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SUMMARY

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U.S. Army Long-Range Precision Fires: Background and Issues for Congress

Improvements to potential adversaries' artillery systems present a challenge to the U.S. military, the Army in particular. In addition to the challenge of improved artillery system capabilities and new employment techniques, the proliferation of special munitions—such as precision, thermobaric, and top-attack munitions—has renewed concerns about the potential impact of enemy cannon and rocket artillery on U.S. combat operations and ground combat systems.

In response to this challenge, the U.S. Army is seeking to improve its ability to deliver what it refers to as long-range precision fires (LRPF) by upgrading current artillery and missile systems, developing new longer-range cannons and hypersonic weapons, and modifying existing air- and sea-launched missiles and cruise missiles for ground launch by Army units.

Both the 2018 National Defense Strategy and the Army's Multi-Domain Operations operational concept call for improved Army LRPF capability to counter what has been described as Russian and Chinese anti-access, area denial (A2/AD) strategies designed to limit the freedom of movement and action of U.S. forces in both Europe and the Pacific region.

The Army has five major programs or efforts underway or under consideration to improve long-range precision fires capabilities:

- **The Extended Range Cannon Artillery (ERCA) program** plans to develop a system capable of accurately firing at targets more than 70 kilometers away, an improvement over the 30-kilometer target distance of current systems.
- **The Precision Strike Missile (PrSM)** is a surface-to-surface, all weather, precision-strike guided missile fired from the M270A1 Multiple Launch Rocket System (MLRS) and the M142 High Mobility Artillery Rocket System (HIMARS). PrSM is intended to replace current MLRS and HIMARS missiles and doubles the current rate-of-fire, with two missiles per launch pod.
- The Army is examining the feasibility of developing a **Strategic Long-Range Cannon (SLRC)** that can fire a projectile at hypersonic speeds up to 1,000 miles to engage air defense, artillery, and missile systems and command and control targets.
- The Army, Navy, Air Force, and Missile Defense Agency (MDA) are developing a **Common- Hypersonic Glide Body (C-HGB)**, which the Army plans to use as part of its Long-Range Hypersonic Weapon (LRHW) program, enabling the C-HGB to be launched from mobile Army ground missile launchers.
- Finally, the Army is attempting to modify existing **Navy SM-6** and **UGM-109 Land Attack Missiles** for ground launch to provide the Army with a mid-range missile capability.

In its oversight, authorization, and appropriations roles, Congress might further study the Army's LRPF program, given potential resource constraints and the importance the Army places on LRPF. Potential issues for Congress include

- justification for strategic cannons, hypersonics, and mid-range battlefield missiles;
- estimated LRPF total costs;
- LRPF and the U.S. Indo-Pacific Command's Investment Plan for the Pacific Deterrence Initiative (PDI);
- force structure requirements;
- LRPF in the Reserve Components;
- other Services' views on Army LRPF; and
- commanding and controlling and targeting long-range fires.

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Why Is This Issue Important to Congress?

Article I, Section 8, of the Constitution gives Congress the authority to "raise and support Armies." On an annual basis, Congress authorizes and appropriates funds for the Army to, among other things, modernize its fleet of ground combat systems. As part of this process, congressional defense committees annually hold dedicated hearings on the Army's budget request for the upcoming fiscal year and a hearing specifically on Army modernization. Congressional defense committees also, on occasion, hold hearings on specific Army ground combat systems.

According to the Army's 2019 Modernization Strategy and statements by Army leadership, long-range precision fires (LRPF) is the Army's primary modernization priority.[1] The Army anticipates that its "budget will remain flat, resulting in reduced spending power over time."[2] Suggestions that the Biden Administration's FY2022 defense budget request might be "flat," along with the potential results of the recently announced FY2022 defense budget review[3] could have implications for the Army's LRPF modernization plans. In its oversight, authorization, and appropriations roles, Congress might further study the Army's LRPF program, given potential resource constraints and the importance the Army places on LRPF.

Background

Perceived Need for Army Long-Range Precision Fires

While the Army has a variety of means to deliver long-range fires, such as organic attack helicopters and unmanned aerial vehicles (UAVs) and air support from Navy and Air Force aircraft, these assets are frequently unavailable due to adverse weather and terrain as well as availability. U.S. Army cannon artillery and missile and rocket systems, on the other hand, generally do not suffer from these restrictions and are part of Army formations from the brigade to corps level.

From a threat perspective, the proliferation of special munitions (e.g., precision, thermobaric, and top-attack munitions), along with improving artillery system capabilities and new employment techniques, have renewed concerns about the potential impact of enemy cannon and rocket artillery on U.S. combat operations and ground combat systems. One senior U.S. Army official contends, "Russia possesses a variety of rocket, missile, and cannon artillery systems that outrange and are more lethal than U.S. Army artillery systems and munitions."[4] Operationally, one study noted that:

> Russian artillery, particularly rocket launchers with conventional, thermobaric, and cluster munitions—using unmanned aerial systems (UAS), both for target location and battle

[1] U.S. Army, *2019 Modernization Strategy: Investing in the Future*, p. 7; U.S. Congress, Senate Armed Services Committee, *Posture of the United States Army*, statement by the Honorable Mark T. Esper, Secretary of the Army, and General Mark A. Milley, Chief of Staff United States Army, 116th Cong., 1st sess., March 26, 2019, p. 6; and Mandy Mayfield, "JUST IN: Army Examining Basing Options for New Weapons in Indo-Pacific," *National Defense*, July 31, 2020.

[2] U.S. Army, *2019 Modernization Strategy: Investing in the Future*, p. 3.

[3] Paul McCleary, "No Growth, No Big Cuts Likely For First Biden Defense Budget," *Breaking Defense*, February 23, 2021, and Tony Bertuca, "Pentagon Lays Out New Defense Budget Review Strategy," *InsideDefense.com*, February 24, 2021.

[4] Bryan Bender, "The Secret U.S. Army Study that Targets Moscow," *Politico*, April 14, 2016.

> damage assessment—is particularly effective against Ukrainian light armor and infantry formations.[5]

In a similar manner, China is reportedly upgrading both its cannon and rocket artillery. Another study noted:

> The entrance of the Chinese and their greater emphasis on much heavier, longer-range rockets that begin to bridge the gap between rocket artillery and short-range ballistic missiles could have a significant effect over time in extending the trend toward longer-range strike systems.[6]

Compared with potential adversaries' longer-range systems, wider variety of munitions, and innovative target acquisition techniques, a diminished U.S. artillery capability—based on fewer units, limitations on cluster munitions use, and shorter effective ranges—could present significant battlefield challenges for the U.S. Army, with implications for modernization efforts.

Long-Range Precision Fires and the National Defense Strategy (NDS) and Multi-Domain Operations (MDO)

The Army's perceived need to improve the range and precision of its current artillery systems is viewed by many observers to justify, to a degree, developmental and modernization efforts. These undertakings are considered to play a crucial role in supporting the U.S. National Defense Strategy. Proposed improvements to the Army's artillery capabilities should support how the Army and the Joint Force intends to fight.

National Defense Strategy

In 2018, the Commission on the National Defense Strategy for the United States published its congressionally-mandated (P.L. 114-328, §942) "independent, nonpartisan review of the 2018 National Defense Strategy (NDS) and issues of U.S. defense strategy and policy more broadly."[7] Among their many recommendations, the Commission stated:

> Of the five competitors and adversaries named in the NDS, four—China, North Korea, Russia, and terrorist groups—are active in the Indo-Pacific region. Deterring aggression in this region requires establishing a forward-deployed defense-in-depth posture. Protecting U.S. interests from China and Russia will require additional investment in the submarine fleet; intelligence, surveillance, and reconnaissance (ISR) assets; air defense; long-range strike platforms; and **long-range ground-based fires** [emphasis added].[8]

Specifically related to the Army, the Commission recommended:

> The United States will need capacity enhancements in the Army. More armor, **long-range fires** [emphasis added], engineering, and air-defense units are required to meet the ground-

[5] David Johnson, "The Challenges of the Now and What They Mean for America's Land Forces," RAND Arroyo Center Briefing, 2016, p. 8.

[6] John Gordon IV et al., *Comparing U.S. Army Systems with Foreign Counterparts: Identifying Possible Capability Gaps and Insights from Other Armies*, RAND Corporation Research Report, 2014, p. 30.

[7] Eric Edelman (Co-Chair), Christine Fox, Kathleen Hicks, Jack Keane, Andrew Krepinevich, Jon Kyl, Gary Roughead (Co-Chair), Thomas Mahnken, Michael McCord, Michael Morell, Anne Patterson, and Roger Zakheim, "Providing for the Common Defense: The Assessment and Recommendations of the National Defense Strategy Commission, " Commission on the National Defense Strategy for the United States, Washington, DC, November 2018, p. iii.

[8] Ibid., p. 34.

> heavy challenges posed by Russia in Eastern Europe and while maintaining a robust deterrent to aggression on the Korean Peninsula.[9]

In addition to acknowledging the importance of long-range precision fires in U.S. defense strategy, the Commission's recommendations seem to support Army requirements regarding the need to significantly upgrade the Army's long-range precision fires capability.

Multi-Domain Operations[10]

In December 2018, the Army introduced its Multi-Domain Operations (MDO) operational concept. According to the Army, MDO was developed in response to the 2018 National Defense Strategy, which shifted the previous focus of U.S. national security from countering violent extremists worldwide to confronting revisionist powers—primarily Russia and China. The MDO concept is to prevail by competing successfully in all domains, short of conflict, to deter a potential enemy. If deterrence fails, Army forces—along with the Joint Force—are to

- **penetrate** enemy anti-access and area denial systems (layered and integrated long-range precision-strike systems, littoral anti-ship capabilities, air defenses, and long-range artillery and rocket systems) to enable strategic and operational maneuver of U.S. forces;
- **disintegrate**—disrupt, degrade, or destroy enemy anti-access and area denial systems to enable operational and tactical maneuver of U.S. forces;
- **exploit** the resulting freedom of maneuver to achieve operational and strategic objectives by defeating enemy forces in all domains; and
- **recompete**—consolidate gains across domains and force a return to competition on favorable terms to the United States and allies.

