

Sensors

Executive Summary

- The Missile Defense Agency (MDA) has gained significant operational experience with each of the Ballistic Missile Defense System (BMDS) sensors since the completion of sensor upgrade and development programs.
- During FY14, BMDS sensors participated in two major ground tests, three flight tests, and observed numerous targets of opportunity such as domestic or foreign launch events.
- Accreditation of each of the sensor models for use in performance assessments continues to progress, but is still incomplete.

System

The BMDS sensors are systems that provide real-time ballistic missile threat data to the BMDS. The data are used to counter ballistic missile attacks. These sensor systems are operated by the Army, Navy, Air Force, and the MDA, and include a satellite-based, infrared sensor system and five phased array radar system types. The sensor systems are:

- Space-Based Infrared System/Defense Support Program (SBIRS/DSP), a satellite constellation of infrared sensors operated by the Air Force with an external interface to the BMDS located at Buckley AFB, Colorado
- Fixed site, fixed orientation, phased array radars
 - COBRA DANE Radar Upgrade (CDU), an L-band radar (one radar face that provides 120-degree azimuth field of view) operated by the Air Force and located at Eareckson Air Station (Shemya Island), Alaska.
 - Upgraded Early Warning Radars (UEWRs), ultra-high frequency radars operated by the Air Force and located at Beale AFB, California (two radar faces that provide 240-degree azimuth field of view); Fylingdales, United Kingdom (three radar faces that provide 360-degree azimuth field of



SBIRS/DSP



COBRA DANE



UEWR

view); and Thule, Greenland (two radar faces that provide 240-degree azimuth field of view). The MDA and Air Force Space Command (AFSPC) awarded a contract in July 2012 for the upgrade of the Early Warning Radar (EWR) at Clear Air Force Station, Alaska. In December 2012, a contract option was exercised for the upgrade of the EWR at Cape Cod Air Force Station, Massachusetts.

- Mobile/portable phased array radars

- AN/TPY-2

Forward-Based Mode (FBM) radars, X-band radars operated by the Army and located at sites in Japan, Israel, Turkey, and the U.S. Central Command area of responsibility.



AN/TPY-2

- AN/SPY-1 radars in track and cue mode,

S-band radars (four radar faces that provide 360-degree azimuth field of view) operated by the Navy and located aboard 33 Aegis Ballistic Missile Defense (BMD)-capable cruisers and destroyers.



Aegis BMD

- SBX radar, an X-band radar operated by the MDA and located aboard a twin-hulled, semi-submersible, self-propelled, ocean-going platform.



SBX

Mission

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

- Detect, track, and classify ballistic missile threats that target the United States and U.S. allies
- Provide data for situational awareness and battle management to the Combatant Commands through the BMDS Command and Control, Battle Management, and Communications (C2BMC)
- Provide data that support engagement of ballistic missile threats by ballistic missile defense systems

Major Contractors

- AN/SPY-1 Radar (Aegis BMD): Lockheed Martin Corporation, Mission Systems and Training – Moorestown, New Jersey
- AN/TPY-2 (FBM) Radar, CDU Radar, SBX Radar, and UEWrs/EWRs: Raytheon Company, Integrated Defense Systems – Tewksbury, Massachusetts
- SBIRS: Lockheed Martin Space Systems – Sunnyvale, California
- DSP: Northrop Grumman Corporation, Aerospace Systems – Redondo Beach, California

Activity

The MDA conducted testing during FY14 in accordance with the DOT&E-approved Integrated Master Test Plan.

Aegis BMD Radar

- The MDA used hardware and software representations of the Aegis BMD radar in its hardware-in-the-loop (HWIL) test, Ground Test Integrated-04e (GTI-04e) Part 2, in April and May 2014. In this test, the Aegis BMD radar representation detected and tracked simulated intercontinental ballistic missile (ICBM) threats to the U.S. Homeland and forwarded the track data to an HWIL representation of the C2BMC.
- The Aegis BMD radar, in its long-range surveillance and track mode, participated in Flight Test Ground-Based Interceptor-06b (FTG-06b) in June 2014. The Aegis BMD radar detected and tracked the intermediate-range ballistic missile (IRBM) target and forwarded the track data to the C2BMC system.

AN/TPY-2 (FBM) Radar

- The MDA used HWIL representations of the AN/TPY-2 (FBM) radar in GTI-04e Part 2 in April and May 2014. The AN/TPY-2 (FBM) radar representations detected and tracked simulated ICBM threats to the U.S. Homeland and forwarded the track data to an HWIL representation of the C2BMC.
- The MDA used HWIL representations of the AN/TPY-2 (FBM) radar in its Fast Exchange HWIL ground test in June 2014. The MDA used three AN/TPY-2 (FBM) radars in its Fast Exchange distributed ground test in August 2014. In the Fast Exchange ground tests, the MDA investigated the level of mutual sensor support between multiple AN/TPY-2 (FBM) radars and the C2BMC system.

CDU Upgrade

- In FY14, the U.S. Air Force used the CDU radar to observe targets of opportunity. The AFSPC also used the CDU radar as a contributory sensor to the Space Surveillance Network to track orbital debris and active satellites.

