Ship Self-Defense System (SSDS) Mk 2 Integrated Combat Systems

Clockwise from top left: SSDS Mk 2 Mod 3 on LHD 8; Mod 6 on CVN 78; Mod 5 on LSD 51; Mod 2 on LPD 20; Mod 4 on LHA 6; and Mod 1 on CVN 68

DOT&E published a classified early fielding report for the CVN 78 *Gerald R. Ford*-Class Nuclear Aircraft Carrier program in April 2023 in advance of the ship's initial deployment. The report addresses performance shortfalls observed to date on the Ship Self-Defense System (SSDS) Mk 2 Mod 6 with Baseline 10. The Navy began the cybersecurity evaluation of SSDS Mk 2 Mod 6 with Baseline 10 (CVN 78 configuration) in July 2023 at the Surface Combat Systems Center land-based test facility in Wallops Island, Virginia. At the same facility, the Navy started land-based developmental testing of SSDS Mk 2 Mods 2 and 6 with Baseline 12. Operational tests of SSDS Mk 2 Mod 6 with Baseline 10 aboard CVN 78 are planned in 1QFY25.

SYSTEM DESCRIPTION

SSDS Mk 2 is the command and control system aboard amphibious ships and aircraft carriers. It comprises a local area network with processors that host tactical programs, and interfaces to external systems. SSDS Mk 2 integrates the following systems: horizon search radars (i.e., SPQ-9B and SPY-3), volume search radars (i.e., SPS-48, SPS-49, SPY-4 and SPY-6), MK 9 tracker illuminator system for Evolved Sea Sparrow Missile (ESSM), SLQ-32 electronic warfare system, Cooperative Engagement Capability (CEC) sensor fusion and netting system, ESSM and Rolling Airframe Missile (RAM) launchers, and Close-In Weapon System 20mm Gatling gun. SSDS includes operator workstations that display real-time tactical information.

SSDS Mk 2 has six variants referred to as mods. Each mod represents the integration of a unique set of sensors and self-defense weapon systems for a specific ship class.

- Mod 1 on *Nimitz*-class aircraft carriers (CVN 68 class)
- Mod 2 on *San Antonio*-class amphibious transport dock ships (LPD 17 class)
- Mod 3 on *Wasp*-class landing helicopter dock ships (LHD 1 class)
- Mod 4 on *America*-class landing helicopter assault ships (LHA 6 class)
- Mod 5 on *Whidbey Island*-class and *Harpers Ferry*-class dock landing ships (LSD 41 and LSD 49 classes)
- Mod 6 on *Ford*-class aircraft carriers (CVN 78 class)

SSDS Mk 2 capability improvements are delivered via software and hardware baselines within each mod. Individual ships in a class may have different SSDS software baselines, but they have the same SSDS mod. Most SSDS-based commissioned ships have baselines up to and including SSDS Mk 2 Baseline 10. The Navy is developing SSDS Mk 2 Baseline 12, which includes major changes to engagement doctrine and weapon scheduling algorithms intended to improve ship survivability.

MISSION

Navy commanders use SSDS Mk 2 for timely engagement of anti-ship cruise missile (ASCM) threats to their ship. Further, SSDS Mk 2 contributes to the commander's tactical picture during air, surface, amphibious, and undersea warfare missions by combining participating units' sensor data into a real-time composite target track picture of the battlespace.

PROGRAM

SSDS Mk 1 achieved Milestone C in 1998. In 2005, the Navy transitioned to SSDS Mk 2. SSDS Mk 2 is an Acquisition Category IC program. The Navy completed testing of the SSDS Mk 2 Mods 2 and 3 prior to May 2018, when DOT&E approved Revision C of the SSDS Mk 2 TEMP. That revision included operational tests of SSDS Mk 2 Mod 1, SSDS Mod 4 with Baseline 9 on the LHA 6 class, SSDS Mk 2 Mod 5 with Baseline 9 on LSD 41 and LSD 49 classes, and SSDS Mk 2 Mod 6 with Baseline 10 on CVN 78.

The Navy continued to develop an Air Warfare Ship Self-Defense Enterprise TEMP that includes FOT&E of SSDS Mk 2 with Baseline 12 (all mods). Testing planned in this TEMP will assess performance of updates to SSDS Mk 2 mods to address significant changes to the systems on each ship class and will include testing on new construction ships: SSDS Mk 2 Mod 4 with Baseline 12 will be tested on *Bougainville* (LHA 8), SSDS Mk 2 Mod 2 with Baseline 12 on *Harrisburg* (LPD 30), and SSDS Mk 2 Mod 6 with Baseline 12 on *John F. Kennedy* (CVN 79). Testing will also address the back-fit of Baseline 12 on existing ships. The Navy plans to start operational testing in FY27 aboard the Navy's Self-Defense Test Ship (SDTS).

» MAJOR CONTRACTORS

- Lockheed Martin Corporation – Bethesda, Maryland
- Raytheon, a subsidiary of RTX (formerly Raytheon Technologies) – Arlington, Virginia

TEST ADEQUACY

The Navy has yet to execute the SSDS Mk 2 Mod 1 testing outlined in the 2018 SSDS Mk 2 TEMP to assess force-level interoperability when integrated into a carrier strike group.

