

Aegis Modernization Program

Executive Summary

- The Navy is modernizing the Aegis Weapon System (AWS) installed on Baseline 3 USS *Ticonderoga* (CG 47) class cruisers and the Flight I USS *Arleigh Burke* (DDG 51) destroyers to the AWS Advanced Capability Build 2012 (Baseline 9A and 9C, respectively). New construction DDGs, beginning with USS *John Finn* (DDG 113), will be equipped with Baseline 9C as well.
- Testing completed to date is insufficient to make a determination of operational effectiveness or suitability for Aegis Baseline 9A or 9C.
- In accordance with National Defense Authorization Act of 2008, Section 231, DOT&E submitted Early Fielding Reports in July and November 2015 for each baseline incident in response to the Navy's deployment of USS *Normandy* and USS *Benfold*, and prior to the completion of operational testing. Testing on Baseline 9A and 9C ships to date suggest that area air defense performance against subsonic and supersonic high-diving targets is consistent with historical performance against comparable threats; however, during operational testing, the Navy has not yet demonstrated performance against more stressing presentations.
- In February 2015, the Navy commenced Baseline 9A operational testing on USS *Chancellorsville* (CG 62). One planned live fire event was deferred due to target availability, and two of four additional planned at-sea events were not completed because of test execution problems. These unexecuted operational test events are currently scheduled for late 1QFY16.
- From November 2014 through April 2015, as part of Combat System Ship Qualification Trials, the Navy conducted integrated developmental and operational testing in the air defense and Undersea Warfare mission areas on USS *John Paul Jones* (DDG 53), USS *Benfold* (DDG 65), and USS *Barry* (DDG 52). Data from these events will supplement data collected during dedicated operational testing for Baseline 9C. The Navy is scheduled to begin Baseline 9C operational testing on USS *John Paul Jones* (DDG 53) in FY16.
- The lack of an adequate modeling and simulation (M&S) suite of the Aegis Combat System, as well as the lack of an Aegis equipped Self-Defense Test Ship (SDTS) where the ship's full self-defense kill chain can be tested, precludes assessment of the Baseline 9 Probability of Raid Annihilation requirement.
- The Navy will not fully assess Aegis Integrated Air and Missile Defense (IAMD) until a validated M&S test bed is developed and validated. The test bed is planned to be available by FY20, but there is no agreed upon strategy to validate the model to support assessment of the close-in, self-defense battlespace. A limited IAMD assessment will be made during Baseline 9C operational testing on DDGs.



- The Navy fielded the Navy Integrated Fire Control – Counter Air (NIFC-CA) From-the-Sea (FTS) Increment I capability with the deployment of the first E-2D and Baseline 9-equipped Carrier Strike Group in FY15. NIFC-CA FTS Increment I developmental test events in FY13 and FY14 demonstrated a basic capability, but its effectiveness under operationally realistic conditions is undetermined.
- As discussed in the July 2015 Aegis Baseline 9A Early Fielding Report, DOT&E is concerned with results from the cruiser cybersecurity evaluation and performance in the Surface Warfare mission area. Follow-on cybersecurity and Surface Warfare operational testing will be required.

System

- The Navy's Aegis Modernization program provides updated technology and systems for existing Aegis-guided missile cruisers (CG 47 class) and destroyers (DDG 51 class). This planned, phased program provides similar technology and systems for new construction destroyers.
- The AWS, carried on DDG 51-guided missile destroyers and CG 47-guided missile cruisers, 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 (DDGs 79 Flight IIA 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

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- Harpoon anti-ship cruise missiles (DDGs 51 through 78, CGs 52 through 73)
- Vertical Launch System that can launch Tomahawk land attack missiles, Standard surface-to-air missiles, Evolved Seasparrow Missiles, and Vertical Launch Anti-Submarine Rocket missiles
- The AWS on Baseline 3 USS *Ticonderoga* (CG 47) class cruisers and Flight I USS *Arleigh Burke* destroyers is being upgraded to Baseline 9A and 9C, respectfully. Baseline 9 will provide the following new capabilities:
 - Full Standard Missile-6 (SM-6) integration
 - IAMD, to include simultaneous air defense and ballistic missile defense missions on Aegis destroyers equipped with the new Multi-Mission Signal Processor
 - NIFC-CA FTS capability
- Starting with USS *John Finn* (DDG 113), the AWS on new construction Aegis-guided missile destroyers is Baseline 9C.
- 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
- Simultaneous offensive and defensive warfare operations
- Operations independently or in concert with Carrier or Expeditionary Strike Groups and with other joint or coalition partners

