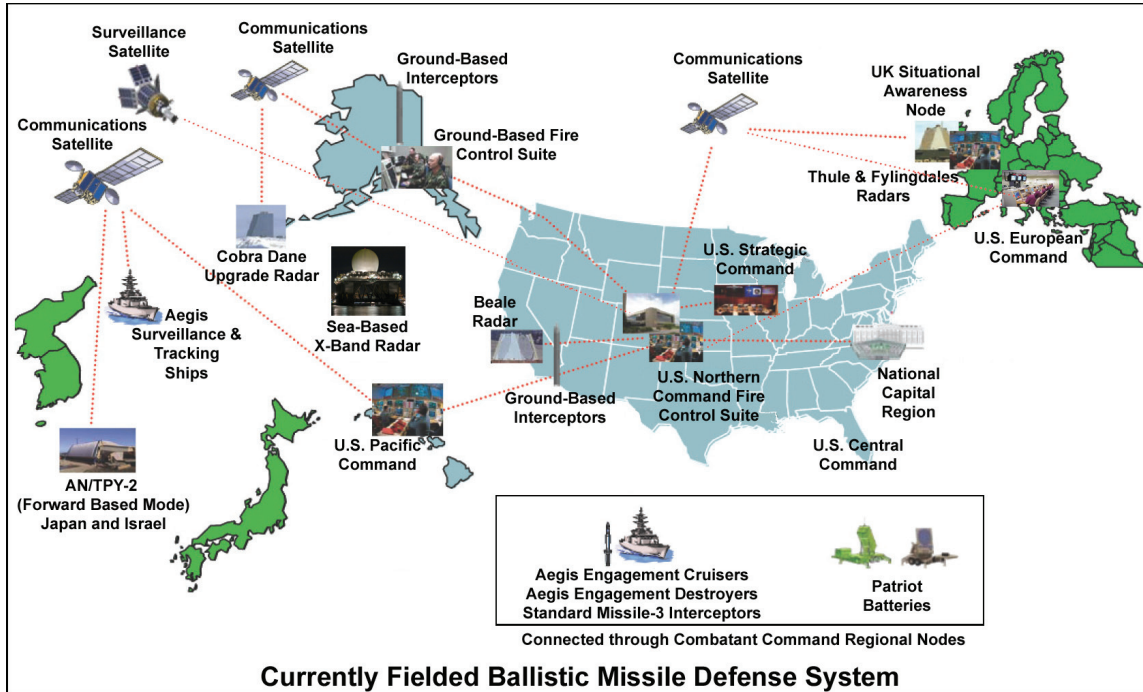


## Ballistic Missile Defense System (BMDS)



### Executive Summary

- The Missile Defense Agency (MDA) continued execution of its Integrated Master Test Plan (IMTP) to collect the data needed to accredit the models and simulations used for assessing the performance and effectiveness of the Ballistic Missile Defense System (BMDS).
- Using the Standard Missile-3 (SM-3) Block IA interceptor, Aegis Ballistic Missile Defense (Aegis BMD) intercepted an intermediate-range ballistic missile using up-range data from an AN/TPY-2 (Forward-Based Mode [FBM]) radar and, in a Japanese Aegis BMD flight test, it intercepted a medium-range separating ballistic missile. Aegis BMD failed to intercept the target in the first flight test of the SM-3 Block IB interceptor during FY11.
- The Ground-based Midcourse Defense (GMD) element conducted an unsuccessful intercept flight test during FY11.
- The Terminal High-Altitude Area Defense (THAAD) program conducted a successful IOT&E flight test on October 3, 2011.
- The Patriot program conducted a successful intercept flight test using a Missile Segment Enhancement (MSE) interceptor during FY11 and conducted three successful developmental flight test missions in early FY12.
- Command, Control, Battle Management, and Communications (C2BMC) demonstrated the ability to control a single AN/TPY-2 (FBM) radar, receive and forward tracks, receive and display weapon element status data from several elements (Aegis BMD, THAAD, and Patriot), and interact with the GMD element through the GMD fire control during flight test

events. The ability to control two AN/TPY-2 (FBM) radars has been demonstrated through hardware-in-the-loop ground testing, but not with operational radars using operational communications architectures and hardware.

### System

- The current BMDS architecture integrates ballistic missile defense capabilities against all ranges of threats.
- BMDS is a distributed system currently comprised of four elements (three shooter elements and one command and control element) and five sensor systems (four radar systems and one space-based system).

### Elements

- Aegis BMD (shooter)
- C2BMC (command and control)
- GMD (shooter)
- Patriot (shooter)

### Sensors

- Aegis BMD AN/SPY-1 Radar
- Cobra Dane Radar
- Upgraded Early Warning Radars (UEWRs)
- AN/TPY-2 (FBM) Radar
- Space-Based Infrared System/Defense Support Program (SBIRS/DSP)
- Sea-Based X-Band (SBX) Radar (primarily a test asset that can be operationally deployed as needed)
- THAAD is a projected near-term addition to the BMDS.

