

## Ground-Based Midcourse Defense (GMD)

### Executive Summary

- The Missile Defense Agency (MDA) conducted Flight Test Ground-based Interceptor-06 (FTG-06), an intercept flight test, in January 2010. FTG-06 experienced targeting radar and interceptor kill vehicle malfunctions, and failed to intercept its intended target. As a result, the MDA changed the GMD baseline test program by adding FTG-06a in 1QFY11 as a re-test. This re-test is necessary to collect data on GMD-critical engagement conditions. This re-test will likely delay the previous flight test program by at least six months.
- The MDA conducted Booster Verification Test-01 (BVT-01), a two-stage interceptor boost vehicle test, in June 2010. Data from BVT-01 suggest that the Ground-based Midcourse Defense (GMD) two-stage interceptor could prove a viable boost vehicle in addition to the currently deployed three-stage interceptor.
- Ground tests supported characterization of GMD performance and development of operational tactics, techniques, and procedures. Test results suggested GMD provides a capability to defend the United States against limited, emerging, uncomplicated, long-range, ballistic missile threats. Lack of sufficient data for comprehensive model and simulation validation and accreditation continues to preclude a full end-to-end performance evaluation.
- Continuing evolution of the interceptor design has resulted in multiple interceptor configurations among the fielded interceptors and test assets. These configuration differences complicate assessment of interceptor operational effectiveness and suitability.

### System

GMD is the principal element used by the Ballistic Missile Defense System (BMDS) for the Homeland Defense mission. The current distributed GMD configuration consists of the following systems:

- Cobra Dane Upgrade Radar at Eareckson Air Station (Shemya Island), Alaska
- Upgraded Early Warning Radars (UEWR) at Beale AFB, California, and Fylingdales, United Kingdom.
- Ground-based Interceptor (GBI) missiles at Fort Greely, Alaska, and Vandenberg AFB, California.
- GMD Fire Control (GFC) nodes residing at the Missile Defense Integration and Operations Center, Schriever AFB, Colorado, and Fort Greely, Alaska. The ground system includes GFC, Command Launch Equipment (CLE), and



In-Flight Interceptor Communications System Data Terminals at Vandenberg AFB, California; Fort Greely, Alaska; and Shemya Island, Alaska.

- External interfaces including Aegis Ballistic Missile Defense (Aegis BMD); North American Aerospace Defense – Northern Command (NORAD-NORTHCOM) Command Center (N2C2) and Command, Control, Battle Management, and Communications (C2BMC), Peterson AFB, Colorado; Space-Based Infrared System/Defense Support Program (SBIRS/DSP), Buckley AFB, Colorado; and AN/TPY-2 (Forward-Based Mission (FBM)) radar, Shariki Air Base, Japan.

### Mission

U.S. Strategic Command operators will use the GMD system to defend U.S. territory, deployed forces, friends, and allies against threat ballistic missiles (intercontinental- and intermediate-range missiles).

### Major Contractors

- The Boeing Company, Integrated Defense Systems, Missile Defense Systems – Huntsville, Alabama
- Orbital Sciences Corporation – Chandler, Arizona
- Raytheon Missile Systems – Tucson, Arizona
- Northrop Grumman Information Systems – Huntsville, Alabama

