

## AGM-88E Advanced Anti-Radiation Guided Missile (AARGM) Program

### Executive Summary

- The AGM-88E Advanced Anti-Radiation Guided Missile (AARGM) is not operationally suitable and not operationally effective after Block 1 operational testing was prematurely terminated. DOT&E rescinded approval of the Block 1 operational test plan on June 13, 2016, after numerous performance problems were discovered but not corrected, a significant decline below Capability Production Document (CPD) Key System Attribute (KSA) requirements in reliability occurred, and multiple revisions to the software were made causing serious concern over software stability.
- AARGM was previously evaluated as operationally suitable, but not operationally effective due to multiple deficiencies discovered during IOT&E in FY11-12. Reliability problems below CPD requirements were noted during IOT&E, but the subsequent Verification of Correction of Deficiencies resulted in an improving reliability growth curve projection and numbers which met the CPD reliability requirements.
- The Block 1 Upgrade integrated testing was conducted by Navy test squadrons VX-31 and VX-9 beginning in 4QFY14 and ending after DOT&E rescinded approval in 3QFY16.
- The Navy held a Gate 6 Review on August 2, 2016, to determine the way forward for the program. At this review, the operational test community for the AARGM program (VX-9, Commander, Operational Test and Evaluation Force (COTF), and DOT&E) detailed the numerous problems and deficiencies noted affecting weapon accuracy, declining weapon reliability well below the CPD requirements, and software stability concerns after multiple software changes during the Block 1 Upgrade testing. The Program Office stated that they were now meeting all Key Performance Parameters (KPPs) and should be allowed to continue testing. The operational test community acknowledged that the program is meeting KPPs, but pointed out that the weapon system is failing to meet a KSA (reliability) and several other significant CPD requirements, which affect system performance and accuracy and significantly limit effectiveness against many advanced threats and threat counter-anti-radiation missile (ARM) tactics. Moreover, software was being revised and was not stable for operational testing. Software must be stable and fully production representative with numerous new versions used during operational testing. The Navy leadership agreed with the Program Office and directed that testing continue as developmental testing with VX-9, COTF, and DOT&E participating in an assisting role as necessary/desired.
- The Navy intends to release the Block 1 Upgrade software to the fleet in 3QFY17 without completing operational testing and without adequately addressing the numerous performance,



- reliability, and software stability problems discovered during Block 1 Upgrade testing.
- AARGM Extended Range (ER) is currently based on the Block 1 Upgrade weapon and will require extensive work to correct the accuracy, reliability, and software deficiencies discovered during Block 1 testing.

### System

- AARGM supplements the AGM-88B/C High-Speed Anti-Radiation Missile (HARM) and is specifically designed to prosecute targets that stop radiating, executing point-to-point missions against traditional and non traditional air defense systems.
- AARGM uses a new guidance section and a modified HARM control section and fins. The Navy intends to employ AARGM on F/A-18A-F and EA-18G platforms.
- AARGM incorporates digital Anti-Radiation Homing, a GPS, Millimeter Wave guidance, and a Weapon Impact Assessment transmitter.
  - Anti-Radiation Homing improvements include an increased field of view and increased detection range compared to HARM.
  - The GPS allows position accuracy in location and time.
  - The Weapons Impact Assessment capability allows transmission of real-time hit assessment via a national broadcast data system.
  - The Millimeter Wave radar technology allows target discrimination and guidance during the terminal flight phase.
  - The Weapon uses an internal GPS and Inertial Navigation System with mission planning data to establish Missile Impact Zones and Missile Avoidance Zones in an effort to reduce fratricide.

# FY16 NAVY PROGRAMS

- The Navy intended for the AARGM Block 1 Upgrade (a software-only upgrade) to deliver Full Operational Capability, including Block 0 capability improvements and software changes to provide deferred capability requirements and address deficiencies identified during IOT&E.

## Mission

Commanders employ aircraft equipped with AARGM to conduct pre-planned, on-call, and time-sensitive reactive anti-radiation

targeting to suppress, degrade, and destroy radio frequency enabled surface-to-air missile defense systems regardless whether the systems continue radiating or shut down.