# BALLISTIC MISSILE DEFENSE SYSTEMS

- Advanced technology BMDS capabilities include the following:
  - Airborne Laser Test Bed
  - Precision Tracking Space System, a follow-on to the Space Tracking and Surveillance System (STSS)
  - Airborne Infrared Sensors

## Mission

- The U.S. Strategic Command is responsible for synchronizing and integrating ballistic missile defenses employing U.S. Northern Command, U.S. Pacific Command, U.S. Central Command, and U.S. European Command assets, and the BMDS to defend U.S. territory, deployed forces, friends, and allies against ballistic missile threats of all ranges and in all phases of flight. Initial capability permits defending U.S. territory against simple ballistic missile threats and defending deployed forces, friends, and allies from theater-level ballistic missile threats.

- U.S. Strategic Command, U.S. Northern Command, U.S. European Command, U.S. Central Command, and U.S. Pacific Command will maintain situational awareness across the full mission engagement space using the C2BMC element of the BMDS.
- The Army employs Patriot to provide theater defense for deployed forces against short- and medium-range threats.

## Major Contractors

- The Boeing Company, Integrated Defense Systems, Missile Defense Systems – Huntsville, Alabama
- Lockheed Martin
  - Missile and Fire Control – Dallas, Texas
  - Maritime Systems & Sensors – Moorestown, New Jersey
  - Information Systems and Global Services – Gaithersburg, Maryland
- Raytheon Missile Systems – Tucson, Arizona

## Activity

- The MDA, in collaboration with the Operational Test Community, made two updates to the IMTP using critical factors analysis (also referred to as Critical Engagement Conditions) and considered other important data needs (also referred to as Empirical Measurement Events) to drive test design, planning, and execution.
- The MDA conducted Technical Assessment-04 (TA-04) to assess the readiness and integration of BMDS element-level digital simulations for participation in Performance Assessment-04, which is planned for 4QFY13.
- During July 2011, a short-range air-launched target was launched in Flight Test Other-17 (FTX-17). This was the return-to-flight test of air-launched targets after they were grounded following a failure in Flight Test THAAD-11 (FTT-11).
- In March 2011, a short-range ballistic missile target was launched, and for the first time, STSS demonstrator satellites acquired and tracked the target from boost through midcourse, with data transmitted to ground stations and sent to an underway Aegis BMD 3.6.1 ship in near-real-time (FTX-16 E1).
- During Flight Test Standard Missile-15 (FTM-15), ground stations sent STSS target track data to the C2BMC Experimental Labs for a simulated remote engagement by the Aegis BMD ship.

## Aegis BMD

- In FY11, the Aegis BMD program continued the test and evaluation of the Aegis BMD 3.6.1 software load with the SM-3 Block IA interceptors. Aegis BMD 4.0.1 system testing was conducted both at-sea and in land-based laboratory facilities.
- The Aegis BMD program conducted three intercept tests. The first was Japan Flight Test Standard Missile-4

(JFTM-4) in October 2010 with Aegis BMD 3.6.1. The second was FTM-15 in April 2011 with Aegis BMD 3.6.1. The third was FTM-16 Event 2 in September 2011 with Aegis BMD 4.0.1. Using the fielded SM-3 Block IA interceptor, FTM-15 demonstrated, for the first time, the Aegis BMD capability to engage an intermediate-range separating ballistic missile during the midcourse phase of flight. This capability supports Phase 1 of the Phased Adaptive Approach for defense of Europe. The SM-3 Block IB interceptor failed to hit its target during FTM-16 Event 2.

- Aegis BMD also participated in several BMDS system-level flight and ground tests including:
  - Fast Eagle hardware-in-the-loop exercise in October 2010
  - Assured Response 04X in October 2010
  - Flight Test Ground-based Interceptor-06a (FTG-06a) in December 2010
  - Ground Test Distributed-04b (GTD-04b) in February and March 2011
  - Ground Test Integrated-04d (GTI-04d) in July 2011
  - Technical Assessment-04 (TA-04)
  - GTD-04d Part I

## GMD

- GMD executed the FTG-06a event in December 2010. FTG-06a was a re-test of the unsuccessful FTG-06 intercept attempt in January 2010. The AN/TPY-2 and SBX radars provided acquisition, track, and discrimination data to the GMD system. This test resulted in a failed target intercept. FTG-06a was the second flight test and intercept attempt by an interceptor equipped with the new Capability Enhancement II (CE II) Exo-atmospheric Kill Vehicle (EKV).

# BALLISTIC MISSILE DEFENSE SYSTEMS

- The MDA executed the system-level event, GTD-04b, in February and March 2011 using fielded and to-be-fielded element software and BMDS element representations, which included GMD.

## **THAAD**

- The THAAD program conducted one intercept flight test, Flight Test THAAD-12 (FTT-12) (IOT&E) on October 4, 2011, that ended in intercepts of two threat-representative targets.
- THAAD participated in GTD-04b and TA-04.

