

Ground-Based Midcourse Defense (GMD)

Executive Summary

- The Missile Defense Agency (MDA) restructured the Ground-based Midcourse Defense (GMD) test program to focus on acquisition of data needed for validation and accreditation of GMD models and simulations, which are necessary for evaluation of GMD effectiveness and suitability. The restructured program extended GMD flight tests through FY20.
- The MDA conducted Flight Test GMD Interceptor (FTG)-05, an intercept flight test, in December 2008. FTG-05 demonstrated all threat engagement functions within an uncomplicated, threat-representative test scenario, against an uncomplicated, threat-representative target. The target missile experienced a malfunction that precluded achievement of all planned test objectives. Although the interceptor also experienced a malfunction, it did not impact achievement of test objectives. The MDA developed an interceptor hardware change to mitigate the risk of a similar GMD interceptor malfunction.
- Ground tests supported characterization of GMD performance and development of warfighter operational tactics, techniques, and procedures. Test results suggested the GMD provided a capability to defend the United States against the limited, emerging, uncomplicated, long-range, ballistic missile threats. Lack of sufficient data for comprehensive model and simulation validation and accreditation continued 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 reside at the Missile Defense Integration and Operations Center, Schriever AFB, Colorado; and Fort Greely, Alaska. The GFC includes In-Flight Interceptor Communications System Data Terminals at Vandenberg AFB, California; Fort Greely, Alaska; and Shemya Island, Alaska.
- External interfaces include Aegis Ballistic Missile Defense (Aegis BMD); Cheyenne Mountain Directorate, Colorado; 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).

Prime Contractors

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

Activity

- As part of the process to revise the Integrated Master Test Plan (IMTP) and restructure the BMDS test program, the MDA identified seven Critical Engagement Conditions (CECs)

and seven Empirical Engagement Events (EMEs) for which flight and ground testing will collect data to validate the GMD models and simulations. The restructured GMD test

BALLISTIC MISSILE DEFENSE SYSTEMS

baseline not only defined tests for FY10-15, but also specified additional needed flight tests through FY20.

- The MDA conducted FTG-05 in December 2008 to test and evaluate GMD performance against a long-range ballistic missile target using target tracking data from multiple BMDS sensors. The MDA launched a long-range, threat-representative target missile from Kodiak, Alaska, toward a broad ocean area west of California. BMDS operational sensors (AN/TPY-2 (FBM), Aegis AN/SPY-1, Sea-Based X-band Radar (SBX), and UEWB-Beale) acquired and tracked the target missile and transmitted data to the operational GFC, which generated a weapon task plan. An operational crew of the 49th Missile Defense Battalion at Fort Greely, Alaska, remotely directed the launch of a GMD interceptor from a test silo at Vandenberg AFB, California. The GMD interceptor intercepted the target missile's simulated warhead.
- The MDA and the BMDS Operational Test Agency (OTA) Team conducted one major ground test and one focused, limited-scenario ground test during FY09:
 - Ground Test Distributed-03 (GTD-03) in February and March 2009 was an integrated ground test using the fielded components and communications to test functionality, interoperability, and performance of the GMD and BMDS. Simulated threat scenarios stimulated the fielded components. Warfighters from the Army's 100th Missile Defense Brigade and 49th Missile Defense Battalion performed their planned wartime duties in a realistic exercise of the fielded BMDS capability.
 - Focused Ground Test-03e (GTX-03e) in July 2009 was an integrated ground test formally requested by U.S. Northern Command and U.S. Pacific Command to characterize fielded BMDS element capabilities, including the GMD, and warfighter operational tactics, techniques, and procedures. Simulated threat and non-threat scenarios stimulated BMDS hardware-in-the-loop element and component representations to test functionality, interoperability, and performance of the fielded capability. Warfighters, deployed from the Army's 100th Missile Defense Brigade to the GMD hardware-in-the-loop laboratory in Huntsville, Alabama, exercised their operational procedures.
- In response to emerging contingencies, the MDA conducted a series of ground tests to assess the capability of the currently configured GMD system against potential threats to the United States and Pacific Rim allies. These tests:
 - Utilized multiple GMD and BMDS hardware-in-the-loop laboratories
 - Deployed warfighters to operate the hardware-in-the-loop laboratories, which provided additional training opportunities and venues to exercise operational tactics, techniques, and procedures
 - Included participation by the BMDS OTA Team, gaining valuable insights into the capabilities and limitations of the currently deployed system

Assessment

- The new GMD baseline test program directed needed focus on data collection for resolution of identified CECs and EMEs. These data are necessary to validate GMD models and simulations, which are essential for evaluation of operational effectiveness and suitability. The plan incorporates periods of stable system configuration to enable data acquisition and operational testing.
- FTG-05 demonstrated real-time acquisition and track of a threat-representative target by four operational sensors; data transmission from the sensors to the GFC; GFC data correlation and engagement planning; human in control; execution of warfighter tactics, techniques, and procedures; interceptor performance; and target intercept. The engagement and engagement conditions represented an uncomplicated threat and threat environment. FTG-05 exercised adequate flight test operational realism. A target subsystem malfunction precluded achievement of all the planned test objectives. An interceptor malfunction, although not affecting achievement of test objectives, resulted in a hardware change to mitigate the risk of a similar GMD interceptor malfunction.
- Ground tests GTD-03 and GTX-03e were adequate for characterization of GMD behavior and provided insight into GMD functionality, interoperability, and performance. These tests provided the most accurate representation of the BMDS and GMD for the characterization of performance and for the development and exercise of warfighter operational procedures. Test results suggested GMD provided a capability to defend the United States against limited numbers of long-range ballistic missiles with uncomplicated, emerging threat warheads. The tests identified specific defended regions that posed greater difficulty to defend. Full end-to-end performance evaluation was not possible since specific models and simulations either lacked applicable data, or the applicable data did not meet the acceptability criteria for accreditation as jointly established between the MDA and the BMDS OTA Team.
- Interceptor design evolution complicated assessment of interceptor operational effectiveness and suitability. Continued interceptor configuration changes driven by component obsolescence and problems discovered in flight test have resulted in interceptor-to-interceptor differences among both fielded interceptors and flight test assets.
- 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. Incomplete data requirements for the GMD interceptor and command and 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 IMTP update process, the MDA is defining the scope of required survivability testing, survivability assessment objectives, measures of performance, and data requirements.

BALLISTIC MISSILE DEFENSE SYSTEMS

Recommendations

- Status of Previous Recommendations. The MDA has satisfactorily addressed eight of the previous nine GMD recommendations. Although the MDA has made progress, one recommendation to review lethality simulation accreditation remains outstanding.
- FY09 Recommendation.
 1. The MDA should review the IMTP for resource and schedule impacts to the GMD program resulting from changes needed to support the test program for phased, adaptive approach to providing missile defense for Europe.

BALLISTIC MISSILE DEFENSE SYSTEMS