

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

### Executive Summary

- The Army conducted the Paladin Integrated Management (PIM) Breech Reliability and High Angle Modular Artillery Charge System (MACS) 5H test from January 30 through February 8, 2020, at Yuma Proving Ground, Arizona.
- Self-Propelled Howitzer (SPH) Phase one and two breech parts demonstrated improved breech reliability. The Army started incorporating the redesigned breech components across the fleet.
- The Army may need to stockpile spare legacy breech and cannon-related parts to support operations in a high intensity environment until sufficient production exists for the new breech and firing train components.
- Following the award of the Full-Rate Production contract to BAE Systems in January 2020, the program achieved the production goal of eight systems per month, implemented system software updates, and completed upgrades to system technical manuals.
- The program plans to execute several modifications from 3QFY23 to 2QFY25 to mitigate adverse effects from underbody blast events. The modifications include floor mat retention brackets that are part of the FY24 PIM production, and a series of modifications to improve projectile stowage security.
- The PIM program anticipates achieving Full Material Release in July 2022, and Full Operational Capability in 2034.

### System

- The M109 Family of Vehicles (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 maneuverability over the legacy M109A6 howitzer. The Army is updating some of the breech components based upon results from testing in the second IOT&E and the breech reliability/high angle test in early 2020.
  - 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 designed an underbody kit to determine the potential protection an SPH and CAT could provide against IEDs similar to those encountered in Iraq and Afghanistan. The Army purchased five underbody kits for test purposes. The Army does not intend to equip the SPH or CAT with the underbody kit at this time.
- 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.

### 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

# FY20 ARMY PROGRAMS

## Activity

- The Army conducted developmental testing throughout 2019 to address breech reliability fixes. The final configuration, including modifications to the firing mechanism, breech spring packs, cam and roller, and block stop and carrier plunger, completed its final breech reliability testing as a follow-on test event with soldier crews in February 2020 at Yuma Proving Ground, Arizona. The breech reliability testing addressed missions not fired during the IOT&E, such as firing the MACS 5H at high quadrant elevation.
- The Army is finalizing production plans to mass-produce the modified breech components to support implementation efforts in the field and provide necessary spare parts.
- The Army is investigating a slide block breech for the M109A7 to replace the current breech.
- The Army updated technical manuals and training consistent with recommendations from previous operational testing and validated those changes during the breech reliability test at Yuma Proving Ground in February. The changes addressed recurring on-board preventive maintenance tasks and operating techniques to ensure consistent and reliable functioning of the breech and its subcomponents when firing the MACS 5H propelling charge.
- The program plans to execute several modifications from 3QFY23 to 2QFY25 to mitigate negative effects from underbody blast events. The modifications include floor mat retention brackets and a series of modifications to improve projectile stowage security that are part of the FY24 PIM production.
  - The floor mat retention improvement ensure that the floor mats stay on the floor and not become airborne during underbody blast events.
  - The program will implement a Vertical Ammunition Cover to retain stowed rounds.
  - The program developed an improved J-hook latch for ammunition retention. This heavier latch is part of the FY22 production cut-in and will be incorporated into the Extended Range Cannon Artillery (ERCA).
  - The compartment portion of the turret provides space for projectile stowage and what are known as oddment trays. The program is developing an engineering change proposal to reinforce the securing devices for the projectiles and trays. All of these changes will carry over to the ERCA Increment 1 platform that leverages the PIM turret.
- The current program schedule shows Production Verification Testing starting in December 2020 with completion in May 2021.

- The PIM program anticipates achieving Full Material Release in July 2022 and Full Operational Capability in 2034.

## Assessment

- The SPH and CAT are operationally effective. A field artillery unit equipped with the SPH provided accurate artillery fires and conducted movement and maneuver sufficient to keep pace with an Armored Brigade Combat Team.
- In operational testing, both the CAT and SPH showed significant improvement over the speed and maneuverability demonstrated by the legacy ammunition carrier and howitzer.
- The CAT resupply vehicle is suitable. The CAT exceeded its reliability and availability requirement. The SPH is operationally suitable when firing MACS charges up through charge 4H.
- The SPH has improved when firing MACS charge 5H for environments requiring greater ranges.
  - Since the IOT&E, the Army implemented a two-phased approach to correct legacy breech reliability failures. Phase one addressed subcomponents of the legacy breech; phase two included more comprehensive design changes for the gun mount and cradle. Neither phase changed the basic breech design.
  - The results from the Yuma Proving Ground test indicate that the breech modifications improved the reliability of the breech when firing the MACS 5H propelling charge consistent with realistic combat firing mission operations.
- The crew compartment Automatic Fire Extinguisher System (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 implement across the fleet, the final design changes, and subcomponent modifications to address breech reliability shortcomings when firing MACS 5H.
2. Continue to examine a slide block breech for the M109A7.
3. Finalize production plans for the modified breech components and consider stockpiling breech parts with deployed artillery units or prepositioned fleets until receipt of component modifications and their installation
4. Correct the deficiencies in the SPH's crew compartment AFES and validate those fixes in test.