

M109 Family of Vehicles (FoV) Paladin Integrated Management (PIM)

Executive Summary

- In November 2012, the Army conducted the Paladin Integrated Management (PIM) Limited User Test (LUT) at Yuma Proving Ground (YPG), Arizona. Soldier crews operating 2 PIM Self-propelled Howitzers (SPHs) and 2 Carrier, Ammunition, Tracked (CAT) resupply vehicles fired 1,247 projectiles and drove 864 miles during 6 days of operational testing.
 - During the LUT, the delivery accuracy of the PIM-equipped unit firing unguided high-explosive projectiles was comparable to the accuracy of the Field Artillery unit that conducted the Paladin M109A6 FOT&E.
 - The LUT test unit was not as timely as units equipped with the current Paladin M109A6 Howitzer and did not achieve accuracy requirements when firing the M795 and M107 high-explosive projectiles at short ranges.
 - Performance of the SPH and CAT during the LUT indicates the program is meeting reliability growth estimates necessary for achieving operational suitability in the July 2016 IOT&E.
- During post-LUT developmental testing, Soldier crews operating a PIM SPH with hardware and software changes intended to fix problems identified during the LUT demonstrated improved fire mission timeliness and rate-of-fire and emergency fire mission time standards.
- Compatibility testing of a PIM SPH firing the Precision Guidance Kit (PGK) and the Excalibur precision munition demonstrated increased delivery accuracy.
- As part of the LFT&E program, armor performance testing demonstrated PIM armor configurations provide required levels of threat protection. Ballistic Hull and Turret (BH&T) exploitation testing revealed vulnerable areas in the SPH and CAT. Underbody blast testing will not be accomplished until the 5A prototype and full-up systems are available.

System

- The M109 Family of Vehicles (FoV) PIM consists of two vehicles, the SPH and CAT.
- The M109 FoV SPH is a tracked, self-propelled 155 mm howitzer designed to improve sustainability over the legacy M109A6 howitzer fleet. The full-rate production howitzers will have a newly designed hull, modified Bradley Fighting Vehicle power train and suspension, and a high-voltage electrical system. The SPH is operated by a crew of 4 and can engage targets at ranges of 22 kilometers using standard projectiles and 30 kilometers using rocket-assisted projectiles.
- The M109 FoV CAT supplies the SPH with ammunition. The full-rate production ammunition carriers will have a



- common chassis with the SPH. The ammunition carriers are designed to carry 12,000 pounds of ammunition in various configurations and a crew of 4 Soldiers.
- The Army will equip the SPH and CAT with two armor configurations to meet two threshold requirements for force protection and survivability – Threshold 1 (T1) and Threshold 2 (T2).
- The base T1 armor configuration is integral to the SPH and CAT. The T2 configuration is intended to meet protection requirements beyond the T1 threshold with add-on armor kits. The Army plans to employ PIM vehicles in the T1 configuration during normal operations and will equip the SPH and CAT with T2 add-on armor kits during combat operations.
- The M109 FoV SPH can fire the PGK and the Excalibur precision munition to increase delivery accuracy. The Army developed the PGK to reduce the dispersion of unguided projectiles and the Excalibur precision munition to provide Field Artillery units a precision engagement capability.
- The Army intends to employ the M109 FoV as part of a Fires Battalion in the Armored Brigade Combat Team and Artillery Fires Brigades with the capability to support any Brigade Combat Team.
- The Army plans to field up to 557 sets of the M109 FoV with full-rate production planned for FY17.

Mission

Field Artillery units employ the M109 FoV to destroy, defeat, or disrupt the enemy by providing integrated, massed, and precision indirect fire effects in support of maneuver units conducting unified land operations.