According to the Army, successfully prosecuting an MDO requires longer-ranged, precision artillery systems that can counter enemy long-range precision-strike systems and penetrate and disintegrate enemy defenses. MDO is to be a central feature of the new Joint Warfighting Concept featuring All Domain Operations—"next-generation, information-based wars using enormous amounts of fast computer analysis across the land, air, sea, space and cyberspace domains."[11] The Department of Defense (DOD) anticipates the new Joint Warfighting Concept will be published and adopted sometime in 2021.[12]

Post-Cold War History of Army Artillery

During the Cold War, a robust U.S. Army artillery capability was seen as a means of countering numerically superior armored and mechanized forces of the Soviet Union and Warsaw Pact.[13] During the Cold War years, Army artillery units consisted of 105 mm, 155 mm, and 8-inch cannon artillery, including both self-propelled and towed variants. Both 155 mm and 8-inch

[9] Ibid., p. 36.

[10] Information in this section is taken directly from U.S. Army Training and Doctrine Command (TRADOC) Pamphlet 525-3-1, "The U.S. Army in Multi-Domain Operations 2028," December 6, 2018. For additional information on MDO, see CRS In Focus IF11409, *Defense Primer: Army Multi-Domain Operations (MDO)*, by Andrew Feickert.

[11] Theresa Hitchens, "COVID Delays Joint Warfighting Concept: Hyten, "*Breaking Defense*, January 22, 2021.

[12] Ibid.

[13] CRS Report R44741, *Selected Foreign Counterparts of U.S. Army Ground Combat Systems and Implications for Combat Operations and Modernization*, by Andrew Feickert.

cannon artillery systems could fire nuclear projectiles and conventional shells. The Army also had two nuclear-capable tactical ballistic missiles: the Lance, with a range of about 75 miles, and the two-stage Pershing, with a range of about 460 miles. In 1982, the Army fielded the Multiple Launch Rocket System (MLRS), which could fire rockets with high-explosive and cluster munitions[14] warheads out to a range of 165 miles.

With the end of the Cold War in 1991, the George H.W. Bush Administration and later the Clinton Administration sought to reduce U.S. military forces in response to perceived decreases in the threat to U.S. security interests and a desire to use savings from reduced defense budgets as a "Peace Dividend" to fund other nonmilitary governmental needs.[15]

According to the Congressional Budget Office (CBO), in January 1992, the Clinton Administration submitted a plan to significantly reduce the number of military forces, particularly those in the Army and the tactical Air Force.[16] For example, between 1990 and 1997, the number of Active and Reserve divisions in the Army were to be reduced by 10 divisions, including 6 divisions from the Active forces and 4 from the Reserves.[17]

As part of Amy force reductions, the number of field artillery units decreased significantly. According to the Army Center of Military History:

> A total of 218 field artillery battalions (96 Regular Army, 17 Army Reserve, and 105 Army National Guard) and 38 batteries, including the batteries in armored cavalry regiments (27 Regular Army and 11 Army National Guard), existed in 1989 prior to the Persian Gulf War. By 1999, only 141 battalions (50 Regular Army and 91 Army National Guard) and 22 batteries (12 Regular Army and 10 Army National Guard) remained. Army Reserve field artillery was reduced by 100 percent as a result of the "bottom-up" review by Secretary of Defense Les Aspin in 1993, which in fact eliminated all Army Reserve combat arms units, allowing that component to focus on support and service organizations.[18]

Attempts to Modernize Army Combat Systems[19]

The U.S. Army's current fleet of tanks, tracked infantry fighting vehicles, self-propelled (SP) artillery, and multiple launch rocket systems—the nucleus of the Army's armored ground forces—was developed in the 1970s and fielded in the 1980s to counter the Soviet Union's and Warsaw Pact's numerically superior ground forces. The combat performance of these systems against Iraqi forces Operation Desert Storm in 1991 reaffirmed for many the role these systems would play in future Army ground operations.

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[14] For information on cluster munitions, see CRS Report RS22907, *Cluster Munitions: Background and Issues for Congress*, by Andrew Feickert and Paul K. Kerr.

[15] Hobart Rowen, "Making the 'Peace Dividend' a Reality," *Washington Post*, October 3, 1991, and Joshua Shifrinson, "George H.W. Bush: American Radical," *War on the Rocks*, December 10, 2018.

[16] CBO: Structuring U.S. Forces After the Cold War: Costs and Effects of Increased Reliance on the Reserves, September 1992, p. x.

[17] Ibid.

[18] Janice E. McKenney, "The Organizational History of Field Artillery, 1775–2003," Center of Military History, United States Army, Washington, DC, 2007, p. 317.

[19] Information in this section is taken from CRS Report R44741, *Selected Foreign Counterparts of U.S. Army Ground Combat Systems and Implications for Combat Operations and Modernization*, by Andrew Feickert, and CRS Report RL32888, *Army Future Combat System (FCS) "Spin-Outs" and Ground Combat Vehicle (GCV): Background and Issues for Congress*, by Andrew Feickert and Nathan J. Lucas.

Efforts to modernize these systems was not as successful as was their performance in Desert Storm. In 2002, the Secretary of Defense cancelled the $11 billion Crusader self-propelled artillery system, largely due to its excessive weight and cost. In 2009, the Secretary of Defense cancelled the $160 billion Future Combat System (FCS) program, intended to develop replacements for the M-1 Abrams tank, the M-2 Bradley IFV, and the M-109A6 Paladin artillery system, due to unrealistic technology expectations and cost. Under the FCS program, the Non-Line-of-Sight-Cannon (NLOS-C) was to have replaced the M-109A6; this program was cancelled when the FCS program was terminated in 2009. One defense expert reportedly suggested, "The FCS program was such a massive failure and a missed opportunity for Army modernization. I think this program single-handedly set the Army back a generation in vehicle technology."[20]

International Agreements Governing Munitions and Battlefield Missile Range

Current U.S. artillery systems, as well as future modernization plans (including LRPF efforts), are governed by two primary international agreements. These agreements are discussed briefly:

United Nations (UN) Convention on Cluster Munitions (CCM)[21]

According to the UN:

> The Convention on Cluster Munitions (CCM) prohibits under any circumstances the use, development, production, acquisition, stockpiling and transfer of cluster munitions, as well as the assistance or encouragement of anyone to engage in prohibited activities. A cluster munition is a weapon consisting of a container or dispenser from which many submunitions or bomblets are scattered over wide areas. Many submunitions are unreliable and fail to explode, thus creating a potential humanitarian impact on civilians both during as well as long after the conflict ends. The Convention provides a comprehensive international response to the suffering caused by the use of cluster munitions and their remnants, to prevent the proliferation and future use of these weapons.
>
> The Convention was opened for signature in Oslo on 3 December 2008 and entered into force on 1 August 2010.[22]

The United States, Russia, China, Israel, Egypt, India, and Pakistan did not participate in the CCM talks, nor did they sign the agreement. Despite not signing the agreement, the United States and DOD decided to undertake efforts to reduce the failure rate of cluster munitions to 1% or less to comply with the spirit of the Convention. DOD issued policy directives in 2008 and 2017 requiring, without exception, that cluster munitions used after 2018 must leave 1% or less of unexploded submunitions on the battlefield.[23]

DOD's 2017 revised policy reversed the 2008 policy requirement regarding cluster munitions. The revised policy permits combatant commanders to use cluster munitions that do not meet the

[20] Sebastian Sprenger, "30 Years: Future Combat Systems—Acquisition Gone Wrong," *Defense News,* October 25, 2016.

[21] For additional information on cluster munitions, see CRS Report RS22907, *Cluster Munitions: Background and Issues for Congress*, by Andrew Feickert and Paul K. Kerr.

[22] United Nations Office of Disarmament Affairs, "Convention on Cluster Munitions," https://www.un.org/disarmament/convention-on-cluster-munitions, accessed February 18, 2021.

[23] DOD Policy on Cluster Munitions and Unintended Harm to Civilians, June 19, 2008, and Memorandum from the Deputy Secretary of Defense, Subject: DOD Policy on Cluster Munitions, November 30, 2017.

1% or less unexploded submunitions standard in extreme situations to meet immediate warfighting demands. Furthermore, the 2017 policy does not establish a deadline to replace cluster munitions exceeding the 1% rate; these munitions are be removed only after new munitions that meet the 1% or less unexploded submunitions standard are fielded in sufficient quantities to meet combatant commander requirements. However, the policy stipulates that DOD "will only procure cluster munitions containing submunitions or submunition warheads" meeting the 2008 unexploded ordnance (UXO) requirement or possessing "advanced features to minimize the risks posed by unexploded submunitions."[24]

In December 2008, the Army decided to cease procurement of a Guided Multiple Launch Rocket System (GMLRS) warhead—the Dual-Purpose Improved Conventional Munition (DPICM) warhead—because its submunitions had a dud rate up to 5%.[25] As efforts to reduce submunition failure rates to 1% or less have proven difficult to achieve, newer munitions being developed for cannons and missiles have instead focused on unitary warheads.

