

Sensors

Executive Summary

- In December 2008, the Missile Defense Agency (MDA) conducted the Flight Test Ground-based Interceptor (FTG)-05 event employing the AN/TPY-2 (Forward-Based Mode (FBM)) radar, the Aegis Ballistic Missile Defense (BMD) AN/SPY-1 radar, the Sea-Based X-band (SBX) radar, and the Upgraded Early Warning Radar-Beale (UEWR-Beale). These sensors provided data that contributed to the intercept of the target.
- The Ballistic Missile Defense System (BMDS) Operational Test Agency (OTA) has not validated or accredited any high fidelity performance models and simulations for assessing the performance of BMDS sensors.
- The AN/TPY-2 (FBM) participated in the Israeli Arrow System Test-13 (AST-13) flight test and successfully supported a series of ground tests that demonstrated forward-based discrimination capabilities and integration with the Block 3.5 Arrow Weapon System.

System

The BMDS sensors are the following:

- Aegis BMD radars: Aegis AN/SPY-1 radars modified to provide surveillance and tracking of long-range ballistic missiles.
- AN/TPY-2 (FBM) (formerly called Forward-based X-band Transportable (FBX-T) Radar: A Terminal High Altitude Area Defense high resolution, X-band, phased array radar with modified software to provide acquisition and tracking of ballistic missiles of all ranges in the boost phase and the transition to the midcourse phase of flight. There are two radars operationally deployed, one to Shariki, Japan, and the other to Israel.
- Cobra Dane Upgrade (CDU) radar: An L band, fixed site, fixed orientation, phased array radar located at Shemya, Alaska.
- Space-Based Infrared System/Defense Support Program (SBIRS/DSP): An infrared satellite constellation



Aegis BMD



AN/TPY-2



Cobra Dane

and ground stations (primary and backup) that provide the BMDS with the initial notification of a ballistic missile launch and defended area determination.

- SBX radar: An X-band phased array radar on a movable mount, positioned on a fifth generation twin-hulled, semi-submersible, self propelled ocean-going platform, home ported at Adak, Alaska.
- Upgraded Early Warning Radars (UEWRs): Ultra High Frequency fixed site, fixed orientation, phased array radars located at Beale AFB, California (two radar sides or “faces,” 240-degree azimuth field of view), and Fylingdales, England (three “faces,” 360-degree azimuth field of view). Thule Air Base, Greenland (two “faces,” 240-degree azimuth field of view) will be added to the BMDS in FY10.



SBIRS/DSP



SBX



UEWR

Mission

U.S. Strategic Command, U.S. Northern Command, U.S. European Command, U.S. Pacific Command, and U.S. Central Command warfighters will use the BMDS sensors to:

- Detect, track, and classify ballistic missile threats targeting the United States, its allies, and its friends
- Provide data for Situational Awareness and battle management to the BMDS Command, Control, Battle Management, and Communications (C2BMC) element
- Provide track data to generate weapon task plans for ballistic missile defensive systems such as Aegis BMD and Ground-based Midcourse Defense (GMD)

Prime Contractors

- Aegis AN/SPY-1: Lockheed Martin, Moorestown, New Jersey
- AN/TPY-2: Raytheon Integrated Defense Systems, Tewksbury, Massachusetts

BALLISTIC MISSILE DEFENSE SYSTEMS

- CDU: The Boeing Company, Integrated Defense Systems, Missile Defense Systems, Huntsville, Alabama
- SBIRS: Lockheed Martin Space Systems Company, Sunnyvale, California
- SBX: The Boeing Company, Integrated Defense Systems, Missile Defense Systems, Huntsville, Alabama
- UEWRs: Beale AFB and Fylingdales - The Boeing Company, Integrated Defense Systems, Missile Defense Systems, Huntsville, Alabama; Thule - Raytheon Missile Defense Center, Woburn, Massachusetts

