

## Ballistic Missile Defense System (BMDS)



### Executive Summary

- Missile Defense Agency (MDA) testing continues to move from element-centric testing to Ballistic Missile Defense System (BMDS)-centric testing.
- A second attempt by Ground-based Midcourse Defense (GMD) to intercept a live target using an operationally-configured interceptor (with a range safety kit installed), kill vehicle, and primary radar sensor resulted in a no-test due to target failure. The retest in September was successful and met all test objectives.
- Terminal High-Altitude Area Defense (THAAD) and Aegis Ballistic Missile Defense (BMD), theater elements of the BMDS, made good progress with seven successful flight tests this year between them.
- Command, Control, Battle Management, and Communications (C2BMC) continues to rectify display inaccuracies and address issues with situational awareness; battle management capability is still in early development.
- Sensor fusion remains untested during end-to-end live intercept flight tests.
- Target availability, reliability, performance, and cost are becoming issues in BMDS flight testing.

### System

- The current BMDS architecture integrates ballistic missile defense capabilities against all ranges of threats.
- BMDS is a distributed system currently composed of four elements and six sensor systems:

#### Elements

- Aegis BMD

- C2BMC
- GMD
- Patriot Advanced Capability 3 (PAC-3)

#### Sensors

- Aegis BMD SPY-1 Radar
- Cobra Dane Radar
- Upgraded Early Warning Radars (UEWR) – Beale and Fylingdales
- AN/TPY-2 radar (formerly Forward-Based X-band Transportable radar, or FBX-T)
- Space-Based Infrared System (SBIRS) / Defense Support Program (DSP)
- BMDS is employed as part of an integrated strategic defense plan.
- Near-term additions to the BMDS include the Sea-Based X-Band (SBX) Radar and THAAD.
- Far-term additions to the BMDS may include:
  - Airborne Laser (ABL)
  - Kinetic Energy Interceptor (KEI)
  - Multiple Kill Vehicle (MKV)
  - Space Tracking and Surveillance System (STSS)

### Mission

- U.S. Strategic Command is responsible for overall ballistic missile defense and will employ the BMDS to defend the U.S. territory, deployed forces, friends, and allies against ballistic missile threats of all ranges, in all phases of flight. Initial capability will permit defending the U.S. territory against simple ballistic missile threats.

# BALLISTIC MISSILE DEFENSE SYSTEMS

- U.S. Strategic Command and U.S. Pacific Command will maintain situational awareness across the full mission space using the C2BMC system.
- The Army employs PAC-3 to provide theater defense for the deployed forces against short- and medium-range threats. The

Missile Defense Agency (MDA) transitioned PAC-3 to the Army; PAC-3 is reported as an Army program.

## Activity

- In May 2007, GMD attempted intercept flight test, Flight Test Ground-based Interceptor-03 (FTG-03). This resulted in a no-test due to a target vehicle failure. FTG-03a, the retest, successfully completed in September 2007, meeting all test objectives.
- The MDA executed Flight Test Other-2 (FTX-2) in March 2007. The test provided data to assess Block 06 functionality and interoperability. The MDA learned new lessons during radar data collection on the new target that required adjustments to the SBX software and performance parameters for the final Block 06 architecture.
- Aegis BMD attempted Flight Test Standard Missile-11 (FTM-11) in December 2006. This resulted in a no-test due to operator failure. FTM-11 Event 4, a repeat of FTM-11 in April 2007, resulted in a successful intercept. FTM-12, conducted in June 2007, and FTM-13, conducted in November 2007, were also successful intercept tests. Aegis BMD also participated in a live tracking exercise, Glory Trip-193, in February 2007.
- C2BMC conducted developmental and integration testing, and participated in several wargames as well as during Aegis BMD, GMD, and Patriot flight tests.
- Patriot conducted several flight and ground tests, including:
  - Five flight tests between October 2006 and July 2007 with one failure
  - Limited User Test regression testing in January/February 2007
  - Lethality testing in July 2007
- THAAD conducted one non-intercept flight test (FTT-05) in June 2007, one radar characterization test (RDC-1d) in which the target did not function correctly limiting objective accomplishment, and three successful intercept flight tests between January and October 2007: Flight Test THAAD-06 (FTT-06), FTT-07, and FTT-08.
- During FY07, the MDA conducted two system-level ground tests, Ground Test Distributed-01 (GTD-01) in November 2006, and Ground Test Integrated-02 (GTI-02) in September 2007. In addition, the MDA conducted one partial system-level test, Ground Test Other-02a (GTX-02a), in February 2007. The MDA also conducted Performance Assessment-07 (PA-07), in a BMDS-level end-to-end digital simulation, to assess the capability of BMDS architecture expected to be fielded by December 31, 2007. Results will be reported in the FY07 BMDS Report to Congress.
- In FY07, the MDA declared UEWR-Fylingdales as an early capability delivery radar, but not as part of the BMDS operational baseline. The MDA will assess the radar's

suitability for inclusion in the operational baseline after GTD-02 scheduled for November-December 2007.

