Aegis Ballistic Missile Defense (Aegis BMD)

Executive Summary

- The Aegis Ballistic Missile Defense (BMD) program participated in two non-intercept flight test events in FY20 with live ballistic missile targets and a hypersonic glide vehicle (HGV), one of which also exercised interoperability between U.S. and allied naval assets.
- Aegis BMD participated in two Ballistic Missile Defense System (BMDS) ground tests with hardware-in-the-loop (HWIL) and modeling and simulation (M&S) representations that provided data on Aegis BMD interoperability and weapon system functionality in various regional/theater and strategic scenarios.
- The Missile Defense Agency (MDA) delivered results from a subset of the high-fidelity M&S operational test runs for record for the Standard Missile (SM)-3 Block IIA missile. The MDA found errors in these M&S runs and is addressing the error. The data from these re-executed runs will support the DOT&E assessment of the operational effectiveness of the SM-3 Block IIA missile in FY21.
- The MDA conducted Flight Test Aegis Weapon System (FTM)-44 in November 2020, where an Aegis destroyer intercepted an intercontinental ballistic missile (ICBM) target with an SM-3 Block IIA missile using Aegis BMD's engage-on-remote capability. DOT&E will report the results of this flight test in a separate report.

System

- Aegis BMD uses SM-3 guided missiles to intercept ballistic missile threats outside the Earth's atmosphere, and uses SM-2 or SM-6 guided missiles to intercept ballistic missile and anti-air warfare threats within the atmosphere using Sea-Based Terminal (SBT) and self-defense capabilities. In addition to guided missile engagement support, the ship-based AN/SPY-1 radar provides long-range surveillance and track functions to support other BMDS elements.
- The Navy is developing the AN/SPY-6 Air and Missile Defense Radar for future Aegis destroyers to provide increased radar sensitivity, extended detection ranges, and simultaneous sensor support of ballistic missile and air defense functions.

Aegis Cruiser

Aegis Ashore and Vertical Launch System

Mission

Combatant Commanders will employ the Aegis BMD weapon system (sea- and land-based variants) to defend deployed forces and allies from short- to intermediate-range ballistic missile threats, and to provide forward-deployed sensor capabilities.

Major Contractors

- Aegis Weapon System: Lockheed Martin Corporation, Rotary and Mission Systems – Moorestown, New Jersey
- AN/SPY-1 Radar: Lockheed Martin Corporation, Rotary and Mission Systems – Moorestown, New Jersey
- SM-3, SM-2 Block IV, and SM-6 Missiles: Raytheon Missiles and Defense Company – Tucson, Arizona
- AN/SPY-6(V)1 Radar: Raytheon Missiles and Defense Company – Tewksbury, Massachusetts

Activity

- The MDA conducted testing in accordance with the DOT&E-approved BMDS Integrated Master Test Plan.
- The coronavirus (COVID-19) pandemic caused a 6 month or greater delay to Aegis BMD's first ICBM intercept attempt, FTM-44, and to the first SBT Increment 2 flight test in BMD Initialized mode, FTM-31 Event 1 (E1). The MDA conducted FTM-44 in November 2020 and plans to conduct FTM-31 E1 in April 2021.
- Aegis BMD participated in two non–intercept flight test events in FY20 with live ballistic missile targets and an HGV.
  - During Flight Test Experimental Other (FEX)-01 in March 2020, an Aegis BMD destroyer engaged an HGV with a simulated SM-6 Dual II missile. The AN/SPY-6(V)1 Radar participated in the event.
  - During the Pacific Dragon – 2020 Navy fleet exercise in August 2020, an Aegis destroyer engaged a short-range ballistic missile (SRBM) with a simulated SM-3 Block IB Threat Upgrade missile. Both ship and Aegis Ashore Missile Defense Test Complex (AAMDTC) detected and tracked the SRBM and reported data to the BMDS.
- In FY20, two BMDS ground tests involving HWIL and M&S representations of Aegis BMD provided information on interoperability and weapon system functionality in various regional/theater and strategic scenarios. The BMDS Operational Test Agency and the Navy Commander, Operational Test and Evaluation Force (COMOPTEVFOR) accredited the participating M&S used in the ground tests.

