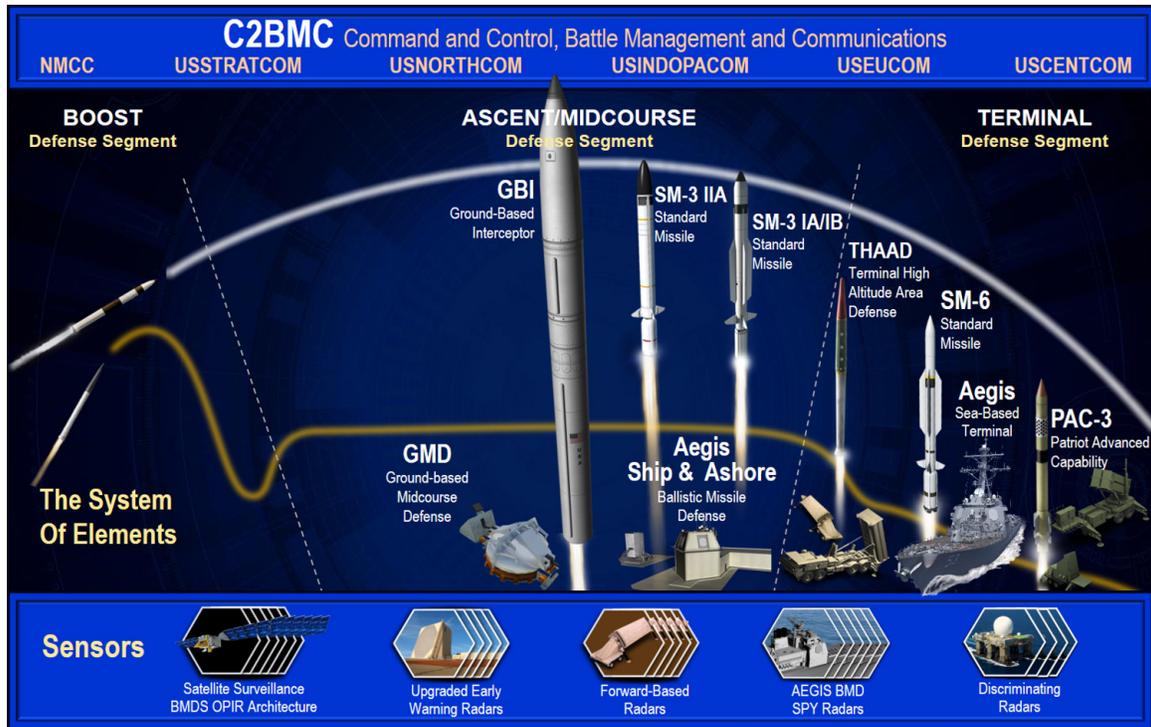


Ballistic Missile Defense System (BMDS)



BMD - Ballistic Missile Defense
 BMDS - Ballistic Missile Defense System
 NMCC - National Military Command Center
 OPIR - Overhead Persistent Infrared

USCENTCOM - U.S. Central Command
 USEUCOM - U.S. European Command
 USINDOPACOM - U.S. Indo-Pacific Command
 USNORTHCOM - U.S. Northern Command
 USSTRATCOM - U.S. Strategic Command

Executive Summary

- The Ground-based Midcourse Defense (GMD) weapon system has demonstrated capability to defend the U.S. Homeland from a small number of intermediate-range ballistic missile (IRBM) or intercontinental ballistic missile (ICBM) threats (greater than 3,000 km range) with simple countermeasures when the Homeland Defense Ballistic Missile Defense System (BMDS) employs its full architecture of sensors/command and control.
- The Regional/Theater BMDS has demonstrated capability to defend the U.S. Indo-Pacific Command (USINDOPACOM), U.S. European Command (USEUCOM), and U.S. Central Command (USCENTCOM) areas of responsibility from small numbers of medium-range ballistic missile or IRBM threats (1,000 to 4,000 km range) and short-range ballistic missile threats (less than 1,000 km range).
- The Missile Defense Agency (MDA) continued to mature BMDS operational effectiveness in FY20 during 16 test events, 3 live fire investigations, 7 wargames, and 15 exercises across 5 Combatant Commands. The MDA did not conduct full system-level Homeland Defense flight testing, Regional/Theater Defense flight testing, or operational cybersecurity testing in FY20.
- The MDA strengthened the linkage between test schedules and acquisition decisions, such as Operational Capability Baseline decisions, technical capability declarations, or materiel production decisions. While a productive start, the MDA needs to increase emphasis on completing all testing ahead of these programmatic acquisition decisions.
- Quantitative evaluation of BMDS operational effectiveness is dependent on modeling and simulation (M&S), and M&S activities are expanding rapidly. The MDA should emphasize completing both developmental and operational M&S accreditation in support of its programmatic acquisition decisions.