Intermediate-Range Nuclear Forces (INF) Treaty[26]

From 1987 to 2019, the United States and Russia were signatories to the INF Treaty, which required both countries to eliminate and reduce nuclear and ground-launched missiles according to their range. In 2019, following U.S. allegations that Russia had violated its treaty obligations, the United States withdrew from the treaty. According to the Arms Control Association:

> The 1987 Intermediate-Range Nuclear Forces (INF) Treaty required the United States and the Soviet Union to eliminate and permanently forswear all of their nuclear and conventional ground-launched ballistic and cruise missiles with ranges of 500 to 5,500 kilometers. The treaty marked the first time the superpowers had agreed to reduce their nuclear arsenals, eliminate an entire category of nuclear weapons, and employ extensive on-site inspections for verification. As a result of the INF Treaty, the United States and the Soviet Union destroyed a total of 2,692 short-, medium-, and intermediate-range missiles by the treaty's implementation deadline of June 1, 1991.[27]

With respect to alleged Russian violations and U.S. withdrawal from the treaty, the Arms Control Association also noted:

> The United States first alleged in its July 2014 Compliance Report that Russia was in violation of its INF Treaty obligations "not to possess, produce, or flight-test" a ground-launched cruise missile having a range of 500 to 5,500 kilometers or "to possess or produce launchers of such missiles." Subsequent State Department assessments in 2015, 2016, 2017, and 2018 repeated these allegations. In March 2017, a top U.S. official confirmed press reports that Russia had begun deploying the noncompliant missile. Russia has denied that it is in violation of the agreement and has accused the United States of being in noncompliance.

[24] Memorandum from the Deputy Secretary of Defense, Subject: DoD Policy on Cluster Munitions, November 30, 2017.

[25] Kate Brannen, "Army Will Stop Procurement of GMLRS-DPICM After Final Deliveries," *InsideDefense.com*, December 1, 2008.

[26] For additional information on the INF Treaty see CRS Report R43832, *Russian Compliance with the Intermediate Range Nuclear Forces (INF) Treaty: Background and Issues for Congress*, by Amy F. Woolf.

[27] Arms Control Association, "The Intermediate-Range Nuclear Forces (INF) Treaty at a Glance," https://www.armscontrol.org/factsheets/INFtreaty#:~:text=The%201987%20Intermediate%2DRange%20Nuclear,of%20500%20to%205%2C500%20kilometers, August 2019, accessed February 18, 2021.

> On February 2, 2019 the Trump administration declared a suspension of U.S. obligations under the INF Treaty and formally announced its intention to withdraw from the treaty in six months. Shortly thereafter, Russian President Vladimir Putin also announced that Russia will be officially suspending its treaty obligations as well.
>
> On Aug. 2, 2019, the United States formally withdrew from the INF Treaty.[28]

While the INF Treaty was in force, U.S. Army missiles were limited to a range of 499 kilometers. However, after the United States withdrew from the treaty in 2019, this range limitation no longer applied. As a result, the Army is now seemingly permitted to develop and procure both ground-launched ballistic and cruise missiles with a range in excess of 500 kilometers.

Current Army Artillery Force Structure and Systems

Current Army Artillery Force Structure

According to the Army, as of March 1, 2021, the Active Component and Army National Guard (ARNG) had the following number of artillery battalions:

Table 1. U.S. Army Field Artillery Battalions

As of March 1, 2021

System Type	Battalions	Totals
155 mm Towed	Active: 7 ARNG: 9	16
155 mm Self-Propelled (SP)	Active: 11 ARNG: 15	26
Multiple Launch Rocket System (MLRS)	Active: 8 ARNG: 2	10
High Mobility Artillery Rocket System (HIMARS)	Active: 5 ARNG: 12	17
Composite Infantry Brigade Combat Team (IBCT) Artillery Battalions (a)	Active: 13 ARNG: 20	33
TOTALS	Active: 44 ARNG: 58	102

Source: Information provided to CRS by Army Staff, March 3, 2021.

a. Composite IBCT Artillery Battalions consist of one battery of towed 155 mm cannons and two batteries of towed 105 mm cannons.

Current Artillery Systems in Combat

The Army has a variety of cannon artillery systems in use with the Active and Reserve components. A 2019 RAND Report summarizes these systems and associated units:

> **Cannon Systems**
>
> Howitzer [cannon] systems, whether towed or self-propelled, are the primary brigade-level fire support units in the Army. Compared with mortars, howitzers are much larger and

[28] Ibid.

heavier and fire larger projectiles at greater distances, but at lower rates of fire The 155mm cannons in the Army's inventory are also capable of firing the M982 "Excalibur" Global Positioning System (GPS)-guided projectile, which has a maximum range of almost 40 km when fired from a 39-caliber gun (both the towed and self-propelled 155mm howitzers in service in the Army have 39-caliber barrels). There is also an older precision round, the M712 "Copperhead," which is laser-guided, though it has more limited range (16 km). Of additional note, the Army has also funded the M1156 Precision Guidance Kit (PGK) fuze for full-rate production as of 2016; this will provide a much more cost-effective precision capability as it leverages existing ammunition, although these will not have the extended range of Excalibur.

Each Brigade Combat Team (BCT) has an organic field artillery battalion equipped with 18 howitzers, organized in three batteries of six guns each:

- The Infantry Brigade Combat Team's (IBCT's) field artillery battalion has two batteries of M119 105mm howitzers [**Figure 1**] and one battery of M777 155mm howitzers [**Figure 2**];
- The Stryker Brigade Combat Team's (SBCT's) field artillery battalion has three batteries of M777 155mm howitzers; and
- The Armored Brigade Combat Team's (ABCT's) field artillery battalion has three batteries of M109A6 Paladin self-propelled howitzers.

Only the IBCT still fields 105mm howitzers; although they are less capable, they are much lighter than 155s and may be towed by a High-Mobility Multipurpose Wheeled Vehicle (HMMWV). The IBCT's single battery of 155mm howitzers gives it an extended-range precision capability, albeit in limited numbers.

The Army's sole remaining self-propelled howitzer is the M109A6 Paladin [**Figure 3**]. The M109 series of howitzers has been in service for over half a century, and has been modernized repeatedly. The latest version, currently in low-rate initial production, is the M109A7 [**Figure 4**]. When fielded, the M109A7 will be almost a completely different vehicle than the original 109. It, and its companion ammunition supply vehicle, the M992A3, have been rebuilt around a new hull that has substantial commonality with the Bradley fighting vehicle. Although some elements of the weapon system are being improved in the new vehicle, the major improvements will be on the vehicle's reliability and automotive performance.[29]

[29] John Gordon IV, Igor Mikolic-Torreira, D. Sean Barnett, Katharina Ley Best, Scott Boston, Dan Madden, Danielle C. Tarraf, Jordan Willcox, *Army Fires Capabilities for 2025 and Beyond*, RAND Corporation, 2019, pp. 80-82.

Figure 1. M-119 105 mm Towed Howitzer

Source: https://jpeoaa.army.mil/tas/Products/m119a3/, accessed February 9, 2021.

Figure 2. M-777 155 mm Towed Howitzer

Source: https://asc.army.mil/web/portfolio-item/peo-ammo-lw155/, accessed February 9, 2021.

Figure 3. M-109A6 Paladin 155 mm Self-Propelled Howitzer

Source: https://www.dvidshub.net/image/1853828/several-m109a6-paladin-self-propelled-howitzers-conduct-test-fire, accessed February 9, 2021.

Figure 4. M-109A7 Paladin 155 mm Self-Propelled Howitzer

Source: https://www.army.mil/article/202166/field_artillery_soldiers_test_latest_m109a7_paladin_howitzer_upgrade_at_ft_riley, accessed February 9, 2021.

Also from the 2019 RAND report:

> **Rocket/Missile Systems**
>
> The Army has two rocket launcher systems: the tracked M270A1 Multiple Launch Rocket System (MLRS) [**Figure 5**] and the wheeled M142 High Mobility Artillery Rocket System (HIMARS) [**Figure 6**]. Both systems fire the same family of 227mm rockets, as well as a tactical ballistic missile, the Army Tactical Missile System (ATACMS).[30] Both are fielded in field artillery brigades and in some cases at the division level. Figure 4.2 shows HIMARS firing ATACMS. Compared with cannons and mortars, the Army's rockets fire much farther and carry much heavier lethal payloads. Although originally designed with a very heavy Dual-Purpose Improved Conventional Munition (DPICM)[31] payload, the main rocket currently employed is the GPS-guided M31 Guided Multiple Launch Rocket System (GMLRS) rocket[32], which has a unitary HE warhead. The rockets are loaded onto the

[30] According to the Army, "Army Tactical Missile Systems (ATACMS) are 24/7, all-weather, surface-to-surface, inertially-guided missiles used to engage targets in the corps/Army area of influence. ATACMS were used extensively in both Operation Desert Storm (1991) and in Operation Iraqi Freedom (2003) ground wars for shaping operations by the joint force, Joint Special Operations Forces and Army Land Component Command at operational levels. There is one missile per launching assembly (missile pod) with two missiles per launcher load in the M270/M270A1 Multiple-Launch Rocket System and one missile in the M142 High Mobility Artillery Rocket System launcher," https://asc.army.mil/web/portfolio-item/atacms/, accessed February 10, 2021.

[31] DPICM munitions contain hundreds of smaller "cluster bomb" explosives that are often left unexploded across the battlefield, which creates a danger to civilians. Currently, efforts are underway to develop news types of munitions that have similar effects but do not present the residual hazard of unexploded munitions.

[32] According to the Army, "Guided Multiple Launch Rocket System (GMLRS) is a surface-to-surface system used to

launchers in pods of six; two pods may be loaded onto the MLRS launcher, while HIMARS can carry one.

In addition to rockets, both launchers can fire the MGM-140 ATACMS missile. Like the MLRS rockets, ATACMS was originally developed with a submunition payload, but the primary version in current use has a unitary HE warhead (ATACMS Block 1A Unitary). ATACMS is a 610mm missile that has a maximum range of about 300 km.