Activity

- As part of the process to revise the Integrated Master Test Plan (IMTP) and restructure the test program, the MDA identified 16 Critical Engagement Conditions (CECs) and six Empirical Measurement Events (EMEs) for which flight and ground testing will collect data to validate the sensor models and simulations.
- CDU: During the past year, CDU participated in several ground test events, culminating in the system-level exercise, Ground Test Distributed (GTD)-03, in March 2009.
- SBX: SBX collected track and discrimination data on the target during the FTG-05 flight test in December 2008. A target sub-system malfunction precluded completion of specific test objectives. SBX participated in ground test events including the focused ground test GTX-03e in July 2009 and the system-level GTD-03 event in March 2009.
- UEWR: UEWR-Beale participated in the FTG-05 flight test. The UEWRs (Beale and Fylingdales) also participated in several MDA system-level ground test events, notably GTD-03 in March 2009.
- AN/TPY-2 (FBM): AN/TPY-2 (FBM) radar #1 observed the FTG-05 target in December 2008 from its test location in Juneau, Alaska. The MDA deployed AN/TPY-2 (FBM) radar #3 to Israel. In Israel, it participated in the AST-13 flight test by providing track data on the target through C2BMC to the Block 3.5 Arrow Weapon System. This radar also successfully supported a series of ground tests which demonstrated forward-based discrimination capabilities and integration with the Block 3.5 Arrow Weapon System.
- The radar also participated in several ground test events, notably the March 2009 GTD-03 event and the GTX-03e event in July 2009. The AN/TPY-2 (FBM) test asset at Vandenberg AFB, California, has begun using targets of opportunity (Glory Trip-199 and -195) to assess the next software capability release.
- Aegis BMD AN/SPY-1: Aegis BMD AN/SPY-1 participated in multiple live tracking exercises, ground tests, and operational tasking during FY09. Its ground test participation culminated in the system-level GTD-03 event.
- SBIRS/DSP: SBIRS/DSP participated in several ground tests culminating in the distributed ground test GTD-03 in March 2009. A full discussion of the Air Force SBIRS program is provided under a separate entry.
- The MDA conducted System Post Flight Reconstructions (SPFR) for GTX-03b (FTX-03 SPFR), FTG-05 SPFR, and FTT-10a SPFR to support of anchoring SBX, AN/TPY-2, and UEWR radar models.

Assessment

- CDU: Due to its location and field of view, CDU has not participated in BMDS intercept flight test events. Performance estimates for the current configuration of CDU have been limited to the ground test results and targets of opportunity. These estimates rely on models and simulations that are not yet validated and accredited for use in assessing performance. To collect the required data, the MDA will fly another target through the CDU field of view. This flight test event is currently scheduled during 4QFY10.
- SBX: During FTG-05, SBX supported the intercept as part of an ensemble of sensors including AN/TPY-2 (FBM), Aegis BMD, and UEWR-Beale. SBX has not supported a live intercept as the sole primary sensor. SBX performance estimates are currently based on unaccredited models and simulations. Significant work remains to collect the applicable data necessary to validate modeling of SBX performance in the post intercept debris environment.
- UEWRs: UEWR-Beale participated in FTG-05, and UEWRs at both Beale and Fylingdales participated in GTD-03. UEWR-Beale and -Fylingdales performance estimates are based on unaccredited models and simulations.
- AN/TPY-2 (FBM): The AN/TPY-2 (FBM) radar deployed to Shariki, Japan, saw significant operational tasking in FY09. During Israeli flight test AST-13, the AN/TPY-2 (FBM) radar #3 acquired the target and passed radar cue data to the Arrow Weapon System allowing it to successfully acquire and track the target. The radar also successfully supported a series of ground tests which demonstrated forward-based discrimination capabilities and integration with Israel's Block 3.5 Arrow Weapon System. Although significant operational data have been collected, performance estimates for the AN/TPY-2 (FBM) are based on unaccredited models and simulations.
- Aegis BMD AN/SPY-1: Aegis BMD AN/SPY-1 continues to support BMDS testing and operational taskings. The MDA continues to evaluate Aegis BMD AN/SPY-1 interoperability with other elements and the BMDS. The MDA has not yet conducted a GMD flight test that used AN/SPY-1 radar data in real-time as the primary data source for developing a GMD weapon task plan. During FTG-05, Aegis BMD supported the intercept as part of an ensemble of sensors including AN/TPY-2 (FBM), SBX, and UEWR-Beale.
- SBIRS/DSP: SBIRS/DSP continues to improve its ability to support the BMDS with timely and accurate launch data and predictive impact data. A more detailed assessment of SBIRS

BALLISTIC MISSILE DEFENSE SYSTEMS

performance is contained in the Air Force SBIRS program entry.

- Overall: Since the completion of their respective upgrade or development programs, the MDA has gained significant operational experience with each of these sensors. The most important area of concern is the development of consistent, validated environmental and post-intercept debris models to assess integrated system performance.

Recommendations

- Status of Previous Recommendations. The MDA satisfactorily addressed the final two outstanding recommendations.
- FY09 Recommendation.
 1. The MDA should, in concert with the combatant commanders, develop concepts of operations for any new sensors to be used as part of the phased adaptive approach to providing missile defense to Europe.

BALLISTIC MISSILE DEFENSE SYSTEMS