

## Standard Missile-6 (SM-6)

### Executive Summary

- The performance deficiency discovered during IOT&E and outlined in the May 2013 classified Standard Missile-6 (SM-6) IOT&E report remains unresolved and continues to affect DOT&E's final assessment of effectiveness.
  - The Navy is assessing several options for a solution, each with varying degrees of complexity. A primary concern is to ensure the solution causes no degradation to the existing SM-6 performance envelope.
  - The Navy plans to incorporate these changes in Block I (BLK I) and Block IA (BLK IA) production variants and conduct operational testing in FY17.
- In FY16, the Navy completed FOT&E live fire testing. These tests provided validation data for the modeling and simulation runs for the record phase of the FOT&E. The Navy intends to conduct the modeling and simulation tests in FY17, which will complete the SM-6 BLK I FOT&E.
- In FY16, the Navy successfully demonstrated the maximum range Key Performance Parameter (KPP) and the launch availability Key System Attribute during SM-6 BLK I FOT&E and Aegis Baseline 9 operational testing.
- The Navy commenced developmental testing of pre-planned product improvements to the SM-6 BLK I missile in FY14; these improvements are the SM-6 BLK IA configuration. The Navy conducted a successful developmental test of the SM-6 BLK IA Guidance Test Vehicle (GTV) mission (GTV-3) in FY16. The Navy plans to conduct operational testing of the SM-6 BLK IA in FY17.
- The Navy conducted six SM-6 BLK I missile tests during FY16. Of the planned launches, four successfully supported FOT&E with Aegis Baseline 9; one test successfully supported Navy Integrated Fire Control – Collateral (NIFC-CC) Demonstration; one Agile Prism developmental test launch was unsuccessful.
- The uplink/downlink antenna shroud reliability problem discovered in IOT&E has been resolved; 34 production missiles with the new design have been fired without failure.
- NIFC – Counter Air (CA) From-the-Sea (FTS) Increment I became a fielded capability in 2015 and fully integrated as a tactical option in fleet air defense. Future testing of the Advanced Capability Build (ACB) 16 and ACB 20 Aegis Modernizations and SM-6 will evaluate the NIFC-CA FTS Increment II capability.

### System

- SM-6 is the latest evolution of the Standard Missile family of fleet air defense missiles.
- The Navy employs the SM-6 from cruisers and destroyers equipped with the Aegis combat systems.
- The SM-6 seeker and terminal guidance electronics derive from technology developed in the Advanced Medium-Range Air-to-Air Missile program.



- SM-6 retains the legacy Standard Missile semi-active radar homing capability.
- SM-6 receives midcourse flight control from the Aegis Combat System (ACS) via ship's radar; terminal flight control is autonomous via the missile's active seeker or supported by the ACS via the ship's illuminator.
- The Navy is upgrading SM-6 to the BLK I configuration to address hardware and software improvements and to address advanced threats.
- SM-6 Dual I capability is being added to provide Sea-Based Terminal capability against short-range ballistic missiles.
- The Navy is upgrading the SM-6 to add an anti-surface target capability.

### Mission

- The Joint Force Commander/Strike Group Commander will employ naval units equipped with the SM-6 for air defense against fixed-/rotary-winged targets and anti-ship missiles operating at altitudes ranging from very high to sea skimming.
- The Joint Force Commander will use SM-6 as part of the NIFC-CA FTS operational concept to provide extended range over-the-horizon capability against at-sea and overland threats.
- The Joint Force Commander will use SM-6 as part of the NIFC-CC operational concept to provide extended range capability against surface targets.

### Major Contractor

Raytheon Missile Systems – Tucson, Arizona

# FY16 NAVY PROGRAMS

## Activity

- The Navy conducted six SM-6 BLK I missile tests during FY16. Of the planned launches, four successfully supported FOT&E with Aegis Baseline 9, one successfully supported the NIFC-CA Tactical Demonstration, but one supporting the Aegis Agile Prism demonstration was unsuccessful.

### SM-6 BLK I FOT&E

- In January 2016, at the Pacific Missile Range Facility, Kauai, Hawaii:
  - An SM-6 BLK I FOT&E mission (D1A) successfully engaged a maximum downrange target.
  - An SM-6 BLK I FOT&E mission (D1B) successfully engaged a maximum cross-range target.
  - An SM-6 BLK I FOT&E mission (D1D) successfully engaged two SM-6s against two subsonic targets. An Aegis Weapon Control System integration problem appeared that did not affect the mission.
  - An SM-6 BLK I FOT&E mission (D1Ga) successfully engaged a target that was using electronic attack against the SM-6.
- The Navy conducted the FOT&E in accordance with the DOT&E-approved test plan.

### Navy Integrated Fire Control – Collateral (NIFC-CC) Demonstration

- In January 2016, at the Pacific Missile Range Facility, the Navy successfully conducted the SM-6 NIFC-CC Demonstration mission.

### Navy Integrated Fire Control – Counter Air From the Sea Increment I (NIFC-CA FTS Increment I)

- In September 2016, at White Sands Missile Range, New Mexico, the Navy and Marine Corps successfully conducted a NIFC-CA FTS Increment I demonstration event using an F-35 Lightning II as a targeting source for the Aegis BL9 Desert Ship test configuration and the SM-6. This demonstration was developmental testing and did not represent a fleet operational configuration of the ACS or all the required communications links. The demonstration used a non-tactical engineering computer software build in the Aegis Desert Ship test site, itself not fully representative of the ACS, interfaced to a datalink gateway that could receive the F-35 Multifunction Advanced Data Link (MADL) and port track data from the aircraft sensor to the AWS. Using this track data, an SM-6 was initialized and launched at an MQM-107 unmanned target drone.
- In September 2016, at the Pacific Missile Test Center, California, the Navy conducted an at-sea flight demonstration of the NIFC-CA FTS Increment I.