Both GMLRS and ATACMS were used extensively in Iraq; GMLRS, being highly accurate and with a 200-lb unitary warhead that limits collateral damage relative to air-delivered ordinance, has earned a reputation for accuracy and has been used in close proximity to troops. This is a somewhat atypical use of rockets, which historically have often been used to saturate large areas with large amounts of explosives or large numbers of submunitions.[33]

Figure 5. M270A1 Multiple Launch Rocket System (MLRS)

Source: https://www.dvidshub.net/news/358580/rockets-return-europe, accessed February 9, 2021.

attack, neutralize, suppress and destroy targets using indirect precision fires up to 70-plus km. GMLRS munitions have greater accuracy than ballistic rockets with a higher probability of kill and a reduced logistics footprint. The current GMLRS family of munitions consists of three fielded variants: Dual-Purpose Improved Conventional Munition (DPICM) and the Alternative Warhead (AW) variants to service area targets; and the unitary variant with a single 200-pound-class high-explosive charge to service point targets with low collateral damage. GMLRS is employed with the M270A1 Multiple Launch Rocket System and M142 High Mobility Artillery Rocket System launchers," https://asc.army.mil/web/portfolio-item/guided-multiple-launch-rocket-system-gmlrs-dpicmunitaryalternative-warhead/, accessed February 10, 2021.

[33] John Gordon IV, Igor Mikolic-Torreira, D. Sean Barnett, Katharina Ley Best, Scott Boston, Dan Madden, Danielle C. Tarraf, Jordan Willcox, Army Fires Capabilities for 2025 and Beyond, RAND Corporation, 2019, p. 81.

Figure 6. M142 High Mobility Artillery Rocket System (HIMARS)

Source: https://asc.army.mil/web/portfolio-item/guided-multiple-launch-rocket-system-gmlrs-dpicmunitaryalternative-warhead/ accessed February 9, 2021.

Select Long-Range Precision Fires Modernization Programs

As part of overall Army modernization, the aforementioned cannon and rocket artillery systems are being upgraded to improve capabilities and extend their useful service life. The following section summarizes the Army programs intended to improve its capability to deliver long-range precision fires.

Extended Range Cannon Artillery (ERCA)

Figure 7. Extended Range Cannon Artillery (ERCA)

M-1097A Paladin modified with prototype 58 caliber cannon

Source: https://www.army.mil/article/225777/erca_autoloader_is_being_tested_for_first_time_at_yuma_proving_ground, accessed February 10, 2021.

Description[34]

The ERCA Program (**Figure 7)** is intended to develop a system that can accurately fire at targets more than 70 kilometers away—a dramatic increase over the 30 kilometers that a currently fielded M-1097A 155 mm howitzer can fire. The ERCA program essentially consists of two items: a new rocket-boosted shell, the XM1113, and a longer howitzer barrel adapted to the current M-1097A Paladin system. The longer barrel design contains the rapidly expanding propellant gasses longer, which enables the projectiles to accelerate at greater speeds before exiting the muzzle. Also planned for development are an autoloader to increase the howitzer's rate of fire as high as 10 rounds a minute (or one shell every six seconds) and a communications system that are to work in GPS-denied environments. Initial plans call for 18 howitzers—a full battalion—entering service in 2023. The howitzers are being developed at the Army's Picatinny Arsenal, New Jersey, and BAE Systems' facilities in York, PA; Sterling Heights, MI; and Minneapolis, MN.

[34] Information in this section is taken from Major. Gen. Cedric T. Wins, "RDECOM's Road Map to Modernizing the Army: Long-Range Precision Fires," *Army News,* September 26, 2018, and BAE Systems, "U.S. Army Awards BAE Systems $45 Million Contract for Extended Range Cannon Artillery Prototype," July 15, 2019.

Program Summary

The Government Accountability Office (GAO) provided the following ERCA program summary:

> The Army's ERCA program is an upgrade to the M109 self-propelled howitzer intended to improve its lethality, range, and reliability. ERCA Increment 1C, a middle-tier[35] rapid prototyping effort, will add equipment to the existing M109 vehicle to mature the design of the upgrade. The Army also plans an Increment 2 effort that will include additional vehicle enhancements. We assessed the Increment 1C rapid prototyping effort.
>
> The Army initiated ERCA Increment 1C as a middle-tier acquisition rapid prototyping effort in September 2018 with an objective of building 18 prototypes equipped with new armament, electrical systems, and other upgrades beginning in fiscal year 2021. The Army plans to issue the prototypes to a battalion for operational testing by fiscal year 2023. The rapid prototyping effort is projected to end in October 2023 with the 18 prototypes issued to the battalion to gather information for future ERCA increments. In July 2019, the program made an award using other transaction authority to BAE Systems for Increment 1C engineering analysis, prototype hardware fabrication and integration, and power updates. The Army also plans to make multiple additional awards in the future using other transaction authority for integration support, prototype fabrication, steel gun mount, and loader assist prototypes.
>
> The Army plans a separate Increment 2 effort, which it expects will leverage the cannon and other components designed in Increment 1C. The Army currently expects to also use the middle-tier rapid prototyping pathway for this effort, and plans to build and issue 18 prototype vehicles starting in fiscal year 2024.[36]

In its report, GAO noted that "the program also did not have a cost estimate informed by independent assessment or formal schedule risk assessment at the time of program initiation," and that "the Army currently expects Increment 1C to cost approximately $486 million."[37] According to the Army, anticipated funding from FY2022 to FY2026 of approximately $1.4 billion is intended to

- fully fund the part of the program intended to extend the system's range beyond 70 kilometers;
- complete prototype testing and conduct operational assessment to gain soldier feedback;
- procure 77 ERCA vehicles equipped with increased range capability; and
- continue efforts exploring material solutions to improve ERCA rate of fire.[38]

[35] According to the Defense Acquisition University, "Middle Tier Acquisition (MTA) is a rapid acquisition interim approach that focuses on delivering capability in a period of 2-5 years. The interim approach was granted by Congress in the FY2016 National Defense Authorization Act (NDAA) Section 804 and is not to be subject to the Joint Capabilities Integration Development System (JCIDS) and DOD Directive 5000.01 'Defense Acquisition System.' The approach consists of utilizing two acquisition pathways: (1) Rapid Prototyping and (2) Rapid Fielding. It does this by streamlining the testing and deployment of prototypes or upgrading existing systems with already proven technology."

[36] United States Government Accountability Office (GAO), "Report to Congressional Committees: Defense Acquisitions Annual Assessment Drive to Deliver Capabilities Faster Increases Importance of Program Knowledge and Consistent Data for Oversight Report to Congressional Committees," GAO-20-439, June 2020, p. 99.

[37] Ibid., p. 100.

[38] Taken from the Army briefing, "Long Range Fires Cross Functional Team; ERCA Rate of Fires Initiatives," December 7, 2020.

Program Developments

In December 2020, a prototype ERCA system reportedly hit a target 70 kilometers (43 miles) away during testing at Yuma Proving Ground, Arizona.[39] According to the Army, in October 2019, it conducted demonstrations of the new XM1113 and Excalibur M982 munitions from a prototype ERCA self-propelled howitzer and test shots exceeded previous maximum ranges.[40] Internal Army efforts to design an autoloader have reportedly run into developmental difficulties, with the Army looking to small business for alternatives.[41] Given these setbacks, some say a functioning autoloader capacity for the ERCA may not be available by 2024, as previously planned.[42]

Precision Strike Missile (PrSM)

Figure 8. Precision Strike Missile (PrSM)

Source: https://www.lockheedmartin.com/en-us/products/precision-strike-missile.html, accessed February 16, 2021.

[39] Jen Judson, "Army Long-Range Cannon Gets Direct Hit on Target 43 Miles Away," *Defense News*, December 21, 2020.

[40] Devon L. Suits, "Army Working Toward Improved Long Range Precision Fires," *Army News Service*, October 10, 2019.

[41] Ashley Roque, "Rapid Fire: US Army Eyeing Revamped ERCA Autoloader and Alternative Solutions," *Jane's Defence*, October 7, 2020.

[42] Ibid.

Description

According to the Army,[43] the Precision Strike Missile (PrSM) **(Figure 8)** is a surface-to-surface, all-weather, precision-strike guided missile fired from the M270A1 Multiple Launch Rocket System (MLRS) and the M142 High Mobility Artillery Rocket System (HIMARS). PrSM, which is intended replace ATACMS, doubles the current rate-of-fire with two missiles per launch pod. A ballistic missile with a cluster munition-compliant payload, the PrSM is to be used for attacking threat air defense systems, missile launchers, command and control centers, troop assembly/staging areas, and high-payoff targets throughout the battlefield. The missile is designed to exceed a range of more than 500 kilometers.[44] Lockheed Martin is currently the PrSM's only prime contractor.