## Major Contractor

Orbital/Alliant Techsystems – Northridge, California

## Activity

- In June 2015, DOT&E approved the AARGM FOT&E test plan developed by the Program Office and COTF. The test plan was adequate to address the testing of deferred capabilities and deficiencies discovered during initial developmental test and evaluation and IOT&E.
- The Block 1 Upgrade integrated testing was conducted by Navy test squadrons VX-31 and VX-9 beginning in 4QFY14 and ending after DOT&E rescinded approval in 3QFY16.
- Based on numerous deficiencies discovered during Phase 1 testing and subsequent rounds of testing, significant software updates were required, and an additional integrated test phase was introduced (Phase 1a). Software versions R2.1, R2.2, R2.2.1, R2.2.2, and R2.2.3 were created and delivered during integrated testing to address some of these deficiencies. R2.2.3 is the current version of software for the Block 1 Upgrade.
- The Navy conducted eight live fire test events during Block 1 Upgrade testing. Two of the eight tests have been determined failures, with both impacting the ground significant distances away from their intended targets and having little to no weapons effect on the actual targets. A thorough analysis of the causes of these weapon misses revealed several significant classified problems affecting the accuracy of the weapon. While these problems do not affect KPPs, they do negatively affect weapon performance and accuracy.
- Multiple operational mission failures (OMFs) occurred during the Block 1 Upgrade testing. Four of the nine weapons delivered to China Lake, California, for testing had hardware failures and were returned to the manufacturer. Subsequent testing revealed a much higher number of OMFs than was previously encountered during IOT&E with system-of-system reliability of 20.77 hours Mean Time Between Operational Mission Failure (MTBOMF) as compared to the CPD requirement and KSA of 28.0 hours (Production Threshold and 280.0 hours Production Objective) and a system under test reliability of 31.15 hours MTBOMF as compared to the CPD requirement of 72.0 hours.
- DOT&E rescinded approval of the operational test plan on June 13, 2016, and directed additional measures to restart OT&E to correct the classified problems affecting weapon accuracy.
- DOT&E also directed the Navy to develop an updated live fire test plan that would result in an acceptable level of statistical

confidence after two of the eight live fire shots failed. At a minimum, DOT&E believed that 5 more live fire shots, for a total of 13, would be needed to gain the required statistical confidence in the Block 1 Upgrade.

- DOT&E recommended that the Navy develop a plan to improve weapon reliability as weapon reliability during FOT&E was considerably worse than demonstrated in the poor results of IOT&E.
- The Navy appropriated funding for Orbital/Alliant Techsystems to conduct an assessment to identify near term risks of thermal protection properties of the current nose cone and seeker if the rocket motor were redesigned to extend the missile range. If the assessment results are positive, the Navy is considering funding Orbital/Alliant Techsystems to redesign the rocket motor to use with the current Block 1 seeker for an AARGM ER variant.

## Assessment

- The FY16 status is assessed as not operationally suitable and not operationally effective due to numerous deficiencies with weapon performance, accuracy, reliability, and software stability revealed during Block 1 Upgrade testing. The details of these deficiencies will be discussed in the forthcoming classified Block 1 Upgrade Operational Test Report.
- Based on IOT&E test data, AARGM was determined to be operationally suitable, but not operationally effective. The details of these deficiencies are discussed in the classified DOT&E IOT&E report published in August 2012.
- The Navy streamlined the Block 1 Upgrade test design and utilized a combined test strategy of developmental and operational testing simultaneously in a prolonged integrated test phase. There was no dedicated developmental testing designed into this test plan. In retrospect and for future AARGM ER testing, a dedicated developmental test phase is necessary for a weapon system software upgrade of this magnitude. This creates a dedicated period of problem discoveries and corrections to take place prior to beginning operational testing with an operationally representative and stable software version and weapon system.
- The discovery of significant problems found during the detailed analysis of the two live fire test shot failures are classified but significantly affect weapon accuracy and performance. The Navy has chosen to accept the problems

without correction because they are not tied to KPPs and will continue with the software release and fielding. These significant problems mean AARGM will not be effective if used to target existing advanced threat surface-to-air missile systems in current and future conflicts using AARGM. Future doctrine is being developed on the faulty premise that AARGM will be able to address these advanced systems, particularly in an Anti-Access and Area Denial (A2AD) environment. The Navy needs to fix the problems discovered during the Block 1 Upgrade FOT&E, or change their future doctrine to reflect the limitations discovered during this failed operational test.

- The Navy is planning on releasing the Block 1 Upgrade to the fleet without adequate operational testing after DOT&E rescinded approval of the test plan and required the Navy to fix several classified problems affecting weapon accuracy and performance and to correct its declining reliability. The Navy decided to continue testing without correcting the majority of these classified deficiencies or addressing the reliability problems. The Block 1 Upgrade only corrects two deferred KPPs from Block 0 and delivers only a small increase in capability while introducing a host of new performance and worsening reliability problems.
- Block 1 Upgrade performance provides limited employment capability against advanced threat surface-to-air radar systems. AARGM ER is currently based on the Block 1 Upgrade

technology and will require extensive work to correct the accuracy, reliability, and software deficiencies discovered during Block 1 testing and documented in DOT&E's memo to the Assistant Secretary of the Navy for Research, Development, and Acquisition dated June 13, 2016.

## Recommendations

- Status of Previous Recommendations. The Navy addressed all previous recommendations.
- FY16 Recommendations. The Navy should:
  1. Submit an updated operational test plan for DOT&E's approval to correct the accuracy, reliability, and software deficiencies discovered during previous Block 1 testing prior to fleet release. Conduct dedicated developmental testing prior to further operational testing to ensure the operational test asset performance is stable and is production representative.
  2. Assess current and future Navy and Marine Corps doctrine to counter advanced threat surface-to-air missile systems, particularly in an A2AD environment, taking into account the classified problems discovered during previous testing.
  3. Improve seeker performance against advanced threat surface-to-air radar systems prior to investing time, money, and resources in extending the current system's range in an AGM-88E AARGM ER concept.

**FY16 NAVY PROGRAMS**