

## Terminal High-Altitude Area Defense (THAAD)

### Executive Summary

- The Terminal High-Altitude Area Defense (THAAD) program participated in one Ballistic Missile Defense System (BMDS) operational flight test in November 2015, in accordance with the DOT&E-approved Integrated Master Test Plan, intercepting two ballistic missile targets.
- THAAD participated in four BMDS ground tests, providing information on THAAD interoperability and functionality within the BMDS for various regional/theater scenarios.
- The THAAD program conducted a Cybersecurity Red Team Assessment in March 2016 and a Limited User Test of the Table Top Trainer in June 2016.
- The THAAD program continued work on achieving a Full Materiel Release of the first two THAAD batteries, which achieved Conditional Materiel Release in February 2012.

### System

- THAAD is intended to complement the lower-tier Patriot system and the upper-tier Aegis Ballistic Missile Defense (BMD); it can engage threat ballistic missiles in both the endo- and exo-atmosphere.
- THAAD consists of five major components:
  - Missiles
  - Launchers
  - AN/TPY-2 Radar (Terminal Mode)
  - THAAD Fire Control and Communications
  - THAAD Peculiar Support Equipment
- THAAD can accept target cues for acquisition from Aegis BMD, from other regional sensors, and through command and control systems.

### Mission

U.S. Strategic Command deploys THAAD to protect critical assets worldwide. U.S. Northern Command, U.S.



Pacific Command (USPACOM), U.S. European Command (USEUCOM), and U.S. Central Command (USCENTCOM) will use THAAD to intercept short- to intermediate-range ballistic missile (SRBM/IRBM) threats in their areas of responsibility.

### Major Contractors

- Prime: Lockheed Martin Corporation, Missiles and Fire Control – Dallas, Texas
- Interceptors: Lockheed Martin Corporation, Missiles and Fire Control – Troy, Alabama
- AN/TPY-2 Radar (Terminal Mode): Raytheon Company, Integrated Defense Systems – Tewksbury, Massachusetts

### Activity

- The Missile Defense Agency (MDA) conducted all testing in accordance with the DOT&E-approved Integrated Master Test Plan.
- The MDA conducted system-level Flight Test Operational-02 (FTO-02) Event 2a in November 2015 at Wake Island and the broad ocean area surrounding it. This test used THAAD version 2.7 software and a Lot 4 and Fire Unit Fielded interceptor. THAAD completed near-simultaneous engagements of two targets: a complex SRBM and a medium-range ballistic missile (MRBM). The engagement of the MRBM occurred following the failure of an Aegis BMD Standard Missile-3 Block IB guided missile to intercept

- the target. An AN/TPY-2 (Forward-Based Mode) radar, in addition to the THAAD (Terminal Mode) radar, also tracked the targets. The MDA initially attempted to conduct this test in October 2015 as FTO-02 Event 2; however, due to a THAAD target malfunction, the event was a “No Test.”
- THAAD provided hardware-in-the-loop representations for four BMDS ground tests that provided information on THAAD interoperability and functionality in various regional/theater scenarios.
  - Ground Test Distributed-06 (GTD-06) Part 1 in October 2015 examined defense of USEUCOM and USCENTCOM scenarios, using THAAD version 2.7 software.

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- Ground Test Integrated-06 (GTI-06) Part 2 in April 2016 examined defense of USPACOM and Homeland defense scenarios, using THAAD version 2.8 software.
- GTI-Israel-16 in June 2016 studied interoperability between the BMDS and the Arrow Weapon System for maintaining shared situational awareness, using THAAD version 2.7 software.
- GTD-06 Part 2 in September 2016 again examined defense of USPACOM and Homeland defense scenarios, using THAAD version 2.8 software.
- The THAAD program also conducted several smaller test events including a Cybersecurity Red Team Assessment in March 2016 and a Limited User Test of the Table Top Trainer in June 2016.