Program Summary

According to GAO:

> The Army plans to conduct an independent technical risk assessment prior to PrSM's expected development start in June 2021. Army officials report that in the meantime, they are taking steps to mitigate technology risk. For example, the Army conducted a prototype missile test to a range of 240 kilometers in December 2019. The Army plans to demonstrate the objective range of 499 kilometers at a later date, but program officials said that they have yet to schedule that test.
>
> The Army initially tested the missile with the M142 rocket launcher. Demonstrations with the M270A2 launcher are dependent on completion of upgrades to that system. According to program officials, the Army will complete these upgrades by fiscal year 2023 to support the missile's early capability.[45]

The Army plans to start operational testing in August 2024 and achieve Initial Operational Capability in August 2025.[46] Estimated program costs and quantities (in FY2020 dollars in millions) are $895 million for development and $2,038 million for procurement, for a total of 51 missiles for testing and 2,422 for the approved acquisition objective.[47]

Program Developments

On December 10, 2019, Lockheed Martin reportedly conducted a successful test at the White Sands Missile Range, NM, where the PrSM was successfully fired from a HIMARS and flew about 240 kilometers to the target area.[48] In April 2020, Lockheed Martin conducted its third successful test, whereas Raytheon reportedly decided in March 2020 not to continue its participation in the development and testing phase, but plans to compete in future PrSM development phases.[49] In May 2020, the Army reportedly drafted "an acquisition strategy calling

[43] United States Army Acquisition Support Center, "Precision Strike Missile (PrSM)," https://asc.army.mil/web/portfolio-item/ms-prsm/, accessed February 21, 2021.

[44] Monica Guthrie, "Precision Strike Missile Conducts Third Test Firing," Army News Service, April 30, 2020.

[45] United States Government Accountability Office (GAO), "Report to Congressional Committees: Defense Acquisitions Annual Assessment Drive to Deliver Capabilities Faster Increases Importance of Program Knowledge and Consistent Data for Oversight Report to Congressional Committees," GAO-20-439, June 2020, p. 97.

[46] Ibid.

[47] Ibid.

[48] Ashley Tressel, "Lockheed Announces Successful First Test of PrSM," *InsideDefense.com*, December 10, 2019.

[49] Ashley Tressel, "Army, Lockheed Conduct Third Successful Test Flight of Precision Strike Missile," *InsideDefense.com*, April 30, 2020.

for at least three additional opportunities for competition on the Precision Strike Missile, giving Raytheon—which was bumped from the contest in March—and other interested companies a chance to improve the base missile being developed by Lockheed Martin as a follow-on to the Army Tactical Missile." [50] In June 2020, the Army reportedly completed a test of an advanced PrSM multi-mode seeker (presently radio frequency [RF] and imaging infrared [IR]).[51] The seeker is intended to locate targets in a denied environment and engage targets with unknown or poorly located coordinates, such as ships moving at sea.[52]

Strategic Long Range Cannon (SLRC)

Description

The Army is reportedly examining the feasibility of developing a cannon that can fire a projectile at hypersonic speeds up to 1,000 miles to engage air defense, artillery, and missile systems and command and control targets.[53] The SLRC is to consist of a cannon, prime mover and trailer, and projectiles capable of delivering massed fires at strategic ranges.[54] The SLRC battery is to include four special platforms with cannons and heavy equipment transporters for the battery's other equipment. Each SLRC could be manned by a crew of eight soldiers.[55]

Program Summary

The SLRC is not currently a program of record.[56] The Army plans to demonstrate a prototype of the long-range cannon in 2023, after which it intends to decide whether to begin a program of record.[57] Some observers have suggested that "the technology needed to achieve such a capability is so cutting edge that it's unknown whether that specific distance can be achieved at a cost that won't break the bank."[58] In addition to cost concerns that some have raised, some also have concerns regarding the Army's ability to acquire and engage targets at these extended ranges with its own organic assets.[59]

Some in Congress have expressed concerns about the feasibility of, and need for, the SLRC. For example, H.Rept. 116-120 of the FY2020 NDAA (P.L. 116-92) calls for the National Academies

[50] Jason Sherman, "Army Eyes Three Future Competitions to Upgrade PrSM," *InsideDefense.com*, May 8, 2020.

[51] "Army Tests Future PrSM Seeker," *Jane's Defence,* June 8, 2020.

[52] Ibid.

[53] Jason Sherman, "Army Preparing to Award Contracts for Strategic Long Range Cannon," *InsideDefense.com*, October 18, 2019.

[54] Dylan Malyasov, "U.S. Army Criticized for Crazy 1,000 km Range Super Cannon Concept," *DefenceBlog*, October 12, 2020.

[55] Ibid.

[56] The Defense Acquisition University defines a program of record as a program recorded in the current Future Years Defense Program (FYDP) or as updated from the last FYDP. Program of Record can also refer to a program having successfully achieved formal program initiation, normally Milestone B in the Defense Acquisition Process which is considered the formal start of a program.

[57] Sydney J. Freedberg, "Army Tests New A2/D2 Tools: Howitzers, Missiles, and 1,000 Mile Super-Gun," *Breaking Defense*, May 1, 2020.

[58] Jen Judson, "Strategic, Long-Range Cannon Preps to Jump its First Tech Hurdle," *Defense News*, October 14, 2019.

[59] Loren Thompson, "Army Breakthroughs In Long-Range Fires Raise Novel Questions About Targeting, Organization, Command," *Forbes*, August 7, 2020.

of Sciences, Engineering, and Medicine to examine the feasibility of the U.S. Army's Strategic Long Range Cannon program.[60] Among other things the study is to

- assess the technology approaches, policies, and concepts of operations of the Army's SLRC and how it supports the Army's Multi Domain Operations (MDO) vision, and
- evaluate the essential technologies, materials, and manufacturing capabilities needed to achieve the program's key performance criteria and develop a technology maturation roadmap.

The report was due to defense committees no later than August 31, 2020, but was not provided by that date. The report is now reportedly expected to be delivered to the defense committees sometime in May 2021.[61] Reportedly, some unspecified work continues on SLRC but the Army is awaiting the findings of the report before continuing further development.[62]

Program Developments[63]

The Army reportedly has already started firing test loads over short ranges to determine SLRC propellant and projectile requirements. As previously noted, the Army plans to start building a functioning SLRC weapon in 2021, with limited-range first test shots likely to begin in 2022, followed by full-range shots in 2023. Based on these results, the Army intends to decide whether or not to develop the SLRC as a program of record.

[60] H.Rept. 116-120, National Defense Authorization Act for Fiscal Year 2020, Report of The Committee on Armed Services House of Representatives on H.R. 2500, June 19, 2019, p. 42.

[61] As per email provided to CRS on February 17, 2021.

[62] Jen Judson, "Strategic Long-Range Cannon Effort on Hold Ahead of Report," *Defense News,* March 9, 2021.

[63] Information in this section is taken from Sydney J. Freedberg, "LRPF: Army Missiles, Cannon Face Big Tests In '21," Breaking Defense, October 21, 2020.

Army Long Range Hypersonic Weapon (LRHW)

Figure 9. Artist Depiction of an Army LRHW Unit

Source: Dylan Malyasov, "Lockheed Martin Releases First Image of New Hypersonic Long-Range Missile System," *DefenseBlog*, October 8, 2020.

Description

According to the Army:

> Hypersonic weapons are capable of flying at five times the speed of sound and operate at varying altitudes, making them unique from other missiles with a ballistic trajectory. The Army Long Range Hypersonic Weapon (LRHW) [**Figure 9**] will introduce a new class of ultrafast, maneuverable, long-range missiles that will launch from mobile ground platforms.[64]

Program Summary

According to the Army:

> Developing hypersonic weapons for a national mission set requires constant cross-service coordination. Collaborating across services, agencies and with the Office of the Secretary of Defense through a joint service memorandum of agreement on design, development, testing and production, the Army, Navy, Air Force and the Missile Defense Agency (MDA) are all accelerating initiatives to field hypersonic weapon systems using a Common

[64] "Hypersonics by 2023," *Army News Services*, September 4, 2019, and Nancy Jones-Bonbrest, "Army Awards Hypersonic Weapon System Contracts," *Army News Service*, September 3, 2019.

> Hypersonic Glide Body (C-HGB). The Navy leads design of the C-HGB, while the Army will lead production and build a commercial industrial base. This cooperation enables the services to leverage one another's technologies as much as possible, while tailoring them to meet specific design and requirements for air, land and sea.[65]

The Army's intent is to

> [f]ield a prototype long-range hypersonic weapon to the strategic fires battalion by fiscal year 2023. This includes hypersonic missiles with the C-HGB, existing trucks and modified trailers with new launchers, and an existing Army command-and-control system.[66]

Program Developments

According to the Army:

> In March 2019, the Secretary and Chief of Staff of the Army directed the accelerated delivery of a prototype ground-launched hypersonic weapon with residual combat capability by Fiscal Year (FY) 2023. To execute this strategy, the Army Rapid Capabilities and Critical Technologies Office (RCCTO) has selected two prime contractors to build and integrate components of the LRHW prototype. On August 29, the Army awarded an Other Transaction Authority (OTA) agreement to Dynetics in the amount of $351.6 million to produce the first commercially manufactured set of prototype Common-Hypersonic Glide Body (C-HGB) systems. Also on August 29, the Army awarded a second OTA[67] agreement to Lockheed Martin in the amount of $347.0 million as the LRHW prototype system integrator.[68]

Reportedly, "the Army has set an 'aggressive' test plan for the LRHW program that calls for six flights, including two executed by soldiers who will operate the first battery of the new ground-launched strategic weapon, by 2023."[69] On March 19, 2020, the Army and Navy reportedly successfully test-fired the C-HGB at the Pacific Missile Range Facility, in Kauai, HI, clearing the C-HGB for further development.[70]

Other Army Missile Efforts

According to reports, the Army is pursuing a new mid-range missile system or systems capable of attacking moving targets at land and at sea.[71] The effort is intended to fill a gap in the Army's

[65] "Hypersonics by 2023," *Army News Services*, September 4, 2019.

[66] Ibid.

[67] From the Defense Acquisition University: "Other Transaction Authority (OTA) is the term commonly used to refer to the (10 U.S.C. 2371b) authority of the DOD to carry out certain prototype, research and production projects. Other Transaction (OT) authorities were created to give DOD the flexibility necessary to adopt and incorporate business practices that reflect commercial industry standards and best practices into its award instruments. As of the 2016 National Defense Authorization Act (NDAA) Section 845, the DOD currently has permanent authority to award OT under (10 U.S.C. 2371) for (1) Research, (2) Prototype, and (3) Production Purposes." [quotation marks correct?]

