

Aegis Modernization Program



In FY23, the Navy's Operational Test and Evaluation Force (OPTEVFOR) conducted operational testing on ships with the Capability Package (CP) 22-1 and Baseline 9.2.1 variants of the Aegis Weapon System (AWS) Advanced Capability Build 16 (ACB 16). Due to scheduling delays and correctable performance issues, the Navy now expects ACB 16 testing to continue until 1QFY25. DOT&E plans to deliver an early fielding report on ACB 16 CP 22-1 operational performance in 2QFY24 and a final ACB 16 OT&E report in FY25 after completion of operational testing. Operational testing continues to demonstrate hardware reliability and software stability concerns with the Aegis Display System and the AN/SPY-1 radar. As stated in the FY22 Annual Report, test adequacy is at risk because the program lacks an approved Test and Evaluation Master Plan (TEMP).

SYSTEM DESCRIPTION

The Aegis Combat System is an advanced weapon control system comprised of sensors, control elements, and weapons to detect, track, engage, and destroy airborne, surface, and subsurface threats. The Aegis Combat System's key components

include: 1) an AWS that comprises the hardware and software modifications to integrate combat systems capabilities, as well as the AN/SPY-1 or AN/SPY-6(V)1 three-dimensional multi-function radar on Flight III *Arleigh Burke*-class (DDG 51) Aegis guided missile destroyers; 2) a Phalanx Close-In Weapon System; 3) a 5-inch diameter multipurpose gun system; 4) the Vertical Launch

System that can launch Tomahawk missiles, SM-2, SM-3, and SM-6 Standard Missiles, Evolved Sea Sparrow Missiles (ESSM), and Vertical Launch Anti-Submarine Rockets; 5) AN/SPQ-9B Horizon Search Radar; 6) Surface Electronic Warfare Improvement Program (AN/SLQ-32(V)6); 6) Cooperative Engagement Capability; and 7) an AN/SQQ-89 undersea warfare suite, which also incorporates

integration with the MH-60R helicopter. The Navy's Aegis Modernization Program updates the AWS to improve Aegis Combat System integration and capabilities on *Ticonderoga*-class (CG 47) Aegis guided missile cruisers and *Arleigh Burke*-class (DDG 51) Aegis guided missile destroyers.

MISSION

The Joint Force Commander/Strike Group Commander employs CG 47 ships and DDG 51 ships equipped with Aegis to conduct:

- Area and self-defense anti-air warfare in defense of the strike group;
- Anti-surface warfare;
- Anti-submarine warfare;
- Strike warfare, when armed with Tomahawk missiles;
- Integrated air and missile defense (IAMD); and
- Operations independently or in concert with carrier or expeditionary strike groups and with other joint or coalition partners.

PROGRAM

The Aegis Modernization Program is a non-acquisition category program of record. The Navy updates the AWS through quadrennial ACBs that comprise hardware and software modifications to improve capability. The latest upgrade is ACB 16. The Navy intends four incremental deliveries within ACB 16: Baseline 9.2.0, Baseline 9.2.1,

Baseline 9.2.2, and CP 22-1 (also referred to as Baseline 9.2.3). Each baseline update is intended to build on the previous baseline and improve capabilities through a combination of hardware and software upgrades. The Navy made the decision in FY23 that DDG 51 ships with Technology Insertion (TI16) hardware upgrades, that received, or were scheduled to receive, ACB 16 Baseline 9.2.2, will be upgraded to ACB 16 CP 22-1 to more efficiently resolve technical issues; however, some ships that are intended to be backfit with TI-12H may still receive Baseline 9.2.2 in the future. The evaluation of ACB 16 will be accomplished as a cumulative collection of operational test data from all baseline variants and is expected to complete by 1QFY25. ACB 16 evaluation informs deployment decisions and determines delivered capability for ACB 16 and its variants.

In coordination with DOT&E in FY19, the Navy developed an Aegis ACB 16 TEMP draft, which included the test strategy for the first three ACB 16 baselines, but the Navy did not provide it for DOT&E approval. The Navy subsequently updated the draft TEMP, in coordination with DOT&E, to incorporate CP 22-1. The TEMP is currently in Navy signature routing, but DOT&E has not yet received the TEMP for approval.

In 2QFY24, the Navy intends to begin initial operational testing of the next Aegis ACB, ACB 20, Baseline 10.0 variant in conjunction with the DDG 51 Flight III ship's IOT&E. IOT&E will continue

until at least FY27 due to the delayed ability of the Navy to test some capabilities, including IAMD. The Navy, in coordination with DOT&E, developed a single TEMP describing the testing strategy for ACB 20 (Baseline 10.0), and DDG 51 Flight III with the AN/SPY-6(V)1. DOT&E approved the combined TEMP in September 2022. The Navy took delivery of the first DDG 51 Flight III guided missile destroyer with ACB 20 Baseline 10.0, USS *Jack H. Lucas* (DDG 125), in June 2023. The Navy should begin developing a follow-on TEMP update to address the next iteration of ACB 20 (Baseline 10.1 variant) capabilities that are not covered in the combined TEMP.

