

Aegis Modernization Program

Executive Summary

- The Navy is modernizing the Aegis Weapon System (AWS) on Aegis guided missile cruisers and destroyers via Advanced Capability Build (ACB)-12, ACB-16, and ACB-20 baseline upgrades.
- DOT&E will issue a final report on ACB-12 Baselines 9.A0 and 9.C1 in FY19. To date, the live firing area air defense flight test events on Baselines 9.A0 and 9.C1 indicate that performance against single subsonic and supersonic high diving targets remains consistent with historical results against comparable threats; testing against more stressing target presentations is planned for FY18-22 ACB-16 operational testing.
- In FY18, the Navy began air defense, surface warfare, and cyber survivability operational testing of ACB-16 Phase 0 (Baseline 9.A2A cruiser). The Navy will conduct Phase 1 and Phase 2 (Baseline 9.C2 cruiser and destroyer) integrated and operational test events in FY20-22.
- Previous results of Aegis Baseline 9.A (cruisers) cyber survivability testing can be found in the July 2015 DOT&E Early Fielding Report. Subsequent to that report and the cyber survivability testing of Aegis Ashore installation (Baseline 9.B), the Navy canceled cyber survivability testing of Baseline 9.C1. The September 2018 initial phase of cyber survivability testing on ACB-16 Baseline 9.A2A was postponed due to Hurricane Florence evacuation. This may result in Baseline 9.A2A deployment in FY19 with no cyber survivability testing.
- The Navy must provide an accredited modeling and simulation (M&S) suite of the Aegis Combat System (ACS) in order to adequately assess the Probability of Raid Annihilation requirement for the self-defense mission for Flight III DDG 51 destroyers/ACB-20.
- Navy Integrated Fire Control – Counter Air (NIFC-CA) From-the-Sea (FTS) Increment I became a fielded capability in 2015 and was fully integrated as a tactical option in fleet air defense. Future testing of ACB-16, ACB-20, and Standard Missile (SM)-6 will continue to evaluate the NIFC-CA FTS capability.

System

- The Navy Aegis Modernization program provides updated technology and systems for CG 47-class Aegis guided missile cruisers and DDG 51-class Aegis guided missile destroyers. This planned, phased program provides similar technology and systems for new construction destroyers.
- The AWS integrates the following components:
 - AWS AN/SPY-1 three-dimensional (range, altitude, and azimuth) multi-function radar
 - AN/SQQ-89 undersea warfare suite that includes the AN/SQS-53 sonar, SQR-19 passive towed sonar array



- (DDGs 51 through 78, CGs 52 through 73), and the SH-60B or MH-60R helicopter (Flight IIA DDGs 79 and newer have a hangar to allow the ship to carry and maintain its own helicopter)
- Close-In Weapon System
- A 5-inch diameter gun
- Harpoon anti-ship cruise missiles (DDGs 51 through 78, CGs 52 through 73)
- Vertical Launch System that can launch Tomahawk land attack missiles, SM-2 and -6 surface to-air missile variants, Evolved Sea Sparrow Missiles, and Vertical Launch Anti-Submarine Rocket missiles
- The AWS is upgraded through quadrennial ACBs. The Navy is currently upgrading the AWS to Baseline 9.A2A on CG 47 cruisers and to Baseline 9.2 on Flight IIA and new construction DDG 51 destroyers. Baseline 10 is planned for fielding on Flight III DDG 51 destroyers.
 - ACB-12 Baseline 9.A0 upgraded Baseline 3 *Ticonderoga* (CG 47)-class cruisers.
 - ACB-12 Baseline 9.C1 upgraded Flight I *Arleigh Burke* (DDG 51)-class destroyers.
 - ACB-12 Baseline 9.C1 also equipped new construction Flight IIA DDG 51 destroyers.
 - ACB-16 Baseline 9.C2 and 9.A2A upgrades will be installed on modernized Flight IIA DDG 51 destroyers and Service Life Extension Program for SPY-1B equipped cruisers and Baseline 8 SPY-1A CG 47 cruisers respectively.
 - ACB-20 Baseline 10 upgrades for Flight III DDG 51 destroyers.

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Mission

The Joint Force Commander/Strike Group Commander employs AWS-equipped DDG 51 guided missile destroyers and CG 47 guided missile cruisers to conduct:

- Area and self-defense anti-air warfare in defense of the Strike Group
- Anti-surface warfare and anti-submarine warfare
- Strike warfare, when armed with Tomahawk missiles
- Integrated Air and Missile Defense (IAMD), to include simultaneous offensive and defensive warfare operations
- Operations independently or in concert with Carrier or Expeditionary Strike Groups and with other joint or coalition partners