[68] Nancy Jones-Bonbrest, "Army Awards Hypersonic Weapon System Contracts, *Army News Service*, September 3, 2019.

[69] Jason Sherman, "Army Eyes Half-Dozen Hypersonic Flight Tests to Support LRHW Battery by 2023," *InsideDefense.com*, October 23, 2019.

[70] John A. Tirpak, "Army, Navy Hypersonic Test Clears Way for Weapon Development," *Air Force Magazine*, March 20, 2020.

[71] Jen Judson, "US Army Pursues New Mid-Range Missile, as Tactical Missile Upgrade Hits Delay," *Defense News*, September 2, 2020.

long-range precision fires portfolio, which includes the PrSM and LRHW.[72] In early 2020, the Department of Defense reportedly determined the Army should be assigned a mid-range capability mission.[73] Seeming to affirm this, in July 2020, Army Chief of Staff General James McConville suggested that "the Army would pursue mid-range capabilities, and that, "we're going to have mid-range missiles that can sink ships."[74] During a Rim of the Pacific (RIMPAC) exercise in 2018, the Army test-fired "multiple rockets from the rocket artillery platform at the ex-USS Racine during a combined arms sinking exercise."[75]

According to reports, the Army is exploring the possibility of converting existing U.S. Navy missiles for that purpose:

> On November 6, 2020, the Army awarded Lockheed Martin a $339.3 million contract to "design, build, integrate, test, evaluate, document, deliver, and support" a new Mid-Range Capability, or MRC, essentially converting the Navy Standard Missile (SM)-6 [**Figure 10**] and Tomahawk cruise missiles [**Figure 11**] into a prototype land-based missile system that can strike targets in the range of 500 to 1,500 kilometers, or 310 to 930 miles. The effort builds off tests that the Army conducted last August. The goal is to have an operational new land cruise missile by 2023…. After that 2023 date, the Army will "explore the possibility" of going "beyond the prototype and see if that mid-range capability could be integrated onto an autonomous launcher that would augment existing formations."[76]

If the prototype proves successful, the Army reportedly would organize units into batteries[77] composed of a battery operations center with three parts: a command and control center, a launcher, and the missiles, with four and six missiles per battery.[78]

Congressional Concern with LRPF Programs

Many in Congress have also expressed concern with both Army and Marine LRPF efforts, including its use in an anti-ship role. Section 1715 of the FY2020 National Defense Authorization Act (NDAA) (P.L. 116-92) states:

> a) IN GENERAL.—Not later than March 1, 2020, the Secretary of Defense shall submit to the Committees on Armed Services of the Senate and House of Representatives a report on the efforts by the Army and Marine Corps to develop and deploy ground-based long-range rocket and cannon artillery to counter land and maritime threats.
>
> (b) ELEMENTS.—The report required by subsection (a) shall include each of the following:
>
> (1) An assessment of ongoing and future Army and Marine Corps efforts to develop and deploy ground-based long-range rocket and cannon artillery to counter land and

[72] Ibid.

[73] Jason Sherman, "Army Taps Lockheed to Integrate Tomahawk, SM-6 Into Prototype Land-Launch System," *InsideDense.com*, November 9, 2020.

[74] Ibid.

[75] Ryan Pickrell, "The U.S. Military is Racing to Develop Missiles that Can Sink Ships at Long Distance as China's Naval Power Grows," *Business Insider*, January 18, 2019.

[76] Patrick Tucker, "US Army Aims to Convert Navy Missiles for Remote-Launched Strikes," *Defense One*, November 13, 2020.

[77] An Army artillery battery is equivalent to a company or troop and has between 100 to 200 soldiers and four to nine systems.

[78] Jason Sherman, "Army Taps Lockheed to Integrate Tomahawk, SM-6 Into Prototype Land-Launch System," *InsideDefense.com*, November 9, 2020.

maritime fires in the areas of operations of United States Indo-Pacific Command and United States European Command.

(2) An assessment of and recommendations for how the Department of Defense can improve the development and deployment of such artillery.

(3) An analysis, assessment, and determination of how such artillery employed in support of the United States and allied forces will be stationed, deployed, operationally positioned, and controlled to operate effectively against potential adversaries throughout the depth of their tactical, operational, and strategic formations, including any recommendations of the Secretary regarding how such capabilities and support could be enhanced.

(c) FORM OF REPORT.—The report required by subsection (a) shall be submitted in unclassified form, but may contain a classified annex.[79]

It has not been reported whether the Secretary of Defense has provided his findings to the armed services committees as required.

Figure 10. SM-6 Multi-Purpose Missile

Source: https://www.raytheonmissilesanddefense.com/capabilities/products/sm6-missile, accessed March 1, 2021.

[79] National Defense Authorization Act for Fiscal Year 2020, P.L. 116-92, December 20, 2019.

Figure 11. UGM-109 Tactical Land Attack Missile (TLAM)

Source: https://www.raytheonmissilesanddefense.com/capabilities/products/tomahawk-cruise-missile, accessed March 1, 2021.

Potential Issues for Congress

There are a number of potential issues Congress may face relating to the Army's Long-Range Precision Fires Program. Potential issues include, but are not limited to, the following:

Justification for Strategic Cannons, Hypersonics, and Mid-Range Battlefield Missiles

Many would argue that Army programs such as the ERCA and PrSM are logical upgrades and improvements to proven legacy weapons systems to counter potential adversaries with significantly improved artillery systems and associated capabilities of their own. ERCA and PrSM are considered fundamental components of the Army's traditional battlespace, and they play an important fire support role in brigade, division, and corps-level ground combat operations—a role that the Army has organized, equipped, and trained for arguably since the Second World War to present day.

The Army says that longer-range artillery systems are needed to respond to what DOD calls the enemy anti-access, area denial (A2/AD) environment (layered and integrated long-range precision-strike systems, littoral anti-ship capabilities, air defenses, and long-range artillery and rocket systems), which can theoretically keep U.S. forces at bay and deny freedom of movement. Under this premise, the Army developed its MDO operational concept and is prioritizing and focusing its modernization efforts to support MDO and the Army's ability to counter A2/AD systems.

Some analysts, however, suggest the potential threat from enemy A2/AD systems is overstated and perhaps unfounded. A 2019 report from the U.S. Army War College states:

> Exaggeration and hype suggesting Russia has the ability to interdict its adversaries across large areas of European air and maritime space in particular leads to a distorted picture. If left uncorrected, these inaccuracies could influence policy by constraining response

> options for assertive Russian maneuvers. A public perception that allied reinforcement of the Baltic States is not possible during a time of conflict, for example, will falsely limit the options palatable to US policymakers. Neat circles on a map, while important for drawing attention to the problem, also foster the public impression of "no-go zones" that would be lethal for US or allied military assets. But Russian A2/AD systems will not prevent NATO forces from getting to frontline states. They could, however, prevent NATO from trying at all.[80]

This report further contends:

> Russia commonly demonstrates its air defense capabilities and exploits the myth of A2/AD "bubbles" among its neighbors to sow doubt among NATO allies. In doing so, the Kremlin uses Western insecurities regarding ensured access to its advantage and feeds a perception that NATO cannot operate effectively in a contested environment. The ongoing debate thus becomes a self-constructed psychological threat that reflects Western insecurities toward Russia, thus constituting a way for the Kremlin to be blamed for the West's capability shortfalls.[81]

Another report proposed in 2015 that China's A2/ASD strategy is the result of a misconception regarding potential U.S. military interventions in China:

> Yet, although China is certainly developing military capabilities that would complicate U.S. intervention in a major conflict in the region involving China, Chinese writings on military strategy and operations rarely if ever mention the concept of counter-intervention. Despite the frequent use of the term by outside observers—who attribute the concept to Chinese sources—the Chinese military does not use the term to describe its own strategy. When it does discuss related concepts of "dealing with" or "resisting" a third party's military intervention, it mentions them as a sub-component of one of the core campaigns or scenarios that drive Chinese planning, such as an armed conflict over Taiwan, not as an overarching strategy. The absence of the term and infrequent use of related ideas in authoritative Chinese military writings does not appear to reflect a larger denial-and-deception campaign, since this literature often involves much more sensitive subjects.
>
> This omission matters for several reasons. Identifying "counter-intervention" as the focus of China's military strategy, and attributing it to Chinese sources, sustains a flawed assessment of China's military modernization, mistaking an operational concept for a military strategy or even a grand strategy aimed at pushing the United States out of the Asian littoral. China's military modernization pursues several different goals, some of which might require dealing with potential U.S. military intervention, while others do not. Even within a Taiwan scenario, countering U.S. intervention is only one of a set of operations that the People's Liberation Army (PLA) believes it would need to undertake in such a campaign. More generally, the focus on "counterintervention" overstates the role of the United States in Chinese military planning and contributes to the security dilemma as well as growing security competition in the region.[82]

The Center for a New American Security (CNAS) further challenges the role A2/AD plays in current DOD and Army thinking:

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[80] Keir Giles and Mathieu Boulegue, "Russia's A2/AD Capabilities: Real and Imagined," *Parameters: The U.S. Army War College Quarterly*, vol. 49, no. 1, Parameters Spring/Summer 2019, p. 21.

[81] Ibid., p. 25.

[82] M. Taylor Fravel and Christopher P. Twomey, "Projecting Strategy: The Myth of Chinese Counter-Intervention," *The Washington Quarterly*, sponsored by The Elliott School of International Affairs at George Washington University, Winter 2015, p.172.