Major Contractors

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

Mission

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

Activity

- The Navy conducted Baseline 9A cruiser operational testing on USS *Chancellorsville* in 2QFY15. One planned live fire event was deferred due to target availability, and two of four additional planned at-sea events were not completed because of test execution problems. These unexecuted operational test events are currently scheduled for late 1QFY16. In FY15, the Navy also conducted a cybersecurity assessment and maintenance demonstration.
- In July 2015 and November 2015, DOT&E submitted two Early Fielding Reports on Aegis Baseline 9A and 9C, respectively.
- The Navy conducted integrated developmental and operational testing in the Undersea Warfare mission area on USS *John Paul Jones* and USS *Benfold* as part of each ship's Combat System Ship Qualification Trials in 1QFY15 and 2QFY15, respectively. Data from these events will supplement data collected during dedicated operational testing for Baseline 9C. The Navy is scheduled to begin Baseline 9C operational testing on USS *John Paul Jones* (DDG 53) in FY16.
- The Navy successfully conducted a live fire IAMD event against threat representative cruise and ballistic missile surrogates on USS *John Paul Jones* in November 2014. The event, as conducted, included a less-stressing scenario than planned in the Aegis Modernization Test and Evaluation Master Plan, and it resulted in only one, vice two, SM-3 missiles being fired simultaneously with an SM-2 air defense missile. This was the only live fire event available to assess

Baseline 9C's ability to simultaneously engage cruise missiles and ballistic missiles.

- The Navy conducted all testing in accordance with the DOT&E-approved test plans.

Assessment

- Baseline 9A and 9C testing completed to date was not sufficient to support an assessment of operational effectiveness or suitability prior the FY15 USS *Normandy* and USS *Benfold* deployments. In accordance with National Defense Authorization Act of 2008, Section 231, DOT&E submitted Early Fielding Reports for each baseline. Testing on Baseline 9A and 9C ships to date suggest that area air defense performance against subsonic and supersonic high-diving targets is consistent with historical performance against comparable threats; however, the Navy has not yet demonstrated performance against more stressing presentations during operational testing. Operational testing, to include more stressing presentations, is planned to continue through FY16.
- The Navy will not 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; however, there is no agreed upon strategy to validate the model to support assessment of the close-in, self-defense battlespace. A limited Baseline 9C IAMD operational assessment suggests that DDGs can simultaneously support limited air defense and ballistic missile defense missions, within overall radar resource

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constraints. This assessment is supported by a successful live fire 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.

- Results to date of 12 live flight tests events on Baseline 9A and 9C ships suggest that area air defense performance against single subsonic and supersonic high-diving targets is consistent with historical performance against comparable threats.
- Although not presented for operational testing, the Baseline 9A Surface Warfare performance, specifically counter high-speed surface threats in littoral waters, as demonstrated during developmental testing, indicated no improvements over previous Aegis baseline operational test results. For both Baseline 9A and 9C, these results indicate that AWS does not fully meet desired Surface Warfare performance levels.
- As appropriate, and until the full capability may be operationally tested, DOT&E will provide periodic capability assessments to inform Navy and OSD leadership, as well as Congress, on the progress of T&E of the IAMD mission area.
- Until an Aegis-equipped SDTS is available for testing, it is neither possible to characterize the self-defense capabilities of the Aegis cruisers and destroyers, nor possible to accredit an M&S suite to determine if the ships satisfy their Probability of Raid Annihilation requirements.
- The Navy's NIFC-CA FTS Increment I test events conducted to date are 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. Further testing is planned for FY16; these tests, too, will not be sufficiently challenging to allow an operational effectiveness determination.
- The Navy's combined Baseline 9 and SM-6 FOT&E test events to date have been successful with no SM-6 integration issues revealed.
- The Navy's Aegis Baseline 9A cybersecurity testing revealed significant problems, which are classified. The nature of these problems is such that they could pose significant risk to the cybersecurity for the FY15 deployment. Details can be found in DOT&E's Early Fielding Report dated July 2015.
- Changes made to the radar software presented unexpected issues during the initial phase of the Aegis cruiser at-sea operational test. The Navy is addressing these issues and

remaining cruiser and destroyer operational testing will provide opportunities to confirm these issues have been mitigated.

- During both integrated and operational test events, instability of the Aegis operator consoles adversely affected the conduct of test events. The Navy is addressing these issues and remaining cruiser and destroyer operational testing will provide opportunities to confirm these issues have been mitigated.
- Aegis Baseline 9C has incorporated software changes to address performance against certain stressing air defense threat presentations; however, the effects of these changes remain undemonstrated by testing. Developmental testing of these changes is planned for late 1QFY16.

Recommendations

- Status of Previous Recommendations. The Navy has not addressed the following previous recommendations from FY14. The Navy still needs to:
 1. Continue to improve Aegis ships' capability to counter high-speed surface threats in littoral waters.
 2. Synchronize future baseline operational testing and reporting with intended ship-deployment schedules to ensure that testing and reporting is completed prior to deployment.
 3. Provide the necessary funding to support the procurement of an advanced air and missile defense radar and Aegis-equipped SDTS that is needed to support Aegis Modernization, advanced air and missile defense radar, DDG 51 Flight III, and Evolved Seasparrow Missile Block 2 operational testing.
 4. Characterize Aegis Baseline 9A/C and NIFC-CA FTS Increment I capability against operationally realistic anti-ship cruise missile threats as soon as possible.
 5. Submit a Test and Evaluation Master Plan for DOT&E approval that describes and resources adequate operational testing of future NIFC-CA FTS increments before such capabilities are deployed.
 6. For Baseline 9A, develop and deploy necessary cybersecurity corrective actions and verify correction with a follow-on operational cybersecurity test.
- FY15 Recommendation.
 1. The Navy needs to complete the planned FOT&E events as detailed in the approved test plan as soon as practical.

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