target to avoid crowded airspace, receiving target location updates while in flight. Each missile transmits a picture of the target back to the control cell just prior to impact.

NLOS-LS completed nine tests in 2008, which have demonstrated its design and performance parameters. During November 2008, at White Sands Missile Range, N.M., PAM used its digital SAL seeker to score a direct hit against a T-72 tank from a range of nine kilometers; two days later, PAM demonstrated its SAL and IR seekers for another direct hit on a T-72, this time from 19 kilometers away.

The U.S. Army is considering an air defense application for this munition, which has tested very well. The variant would fill the requirement to destroy low- and slow-moving UAV and rotary wing threats, protecting the future combat system (FCS) BCT, the future brigade combat team (FBCT), during counterinsurgency operations. No current organic capability protects the brigade from these threats.

### The Current Fight

These PGMs are designed to provide commanders the flexibility to manage the precision effects to achieve desired results. Excalibur has a 50-pound warhead and GMLRS unitary has a 200-pound warhead, which can be employed against larger targets, yet both can be employed in close support of friendly troops. Note: PAM will have a 12-pound warhead and will also be employable in close support of troops.

Indirect-fire PGMs allow commanders to attack an enemy mortar crew setting up in downtown Kabul with Excalibur, producing minimum collateral damage, or destroy a two-story duplex with GMLRS unitary, leaving half of the duplex standing. To increase precision strike flexibility, the field artillery is developing “scalable lethality:” a future GMLRS “dial-an-effect” capability.

Commanders have the ability to fire Excalibur from as close as 7.5 kilometers and GMLRS from as far away as 70-plus kilometers. The U.S. Marines in Iraq first gave GMLRS its now-famous title, “70-kilometer sniper rifle.” With the fielding of PAM, the missile can be fired from as close

as 500 meters from its target.

Enhancements to Excalibur due in FY10 extend the round’s range to 35 kilometers on current firing platforms. When PAM comes into the inventory in FY12, commanders will have the ability to precisely attack moving targets from 40 kilometers away.

In the past two years, two operational needs statements from U.S. Central Command (CENTCOM) commanders called for a 120mm mortar PGM in theater, another precision strike option to fill a gap. A mortar PGM would be highly mobile, organic to maneuver battalions (therefore responsive), and reduce the system-to-target range while still maintaining a maximum range that ensures munition versatility.

Recently, an infantry brigade combat team (IBCT) fires battalion was tailored with attached M777A2s to provide a capability to deliver PGMs in Afghanistan. This organization, for the first time, provides the IBCT commander with the ability to deliver precision munitions without waiting on an external asset to deliver long-range precision.

LTC Michael P. Gabel, commander, 4-25 FAR, 10th Mountain Division, deployed to Afghanistan in late 2008. In an e-mail dated 9 December 2008, he wrote about tailoring his field artillery battalion to fire Excalibur, “My third BCT was in OEF [Operation Enduring Freedom] VI and VII. It was the first brigade in Afghanistan to have its rotation extended to 16 months. The good news is we brought back a lot of lessons; for example, the importance of range and firepower in that mountainous terrain.

“During OEF VI and VII, the artillery had to fire its M119 [105mm] howitzers at high angle with maximum charge to get the range required by the terrain. So for our 2009 rotation, we requested and got 12 [155mm] M777A2s — not only to increase our range and firepower, but also to improve our precision and limit collateral damage in urban operations with the Excalibur round.

“We reorganized into a multicapable battalion with 12 triple sevens and kept four M119s for air assault operations. (I turned HHB into an M119 platoon.) We shot 15,000 rounds under this organization in preparation for deployment. I think this multicapable FA battalion organization may be the way to go — it gives maneuver commanders options. We’ll know better after we have been in Afghanistan for awhile.”

These PGMs are not only all weather, but also all terrain, and effective in urban, complex, mountainous, or open terrain. Because of their near-vertical angle of attack, these weapons optimize lethality and minimize collateral damage. Reduced collateral damage permits their use and ability to deliver the desired effect within the rules of engagement (ROE) in some of the most complex terrain.

With Excalibur’s non-ballistic trajectory, it is not limited to clear fields of fire or tied to gun-target lines — it can be fired up to 300 millimeters off the line, and will maneuver to hit whatever target the maneuver commander wants to hit.

U.S. Army and Air Force command systems can be automated to deconflict airspace faster and more accurately than before. The advanced FA tactical data system (AFATDS) now shares information through the battlefield coordination detachment (BCD) to Air Force systems to provide airspace information, enabling rapid coordination to deconflict flight routes in the vicinity of a PGM trajectory.

The lower the level of the tactical PGM’s release authority, the faster its fires are cleared. When clearance and control of Excalibur is delegated down to the task force commander, “it is more responsive than CAS [close air support] or attack aviation,” stated LTC Stephen J. Maranian, in an e-mail dated 11 November 2008, whose attached M777A2 battery (from 3rd Battalion, 321st FA, 18th Fires Brigade) fired Excalibur. Maranian commanded 4th Battalion, 319th Airborne FA Regiment, 173rd Airborne BCT (ABCT), Afghanistan, from the summer of 2007 until July 2008.

COL Charles A. Preysler, recent commander of the 173rd ABCT in Afghanistan, said “[Excalibur] worked as advertised. ...Once we understood the time required to fire the round, it became clear we needed to get permissions and authorities down to the battalion level.”