> For at least a decade, A2/AD has helped focus the DOD on critical Chinese and Russian threats to U.S. military operations in East Asia and Eastern Europe. Today, however, it has outlived its usefulness as a diagnosis of Chinese and Russian approaches to warfare and as a framework for guiding subsequent operational and force-planning decisions based on the challenges they pose. Terminology and words matter, most acutely in problem diagnosis…. If the DOD cannot move beyond A2/AD, it risks wasting billions of taxpayer dollars building a future force based on a flawed premise. More worryingly, it puts the United States at greater risk of losing a future war against China or Russia.[83]

Given these assertions, some may argue that justification for the development of longer-range Army systems primarily on the basis of countering enemy A2/AD and the ability to prosecute MDO may be based more on a perception of enemy capabilities and strategy than on an enemy's actual intent and capabilities. Although developing and deploying Army strategic cannons, hypersonic weapons, and mid-range missiles would increase both the range and capabilities of Army artillery systems, the articulated need for these systems, in terms of countering enemy A2/AD, some could argue, may be overstated. A focus on longer-range cannons and missiles to counter A2/AD, some may contend, could compromise the Army's ability to provide artillery support to brigade, division, and corps-level ground combat operations by consuming resources and funding in a potential budgetary- constrained environment that might otherwise be dedicated to improving ground-based combat capabilities within the Army's traditional battlespace.

Estimated LRPF Total Costs

As the Army's stated modernization priority, Congress may consider whether long-range precision fires should receive funding priority. Although some estimated individual program costs are publicly available for selected programs and efforts in the Army's LRPF portfolio, these costs tend to focus on system-specific Research, Development, Test & Evaluation (RDT&E) and procurement costs and not overall associated costs.

Overall cost is reflected in the "DOTMLPF-P"[84] cost—that is, costs associated with developing and implementing associated **D**octrine; creating new or modifying existing **O**rganizations; **T**raining soldiers and units; acquiring **M**ateriel; changes needed in **L**eadership and education; new or existing **P**ersonnel requirements; new or modified **F**acilities (including training ranges); and changes in **P**olicy. In some cases, this cost can be relatively minimal; in other cases, particularly those involving new, technologically advanced weapon systems, this cost can be more substantial. Sometimes, the DOTMLPF-P cost can be reduced by introducing a new system; for example, one that requires fewer personnel to operate, has fewer and less costly maintenance requirements, or can deliver the same doctrinally-required effects more efficiently. The PrSM, which comes two missiles to a launch pod rather the current single missile per launch pod configuration of ATACMs, is an example of such a system.

Some policymakers may seek a better understanding of DOTMLPF-P costs, not only for the aforementioned LRPF systems under development, but also for the Army's LRPF portfolio as a whole. In the case of the SLRC and LRHW programs, as previously noted, some observers have expressed concerns about the costs associated with developing and fielding these capabilities. In addition, Army efforts to develop a mid-range missile capability—even if based on modifying

[83] Chris Dougherty, "Moving Beyond A2/AD," Center for New American Security, Washington, DC, December 3, 2020.

[84] For a more detailed description of DOTMLPF-P see, https://acqnotes.com/acqnote/acquisitions/dotmlpf-analysis, accessed February 24, 2021.

and acquiring existing Navy systems—could likewise prove costly. In addition, a DOTMLPF-P cost breakdown could prove beneficial if the Army is required to make tradeoffs within its LRPF portfolio due to affordability issues.

As part of a DOD review prior to the submission of President Biden's FY2022 defense budget request, "long-range fires, such as artillery and ground-to-ground missiles," are to be considered for reductions or curtailment in order to fund the President's other defense priorities.[85] If this is the case, knowing the total costs for LRPF systems and the LRPF portfolio could benefit both defense officials and policymakers during the DOD review process.

LRPF and the U.S. Indo-Pacific Command's Investment Plan for the Pacific Deterrence Initiative

In testimony to the Senate Armed Services Committee on March 9, 2021, the Commander of the U.S. Indo-Pacific Command (USINDOPACOM) stated;

> USINDOPACOM requires highly survivable, precision-strike fires featuring increased quantities of ground-based missiles and improved air and long-range naval fires capable of ranges over 500 km. These fires must be supported by electronic warfare, space, cyber, and over-the-horizon radar capabilities. They must also be operationally decentralized and geographically distributed to provide a credible, offensive, and conventional deterrent to assure U.S. freedom of action.[86]

Section 1251 of the National Defense Authorization Act (NDAA) for FY2018 (P.L. 115-91), as amended by Section 1253 of FY2019 NDAA (P.L. 115-232), authorized the Indo-Pacific Stability Initiative to enhance the security and stability of the Indo-Pacific region. Section 1251 of the FY2021 NDAA (P.L. 116-283) requires the Commander of U.S. Indo-Pacific Command (USINDOPACOM) to provide, no later than March 1, 2021, an independent assessment to Congress outlining USINDOPACOM's resourcing requirements for what is now referred to as the Pacific Deterrence Initiative (PDI). In its report to Congress, USINDOPACOM requests $408 million for FY2022 and $2.91 billion for FY2023-FY2027 for "Ground-Based, Long-Range Fires" that are "highly survivable, precision-strike fires can support the air and maritime maneuver from distances greater than 500 km."[87] While no additional detail is provided in this unclassified version, the report notes that "strategic context and more detailed funding profiles are provided in the classified version of this report,"[88] suggesting that additional information related to the Army's LRPF programs may be included in the report's classified version.

Policymakers may review the classified version of USINDOPACOM's report to determine if there are cost and funding implications for the Army's LRPF programs and associated force structure requirements. Furthermore, the classified report might also address where Army LRPF units are to be stationed, which could have operational and cost implications. If the classified

[85] Bryan Bender and David Brown, "Pentagon Scrubs Major Programs Ahead of New Budget Request," *Politico Pro*, February 24, 2021.

[86] Statement of Admiral Philip S. Davidson, U.S. Navy, Commander, U.S. Indo-Pacific Command Before the Senate Armed Services Committee on U.S. Indo-Pacific Command Posture, March 9, 2021, p. 7.

[87] Information in this section is taken from the Unclassified Version of The National Defense Authorization Act (NDAA) 2021 Section 1251, Executive Summary, Independent Assessment U.S. Indo-Pacific Command's Investment Plan Pacific Deterrence Initiative, Fiscal Years 2022 and 2023-2027, as of February 27, 2021, p. 2.

[88] Ibid., p. 1.

version does not contain this level of detail, Congress might examine these issues further with DOD and USINDOPACOM.

Force Structure Requirements

With the possible introduction of new LRPF systems, the Army could be required to create units to employ and support these systems. In such cases, the Army has three basic options to obtain the necessary soldiers:

- The Army could request additional end strength from Congress as part of annual budget requests.[89]
- The Army could convert an existing unit into a new unit. For example, the Army could convert a towed 155 mm howitzer battery into a LRHW battery.
- The Army could deactivate a unit and "use" that unit's end strength to form a new unit. For example, the Army could deactivate an infantry battalion and use its end strength to form a mid-range missile battalion.

The Army does not necessarily have to pick one of these options, as all three can be used concurrently. The Army has the option to request an end strength increase from Congress. However, recent statements from Army leadership proposing that the Army might have to cut end strength to fund modernization[90] suggest that such a request for new LRPF units may be unlikely under current budgetary constraints.

Although the Army has been specific about the LRPF systems it plans to develop, little has been publicly discussed about the conversion or creation of units to employ or support these systems. While references have been made to LRHW and mid-range missile batteries, a Multi-Domain Task Force (MDTF)—an Army unit under development which could be equipped with land-based, deep strike capabilities—as well as a notional Strategic Fires Battalion, little has been said about the following concerns:

- how these units would be organized and equipped;
- how many batteries and battalions are planned to be formed;
- when these units would become operational;
- how many soldiers would be required for these units; and
- where LRPF units might be stationed in the United States and overseas.

In addition to LRPF units themselves, new headquarters and support units might be required to support LRPF units, such as target acquisition, missile maintenance, and other types of logistical units. These units have similar personnel, equipment, and stationing requirements which would also need to be considered when discussing LRPF units.

If the Army intends to request additional end strength for LRPF and associated units, there are budgetary implications for Congress. In addition, new LRPF and associated headquarters and support units could require significant numbers of vehicles and types of new equipment, which

[89] In accordance with 10 U.S.C. §115, Congress annually authorizes the end strength for active duty and reserve component personnel. End strength is the maximum number of personnel permitted in each military service (e.g., Army, Marine Corps, Navy, Air Force) as of September 30, the last day of the fiscal year.

[90] Sydney J, Freedberg, "2021: Will Army Modernization Survive?" *BreakingDefense.com*, December 29, 2020, and Kyle Rempfer, "Army 'Taking a Hard Look' at What End-Strength it Can Actually Afford," *Army Times*, February 18, 2021.

would also have cost implications. If the Army intends to deactivate or convert units, doing so could have operational implications that Congress may discuss with DOD and the Army.

Another concern for Congress might be where these new units are to be based. Reportedly, consideration is being given to stationing a Multi-Domain Task Force (MDTF) in the uninhabited, Japanese-controlled Senkaku Islands (referred to as the Diaoyu Islands by China) but additional diplomatic coordination is required before a final decision can be made.[91] Particularly in the case of stationing LRHW and mid-range missile units overseas, there are likely numerous political considerations that policymakers might explore with the Administration and DOD.

