Ground-Based Midcourse Defense (GMD)

Executive Summary

- Kill vehicle problems continue to impede progress in the Ground-based Midcourse Defense (GMD) flight test program. The Missile Defense Agency (MDA) conducted Flight Test Ground-based Interceptor-06a (FTG-06a) in December 2010. In this test, the exoatmospheric kill vehicle deployed but failed to intercept the target. The back-to-back intercept failures in FY10 and FY11 delayed achievement of flight test program goals by at least two years.
- The majority of fielded interceptors have Capability Enhancement I (CE-I) kill vehicles, which have been successfully flight tested. The MDA continues to discover problems with the GMD CE-II kill vehicle-equipped interceptors that require hardware and software changes. Ground test results suggest that the GMD system provides a limited capability for the defense of the U.S. Homeland against emerging intermediate-range and intercontinental ballistic missile threats. The MDA conducted Ground Test Distributed-04b (GTD-04b) in February and March 2011. GMD participation in that test provided insight into GMD functionality, interoperability, and performance within the BMDS.
- Lack of sufficient data for comprehensive model and simulation verification, validation, and accreditation continues to preclude end-to-end GMD performance assessment. The MDA continues to acquire GMD data and to evolve its data acquisition plan, but acquisition of sufficient data will require several more years of testing.

System

GMD is a Ballistic Missile Defense System (BMDS) element that counters intermediate-range and intercontinental ballistic missile threats to the U.S. Homeland. The BMDS includes:

- Cobra Dane Upgrade Radar at Eareckson Air Station (Shemya Island), Alaska
- Upgraded Early Warning Radars (UEWR) at Beale AFB, California; Fylingdales, United Kingdom; and Thule, Greenland
- Ground-based Interceptor (GBI) missiles at Fort Greely, Alaska, and Vandenberg AFB, California
- GMD ground system including GMD Fire Control (GFC) nodes at Schriever AFB, Colorado, and Fort Greely, Alaska; Command Launch Equipment (CLE) at Vandenberg AFB, California, and Fort Greely, Alaska; and In-Flight Interceptor Communication System Data Terminals at Vandenberg AFB, California, Fort Greely, Alaska, and Shemya Island, Alaska
- GMD secure data and voice communication system including long-haul communications using the Defense Satellite Communication System (DSCS), commercial satellite communications, and fiber optic cable (both terrestrial and submarine)

- External interfaces that connect to Aegis Ballistic Missile Defense (BMD); North American Aerospace Defense – U.S. Northern Command (NORAD-NORTHCOM) Command Center (N2C2) and Command, Control, Battle Management, and Communications (C2BMC) at Peterson AFB, Colorado; Space-Based Infrared System/Defense Support Program (SBIRS/DSP) at Buckley AFB, Colorado; and AN/TPY-2 (Forward-Based Mode [FBM]) radar at Shariki Air Base, Japan
- Sea-Based X-Band (SBX) radar, which is at sea with no permanent homeport (currently under continuing MDA development, but can be operationally deployed as needed)

Mission

Military operators for the U.S. Army Space and Missile Defense Command/Army Forces Strategic Command (the Army service component to U.S. Strategic Command) will use the GMD system to defend the U.S. Homeland against intermediate-range and intercontinental ballistic missile attacks using its weapon, the GBI, to defeat threat missiles during the midcourse segment of flight.

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-06a, a planned intercept flight test, in December 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 CE-II kill vehicle. FTG-06a was a re-test of the unsuccessful FTG-06 intercept attempt in January 2010.
  - The MDA launched an intermediate-range target ballistic missile with a simulated re-entry vehicle and associated objects from the Ronald Reagan Test Site at Kwajalein Atoll in the Republic of the Marshall Islands.
  - The SBIRS/DSP system participated in this flight test.
  - An AN/TPY-2 (FBM) radar at Wake Island and the SBX radar at a test location in the Pacific Ocean provided target acquisition and track data to the GMD system. In addition, the SBX provided discrimination data to the GMD system.
  - C2BMC at Wake Island forwarded AN/TPY-2 radar tracks to GMD and provided situational awareness to combatant commanders.
  - Military personnel from the Army 100th Missile Defense Brigade at Schriever AFB, Colorado, directed the launch of a GMD interceptor from a silo at Vandenberg AFB, California.
  - The GMD interceptor flew to its designated point and deployed an exoatmospheric kill vehicle.
  - The exoatmospheric kill vehicle acquired the target complex and discriminated the most lethal object, but the kill vehicle failed to intercept the target re-entry vehicle.
- Due to the failed FTG-06a intercept, the MDA changed the GMD flight test program.
  - The MDA initiated a Failure Review Board, and that board subsequently identified the root cause of the failure to intercept. The MDA is testing corrective actions on kill vehicle components to correct undesirable performance.
  - The MDA added an interceptor-only flight test, GMD Controlled Test Vehicle-01 (GM CTV-01), in 3QFY12 that would verify interceptor fixes developed in response to the Failure Review Board findings.
  - The MDA added a new intercept flight test attempt, FTG-06b, in 4QFY12 to demonstrate intercept and to achieve the unmet objectives of FTG-06 and FTG-06a.
  - To accommodate the new interceptor flight tests, the MDA rescheduled FTG-13 from 4QFY13 to 4QFY16 (and made it an operational test), FTG-15 from 4QFY16 to 4QFY17, FTG-12 from 4QFY17 to 4QFY21, FTG-08 from 4QFY14 to 3QFY14, and removed the GMD salvo test from FTO-02. The GMD salvo test is now FTG-11, and its planned date remains 4QFY15. FTG-14 moved from 4QFY21 to 4QFY22.
- The MDA conducted BMDS Ground Test Distributed-04b (GTD-04b), a ground test of fielded and to-be-fielded elements, components, and communications, in February and March 2011 to demonstrate functionality, interoperability, and performance of a to-be-fielded version of the BMDS and its elements.
  - Threat scenarios stimulated operational BMDS elements and test version elements located at multiple sites throughout the United States.
  - The GMD system participated and employed GMD communications and an updated version of GFC software in the GFC operational nodes at Schriever AFB, Colorado, and Fort Greely, Alaska.
  - During a portion of GTD-04b, operational military personnel at the Army 100th Missile Defense Brigade at Schriever AFB, Colorado, and the 49th Battalion at Fort Greely, Alaska, executed operational tactics, techniques, and procedures for the simulated GMD defense of the U.S. Homeland against intermediate-range and intercontinental ballistic missile attacks.