System

The BMDS is a geographically distributed system of systems that relies on element interoperability and warfighter integration for operational capability and efficient use of guided missile/interceptor inventory. The BMDS consists of a sensor/command and control architecture and four weapon systems.

- Sensors – COBRA DANE radar; Upgraded Early Warning Radars (UEWRs); Sea-Based X-band (SBX) radar; Aegis AN/SPY-1 radar aboard Aegis Ballistic Missile Defense (BMD)

FY20 BALLISTIC MISSILE DEFENSE SYSTEMS

ships; AN/TPY-2 (Forward-Based Mode (FBM) and Terminal High-Altitude Area Defense (THAAD) Mode) radars; Space-Based Infrared System (SBIRS); BMDS Overhead Persistent Infrared Architecture (BOA); a network of space sensors known as Space-based Kill Assessment (SKA); and the Long Range Discrimination Radar (LRDR), currently under construction.

- Command and Control – Command and Control, Battle Management, and Communications (C2BMC).
- Weapon Systems – GMD, Aegis BMD/Aegis Ashore Missile Defense System (AAMDS), THAAD, and Patriot Advanced Capability-3 (PAC-3).

Mission

The Commanders of U.S. Northern Command, USINDOPACOM, USEUCOM, and USCENTCOM employ the assets of the BMDS to defend the United States, deployed forces, and allies against ballistic missile threats of all ranges.

Major Contractors

- The Boeing Company
 - GMD Integration: Huntsville, Alabama
- Lockheed Martin Corporation
 - Aegis BMD, AAMDS, AN/SPY-1 radar, and LRDR: Moorestown, New Jersey

- C2BMC: Huntsville, Alabama, and Colorado Springs, Colorado
- SBIRS: Sunnyvale, California
- THAAD Weapon System, PAC-3 Command and Launch System, and PAC-3 interceptor variants: Dallas, Texas
- THAAD Interceptors: Troy, Alabama
- Northrop Grumman Corporation
 - GMD Booster Vehicles: Chandler, Arizona
 - GMD Communications Network (GCN), Launch Management System (LMS), and Ground Fire Control (GFC): Huntsville, Alabama
 - BOA: Boulder, Colorado; Colorado Springs, Colorado; and Azusa, California
- Raytheon Technologies Corporation
 - GMD Exo-atmospheric Kill Vehicle and Standard Missile (SM)-2/3/6 Interceptors: Tucson, Arizona
 - PAC-3 Ground System and PAC-2 interceptor variants, AN/SPY-6 radar, AN/TPY-2 radar, SBX radar, and UEWRs: Tewksbury, Massachusetts
 - COBRA DANE Radar: Dulles, Virginia
- L3 Harris Technologies
 - GMD In Flight Interceptor Communication System Data Terminals (IDT): Melbourne, Florida
- Johns Hopkins University, Applied Physics Laboratory
 - SKA: Laurel, Maryland

Activity

- The MDA conducted testing in accordance with the DOT&E-approved Integrated Master Test Plan (IMTP) as affected by the coronavirus (COVID-19) pandemic. Correspondingly, the MDA delayed and modified flight, ground, and cybersecurity test events across the BMDS; as of fall 2020:
 - One-third of the FY20 and the first half of FY21 flight tests have been delayed 2-4 quarters. The second half of the FY21 flight tests have slipped 1-2 quarters. All of the FY20-21 MDA tracking exercises of advanced targets have been delayed 2-4 quarters.
 - One FY20 ground test slipped 1 quarter; the other three tests were executed as scheduled. The initial FY21 ground tests have slipped 1-2 quarters.
 - There were no operational cybersecurity tests planned for FY20; the FY21 tests are maintaining schedule.
- During FY20, the MDA conducted three BMDS-level ground tests, seven element-level flight tests, and one element-level ground test. The MDA also conducted one tracking exercise of an advanced target, one international test, and participated in three Air Force ICBM reliability and sustainment flight tests. The MDA accomplished three GMD subscale light-gas-gun live fire tests against an ICBM target. The MDA did not conduct full system-level Homeland Defense flight tests, Regional/Theater Defense flight tests, or operational cybersecurity testing.
 - In November to December 2019, the MDA conducted a ground test of legacy Homeland Defense exo-atmospheric kill vehicle upgrades and of Capability Increment 5C functionality for USINDOPACOM Regional/Theater Defense.
 - In February 2020, the MDA conducted a ground test evaluating European Phased Adaptive Approach Phase 3 capabilities.
 - In June 2020, the MDA assessed the Patriot Missile Segment Enhancement interceptor launch-on-THAAD capability in USINDOPACOM scenarios.
 - The MDA assessed BMDS elements in 13 other test events. See the individual BMDS element articles (pages 211-222) for reporting on these tests.
- The MDA conducted 7 wargames and 15 exercises across 5 Combatant Commands in FY20 enhancing Combatant Command BMD readiness and increasing Service operator confidence in the deployed elements of the BMDS.
- The MDA revised the IMTP to incorporate BMDS element maturation, program modifications, and fiscal constraints. The most significant new addition to the IMTP this year was the inclusion of a detailed test schedule for cybersecurity tests.
- The MDA updated its rules of engagement for Persistent Cybersecurity Operations (PCO) assessments and participated in test planning for one Combatant Command PCO evaluation.