ARMY PROGRAMS

Major Contractor

BAE Systems – York, Pennsylvania

Activity

- In November 2012, the Army conducted the PIM LUT, in accordance with a DOT&E-approved test plan, at YPG, Arizona. The test unit executed two 72-hour scenarios at an operational tempo consistent with Armored Brigade Combat Team Operational Mode Summary/Mission Profile. Soldier crews operating 2 PIM SPHs and 2 CATs fired 1,247 projectiles and drove 864 miles during 6 days of operational testing.
- In January 2013, the program began installing and testing a series of Corrective Actions, Producibility, and Obsolescence (CPO) changes for the SPH and CAT. CPO changes are the program's systematic approach to address failures identified in operational and developmental testing, improvements in survivability and force protection, maintainability of obsolete government-furnished SPH and CAT components, and integration of Bradley common components. To mitigate risk, the program plans to design, procure, and test CPO changes on prototype vehicles prior to installation on low-rate initial production (LRIP) test articles.
- During compatibility and Lot Acceptance Testing in February 2013 at YPG, Arizona, the program fired 6 Excalibur Increment Ia-2 projectiles from a PIM SPH at targets positioned 9, 25, and 35 kilometers from the howitzer. The radial miss distances for all 6 Excalibur projectiles were less than 10 meters. Previous compatibility testing with PIM SPH firing 3 high-explosive projectiles fuzed with the PGK at a target 15 kilometers from the howitzer resulted in an average radial miss distance of 24 meters.
- In March 2013, post-LUT developmental testing for PIM accuracy, SPH crews fired 36 groups of 6 projectiles at targets positioned 4, 6, and 21.5 kilometers from the howitzer. Projectile groups fired at 21.5 kilometers met PIM accuracy requirements but groups fired at 4 and 6 kilometers did not meet requirements.
- In early 3QFY13, the Army delayed the PIM Milestone C decision from June to October 2013 and revised the PIM LRIP schedule due to LRIP contract delays and reduction in program funding. The revised schedule reduces the program's planned LRIP quantity of 72 sets to 66 sets and LRIP procurement period from 4 years to 3 years. The Army continues to plan for a Full-Rate Production decision with the first PIM unit equipped in January 2017.
- DOT&E approved an updated PIM Test and Evaluation Master Plan (TEMP) on July 24, 2013. The TEMP update revised the test and evaluation strategy to support production and deployment phase testing.
- Planned BH&T exploitation testing to characterize PIM protection provided by current armor configurations is ongoing. The program is addressing vulnerabilities identified

in BH&T testing and developing plans to validate proposed corrective actions. Underbody blast testing will occur when the 5A prototype and full-up systems are available, currently planned for FY15-16.

- The Army is designing and testing a separate underbelly kit (not a component of the T1 and T2 armor configurations) to determine the potential protection an SPH and CAT provide against equivalent IEDs encountered in Iraq and Afghanistan.

Assessment

- During the November 2012 LUT, the delivery accuracy of the PIM-equipped unit firing unguided high-explosive projectiles was comparable to the accuracy of the Field Artillery unit that conducted the Paladin M109A6 FOT&E.
- The LUT test unit was not as timely as units equipped with the current Paladin M109A6 Howitzer, meeting less than 20 percent of conventional fire mission time standards. Rate-of-fire and emergency fire mission timeliness requirements were not achieved. Beginning in 2014, the program plans to make hardware and software improvements to increase rammer movement responsiveness and simultaneous movement with cannon tube elevation to improve PIM fire mission timeliness.
- In 1QFY13 developmental testing using a PIM SPH with hardware and software changes intended to fix problems identified during the LUT, Soldier crews that participated in the LUT demonstrated improved fire mission timeliness and demonstrated rate-of-fire and emergency fire mission time standards.
- During the LUT, the PIM SPH did not achieve accuracy requirements when firing the M795 and M107 high-explosive projectiles at short ranges and demonstrated greater variance in accuracy at night when engaging short- and medium-range targets.
- PIM SPH compatibility with the PGK and the Excalibur precision munition increases delivery accuracy.
- The demonstrated reliability of the SPH and CAT indicates the program is meeting reliability growth estimates necessary for achieving operational suitability in the July 2016 IOT&E.
- The program has identified seven critical path SPH and CAT CPO changes necessary to meet system performance requirements. Verification testing of the CPO modifications on prototype vehicles will reduce the risk of discovering new CPO-related failure modes on LRIP vehicles.
- In LFT&E, armor performance testing demonstrated PIM armor configurations provide required levels of threat protection against fragmenting and other ballistic threats. BH&T testing revealed vulnerable areas in the SPH and CAT.

ARMY PROGRAMS

Recommendations

- Status of Previous Recommendations. The Army has satisfactorily addressed all previous recommendations.
- FY13 Recommendations. The Army should:
 1. Implement planned hardware and software improvements to increase rammer movement responsiveness and simultaneous movement with cannon tube elevation to improve PIM fire mission timeliness.
 2. Continue testing upgraded suspension and transmission components to characterize impacts of increased weight from the add-on armor and underbelly kits.
 3. Determine if the PIM Capabilities Production Document short-range accuracy requirements remain valid and continue efforts to improve PIM SPH accuracy.
 4. Implement and validate planned armor configuration changes for LRIP vehicles prior to full-up system-level testing.

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