LRPF in the Reserve Components

As of March 1, 2021, approximately 57 % of Army artillery battalions were in the Army National Guard (ARNG). While little has been said publicly about the allocation of LRPF systems and units, it is possible that some LRPF systems and units could be in the ARNG. If LRPF systems and units are allocated to the ARNG, potential questions for policymakers include the following:

- Which ARNG units are planned to receive LRPF systems and/or units?
- When would these units receive LRPF systems, and when would new LRPF units be activated?
- Would existing ARNG units be converted to LRPF units or LRPF support units?
- Will any existing ARNG units be deactivated to facilitate the creation of ARNG LRPF or LRPF support units?
- Are there special training requirements associated with LRPF systems and, if so, how will they apply to ARNG soldiers?
- Are there any special range or military construction requirements associated with ARNG LRPF systems or units?
- In the event that the ARNG is not planned to receive LRPF systems or units, what is the Army's rationale for this decision?

Other Services' Views on Army LRPF

The Army is working with both the Navy, Marine Corps, and Air Force on LRPF.[92] As previously discussed, all three Services are involved in developing a Common Hypersonic Glide Body (C-HGB), and the Army is evaluating Navy Standard Missile (SM)-6 and UGM-109 Tomahawk cruise missiles as part of its mid-range missile effort. Some concerns reportedly have been raised by another service about the Army's longer-range systems.

One article explains:

> The baseline version of the Lockheed Martin Precision Strike Missile will enter service in two years with a range of 499 km, but a follow-on version due to be ready in 2025 is expected to have a range up to 800 km. Moreover, the Army has selected the Raytheon SM-6 ballistic missile and UGM-109 Tomahawk cruise missile for a new ground-launched role, with ground-launched prototypes scheduled to debut in 2023. At the same time,

[91] Ashley Roque, "US Army Awaiting 'Diplomatic' Stationing Decision for Indo-Pacific MDTF," *Janes*, March 12, 2021.

[92] Major General Cedric T. Wins, "RDECOM's Road Map to Modernizing the Army: Long-Range Precision Fires," *Army News*, September 26, 2018.

> Lockheed should be fielding the first Long-Range Hypersonic Weapon, a rocket-booster glider with a conventional warhead. **Once those weapons arrive, the Army will no longer rely on the Air Force's inventory of bombers and fighter-bombers to hunt and destroy targets deep inside enemy territory** [emphasis added].[93]

Furthermore, affordability issues are raised:

> Some Air Force officials have already pushed back. "If the Air Force can do something—long-range strike, maybe—one of the services doesn't have to do it," Lt. Gen. David Nahom, the Air Force's deputy chief of staff for plans and programs, said in August [2020]. "But all of us investing in a single area in just a slightly different way—it's just not going to be affordable."[94]

It has been suggested that Army LRPF could be an encroachment on traditionally agreed-to roles and missions:

> It's ridiculous, to be quite candid. It is encroachment on roles and missions. The fact of the matter is the services need to adhere to their core competencies. And the United States Army reaching out to develop weapon systems that operate at thousand-mile range truly is encroachment.[95]

The U.S. Marine Corps is also expanding its long-range precision fires capabilities. The Marines are working with the Army on a variety of land-based options:

> Land-Based Anti-Ship Missile (LBASM) options on the table for ground forces to use against threatening enemy ships since the United States abandoned the INF Treaty. The Long-Range Precision Fires (LRPF) Anti-Ship missile options include: The long-range subsonic Maritime Tomahawk, the ATACMS to Precision Strike Missile [PrSM], the stealthy Long-Range Anti-Ship Missile (LRASM), the stealthy Naval Strike Missile, and the high-speed SM-6 multi-role missile.[96]

Reportedly commenting on LRPF differences between the Army and Marines, General David H. Berger, Commandant of the Marine Corps, stated, "The [U.S.] Army is pursuing longer-range, but much larger, heavier, bulkier systems than we are. But they're not either or; we're going to need both [U.S. Army and USMC]."[97]

The Army reportedly contends there is no service rivalry or role and mission encroachment, and that all Services are required to address the potential Russian and Chinese A2/AD threat.[98] Furthermore, the Army reportedly suggests land-based LRPF systems offer advantages over other air or sea-launched systems:

- **Concealability.** Aircraft and surface warships can be designed with stealth features to hide from radar but are not undetectable. Airbases offer large static

[93] Steve Trimble, "Will U.S. Army Missile Buys Mean Fewer U.S. Air Force Bombers?," *Aviation Week*, February 5, 2021.

[94] Ibid.

[95] Dave Deptula, LTG USAF (Ret) as quoted in Theresa Hitchens, "Long-Range All-Domain Purpose Prompts Roles & Mission Debate," *BreakingDefense.com*, July 9, 2020.

[96] Peter Ong, "Land-Based Anti-Ship Missiles and the U.S. Marine Corps: Options Available," *Naval News*, September 27, 2020.

[97] Ibid.

[98] Sydney J. Freedberg, "Army Says Long Range Missiles Will Help Air Force, Not Compete," *BreakingDefense.com*, July 16, 2020.

targets. Artillery and missile units can be camouflaged or hidden in underground tunnels, as demonstrated by North Korea.[99]

- **Range.** Military aircraft can refuel in mid-air, extending flight indefinitely, but fuel tankers are vulnerable and "unstealthy," considered too vulnerable to fly close to Russian or Chinese air defenses. While Air Force strategic bombers have ranges of thousands of miles, the majority of Air Force, Navy, and Marine strike aircraft are fighters—F-15s, F-16s, F-18s, and F-35s—with ranges of hundreds of miles from ground bases or aircraft carries.[100]
- **Complexity.** Arguably, it is easier to launch a missile "off the back of a truck than from an aircraft, surface ship, or submarine," potentially making "land-based systems cheaper and quicker to develop."[101]

Given the range of views expressed by the Services, Congress might decide to examine these issues. Will Army LRPF systems have an impact on the requirements for other Service's systems, such as Air Force long-range bombers? Will the development of Army LRPF systems grant the Army a degree of independence from the other Services for long-range fire support and, if so, would this free up those Service's assets previously dedicated to support the Army for other missions or uses? With the Army and Marines expanding their LRPF capabilities, is there now redundant capability within the Services, or are all of these assets and capabilities (and perhaps more) needed to address perceived Russian and Chinese threats?

Commanding and Controlling and Targeting Long-Range Fires

In developing LRPF systems to deliver fires, another consideration is the ability to command and control them and to detect, acquire, and engage targets. One defense analyst summarizes the issue and related challenges:

> Target spotting for field artillery typically is provided by warfighting systems organic to the Army, such as scout helicopters and reconnaissance drones. But when targets potentially are a thousand miles away, a different approach will be needed ... much of the targeting information will be provided by space-based assets. That presumably means relying on what used to be called "national technical means," or spy satellites. Targeting information might also be provided by the F-35 fighter, which is nearly invisible to enemy radar and has extensive recon capabilities ... classification (secrecy) level of overhead collections will need to be changed to gain access to much of the required information, but that's just the beginning of the challenge. The Army will need a network that connects sensors to shooters with minimal delay. The Army informally refers to overcoming the sensor-to-shooter challenge in next-gen systems as "convergence," but optimizing the use of very long-range weapons will require a targeting network that spans the entire joint force and beyond, because key sensors have diverse owners.[102]

Another concern that has been raised is who decides how targets will be engaged:

> Who calls for fires? The Army is probably going to regret using the term "strategic" in the name of its long-range cannon, because in American usage that implies complicated release authority for weapons whose use could raise far-reaching issues. It might not be the case

[99] Ibid.

[100] Ibid.

[101] Ibid.

[102] Loren Thompson, "Army Breakthroughs In Long-Range Fires Raise Novel Questions About Targeting, Organization, Command," *Forbes*, August 7, 2020.

> in the Pacific, where distances are so great that a thousand miles is the range at which some tactical targets might need to be engaged (think Chinese warships). But in the close quarters of the European theater, a weapon with that sort of reach potentially raises major geopolitical questions. After all, it is only 700 miles from Warsaw to Moscow.[103]

Reportedly, the Army is exploring how to use satellites for identifying targets for long-range precision fires systems.[104] While reliance on space-based assets is not unique for Army combat systems, if space-based assets are attacked by adversaries and destroyed or disrupted, LRPF systems might not be able to detect, acquire, and engage targets.

The Army intends to rely on DOD's Joint All Domain Command and Control (JADC2) system presently under development.[105] The JADC2 system envisions linking sensors and shooters across air, land, cyber, and sea to detect and acquire targets for its LRPF systems. To test this theory, the Army is presently conducting a series of experiments under what it calls Project Convergence.[106] In 2020, the Army conducted its inaugural Project Convergence exercise at Yuma Proving Ground, AZ, and plans call for exercises in 2021 and 2022. During these exercises, the Army intends to work with the other Services and allies to test, among other things, command and control and sensor-to-shooter linkages using both Service and national assets to facilitate long-range precision fires.

A great deal of attention is being given the various LRPF systems under development. How the Army intends to command and manage these systems, and how they would detect, acquire, and engage targets exceeding the range of current organic systems, could potentially be viewed as of equal and, perhaps, greater importance. While space-based assets might be a possibility, these systems can be readily targeted by various means, and if redundant systems are unavailable, some LRPF systems risk becoming expensive "single point of failure" weapons. With this in mind, policymakers might seek to examine the use of national space-based assets, capabilities being developing under JADC2, and the results of Project Convergence to determine if Army proposals for commanding LRPF units and detecting, acquiring, and engaging targets at long ranges are feasible.

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[103] Ibid.

[104] Joseph Lacdan, "Army to Build on Results from First Project Convergence Exercise," *Army News Service,* September 25, 2020.

[105] For additional information on JADC2, see CRS In Focus IF11493, *Joint All-Domain Command and Control (JADC2),* by John R. Hoehn.

[106] For additional information on the Army's Project Convergence, see CRS In Focus IF11654, *The Army's Project Convergence,* by Andrew Feickert.

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