Because the risk of collateral damage associated with these PGMs is smaller, PGMs, such as Excalibur and GMLRS, allow the commander to delegate release authority for entire categories of targets down the chain of command.

For large-scale precision, U.S. Air Force PGMs are brought to commanders by their FSO. In addition to the FA suite of PGMs,

**M31 GMLRS unitary** — Fired by the M270A1 MLRS launcher and the M142 HIMARS, GMLRS unitary has been highly successful in Iraq and Afghanistan. It has a 200-pound preformed fragmentation warhead and a range of from 15 to 70 kilometers. To date, more than 1,000 IMU-guided, GPS-aided GMLRS have been fired in Iraq and Afghanistan since its initial limited 2005 fielding in Iraq. Many of these rockets were fired safely with impact within 200 meters of friendly troops.

Its original primary target sets are self-propelled and towed howitzers, logistics sites, command posts, and radars and other non-armored targets. In CENTCOM, it has been employed effectively in congested urban environments against concrete buildings or structures, intersections, deep-buried IEDs, and house-borne IEDs. The launcher parks, lays, aims, and fires the rockets in as fast as five-second salvos, automatically programming each rocket to its coordinate.



SGT Andrew D. Pendracki, USMC

*Marines from the 2nd Battalion, 14th Marines fire a Guided Multiple-Launch Rocket System from a High-Mobility Artillery Rocket System in Iraq.*

commanders have the option of air-delivered PGMs, such as the small-diameter bomb (SDB), with a 250-pound warhead, and the joint direct attack munition (JDAM), with options for 500-, 1,000-, and 2,000-pound warheads. These weapons are precise in their destruction of larger infrastructure or concentrations of enemy forces. The only aerial-delivered munition that equals the limited collateral damage estimates (CDEs) of Excalibur, GMLRS unitary, or PAM is the Hellfire missile.

### Excalibur Lessons Learned

While GMLRS has been in the inventory and well appreciated for several years, Excalibur is relatively new and often unfamiliar to BCT commanders. In his e-mail of 11 November 2008, LTC Maranian further discussed several lessons he learned about Excalibur in Afghanistan, which have been echoed by other FA commanders, “We need to educate our maneuver counterparts that Excalibur is *not* Copperhead. Copperhead has left some ‘scar tissue’ with maneuver battalion commanders from their days as company commanders as they remember the cumbersome nature of that old PGM. Further, the default is that commanders want to fire two Excalibur rounds in case one fails. Needless to say, the task force FSOs and FSCOORDs [fire support coordinators] need to coach their maneuver commanders that while there are times when more than one Excalibur should be employed to achieve the desired effects, the reliability of this round far exceeds that of Copperhead, and we do not need to default to firing more than one round. Our experience was that Excalibur has an accuracy of within six meters of the target. With the right target selection standards and delegation of release authority to the task force level, Excalibur can provide reliable first-round accuracy for troops in contact when collateral damage must be minimized.”

Other critical lessons, such as intelligence and precise target location, are paramount for employing PGMs effectively. Commanders must have the intelligence that the target is high-payoff and locate the target precisely or the PGM will attack a no-value target or the wrong location *precisely*. It is also important to know what Excalibur will and will not do — it will not level most buildings, but can destroy rooms inside a building while causing very little collateral damage. This

munition is effective against softer targets.

Today, Excalibur and GMLRS provide BCT commanders all-weather, day and night responsive, precision strike capabilities on planned and unplanned targets in all terrain — PGMs that are organic to a brigade or readily available in the ground force. In the near-future, PAM will bring an additional precision strike capability — attack moving targets — to the BCT. Together, they provide commanders precision effects and range options and reduce collateral damage and logistics burden.

The field artillery continues to work on future precision indirect fire as voiced by the current Chief of FA, Major General Vangjel, “As your fire supporters, we are totally committed to giving you the precision strike capabilities you need — we *won't* let you down.”

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**MG (Retired) David C. Ralston** served as the chief of field artillery and commanding general of Fort Sill, Okla., from August 2005 to September 2007 when he retired. During his tenure as chief of field artillery, he accelerated the fielding of guided multiple-launch rocket system (GMLRS) unitary and Excalibur in CENTCOM after combat commanders issued urgent needs statements for the munitions. He also served as director, Force Management, G3, the Pentagon, Washington, DC; assistant chief of staff for operations in Kosovo; and commander, 1st Cavalry Division Artillery, Fort Hood, Texas. He earned an M.A. from Central Michigan University and was an Army senior service fellow at Harvard University. Currently, he is director of government liaison with Stanley Associates, and a partner in TDRS Consulting in Lawton, Okla.

**Patrecia Slayden Hollis**, until her retirement in late 2007, served as the editor of *Field Artillery* for 20 years and as the first editor of *Fires*. She has interviewed more than 80 senior U.S. and international military leaders, one of her most recent with (then) LTG Raymond T. Odierno, commander, Multinational Corps-Iraq, “2007 Surge of Ground Forces in Iraq — Risks, Challenges, and Successes,” published in the March-April 2008 *Fires*. In 2006, she won the six-state Katie Award and statue from the Dallas Press Club for her interview with USMC LTG John F. Sattler, commander of U.S. and coalition forces during the “Second Battle of Fallujah — Urban Operations in a New Kind of War,” published in the March-April 2006 *Field Artillery*, among other writing awards. She holds an M.A. from George Washington University.

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