Assessment

- Kill vehicle problems continue to impede progress in the GMD flight test program. In FTG-06a, the second flight test of a CE II kill vehicle, the FTG-06 kill vehicle failure mode was not observed, but other undesirable kill vehicle performance occurred and resulted in a failed intercept attempt. The back-to-back intercept flight test failures in FY10 and FY11 delay achievement of intercept flight test program goals by at least two years. The undesirable kill vehicle performance that caused the failed intercept will be reviewed in the classified annex of DOT&E's "2011 Assessment of the Ballistic Missile Defense System (BMDS)" report to Congress.
- FTG-06a achieved a number of test objectives with some limitations. The MDA, for the first time, launched a GMD interceptor on track data provided by the AN/TPY-2 (FBM) radar. In addition, the MDA verified the effectiveness of software changes that were made to the SBX radar in response to its undesirable performance in FTG-06 and demonstrated a capability of the SBX radar to support engagement of an intermediate-range ballistic missile target. The MDA, however, employed the SBX radar in FTG-06 in a manner that departed from full operational realism in order to achieve specific developmental test objectives and to reduce risk to the achievement of primary test objectives. Military personnel from the Army 100th Missile Defense Brigade directed launch of the GMD interceptor, but they employed tailored tactics, techniques, and procedures that departed from full operational realism and that were driven by test constraints. The MDA also acquired additional data on interceptor launch and fly out performances. Although an intercept was not achieved, target complex signature and feature data were collected to verify EKV discrimination algorithms. A classified assessment of the SBIRS/DSP system performance will be reviewed in the classified annex of DOT&E's "2011 Assessment of the Ballistic Missile Defense System (BMDS)" report to Congress.

- GTD-04b demonstrated the integrated capability of new versions of the BMDS and its elements. The GMD system participated in this ground test with a new version of GFC software. The GMD system exercised communications internally among the GMD components and externally to the BMDS and the BMDS sensors at operational locations. GTD-04b provided insight into GMD functionality, interoperability, and performance within the BMDS. Test results suggest that the GMD system provides a limited capability for the defense of the U.S. Homeland against emerging intermediate-range and intercontinental ballistic missile threats. GMD 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.
- Acquisition of suitability data continued. 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 ongoing discovery and fix of interceptor problems complicate assessment of the operational effectiveness and suitability of the GMD interceptor.
- The MDA lacks threat and target payload models for GMD lethality assessment and lacks full-scale, high-fidelity test data to validate GMD lethality performance. Such models and data will be needed.
- MDA survivability testing is not adequate to support a survivability assessment of the GMD system and its components. The MDA has taken several steps to improve the survivability of the GMD operational architecture. These steps include the geographic dispersal of the GFC nodes as well as hardening of a new power plant supporting power generation and distribution to mission-critical facilities and equipment. However, the level of survivability of other specific GMD components to electromagnetic pulse and high-power microwave attacks is uncertain. The MDA has set up a High-Altitude Exoatmospheric Nuclear Survivability Executive Steering Committee to assess and direct efforts. The MDA has also developed a High-Altitude Exoatmospheric Nuclear Survivability standard that is intended to describe better the high-altitude electromagnetic pulse environment.

Recommendations

- Status of Previous Recommendations. The MDA has satisfactorily addressed 9 of the previous 10 GMD recommendations. In FY07, DOT&E recommended the MDA re-examine the GMD-specific lethality simulation needs in light of test data that have emerged from MDA target lethality testing since its last accreditation. Although the MDA has made progress, this recommendation remains open.
- FY11 Recommendation.
  1. The MDA should repeat the flight test to verify root causes and Failure Review Board results for the issues found during FTG-06a to confirm permanent fixes to the problems the board discovered.