- The North American Aerospace Defense Command and U.S. Northern Command sponsored the Vigilant Shield 07 wargame in December 2006.
- The U.S. Strategic Command Joint Functional Component Command for Integrated Missile Defense sponsored the Assured Response 07A wargame in June 2007.
- The BMDS was also represented in Pacific Command's Terminal Fury 07 Exercise, December 2006; in U.S. Forces Japan Keen Edge Exercise, February 2007; and in European Command's Juniper Cobra 07 Exercise, May 2007.

## Assessment

- The MDA, in its spiral development process, designates BMDS capability in three categories:
  - Early Capability Delivery (emergency, low confidence capability), which includes C2BMC version 6.2, Ground-based Interceptor, and UEWR-Fylingdales
  - Partial Capability Delivery (medium confidence capability that supports a warfighter partial mission capability decision), which includes Aegis BMD, UEWR-Beale, Cobra Dane, AN/TPY-2, and GMD Fire Control
  - Full Capability Delivery (highest confidence capability that supports a warfighter full mission capability decision) which includes PAC-3 and C2BMC version 6.0
- The elements that comprise the present and future BMDS are all at different levels of maturity.
  - PAC-3 continues to provide the most mature and well-understood capabilities against its theater-level missile threat set. This assessment is based on the number and complexity of test and evaluation events in which PAC-3 has participated (both flight and ground testing) as well as real-world operations. Recent testing uncovered some deficiencies in PAC-3 that are currently being addressed.
  - Aegis BMD promises to provide a robust theater-level missile defense capability against its threat set. However, this assessment is based on considerably less flight and ground testing than PAC-3, and includes few real-world operations. As with PAC-3, Aegis BMD uncovered several issues that are being addressed.
  - THAAD testing indicates that it will provide a significant increase in capability against short- to intermediate-range threats when it is incorporated into the BMDS in FY10.
  - GMD provides the least mature missile defense capability against its strategic threat set. To date, GMD demonstrated

# BALLISTIC MISSILE DEFENSE SYSTEMS

a limited capability against a simple foreign threat. GMD flight testing to date is not sufficient to provide a high level of statistical confidence in its limited capabilities. Ground testing continues to demonstrate increasing GMD integration, but additional flight test data under realistic conditions is necessary to validate models and simulations and to increase confidence in the ability of these models and simulations to accurately assess system capability.

- The inherent BMDS defensive capability against theater threats increased during the last fiscal year. DOT&E anticipates continued increases in this capability. The inherent BMDS defensive capability against strategic threats, however, remains very basic. The addition of limited operational realism to BMDS testing against strategic threats has uncovered unanticipated deficiencies that will require additional development and testing.
- C2BMC continues to add new functionality. Communications and situational awareness have improved, but adding new sensors and shooters continues to create new challenges. To date, C2BMC is not mature enough to provide an integrated, layered defensive capability against any range of threat missile.
- During the past year, the MDA discovered system deficiencies which resulted in redesigns, testing, and modifications that delayed execution or changed content of test events. For example, FTG-03 was scheduled for the third quarter of 2006, roughly three months after FTG-02 was scheduled in the second quarter of 2006. After FTG-02 completed on September 1, 2006, FTG-03 was rescheduled for the second quarter of 2007. It actually occurred on May 25, 2007, roughly eight months later. Among other things, the program needed this additional time to further analyze, test, and fix the tracking anomaly that occurred during FTG-02. Also, data from FTX-02 demonstrated that SBX needed software modifications to improve discrimination performance during tracking scenarios. This forced MDA to put limitations on the test cases for SBX/GFC integration during GTI-02.
- The MDA is the DoD agency responsible for designing, developing, producing, and/or procuring targets for testing

the nation's ballistic missile defense system. These targets must represent the full spectrum of threat missile capabilities (separating and non-separating re-entry vehicles, varying radar cross sections, countermeasures, etc.) and ranges (intercontinental, intermediate, medium, and short). The appropriate targets are engaged by both strategic and tactical missile defense systems developed by the MDA, the Army, and the Navy.

- During the past 18 months, the MDA has suffered a number of target failures that have seriously impacted test schedules and accomplishment of test objectives. In one case, the MDA had to restructure a program due primarily to target non-availability and cost growth. The MDA is developing the Flexible Target Family (FTF) which it hopes will not only reduce cost through production efficiency and modular flexibility, but also improve reliability and timeliness.
- Unfortunately, the FTF is not ready. As a result, the MDA is forced to continue to use targets that are unreliable and/or don't meet performance requirements that programs need to fully demonstrate their systems' capabilities. The MDA is still several years away from a fully-implemented FTF. The cost-saving goal is a long way from reality. In the meantime, the MDA will continue to suffer schedule delays, retests, and follow-up test requirements as the result of unreliable and inadequate targets. Ultimately, some non-MDA users may not be able to afford the targets provided by the FTF.

## Recommendations

- Status of Previous Recommendations. The MDA has addressed all but one of the DOT&E recommendations from previous annual reports. While the MDA is slowly improving reliability, availability, and maintainability data collection for the BMDS, improvement is still needed in this area (FY05).
- FY07 Recommendation.
  1. The MDA should review its current target development and procurement strategy to confirm the strategy will provide targets that meet performance and schedule expectations at costs proportional to their expected use.