» MAJOR CONTRACTORS

- Lockheed Martin Rotary and Mission Systems – Moorestown, New Jersey
- Raytheon, a subsidiary of RTX (formerly Raytheon Technologies) – Tucson, Arizona
- Bath Iron Works, a subsidiary of General Dynamics Corporation – Bath, Maine
- HII (formerly Huntington Ingalls Industries) – Pascagoula, Mississippi

TEST ADEQUACY

No testing of AWS ACB 16 Baseline 9.2.0 occurred in FY23. OPTEVFOR conducted operational testing of AWS ACB 16 Baseline 9.2.1 on USS *Gettysburg* (CG 64) from August to September 2023 in

accordance with a DOT&E-approved test plan and with observation by DOT&E. Tests consisted of tracking exercises with simulated engagements against manned aircraft, and live fire and tracking exercises against fast inshore attack craft surrogates.

OPTEVFOR conducted additional operational testing of ACB 16 CP 22-1 on USS *McCampbell* (DDG 85) in November 2022, on USS *Lena Sutcliffe Higbee* (DDG 123) in July 2023, and on USS *Preble* (DDG 88) in August 2023. Tests included live missile firings and tracking exercises against anti-ship cruise missile surrogates, tracking exercises with simulated engagements against manned aircraft, live fire against an unmanned aerial vehicle, and live fire and tracking exercises against fast inshore attack craft surrogates. Live missile firings included SM-2 Block IIIA, SM-2 Block IIIB, and ESSM firings. Due to a hardware failure on DDG 88, only suitability data were collected during that operational test period. OPTEVFOR conducted all tests in accordance with DOT&E-approved test plans and with observation by DOT&E.

The Navy is developing the Combat System Test Bed (CSTB) modeling and simulation suite to support the test strategy in the combined TEMP for ACB 20 (Baseline 10.0), DDG 51 Flight III, and the AMDR IOT&Es. The Navy intends to trial the use of the CSTB within the evaluation of Aegis ACB 16 to supplement live testing of the air warfare mission. CSTB is likely to inform attributes of the air

warfare mission but limitations of the CSTB in the ACB 16 configuration preclude an end-to-end assessment of self-defense capability as defined by the ACB 16 Probability of Raid Annihilation requirements. To support this, OPTEVFOR developed a CSTB accreditation plan in FY23 for the assessment of ACB 20 (Baseline 10.0). The Navy is developing the CSTB in incremental stages that align with planned operational testing. However, the Navy does not expect to accredit the CSTB for evaluation of all mission areas until FY27. The Navy should continue development of the CSTB to support current and future AWS baseline testing.

OPTEVFOR plans to continue ACB 16 testing on Baselines 9.2.0, 9.2.1, and CP 22-1 in FY24, and plans cyber survivability testing of ACB 16 CP 22-1 on a DDG 51 ship in April and May 2024. All ACB 16 testing is expected to be completed by 1QFY25. The Navy should ensure that all remaining test assets are scheduled to support completion of ACB 16 testing.

OPTEVFOR is developing a test plan for operational testing of DDG 51 Flight III, Aegis ACB 20 (Baseline 10.0), and AN/SPY-6(V)1 on USS *Jack H. Lucas* (DDG 125) that is planned for 2QFY24.

PERFORMANCE

» EFFECTIVENESS

Not enough data are yet available to determine Aegis ACB 16

operational effectiveness as operational test remains in progress. DOT&E did not submit an early fielding report for ACB 16 Baseline 9.2.2 and ACB 16 CP 22-1 as intended in the FY22 Annual Report. This reporting is delayed until completion of operational testing of CP 22-1 due to delayed fielding caused by the program's intended correction of deficiencies identified in CP 22-1 testing, and the transition of ships from Baseline 9.2.2 to CP 22-1. DOT&E now intends to submit an early fielding report for Aegis ACB 16 in 2QFY24. DOT&E expects to submit a final Aegis ACB 16 OT&E report in 2QFY25 after completion of remaining operational tests.

The AWS integration with active missiles including ESSM Block 2, SM-2 Block IIIC, and SM-6, which are intended for close-in air warfare self-defense and area-air defense, have the potential to improve overall performance of the weapon system. Details are available in the classified early fielding report for ESSM Block 2 utilizing AWS ACB 16 Baseline 9.2.2 of September 2022. DOT&E additionally expects to release a Standard Missile 2 Block IIIC early fielding report, for testing conducted on an ACB 16 CP 22-1 platform, in 2QFY24.

» SUITABILITY

Not enough data are yet available to determine Aegis ACB 16 operational suitability as operational test remains in progress. However, testing continues to demonstrate hardware reliability and software

stability concerns with the Aegis Display System and the AN/SPY-1 radar. Problems with the AN/SPY-1 radar prevented the Navy from completing an operational test event planned for USS *Preble* in August 2023.

» SURVIVABILITY

Not enough data are available to assess the cyber survivability of ACB 16. The Navy plans to complete cyber survivability assessment of CP 22-1 in 3QFY24.

RECOMMENDATIONS

The Navy should:

1. As recommended in the FY22 Annual Report, submit the ACB 16 TEMP for DOT&E approval as soon as feasible to support allocation of necessary test resources.
2. Determine and correct the cause of hardware reliability and software stability problems with the Aegis Display System and AN/SPY-1 radar, as recommended in the FY22 Annual Report.
3. Continue to determine and correct causes of performance deficiencies identified during CP 22-1 testing that have prevented the ability to conduct some operational test events and may have also impacted test results.
4. Continue development, verification, and validation of the CSTB to support its intended use in each AWS baseline's test program.
5. Schedule remaining test assets to support completion of the ACB 16 test program, including the cyber survivability assessment of CP 22-1.
6. Develop the TEMP update for evaluation of ACB 20 (Baseline 10.1) capabilities not in the combined ACB 20 (Baseline 10.0), DDG 51 Flight III, and AN/SPY-6(V)1 TEMP.