

## M109A7 Family of Vehicles (FoV) Paladin Integrated Management (PIM)

### Executive Summary

- In FY18, the Army conducted a second IOT&E on the M109A7 Family of Vehicles (FoV) Paladin Integrated Management (PIM) program that confirmed the Self-Propelled Howitzer (SPH) remained not operationally suitable in environments that require the highest propelling charge, Modular Artillery Charge 5H.
- In FY19, the Army conducted developmental testing of the SPH to increase reliability and address improvements to the breech deficiencies the Army discovered in the FY18 IOT&E.
- The Army delayed the Full-Rate Production (FRP) decision to FY20 due to BAE-York Systems production line quality and capacity challenges.
- The Army recalled 68 PIM low-rate initial production (LRIP) vehicles for complete teardown, inspection, repair, and retesting due to weld deficiencies identified in the BAE production process at York, Pennsylvania.
- The Army plans to conduct missions with soldier crews in February 2020, as part of the phase two breech reliability testing, and to fire high-angle missions not completed during the second IOT&E.

### System

- The M109 FoV PIM program consists of two vehicles: the SPH and Carrier Ammunition Tracked (CAT) resupply vehicle.
  - The M109A7 SPH is a tracked, self-propelled 155-mm howitzer designed to improve sustainability over the legacy M109A6 SPH.
  - The M992A3 CAT supplies the SPH with ammunition. The ammunition carriers have a chassis similar to the SPH. The ammunition carriers are designed to carry 12,000 pounds or 98 rounds of ammunition in various configurations. A crew of four soldiers operates the CAT.
  - 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 Army intends the T2 configuration to meet protection requirements beyond the T1 requirement 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 Army intends to employ the M109 FoV as part of a Fires Battalion in the Armored Brigade Combat Team and Artillery Fires Brigades. The Army plans to field up to 689 sets of the M109 FoV with an FRP planned for FY20.

### Mission

Commanders employ field artillery units equipped with 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.

### Major Contractor

BAE Systems – York, Pennsylvania

### Activity

- DOT&E submitted a report to Congress for the second IOT&E in July 2018 and the LFT&E report in June 2018.
- In FY19, the Army conducted developmental testing to address fixes to breech reliability failures demonstrated during the first IOT&E in FY17 and the second IOT&E in FY18. The Army conducted three engineering tests to assess the

interim fixes for the breech. Following engineering test 3, the Army selected final configurations for updated breech parts. The final configuration, including modifications to the breech, include the firing mechanism, breech spring packs, cam and roller, and block stop and carrier plunger. These breech fixes

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will undergo durability testing at Yuma Proving Ground, Arizona, in October through December 2019.

- The Army will continue to conduct developmental testing to address breech reliability fixes and will address missions not fired during the IOT&E. These include firing the Modular Artillery Charge System 5H at high quadrant elevation, in an excursion event with soldier crews as part of the breech reliability testing during follow-on testing in February 2020.
- The Army has recalled 68 PIM LRIP vehicles for complete teardown, inspection, repair, and retesting due to weld deficiencies in the BAE production process at York, Pennsylvania.
- PEO Ground Combat Systems (GCS), Defense Contracting Management Agency, and the contractor have addressed welding specifications with the goal of improving quality.
- Contractor production has been behind schedule due to production line quality deficiencies and production capacity; however, it has demonstrated reaching production capacity the past couple of months.
- PEO GCS has been actively engaged in continuing assessments of the contractors' efforts at York, Pennsylvania, facilities.
- The Army delayed the FRP decision due to production quality and capacity challenges in the York, Pennsylvania, production facility. The contractor has generated a corrective action plan addressing noncompliance of production quality and production capacity.
- The Army designed an underbody kit to provide protection for SPH and CAT against IEDs similar to those encountered in Iraq and Afghanistan. The Army purchased five underbody kits for test purposes. The Army intends to purchase 540 underbody kits as Theater Provided Equipment to equip the SPH or CAT.
- The Army is finalizing concepts for design and production of an extended-range cannon artillery system and breech assembly. The Army intends to use the PIM chassis, engine, transmission, and turret for this extended-range cannon.

## Assessment

- Analysis is ongoing regarding improved breech reliability testing. DOT&E will provide an operational assessment in May 2020, regarding the results of phase two breech reliability testing.
- The contractor faces significant capacity challenges in the near future with the production of multiple Army and Marine Corps armored combat vehicle programs.

- The Program Office has taken action to correct deficiencies identified in early testing and to validate associated fixes using Developmental Performance, Automotive, and LFT&E programs.
  - Corrective action initiatives include developmental testing of breech component improvements in a three-phased strategy consisting of a series of engineering tests, a 1,000 round durability test, and a developmental/operational follow-on test to assess breech reliability improvements.
  - Additional improvement initiatives include a series of software updates and hardware redesigns to address reliability failures revealed during operational testing. Software upgrades address weapon system performance and maintenance fault generation anomalies. Hardware efforts include development of a Hatch Centric Weapons Station to replace the Crew Remotely Operated Weapon Station.
  - During armor exploitation testing, most of the modified armored areas demonstrated that they provide protection against Key Performance Parameter threats.
  - Changes to the CAT crew compartment Automatic Fire Extinguisher System (AFES) mitigate the deficiency identified in early testing and reduce its vulnerability to fires.
- The crew compartment AFES in the SPH was designed to protect a small, localized area and is deficient in providing adequate fire survivability. The Program Office is modifying the crew compartment AFES to improve SPH crew survivability to fires.

## Recommendations

The Army should:

1. Continue to pursue the final design, development, and integrated testing of a new cannon and breech assembly to address legacy breech and cannon reliability to mitigate range and rate of fire shortcomings in the M109A7 SPH.
2. Consider stockpiling breech parts with deployed artillery units or prepositioned fleets to support legacy M109A6 SPH and M109A7 SPH.
3. Correct the deficiencies in the SPH's crew compartment AFES and validate those fixes in test.