## Assessment

- FTO-02 Event 2a demonstrated that THAAD capabilities against theater and regional threats increased during FY16. THAAD Lot 4 and Fire Unit Fielded interceptors, for the first time, intercepted one complex SRBM and one MRBM threat-representative ballistic missile target while Aegis BMD simultaneously engaged an air-breathing threat. In addition to testing against new threat characteristics, the MDA successfully demonstrated the THAAD radar advanced algorithms for the first time during this test. The test event also demonstrated that recent obsolescence redesigns of hardware and software, which were fully integrated for the first time in this test, caused unintended problems. The THAAD Project Office should further study these design changes to minimize their negative effects.
  - Although THAAD has been deployed to Guam since 2013, THAAD has not yet demonstrated capability against IRBM threats in a flight test. The MDA will demonstrate this capability in FY17 during Flight Test THAAD-18 (FTT-18). This test, in addition to previous flight testing and FTT-15 (also planned for FY17), will demonstrate several key capabilities against longer range threats that the MDA should further explore using end-to-end modeling and simulation.
  - During GTD-06 Part 1, GTI-06 Part 2, and GTD-06 Part 2, the MDA demonstrated aspects of THAAD functionality in different theater scenarios. The BMDS Operational Test Agency (OTA) also reported several findings, consistent with findings from earlier ground tests that affect THAAD interoperability, track management, and radar functions.
  - Although analysis is still ongoing, data from FTO-02 Event 2 and Event 2a indicate that overall reliability failure rates were higher than those observed during the FY15 Reliability Growth Test. The launcher, particularly its 3-kilowatt generator, continued to experience failures.
  - Problems previously discovered during testing, if not corrected, could adversely affect THAAD effectiveness, suitability, or survivability. These problems, the details of which can be found in DOT&E's classified 2015 Assessment of the BMDS, include:
    - Training and documentation are still immature. Training courses and aids are still in development, and errors and omissions in the technical manuals continue to be found during testing.
- Environmental testing revealed some deficiencies which have not been corrected.
  - Some specific aspects of discrimination and classification need improvement.
  - Testing revealed some survivability and cybersecurity shortfalls, which are still in the process of being fixed and assessed.
- The THAAD program continued work on achieving a Full Materiel Release of the first two THAAD batteries, which achieved Conditional Materiel Release in February 2012. The THAAD Project Office continued to address the 19 open conditions that need to be resolved before the Army will grant a Full Materiel Release. The THAAD program will continue to test and fix the open conditions through FY19. Of the original 39 conditions, the THAAD Project Office closed 20 conditions in FY12-15 and 1 condition to "provide a capability to electronically transfer battle plans" in FY16.
  - Work also continues on additional materiel release conditions for follow-on THAAD software versions 1.3.1, 1.4.0, and 2.7.0 (Configuration 2).

## Recommendations

- Status of Previous Recommendations. DOT&E's classified February 2012 THAAD and AN/TPY-2 Radar OT&E and LFT&E report contained 7 recommendations in addition to the 39 Conditional Materiel Release conditions. The MDA should continue to address the two remaining classified recommendations (Effectiveness #2 and Effectiveness #5) and the two remaining unclassified recommendations. The MDA and the Army should:
  1. Implement equipment redesigns and modifications identified during natural environment testing to prevent problems seen in testing (Suitability #11). Some of these deficiencies have been addressed by hardware modifications included in THAAD Configuration 2. Conducting additional ground testing with Configuration 2 (a standing FY14 recommendation) would also provide data to address this recommendation.
  2. Conduct electronic warfare testing and analysis (Survivability #3). The MDA conducted preliminary testing during FY13, but additional testing is required.
  3. The program partially addressed the FY14 recommendation to conduct thorough end-to-end testing of the THAAD Configuration 2 that incorporates considerable obsolescence redesigns of hardware and software. The MDA should continue to plan to rigorously ground test the THAAD system to verify that these changes can withstand the range of environments and conditions required.
  4. The program has begun to address the FY15 recommendation that the MDA should prioritize flight and ground testing that involves THAAD and Patriot engagement coordination, to determine if the information passed between THAAD and Patriot does not disrupt organic intercept capabilities and can contribute to reduced

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interceptor wastage and threat missile leakage. The MDA and Army are considering a combined THAAD and Patriot test in 2018.

- FY16 Recommendation.

1. The MDA and BMDS OTA should plan to conduct high-fidelity modeling and simulation runs against longer

range threats following the FTT-18 and FTT-15 flight test campaign, to include endgame and lethality analyses for these tests.

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