SBIRS/DSP

- In FY14, the U.S. Air Force used the SBIRS/DSP system to observe domestic and foreign launch events and provide launch event data to the operational BMDS. The SBIRS/DSP system also participated in Flight Test Operational-01, Flight Test Standard Missile-22, and FTG-06b.
- A digital representation of the SBIRS/DSP system participated in GTI-04e Part 2 in April and May 2014.

SBX Radar

- In FY14, the SBX began in limited test support status but now serves as both a test and operational asset. The SBX radar can be deployed based on warning of an ICBM threat to the U.S. Homeland and for BMDS flight testing.
- A HWIL representation of the SBX radar participated in GTI-04e Part 2 in April and May 2014. In GTI-04e Part 2, the SBX radar representation detected, tracked, and discriminated simulated ICBM threats to the U.S. Homeland and forwarded the track data to an HWIL representation of the Ground Based Midcourse Defense (GMD) Fire Control (GFC).
- The SBX radar participated in FTG-06b in June 2014. The SBX radar accepted sensor task plans from the GFC, detected, tracked, and discriminated the IRBM target, and forwarded track data to the GFC.

UEWRs/EWRs

- In FY14, the MDA transferred the sustainment responsibility for the Beale, Fylingdales, and Thule UEWRs to AFSPC.
- In FY14, the U.S. Air Force used the Beale, Fylingdales, and Thule UEWRs, and the Clear and Cape Cod EWRs, to observe targets of opportunity. The AFSPC also used these radars as collateral sensors to the Space Surveillance Network to track orbital debris and active satellites.

Assessment

The MDA has gained significant operational experience with each of the BMDS sensors since the completion of the sensor upgrade and development programs. The MDA and the BMDS Operational Test Agency, however, have not fully accredited models and simulations of the BMDS sensors for performance assessment. Representations of the AN/TPY-2 (FBM) radar, the SBX radar, the UEWR, the Aegis BMD radar, and the SBIRS/DSP system have been accredited for limited uses. Representations of the CDU radar have not been accredited.

Aegis BMD Radar

- In GTI-04e Part 2, the MDA demonstrated a capability of the Aegis BMD radar to support GMD engagement of IRBM and ICBM threats. The Aegis BMD radar provided data that supported BMDS situational awareness, BMDS sensor tasking, and GMD engagement planning.
- During FTG-06b, Aegis BMD acquired target objects using its pre-defined autonomous search plan, generated tracks of the target objects, and reported two clusters of objects

to the C2BMC. Based on pre-mission analysis, the MDA anticipated only one cluster of objects being detected and is investigating why this second cluster was observed. Although not experienced in this test and under different circumstances, this second cluster of objects could have generated a second engagement, potentially resulting in Ground-based Interceptor wastage.

AN/TPY-2 (FBM) Radar

- In GTI-04e Part 2, the MDA demonstrated a capability of the AN/TPY-2 (FBM) radar to support GMD engagement of IRBM and ICBM threats. The AN/TPY-2 (FBM) radar representations provided data on the simulated missile threats to the C2BMC system that supported BMDS situational awareness, BMDS sensor tasking, and GMD engagement planning.
- In the Fast Exchange ground tests, the MDA proved the concept of multiple AN/TPY-2 (FBM) radars being mutually supportive across Combatant Command's areas of responsibility. The AN/TPY-2 (FBM) radars detected and tracked simulated missile threats to multiple locations, forwarded the track data to the C2BMC system, and received and responded to C2BMC system tasking.

CDU Upgrade

- Due to its location and field of view, the CDU radar has not participated in BMDS intercept flight tests. However, the CDU radar did observe numerous targets of opportunity.

SBIRS/DSP

- SBIRS/DSP performance and its capability to support BMDS engagement of IRBM and ICBM threats are classified. Detailed analysis can be found in DOT&E's February 2014 BMDS Annual Report.

SBX Radar

- In GTI-04e Part 2, the MDA demonstrated the capability of the SBX radar to support GMD engagement of IRBM and

ICBM threats. After detecting, tracking, and discriminating the inbound missiles, the SBX radar transmitted engagement-quality data to the GFC for intercept prosecution.

- The SBX radar performed nominally during the FTG-06b mission. It detected and tracked the target missile, accurately discriminated all target objects, and transmitted and received target information with the other elements in a timely manner. It correctly determined the engagement hit assessment and reported such to the GMD fire control component.

UEWRs/EWRs

- Due to their locations and fields of view, the UEWRs at Thule and Fylingdales have not participated in BMDS intercept flight tests in an operationally realistic manner. Beale has participated in all flight tests within its field of view and has supplied critical data in analysis of these flight tests. Data from targets of opportunity and ground tests support performance estimates for the current configuration of the UEWRs.
- The MDA and the U.S. Air Force have not yet upgraded the EWRs at Clear and Cape Cod Air Force Stations, and these radars are not yet part of the MDA's sensor network.

Recommendations

- Status of Previous Recommendations. The MDA addressed all but two previous recommendations. The FY09 recommendation on developing sensor concepts of operations in conjunction with the Combatant Commands and demonstrating them in operational testing has yet to be completed. The FY12 recommendation to conduct AN/TPY-2 (FBM) cyber testing also remains open.
- FY14 Recommendations. None.