- The MDA executed and delivered a subset of the required high-fidelity M&S operational test runs for record for the SM-3 Block IIA missile in August 2020. The MDA expects to deliver the remaining runs for record throughout FY21.
- Budgetary reductions may result in a 2- to 3-year delay in Aegis Baseline 10 and AN/SPY-6(V)1 Integrated Air and Missile Defense flight test events, from FY24-25 to FY26-28. Furthermore, new test limitations will substantially reduce the operational realism of AN/SPY-6(V)1 electronic protection testing.
- The MDA is updating the Advanced Radar Development Evaluation Laboratory with an Aegis Baseline 10 virtual test environment that will connect to an in-place AN/SPY-6 engineering development model array. The update is planned to be completed and ready to test in 1QFY21.

Assessment

- Aegis BMD continues to demonstrate a capability to intercept non-separating, simple-separating, and complex-separating ballistic missiles in the midcourse phase of flight with SM-3 missiles. Aegis BMD has also demonstrated a capability to intercept select ballistic missiles in the terminal phase of flight with SM-6 missiles. However, flight testing and M&S have not addressed all expected threat types, ground ranges, and raid sizes. The MDA has used M&S to explore Aegis BMD raid engagement performance, but DOT&E has less confidence in these results because COMOPTEVFOR has been unable to accredit the models due to the lack of validation data from live fire raid engagements and lack of post-intercept debris modeling.
- During Pacific Dragon – 2020, the MDA demonstrated Aegis BMD interoperability with Republic of Korea naval assets while conducting simulated ballistic missile engagements. The AAMDTC demonstrated Aegis interoperability with Australian naval assets while tracking ballistic missile targets.
- DOT&E will provide an assessment of the FTM-44 test results and of the SBT Increment 2 capability (based on the results of FTM-31 E1 and FTM-33) in separate reports.
- MDA ground tests have routinely shown that inter-element coordination and interoperability need improvement to improve engagement efficiency; however, flight testing with multi-element engagement coordination has been limited. Aegis BMD has exercised rudimentary engagement coordination with Terminal High-Altitude Area Defense firing units, but not with Patriot. The MDA plans to exercise engagement coordination between those three theater elements during Flight Test Operational (FTO)-05, but that flight test has been repeatedly delayed and is currently planned for FY28.
- DOT&E and USD(R&E) have prompted the MDA to establish a ground testing approach to support assessments of missile reliability. DOT&E cannot assess SM-3 missile reliability with confidence until the MDA is able to provide additional ground test data that simulate the in-flight environment.
- The MDA delivered results from a subset of the high-fidelity M&S operational test runs for record for the SM-3 IIA missile. The MDA found a problem in one of the models used to conduct the M&S runs. The MDA has identified a fix action and the test runs will be re-run and delivered in FY21. The data from these re-executed runs will support the DOT&E assessment of the operational effectiveness of the SM-3 Block IIA missile in FY21.
- COVID-19 impacts have delayed delivery of high-fidelity M&S operational test runs for record to support an assessment of SBT Increment 2 operational effectiveness. Verification and validation data from flight testing will not be available until FY21 to support model accreditation. M&S operational test runs for record will not be available until FY22.
- The developmental AN/SPY-6(V)1 radar continues to track ballistic missiles during MDA flight tests. The radar detected and tracked the HGV target in FEX-01.

Recommendations

The MDA should:

1. Prioritize resources for FTO-05 to ensure this critical flight test occurs as soon as possible.
2. Conduct Aegis BMD midcourse and terminal phase flight testing with live fire intercepts of raids of two or more ballistic missile targets to aid in the validation of M&S tools.
3. Improve Aegis BMD high-fidelity M&S tools to incorporate post-intercept debris modeling to better assess engagement performance in raid scenarios.
4. Provide data from high-fidelity ground tests to DOT&E to inform SM-3 Block IB Threat Upgrade and Block IIA missile reliability estimates.
5. Work with DOT&E and USD(R&E) to establish a ground testing approach to support assessments of missile reliability.