

## Patriot Advanced Capability-3 (PAC-3)

### Executive Summary

- The Army began the Post Deployment Build-7 (PDB-7) Limited User Test (LUT) in May 2012 at White Sands Missile Range (WSMR), New Mexico. The PDB-7 LUT ended in January 2013 with the completion of Regression Test 2.
- The Army conducted four developmental Patriot flight test missions and one Medium Extended Air Defense System (MEADS) Flight Test (FT) in FY13.
- The Missile Defense Agency conducted an integrated flight test of the Ballistic Missile Defense System (BMDS) in October 2012, during which Patriot engaged and killed a cruise missile target and a tactical ballistic missile target in the debris field caused by another BMDS intercept.
- In the five Patriot flight tests conducted in FY13, Patriot achieved successful intercepts of four short-range ballistic missile targets and three cruise missile targets using Missile Segment Enhancement (MSE) and Patriot Advanced Capability-3 (PAC-3) missiles. The final MSE engagement demonstrated performance in the extended battlespace.

### System

- Patriot is a mobile air and missile defense system that counters missile and aircraft threats. The system includes the following:
  - C-band phased-array radars for detecting, tracking, classifying, identifying, and discriminating targets
  - Battalion and battery battle management elements
  - Communications Relay Groups and Antenna Mast Groups for communicating between battery and battalion assets
  - A mix of PAC-3 hit-to-kill missiles and PAC-2 blast fragmentation warhead missiles for negating missile and aircraft threats
- The newest version of the PAC-3 missile is the Cost Reduction Initiative (CRI) missile. In addition, the Army is developing the PAC-3 MSE missile with increased battlespace defense capabilities and improved lethality.
- Earlier versions of Patriot missiles include the Patriot Standard missile, the PAC-2 Anti-Tactical Missile, and the Guidance Enhanced Missile (GEM) family (includes the GEM-T and



GEM-C missile variants intended to counter tactical ballistic missiles and cruise missiles, respectively).

- The DoD intended MEADS to replace the Patriot system. The DoD decided not to field MEADS and concluded U.S. involvement in the design and development phase of the MEADS program in 2013.

### Mission

Combatant Commanders use Patriot to defend deployed forces and critical assets from missile and aircraft attack and to defeat enemy surveillance air assets (such as unmanned aerial vehicles) in all weather conditions, and in natural and induced environments.

### Major Contractors

- Prime: Raytheon Company, Integrated Defense Systems – Tewksbury, Massachusetts
- PAC-3 Interceptors: Lockheed Martin Corporation, Missile and Fire Control – Dallas, Texas

### Activity

- The Army began the PDB-7 LUT in May 2012 at WSMR, New Mexico. The PDB-7 LUT ended in January 2013 with the completion of Regression Test 2. The Army conducted the testing in accordance with the DOT&E-approved Test and Evaluation Master Plan and test plan.
- During Flight Test Integrated-01 (FTI-01) in October 2012 at the Reagan Test Site (on Kwajalein Atoll and Wake Island),

Patriot performed a near-simultaneous engagement of a short-range ballistic missile target with two PAC-3 interceptors and a cruise missile target with another PAC-3 interceptor. FTI-01 was the first integrated flight test with multiple firing elements (Aegis Ballistic Missile Defense [BMD], Terminal High-Altitude Area Defense [THAAD], and Patriot) engaging