FY20 BALLISTIC MISSILE DEFENSE SYSTEMS

- The MDA and BMDS Operational Test Agency continued to resolve limitations that have previously prohibited independent M&S accreditation while simultaneously developing M&S capabilities in new areas of assessment and emerging threats.

Assessment

- Previous BMDS-level assessments for Homeland and Regional/Theater Defense remain unchanged:
 - The GMD weapon system has demonstrated capability to defend the U.S. Homeland from a small number of IRBM or ICBM threats (greater than 3,000 km range) with simple countermeasures when the Homeland Defense BMDS employs its full architecture of sensors/command and control.
 - The Regional/Theater BMDS demonstrated capability to defend the USINDOPACOM, USEUCOM, and USCENTCOM areas of responsibility from small numbers of medium-range ballistic missile or IRBM threats (1,000 to 4,000 km range) and short-range ballistic missile threats (less than 1,000 km range range).
- During FY20 testing, the MDA collected ground test data supporting development and fielding of new capabilities and architectures associated with BMDS Capability Increments 5B, 5C, and 6B and an urgent materiel release. Test data and resulting assessments are classified; see the DOT&E “FY20 Assessment of the BMDS,” to be published in February 2021.
- The MDA has initiated a process that evaluates individual missile threats based on key features that characterize the total allocated threat space allowing assessment of emerging threats more efficiently and rapidly. Using phenomenology-based threat modeling has allowed the Sea-Based Weapon System Program Office to address the Aegis Weapon System’s allocated threats while significantly reducing the number of individual target missile solutions required, thus increasing the efficacy of flight testing.
- Given the ever-changing and dynamic nature of the IMTP baseline, ensuring tests are scheduled to support their acquisition program decisions is a continual challenge for the MDA. The MDA often makes acquisition decisions based on ground test data, accepting the risk of not having data available

from flight tests or operational cybersecurity assessments. The majority of ground test data come from Ground Test Integrated (GTI) tests, which the MDA conducts in a high-fidelity laboratory-based venue with emulated communications networks. Data from Ground Test Distributed (GTD) tests are generated in an operational test venue using operational communication networks, but are typically only a small subset of GTI test cases. In FY20, the MDA drafted updates to its corporate capability fielding policy and its IMTP-generation instruction to strengthen the linkage between test schedules and acquisition decisions.

- The MDA’s M&S activities are expanding rapidly. The BMDS threat set, sensing environments, and communication pathways necessary in the M&S venues are growing and the framework and models are undergoing significant modifications. Flight and ground test schedules must maintain a strong linkage to enable timely M&S accreditation based on flight test data. Independent M&S accreditation ensures that the pedigree of any data generated by M&S are sufficient for programmatic acquisition decisions, and that data limitations and resulting risks are well understood by the decision-maker.

Recommendations

The MDA should:

1. Continue maturing and expanding the use of phenomenology-based threat modeling, as demonstrated by the Sea-Based Weapon System Program Office, across the agency.
2. Increase emphasis on completing all testing 6 months ahead of programmatic acquisition decisions. As enumerated in the draft update to the MDA fielding policy, 6 months are required for sufficient data analysis; M&S verification, validation, and accreditation; and MDA Corporate Board processing and coordination.
3. Begin execution of PCO on BMDS assets deployed to Combatant Commands.
4. Increase emphasis on completing both developmental and operational M&S accreditation in support of programmatic acquisition decisions.