## **Patriot**

- The Army began the Post-Deployment Build-7 (PDB-7) developmental test and evaluation on July 27, 2011, at White Sands Missile Range (WSMR), New Mexico. Ground testing runs for record ended on October 7. Developmental endurance and flight testing is scheduled to complete in January 2012. Data analysis is ongoing.
- A third MSE missile flight test, Flight Test Patriot-04 (FTP-04) (7-3), was conducted at WSMR in March 2011. Patriot fired two MSE interceptors at a ballistic missile target. The first MSE intercepted the target and the second intercepted debris from the first intercept.
- During the first PDB-7 flight test (FTP-05 or P7-4) at WSMR in November 2011, Patriot fired two Patriot Advanced Capability-3 (PAC-3) missiles at a short-range ballistic missile target. The first PAC-3 intercepted the target. Data analysis is ongoing.
- During the second PDB-7 flight test (P7-3) at WSMR in November 2011, Patriot fired two Guidance Enhanced Missile (GEM) interceptors at a short-range ballistic missile target. The first GEM intercepted the target. Data analysis is ongoing.
- During the third PDB-7 flight test (P7-2) at WSMR in November 2011, Patriot fired a GEM-T and GEM-C interceptor at each of two short-range ballistic missile targets. The GEM-T and GEM-C missile variants are intended to counter tactical ballistic missiles and cruise missiles, respectively. The GEM-Ts intercepted both targets. Data analysis is ongoing.

## **C2BMC**

- C2BMC S6.2 participated in Fast Eagle and Assured Response-04D.
- C2BMC S6.4 participated in Assured Response-04X, FTG-06a, Caravan 2 United States Flight Test-4, GTD-04b, Assured Response-04D, FTM-15, GTI-04d, GTD-04d Part 1, GTX-04a, TA-04, FTM-16 E1, FTM-16 E2, FTT-12, and FTX-16 E1.

## **Assessment**

- The BMDS defensive capability against theater threats increased during the last fiscal year. DOT&E anticipates continued increases in this capability over time.
- The designated military combatants actively participated in all system-level BMDS testing, and nearly all element-level testing. They perform operational roles at individual element

levels through major combatant command levels using operational tactics, techniques, and procedures.

- The elements that comprise the present and future BMDS are at different levels of testing and maturity.

## **Aegis BMD**

- During FTM-15, Aegis BMD demonstrated launch-on-remote capability with “remote engagements authorized” against an intermediate-range ballistic missile target using an AN/TPY-2 (FBM) radar track. This capability supports Phase 1 of the Phased Adaptive Approach for defense of Europe, which is planned for deployment at the end of CY11.
- Aegis BMD flight testing continued to demonstrate the capability to engage separating ballistic missile targets in the midcourse phase with SM-3 Block IA interceptors during both JFTM-4 and FTM-15.
- In its first flight test, the SM-3 Block IB interceptor failed to intercept a separating target during FTM-16 Event 2 due to an in-flight missile failure. A Failure Review Board is analyzing the test data to determine the root cause of this failure.

## **GMD**

- To date, GMD has demonstrated a limited capability against a simple threat. The FTG-06a failure to intercept delayed demonstration of the new CE II EKV-based interceptors and delayed progress in the execution of the revised IMTP by precluding acquisition of specific critical engagement condition data. However, the root cause of the FTG-06a failure has been identified and fixes will be verified during a flight test to be conducted next year. Ground testing continued to demonstrate increasing GMD interoperability with the BMDS sensors and elements.
- GMD capability assessments are complicated by:
  - Extant differences between fielded and flight-tested interceptor configurations
  - Two flight test failures during the past 24 months
  - Interceptor design changes precipitated by parts obsolescence and previous flight test failures

## **THAAD**

- THAAD demonstrated the ability to perform a multiple simultaneous engagement and the execution of a full battle sequence from planning through live operations during the FTT-12 IOT&E.

## **Patriot**

- Patriot continues to provide mature and moderately well-understood capabilities against many of its short- and medium-range ballistic missile threats. This assessment is based on the number and complexity of prior test and evaluation events in which Patriot participated (both flight and ground testing) as well as combat operations during Operation Iraqi Freedom.
- Understanding of Patriot performance against non-tactical ballistic missile threats is limited because Patriot endgame estimates were not made for these threats.

# BALLISTIC MISSILE DEFENSE SYSTEMS

- The full report on Patriot can be found in the Army section of this Annual Report.

## **C2BMC**

- C2BMC continued to demonstrate interoperability with all BMDS elements.
- Ground testing demonstrated the ability to control two AN/TPY-2 (FBM) radars, to execute limited automated sensor and battle management functionality, and to track processing enhancements of C2BMC S6.4. C2BMC has demonstrated the capability to control a single AN/TPY-2 radar during flight testing.

## **Recommendations**

- **Status of Previous Recommendations.** Although the MDA has made progress on previous recommendations, the two FY08 recommendations regarding the BMDS lethality program and BMDS computer network defense, and the FY09 recommendation regarding IMTP execution, are still valid.
- **FY11 Recommendation.**
  1. The MDA should repeat flight tests to verify root causes and Failure Review Board results for the Aegis BMD and GMD flight test failures to confirm permanent fixes to the problems the boards discovered.