### AGILE PRISM

- In March 2016, at the Pacific Missile Range Facility, an SM-6 BLK I missile did not successfully engage either of the two threat targets at low altitude during a developmental test event.

### SM-6 BLK IA

- The Navy commenced developmental testing of pre-planned product improvements to the SM-6 BLK I missile in FY14; these improvements are the SM-6 BLK IA configuration.

The Navy conducted a successful developmental test of the SM-6 BLK IA Guidance Test Vehicle (GTV) mission (GTV-3) in FY16. The Navy plans to conduct operational testing of the SM-6 BLK IA in FY17.

## Assessment

- In FY16, the Navy completed FOT&E live fire testing. These tests provided validation data for the modeling and simulation runs for the record phase of the FOT&E. The Navy will conduct this phase of test during FY17, which will complete the SM-6 BLK I FOT&E.
- During FY16 flight tests, there were no occurrences of the uplink/downlink antenna shroud reliability deficiency. DOT&E considers the uplink/downlink antenna shroud reliability deficiency to be resolved. To date, the Navy has fired 34 SM-6s with full production antennas with no observations of anomalies. At the 80 percent confidence level, the reliability of the antennas is at least 95.4 percent.
- The March 2015 SM-6 BLK I mission D1G misfire remains under investigation by the Navy with no root cause determination to date.
- In the May 2013 SM-6 IOT&E report, DOT&E assessed SM-6 BLK I as suitable. This assessment considered combined data from the IOT&E and developmental/operational flight tests. During FY16 testing, DOT&E collected additional reliability data and assessed that the SM-6 BLK I continues to remain suitable. DOT&E will continue to collect suitability and effectiveness data throughout SM-6 BLK IA FOT&E testing in FY17, as well as during all SM-6 flight testing in support of NIFC-CA FTS, Missile Defense Agency, and Aegis software baseline development.
- The performance deficiency discovered during IOT&E and outlined in the classified IOT&E report remains unresolved and continues to affect DOT&E's final assessment of effectiveness. The Navy is assessing several options for a solution, each with varying degrees of complexity. A primary concern is to ensure the solution causes no degradation to the existing SM-6 performance envelope. The corrective actions will be incorporated into production of the SM-6 BLK I and BLK IA configurations and tested during FOT&E in FY17.
- In FY16, the Navy successfully demonstrated the maximum range KPP during SM-6 FOT&E and the maximum cross-range Key System Attribute.
- DOT&E assesses the launch availability KPP to be resolved. The Navy stored seven missiles aboard an operational ship for at least 8 months prior to firing during FOT&E with no launch availability problems noted. This yields a launch availability of 1.0 with an 80 percent confidence lower bound of 0.81, against a requirement of 0.98.
- Upon completion of the SM-6 FOT&E in FY17, the Navy will have conducted sufficient testing to allow an assessment of the SM-6 Capability Production Document performance requirement for interoperability.
- The failure during the Aegis Agile Prism test remains under investigation by the Navy.

## FY16 NAVY PROGRAMS

- The Navy's NIFC-CA FTS Increment I test events conducted to date were sufficient to demonstrate basic capability; however, these demonstrations were not conducted under operationally realistic conditions or against aerial targets representative of modern threats. Additionally, the scenarios conducted were not sufficiently challenging to demonstrate the NIFC-CA FTS requirements defined in the Navy's September 2012 NIFC-CA FTS Testing Capability Definition Letter. Nevertheless, since NIFC-CA FTS Increment I has been fully integrated as a tactical option in fleet air defense, DOT&E removed the NIFC-CA FTS, as a distinct program, from test and evaluation oversight. DOT&E will assess and report NIFC-CA FTS (Increment II) performance as part of the FY18-23 ACB 16 and ACB 20 Aegis Modernization operational testing and SM-6 FOT&E.
- In September 2016, at White Sands Missile Range, the Navy and Marine Corps successfully conducted a NIFC-CA FTS Increment I demonstration event using an F-35 Lightning II as a targeting source to allow the ACS (partial) installed at the Desert Ship test facility to engage an aerial target with the SM-6. The configuration of the F-35 and the Desert Ship was not operationally representative and not all the required communications links were present. This demonstration was part of developmental testing and did not represent a fleet operational configuration of the ACS. The demonstration used a non-tactical engineering computer software build in the Aegis Desert Ship test site – itself not fully representative of the ACS – interfaced to a datalink gateway that could receive

the F-35 MADL and port track data from the aircraft sensor to the AWS. Using these track data, an SM-6 successfully engaged an MQM-107 unmanned target drone. This demonstration was conducted as a proof of concept to show that the NIFC-CA FTS Increment I capability could utilize additional airborne sensors to provide fire control quality data to the AWS. In the context of the event, this objective was met; however, this demonstration should not be construed as an operational capability.

- In September 2016, at the Pacific Missile Test Center, the Navy successfully conducted an at-sea flight demonstration of the NIFC-CA FTS Increment I. This test resulted in the longest-range SM-6 interception to-date.

### Recommendations

- Status of Previous Recommendations. The Navy is addressing the previous recommendations from FY14 to complete corrective actions of the classified performance deficiency discovered during IOT&E and develop a flight test program to test those corrective actions. The Navy plans to conduct verification flight tests in FY17. The Navy has not addressed the FY15 recommendation; however, this recommendation is rescinded as NIFC-CA FTS Increment I has been fully integrated as a tactical option in fleet air defense, DOT&E removed the NIFC-CA FTS, as a distinct program, from test and evaluation oversight and will be tested as a normal tactic in future Aegis/SM-6 testing.
- FY16 Recommendations. None.

**FY16 NAVY PROGRAMS**