## Activity

- The MDA conducted FTG-06, an intercept flight test attempt, in January 2010 to collect data on multiple critical engagement conditions and to demonstrate (for the first time) intercept of a target by an interceptor equipped with the new Capability Enhancement II (CE II) kill vehicle.
  - The MDA launched an intermediate range target missile with simulated re-entry vehicle from the U.S. Army Reagan Test Site at Kwajalein Atoll in the Republic of the Marshall Islands.
  - The Sea-Based X-band radar participated from a test location in the Pacific Ocean; no other BMDS radar participated in this test.
  - An Army 100th Missile Defense Brigade crew at Schriever AFB, Colorado directed the launch of a GMD interceptor from a test silo at Vandenberg AFB, California.
  - The GMD interceptor failed to intercept the target missile re-entry vehicle.
- The MDA conducted BVT-01, a boost vehicle verification test, in June 2010 to demonstrate launch and fly-out of a prototype 2-stage GMD interceptor and to collect data on multiple critical engagement conditions and one empirical measurement event. The MDA launched the interceptor from a test silo at Vandenberg AFB, California.
- The MDA and the BMDS Operational Test Agency Team conducted Ground Test Integrated-04b (GTI-04b), a BMDS-level hardware-, software-, and operator-in-the-loop ground test, in August 2010 to demonstrate functionality, interoperability, and performance of the BMDS and to characterize BMDS element capabilities.
  - The MDA used multiple ground test facilities located throughout the United States to replicate BMDS element responses, including GMD, to simulated threat scenarios.
  - GMD participated from the Army Advanced Research Center in Huntsville, Alabama.
  - An Army 100th Missile Defense Brigade crew from Schriever AFB, Colorado executed operational tactics, techniques, and procedures for the simulated GMD defensive operation against intercontinental ballistic missile threats.
- The MDA conducted BMDS Technical Assessment 2010, a fully digital BMDS-level simulation, in August 2010 to assess the performance capabilities of the to-be-fielded BMDS configuration. The MDA used multiple threat scenarios in conjunction with digital simulations of the BMDS and its elements. In particular, GMD simulated defense against intercontinental ballistic missile threats.
- Due to the failed FTG-06, the MDA changed the GMD test program by adding FTG-06a in 1QFY11 as a re-test to support data collection on GMD critical engagement conditions.

## Assessment

- FTG-06 demonstrated launch and fly out of the GMD interceptor and limited threat detection, tracking, and engagement capability. In addition, FTG-06 employed, for the first time in flight test, a CE II kill vehicle. Undesirable performances of the Sea-Based X-band radar and the interceptor kill vehicle prevented intercept of the target and acquisition of data on critical engagement conditions. Details of the failed intercept will be discussed in the classified FY10 BMDS report to Congress. The added re-test, FTG-06a, will likely delay the previously planned flight test program by at least six months.
- BVT-01 demonstrated launch and flyout of the prototype GMD 2-stage interceptor. The MDA acquired critical engagement condition data on the launch and flyout environments, and additional data on 2-stage first generation avionics. The MDA is analyzing these data. BVT-01 also demonstrated deployment of a kill vehicle. The MDA collected data on specific critical engagement conditions from this kill vehicle. A malfunction of the kill vehicle, unrelated to problems associated with FTG-06 above, may have degraded the quality of data collected. The MDA is analyzing the data to determine the extent, if any, of the degradation.
- GTI-04b provided the most accurate representation to date of the BMDS and GMD for characterization of performance and for development and exercise of operational procedures. GTI-04b provided insight into GMD functionality, interoperability, and performance within the BMDS. Test results suggested that GMD provides a capability to defend the United States against limited long-range ballistic missiles with uncomplicated, emerging threat re-entry vehicles. The tests identified specific regions within the United States that posed greater difficulty to defend. Full end-to-end performance evaluation was not possible since specific models and simulations either lacked verification and validation data, or verification and validation data did not meet acceptability criteria as jointly established between the MDA and the BMDS Operational Test Agency Team.
- The MDA is currently analyzing the data from Technical Assessment 2010. As previously stated by the MDA, full end-to-end performance evaluation is still a minimum of 6 years away. Specific models and simulations either lack verification and validation data, or verification and validation data does not meet acceptability criteria as jointly established between the MDA and the BMDS Operational Test Agency Team.
- Evolution of interceptor design complicated assessment of operational effectiveness and suitability. Continued configuration changes driven by component obsolescence and problems discovered in flight test have resulted in differences

between fielded interceptors and flight test interceptors, further complicating assessment.

- Acquisition of suitability data continued to improve. Further refinements of the BMDS Joint Reliability and Maintainability Evaluation Team database are necessary to support evaluation of reliability, availability, and maintainability. Insufficient data on the GMD interceptor and command launch equipment limit database utility. In addition, the database lacks software maturity metrics for all components.
- The MDA evaluation of survivability is limited. As part of the annual Integrated Master Test Plan update process, the MDA continues to define the scope of required survivability testing, survivability assessment objectives, measures of performance, and data requirements.

## **Recommendations**

- Status of Previous Recommendations. The MDA has satisfactorily addressed eight of the previous nine GMD recommendations. In FY07, DOT&E recommended the MDA re-examine the GMD-specific lethality simulation needs in light of test data that has emerged from MDA target lethality testing since its last accreditation. Although the MDA has made progress, this recommendation remains open.
- FY10 Recommendations. None.

# BALLISTIC MISSILE DEFENSE SYSTEMS