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- multiple ballistic missile and air-breathing targets in a realistic BMDS-level architecture.
- During MEADS FT-1 in November 2012 at WSMR, Patriot intercepted a cruise missile target with an MSE interceptor.
  - During FT-7-4 in December 2012 at WSMR, Patriot intercepted a short-range ballistic missile target with two MSE interceptors.
  - During the demonstration flight of the Zombie tactical ballistic missile target in April 2013 at WSMR, Patriot intercepted the short-range ballistic missile target with two PAC-3 interceptors.
  - During FT-7-5 in June 2013 at WSMR, Patriot performed a near-simultaneous engagement of a short-range ballistic missile target with two MSE interceptors and a cruise missile target with another MSE interceptor.
  - The next Patriot operational test, the PDB-8 IOT&E, is scheduled to begin in 2015. This IOT&E will provide information to support the Full-Rate Production decision for the MSE interceptor.
- ### Assessment
- The PDB-7 LUT showed:
    - There were improvements in performance against some threats compared to PDB-6.5, but degradations in performance against other threats, the details of which can be found in the classified April 2013 Patriot PDB-7 LUT Assessment Report.
    - Patriot ground system reliability did not meet the threshold requirement, but would have met it had the Patriot radar achieved its allocated reliability goal.
    - Patriot training remains inadequate to prepare operators for complex Patriot engagements. This was true during the PDB 6.5 and PDB-6 LUTs as well. This problem was exacerbated in the PDB-7 LUT because many of the experienced Patriot operators in the test unit were transferred to deploying units prior to the LUT, resulting in many inexperienced users and a high variability in Soldier proficiency across the test unit.
  - During FTI-01, Patriot demonstrated the capability to detect, track, engage, intercept, and kill both a tactical ballistic missile target and a cruise missile target with PAC-3 missiles.
    - The first PAC-3 missile in the ripple method of fire intercepted the ballistic missile target at the planned altitude and range.
    - The second PAC-3 missile performed nominally throughout its flight and properly self-destructed after the first PAC-3 missile intercepted the target.
    - The third PAC-3 missile intercepted the cruise missile target at the planned altitude and range.
  - During FTI-01, Patriot also demonstrated tactical interoperability with BMDS participants including THAAD; Aegis BMD; and the Command and Control, Battle Management, and Communications System.
    - There was a Patriot radar fault, but the operators were able to put the system back online in time to conduct a nominal engagement.
  - All PAC-3 missile subsystems performed as expected.
  - The Patriot engagements were conducted in the debris field from the THAAD intercept and Patriot debris mitigation was nominal.
  - Aegis BMD failed to intercept its ballistic missile target during FTI-01; however, the Missile Defense Agency did not set up the flight test so that Patriot could engage targets that Aegis BMD or THAAD failed to intercept. DOT&E had recommended this be a feature of BMDS flight testing in its FY12 Patriot Annual Report.
  - During MEADS FT-1, MEADS demonstrated the capability to detect, track, engage, intercept, and kill a cruise missile target with an MSE interceptor. The MEADS test configuration consisted of a Battle Management Command, Control, Communications, and Computers Intelligence tactical operations center; a Lightweight Launcher; and a Multifunction Fire Control Radar. This was the first MSE engagement of an air-breathing target.
  - During FT-7-4, Patriot demonstrated the capability to detect, track, engage, intercept, and kill a tactical ballistic missile target with MSE interceptors in a ripple method of fire. The first MSE intercepted and killed the ballistic missile target at the planned altitude and range. The second MSE performed nominally throughout its flight and properly self-destructed after the first MSE intercepted the target.
  - During the Zombie (tactical ballistic missile target) flight test, Patriot demonstrated the capability to detect, track, engage, intercept, and kill a tactical ballistic missile target with PAC-3 missiles.
    - The first PAC-3 missile intercepted the Zombie target at the planned altitude and range, although a missile autopilot error led to the guidance accuracy not being as good as the missile system specification requires.
    - The second PAC-3 missile failed to launch because a launcher problem led to external power not being provided to the missile.
    - A backup PAC-3 missile launched and intercepted debris from the first PAC-3 intercept.
    - Patriot also demonstrated the capability to detect, track, and perform a simulated PAC-3 MSE engagement on a low-altitude cruise missile surrogate target.
  - During FT-7-5, Patriot demonstrated the capability to detect, track, engage, intercept, and kill both a tactical ballistic missile target and a cruise missile target with MSE interceptors.
    - The first MSE missile in the ripple method of fire intercepted and killed the ballistic missile target at the planned altitude and range within the MSE extended battlespace.
    - The second MSE performed nominally throughout its flight and properly self-destructed after the first MSE intercepted the target.
    - The third MSE intercepted and killed the cruise missile target at the planned altitude and range.
  - Continuing obstacles to adequate testing and evaluation of the Patriot system include:

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- The lack of a robust interoperability event during PDB-7 testing.
  - The lack of data required to validate GEM interceptor blast lethality in the Lethality Endgame Simulation.
  - The lack of a robust Force Development Evaluation, preventing the Army from thoroughly examining tactical standard operating procedures prior to developing Patriot PDB-7 tactics, techniques, and procedures. As a result, the engagement procedures used during the PDB-7 LUT against some threats led to decreased system performance.
2. Conduct a Patriot flight test against an anti-radiation missile target to validate models and simulations.
  3. Improve Patriot training.
  4. Have Patriot participate with live interceptors in THAAD flight testing to determine Patriot-to-THAAD interoperability and the capability for Patriot to intercept tactical ballistic missile targets that are not intercepted by THAAD.
  5. Collect reliability data on Patriot systems in the field so that the Mean Time Between Critical Mission Failure can be calculated.
  6. Use test units for future Patriot operational tests that have operationally representative distributions in Soldier proficiency.
  7. Conduct future operational flight tests with unannounced target launches within extended launch windows.

## Recommendations

- Status of Previous Recommendations. The Army satisfactorily addressed 14 of the previous 21 open recommendations. The Army should continue to address the following recommendations:
  1. Conduct Patriot air and missile defense testing during joint and coalition exercises that include large numbers of different aircraft types, sensors, battle management elements, and weapons systems. Conduct Red Team penetration testing during these exercises to test Patriot Information Assurance.
- FY13 Recommendations. In addition to addressing the above recommendations, the Army should:
  1. Improve Patriot radar reliability.
  2. Obtain the data required to validate GEM interceptor blast lethality in the Lethality Endgame Simulation.

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