

## Ground-based Midcourse Defense (GMD)

### Executive Summary

- Previous assessments of the Ground-based Midcourse Defense (GMD) system remain unchanged. GMD has demonstrated a limited capability to defend the U.S. Homeland from small numbers of simple intermediate-range or intercontinental ballistic missile threats launched from North Korea or Iran. DOT&E cannot quantitatively assess GMD performance due to lack of ground tests supported by accredited modeling and simulation (M&S).
- The Missile Defense Agency (MDA) demonstrated Alternate Divert Thrusters (ADTs) for future Ground-Based Interceptors (GBIs) during the Ground-based Midcourse Controlled Test Vehicle-02+ (GM CTV-02+) flight test. Extensive phenomenology data were also collected for discrimination improvement.
- The MDA executed the Ground Test, Integrated-06 (GTI-06) Part 2 and Ground Test, Distributed-06 (GTD-06) Part 2 ground tests assessing Ballistic Missile Defense System (BMDS)-level strategic and theater/regional capabilities in U.S. Northern Command's (USNORTHCOM's) and U.S. Pacific Command's (USPACOM's) areas of responsibility. The MDA demonstrated BMDS interoperability and updated discrimination capability. The lack of accreditation of models and simulation for performance assessment limited using these data for quantitative GMD evaluation.
- The MDA emplaced six GBIs with upgraded Capability Enhancement-II (CE-II) Exo-atmospheric Kill Vehicles (EKVs) and Configuration 1 boosters.
- The MDA declared the In-Flight Interceptor Communication System Data Terminal (IDT) at Fort Drum, New York, available and USNORTHCOM accepted the site in December 2015. USNORTHCOM opened the site for operational use in July 2016.

### System

- GMD counters intermediate range and intercontinental ballistic missile threats to the U.S. Homeland. GMD consists of:
  - GBIs 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 IDTs at Vandenberg AFB, California, Fort Greely, Alaska, and Eareckson Air Station, Alaska
  - GMD secure data and voice communications system, including long-haul communications using the Defense Satellite Communication System, commercial satellite



communications, and fiber-optic cable (both terrestrial and submarine)

- External interfaces that connect to Aegis Ballistic Missile Defense (BMD) ships; North American Aerospace Defense/USNORTHCOM Command Center; Command and Control, Battle Management, and Communications (C2BMC) system at Schriever AFB, Colorado, and Pearl Harbor-Hickman AFB, Hawaii; Space-Based Infrared System (SBIRS) at Buckley AFB, Colorado; and AN/TPY 2 (Forward Based Mode (FBM)) radars at Japan Air Self Defense Force bases in Shariki and Kyoga-Misaki, Japan

### Mission

Military operators from the U.S. Army Space and Missile Defense Command/Army Forces Strategic Command (the Army 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 the GBI to defeat threat missiles during the midcourse segment of flight.

### Major Contractors

- GMD Prime: The Boeing Company, Network and Space Systems – Huntsville, Alabama
- Boost Vehicle: Orbital ATK, Missile Defense Systems – Chandler, Arizona
- EKV: Raytheon Company, Missile Systems – Tucson, Arizona
- Fire Control and Communications: Northrop Grumman Corporation, Information Systems – Huntsville, Alabama

## Activity

- The MDA conducted all testing in accordance with the DOT&E-approved Integrated Master Test Plan.
- The MDA conducted a non-intercept GM CTV-02+ flight test in January 2016. The MDA designed this test to demonstrate ADTs for future GMD interceptors and collect data for use in developing discrimination improvements.
- The MDA executed the GTI-06 Part 2 and GTD-06 Part 2 ground tests in May and September 2016, respectively. The MDA assessed BMDS-level strategic and theater/regional capabilities in USNORTHCOM's and USPACOM's areas of responsibility in integrated (i.e., GTI) and distributed (i.e., GTD) test environments. GTD ground tests use live operational networks, whereas GTI ground tests use laboratory-based networks. The MDA used hardware and software representations of the GMD system; SBIRS; Upgraded Early Warning Radars (UEWRs); C2BMC; an AN/TPY-2 (FBM) radar; an Aegis AN/SPY-1 radar in its long-range surveillance and track mode; and the Sea-Based X-band (SBX) radar. In these tests, the MDA exercised the new GFC software version 6B3.1.
- The MDA emplaced six GBIs with upgraded CE-II EKV and Configuration 1 boosters.
- The MDA completed the Redesigned Kill Vehicle System Requirements Review in November 2015.
- The MDA declared the IDT at Fort Drum, New York, available for use and USNORTHCOM accepted the site in December 2015. USNORTHCOM opened the site for operational use in July 2016.

## Assessment

- Previous assessments of GMD remain unchanged. GMD demonstrates a limited capability to defend the U.S. Homeland from small numbers of simple intermediate-range or intercontinental ballistic missile threats launched from North Korea or Iran.
  - The reliability and availability of the operational GBIs are low, and the MDA continues to discover new failure modes during testing.
  - GMD survivability data are limited and come primarily from facility testing and component-level testing, but known survivability issues exist. Few cybersecurity assessments have been performed to-date.
  - Radar availability shortfalls, the details of which are classified, affect GMD suitability.
- During GM CTV-02+, the MDA demonstrated the new CE-II EKV ADTs in an operationally realistic environment. The ADTs turned on and off as commanded and performed nominally. One controller circuit board associated with one of the ADTs experienced a short and did not command its ADT

to turn on for the later part of the test. This controller circuit board is contained within the GBI guidance module and is not considered part of the ADT subsystem. An anomaly review board determined that foreign object damage was the most likely cause of the controller circuit board failure. The MDA collected extensive phenomenology data for discrimination improvement.

- In GTI-06 Part 2 and GTD-06 Part 2 ground tests, the MDA demonstrated interoperability of the GMD GFC software version 6B3.1 with the SBIRS, UEWRs, C2BMC, AN/TPY-2 (FBM) radar, Aegis BMD AN/SPY-1 radar in its long-range surveillance and track mode, and SBX radar. Discrimination improvements were ground tested as part of the BMDS Capability Increment 3 delivery. A number of GMD software upgrades were ground tested, including the discrimination logic, SBX tasking, and GFC salvo logic. These data support the evaluation of GMD system performance against an expanded strategic threat set.
- Quantitative evaluation of GMD performance will require extensive ground testing with accredited M&S. Data needed to accredit GMD threat, radar, and environmental M&S are either limited or lacking. GMD intercept flight tests have not adequately spanned the operational battlespace to provide data for validation, and subsequent accreditation, of key M&S.

## Recommendations

- Status of Previous Recommendations. The MDA has completed previous recommendations with the exception of one FY14 and one FY15 recommendation:
  1. The MDA has initiated, but not completed, the FY14 recommendation to extend the principles and recommendations contained in the Independent Expert Panel assessment report on the GBI fleet to all Homeland Defense components of the BMDS.
  2. The MDA should determine any additional sensor capability requirements for an effective Defense of Hawaii capability (FY15 recommendation). The MDA has initiated analysis of the needed capability, but has not completed this study.
- FY16 Recommendations. The MDA should:
  1. Improve and demonstrate the reliability and availability of the operational GBIs.
  2. Increase emphasis on GMD survivability testing, including cybersecurity. Tests, demonstrations, and exercises to acquire additional survivability data should be planned for inclusion in the BMDS Integrated Master Test Plan.
  3. Accelerate its effort to accredit M&S for performance assessment supporting GMD OT&E, including Redesigned Kill Vehicle performance and lethality.