PATRIOT / Medium Extended Air Defense System Combined Aggregate Program (PATRIOT/MEADS CAP)

Executive Summary

- The Army conducted six PATRIOT flight tests from November 2005 to June 2006 and achieved four successes.
- The Army conducted a major PATRIOT operational test, the Post-Deployment Build-6 Limited User Test, 4QFY06 through 1QFY07. That event included three flight tests during which PATRIOT successfully intercepted tactical ballistic missile targets and a cruise missile target.

System

- PATRIOT/Medium Extended Air Defense System (MEADS) Combined Aggregate Program (CAP) develops the MEADS system and evolves the PATRIOT missile system to include MEADS components. MEADS is an international co-development program that includes participation from Italy, Germany, and the United States.
- The PATRIOT air and missile defense system includes:
  - A mix of PATRIOT Advanced Capability-3 (PAC-3) hit-to-kill missiles and PAC-2 Guidance Enhanced Missile (GEM) blast-fragmentation warhead missiles for negating air and missile threats
    - The newest version of the PAC-3 interceptor is the Cost-Reduction Initiative (CRI) missile. In addition, the Army is developing the PAC-3 Missile Segment Enhancement (MSE) missile to increase range and altitude capabilities.
    - The newest version of the GEM interceptor is the GEM-T. It is designed primarily to counter aircraft including low-radar cross-section cruise missiles and has improved capability against high-speed short-range ballistic missiles.
  - C-band phased-array radars for detection, acquisition, tracking, classifying, identifying, and discriminating targets
  - Battalion Information and Coordination Centrals, Battery Command Posts, and Engagement Control Stations for battle management

  - Communications Relay Groups and Antenna Mast Groups for communicating with battery and battalion assets
- Planned MEADS development and improvements include:
  - Battle management, command, control, communications, computers, and intelligence elements; Ultra High Frequency-band 360-degree surveillance radars; X-band 360-degree multi-function fire control radars; missile launchers and reloaders
  - MSE missiles developed under the PATRIOT program

Mission

Combatant commanders deploying PATRIOT will have the capability 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, clutter, and electronic countermeasure environments.

Activity

- November 11, 2005. PATRIOT fired three PAC-3 CRI missiles at a short-range aerodynamic ballistic missile. None of the missiles intercepted the target.
- November 17, 2005. The Army and the Missile Defense Agency (MDA) conducted a test demonstrating integration of PATRIOT with the Ballistic Missile Defense System Command, Control, Battle Management, and Communication (C2BMC) element. PATRIOT detected, acquired, tracked, and engaged a short-range ballistic missile target and shared data with the C2BMC via the Link-16 communication network. However, the GEM missile failed to intercept the target.
- January - August 2006. During Post Deployment Build-6 developmental testing, the Army successfully engaged three tactical ballistic missile targets, a cruise missile target, and a subscale aircraft target during four separate flight tests.

- August - November 2006. The Army conducted the Post Deployment Build-6 Limited User Test, which consisted of the following:
  - August - September 2006 – Mobile flight mission simulator hardware-in-the-loop system software testing conducted at Fort Bliss, Texas.
  - September 2006 – Interoperability testing conducted at the Joint National Integration Center in Colorado.
  - November 2006 – Sustained operations testing at McGregor Range, Fort Bliss, Texas.
  - August - November 2006 – Three flight tests during which GEM, GEM-T, and PAC-3 missiles engaged short-range tactical ballistic missile targets and a low-radar cross-section cruise missile target. Preliminary results indicate all targets were successfully intercepted.
- The Army has not yet conducted the Test and Evaluation Master Plan-required PATRIOT flight test against a threat-representative anti-radiation missile target due to difficulties in obtaining an appropriate target. A suitable target was procured through the Navy, but was diverted for a higher priority initiative. This test is important to evaluate the PATRIOT self-defense capability and to demonstrate the capability to defend the Terminal High-Altitude Area Defense system from this threat.

Assessment

- Of the four PATRIOT developmental flight tests the Army conducted against ballistic missiles in FY06, two were successful and two were failures. In one flight test, there were three missile and launcher problems that led to three PATRIOT failures to intercept the target. Missile and ground system software has been modified to prevent similar failures. The problems did not appear in the repeat of the flight test. In another flight test, the PATRIOT interceptor had a reliability failure shortly after launch. PATRIOT successfully intercepted tactical ballistic missile targets in two Limited User Test flight tests in October 2006.
- Both of the FY06 PATRIOT flight tests against air-breathing targets were successful. One of the flight tests used a PAC-2 missile miss bias and maximum fuse delay to conserve the target, to test the kill assessment logic, and to test the shoot-look-shoot capability. The Army conducted a flight test against a low-radar cross-section cruise missile target during the Limited User Test. Preliminary results indicate success.
- Reliability: PATRIOT did not meet its reliability requirements during Post Deployment Build-6 Developmental Test and Evaluation. The PATRIOT battery mean time between critical mission failure was 7.8 hours. This is 2.7 times smaller than the threshold requirement of one critical mission failure per 21 hours and 2.5 times smaller than the mean time between critical mission failure measured during the PAC-3 IOT&E in 2002. The main contributor to low reliability was the radar.
- Maintainability: PATRIOT also did not meet its maintainability requirements during Post Deployment Build-6 Developmental Test and Evaluation. The 16 reliability-relevant mission essential failures for which maintenance was performed had a mean time to repair of 7.3 hours. This is 3.6 times larger than the threshold requirement of 2 hours and 2.1 times larger than the mean time to repair measured during PATRIOT Advanced Capability-3 IOT&E in 2002. The main contributor to low maintainability was the radar.
- Only one flight mission simulator hardware-in-the-loop system was available for the Post Deployment Build-6 Limited User Test. The Army is unable to conduct a robust battalion-level evaluation of PATRIOT performance until a second hardware-in-the-loop system is acquired. Two flight mission simulators should be available for the 2008 Limited User Test. The Army will use them to stress load the PATRIOT system with tactically-representative types and numbers of targets, including friendly aircraft and electronic countermeasures. These simulators will also be useful for training, verifying hardware and software fixes, and minimizing the occurrences of random problems.

Recommendations

- Status of Previous Recommendations. The Army has taken action on all but one of the FY05 DOT&E recommendations. FY05 #2: Air and missile defense testing should occur during joint and coalition exercises that include large numbers of different aircraft types; sensors; Battle Management Command, Control, Communications, Computers, and Intelligence; and weapon systems.
- FY06 Recommendations. The Army should:
  1. Upgrade the existing and new hardware-in-the-loop systems to model electronic countermeasures and identification, friend or foe systems.
  2. Update the Test and Evaluation Master Plan to address changes in the acquisition and supporting test strategies for the MSE missile and MEADS.