Activity

- In June 2018, the Navy conducted Phase 0 operational testing for Aegis ACB-16 (Baseline 9.A2A) on USS *Leyte Gulf* (CG 55). Phase 0 testing covered the software version installed on Aegis cruisers with the SPY-1A radar. Operational testing consisted of air defense tracking events conducted at Service Combat Systems Center, Wallops Island, Virginia. Additionally, three developmental live fire events conducted in the Virginia Capes Operating Area provided supplemental data. The Navy conducted the operational tests in accordance with DOT&E-approved test plans.
- In July/August 2018, at the Pacific Missile Test Center, Point Mugu, California, the Navy continued Phase 0 air defense and surface warfare operational testing on USS *Mobile Bay* (CG 53). Air defense testing consisted of raids of subsonic anti-ship cruise missile (ASCM) surrogate targets. Surface warfare test events included one firing exercise and several tracking exercises against small boats. Problems with aerial targets deviating from the planned flight profile in one event and ship schedule/range operational concerns precluded execution of the tests in accordance with the approved test plan.
- ACB-16 Phase 1 and 2 (Baseline 9.C2 cruisers and destroyers) follow-on integrated and operational testing is planned for FY20-22.
- Cyber survivability testing of Aegis Baseline 9.C1 has been deferred until ACB-16 Baseline 9.C2 operational testing. The first phase of planned cyber survivability testing for ACB-16 for cruisers, scheduled for September 2018, was postponed due to Hurricane Florence evacuation. Cyber survivability testing is planned for Phase 1 on cruisers in FY20 and Phase 2 on destroyers in FY21/22.
- The Navy is developing an M&S suite to supplement live testing and facilitate a more thorough evaluation of air defense performance for DDG 51 Flight III ships in FY23. As part of the overall M&S development strategy, the Navy plans to make limited use of the M&S suite for operational testing of the ACB-16 (Baseline 9.C2) in FY22.

Major Contractors

- General Dynamics Marine Systems Bath Iron Works – Bath, Maine
- Huntington Ingalls Industries (formerly Northrop Grumman Shipbuilding) – Pascagoula, Mississippi
- Lockheed Martin Rotary Mission Systems – Moorestown, New Jersey

- The Navy is developing Test and Evaluation Master Plans for Aegis ACB-16 (Baselines 9.A2 and 9.C2) and for DDG 51 Flight III/ACB-20 (Baseline 10).
- NIFC-CA FTS is being evaluated in conjunction with planned Aegis Modernization operational testing. Increment I became a fielded capability in 2015 and was fully integrated as a tactical option in fleet air defense. Future testing of ACB-16, ACB-20, and SM-6 will evaluate the NIFC-CA FTS Increment II capability.
- DOT&E intends to issue a final report on Baselines 9.A0 and 9.C1 in FY19.

Assessment

- Analysis of completed Phase 0 ACB-16 test events is ongoing. Testing to date is not sufficient to demonstrate the effectiveness of SPY-1A-equipped cruisers in air defense or to evaluate the cyber survivability posture of Aegis cruisers prior to the deployment in FY19. During the live fire test on USS *Mobile Bay*, the execution of one planned air defense firing event against a raid of ASCM surrogates resulted in a significantly different raid profile than planned. While all targets were successfully intercepted, the overall test objectives were not met. Similarly, a planned multi-mission firing event (planned to include small boats, a subsonic ASCM raid, and an unmanned aerial vehicle (UAV) attack) was reduced to an air defense firing against an UAV due to test range execution problems and ship schedule.
- Previous operational testing of Aegis Baselines 9.A0 and 9.C1 indicate that air defense performance against single subsonic and supersonic high-diving ASCM presentations is consistent with historical performance. Aegis Baseline 9 has incorporated software changes to address performance against certain stressing air defense threat presentations. Evaluation of these actions is ongoing throughout ACB-16 operational testing.
- The outcome of the single surface warfare operational testing firing event in FY18 indicates ACB-16 performance was

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consistent with improvements noted in previous testing. This event alone is not sufficient to assess ACB-16 ship surface warfare performance.

- Due to range safety considerations self-defense mission test data collected in manned ship testing is limited and not sufficient to fully assess this mission area.
- Similarly, the Navy cannot fully assess Aegis IAMD until an AWS M&S test bed is developed and validated. The test bed is under development and is planned to be available by FY20. A limited Baseline 9.C1 IAMD operational assessment suggests that DDGs can simultaneously support limited air defense and ballistic missile defense missions within overall radar resource constraints. This assessment is supported by a single successful live firing event, managed by the Missile Defense Agency, which included simultaneous live firing of SM-2 and SM-3 missiles against threat-representative targets

in an IAMD engagement. More stressing IAMD scenarios are planned for ACB-16 and ACB-20 testing

- Results of previous Aegis Baseline 9.A (cruisers) cyber survivability testing can be found in the July 2015 DOT&E Early Fielding Report. Subsequent to this report, and the cyber survivability testing of Aegis Ashore installation (Baseline 9.B), the Navy canceled cyber survivability testing of Baseline 9.C1 and will evaluate implementation of fixes to previous problems as part of ACB-16 operational testing.

Recommendation

1. The Navy needs an accredited M&S suite of the ACS to adequately assess the Probability of Raid Annihilation requirement for the self-defense mission for Flight III DDG 51 destroyers/ACB-20.

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