The Navy completed operational test on SSDS Mk 2 Mod 4 in 1QFY18 during the IOT&E of USS *America* (LHA 6). Results are documented in the USS *America* (LHA 6) Combined IOT&E and LFT&E Report of April 2019.

The Navy conducted one operational test on SSDS Mk 2 Mod 5 in 2016, The results were documented in the Ship Self-Defense of LSD 41/49-Class Ships Equipped with the Ship Self-Defense System Mk 2 Mod 5 Early Fielding Report of November 2017. The Navy plans to keep four LSD 49-class ships until FY33 but does not plan to execute the remaining eight SSDS Mk 2 Mod 5 test events for LSD ships outlined in the 2018 SSDS TEMP.

There were several operational tests of SSDS Mk 2 Mod 6 with Baseline 10 since 2019. Results were documented in the USS *Gerald R. Ford* (CVN 78) – Air Warfare Self-Defense Interim Assessment of April 2022. In April 2023, prior to the deployment of CVN 78 with SSDS Mk 2 Mod 6, DOT&E published a classified early fielding report which detailed the combat system's performance from completed test events in previous years. Only a limited assessment of the combat system's effectiveness aboard CVN 78 was possible due to the low number of anti-air warfare (AAW) test events against ASCM surrogates. The Navy must complete development and accreditation of the Probability of Raid Annihilation modeling and simulation (M&S) suite to support the full evaluation of SSDS Mk 2 Mod 6 for ASCM defense. The remaining live tests for SSDS Mk 2 Mod 6 that the Navy intends to complete in FY24 are needed to expand demonstration of AAW capabilities and to provide data for verification and validation of the M&S suite.

The Navy conducted two land-based developmental test (LBDT) events of SSDS Mk 2 Baseline 12 in the Mod 2 and Mod 6 configurations at the Surface Combat Systems Center (SCSC) in Wallops Island, Virginia in 3QFY23. The Navy intends to conduct several more LBDT events in support of SSDS Mk 2 Baseline 12. The next LBDT is scheduled for 2QFY24.

The Navy began cybersecurity evaluation of CVN 78, which included SSDS Mk 2 Mod 6 Baseline 10, at the SCSC in July 2023. The test was conducted in accordance with a DOT&E-approved test plan and observed by DOT&E. The Navy plans cybersecurity evaluation aboard CVN 78 in 2QFY24.

PERFORMANCE

» ### EFFECTIVENESS

No data were collected in FY23 that would change previously provided assessment of effectiveness for SSDS Mk 2 Mods 1, 4, and 5.

Insufficient data are available to determine the operational effectiveness of SSDS Mk 2 Mod 6 with Baseline 10 against ASCMs. Remaining test events will provide more data, but there may not be enough data available to determine the operational effectiveness and suitability of the SSDS Mk 2 Mod 6 self-defense capability against ASCMs at the completion of CVN 78 IOT&E. The Navy planned to use ten live operational firing events from the DDG 1000 *Zumwalt*-Class IOT&E, but modifications to the DDG 1000 combat system no longer support the use of the DDG 1000 test data for validation of the Probability of Raid Annihilation (PRA) test bed M&S suite for the combat system. SSDS Mk 2 Mod 6 tracking capability of small boats and unmanned aerial vehicles from the July 2022 event are included in this year's Annual Report entry for the CVN 78 program. Performance shortfalls identified to date are in the classified USS *Gerald R. Ford* (CVN 78) – Air Warfare Self-Defense Interim Assessment of April 2022 and the classified USS *Gerald R. Ford* (CVN 78) Early Fielding Report of April 2023.

Early developmental testing does not provide sufficient data to assess the risks to operational

effectiveness of SSDS Mk 2 Baseline 12 Mods 2 and 6. Testing at Wallops Island is typical of early developmental testing with the system still in the problem discovery phase. Many test-analyze-fix cycles are likely to be needed before the integrated SSDS Mk 2 Baseline 12 combat systems can properly perform their air warfare mission.

» SUITABILITY

No data were collected in FY23 that would change the previously provided assessment of suitability for SSDS Mk 2 Mods 1, 4, and 5. Insufficient data are available to determine the operational suitability of SSDS Mk 2 Mod 6, as reported in the classified USS *Gerald R. Ford* (CVN 78) Early Fielding Report of April 2023.

No data are available to assess the suitability of SSDS Mk 2 Baseline 12 combat systems as they are in early developmental testing and additional modifications are expected.

» SURVIVABILITY

Data are not yet available to assess cyber survivability for SSDS Mk 2 Mod 6 on CVN 78. The determination will depend on data from the FY23 land-based test and the data yet to be collected during CVN 78 shipboard operational cyber survivability testing scheduled for FY24. The shipboard data is necessary to validate the data collected at the land-based test facility.

RECOMMENDATIONS

The Navy should:

1. Complete remaining AAW testing on CVN 78 to support demonstration of SSDS Mk 2 Mod 6 capability against surrogate threat ASCMs and validate M&S for operational assessment.

2. Complete development of the CVN 78 Probability of Raid Annihilation M&S suite in FY24 and conduct verification and validation of its accuracy to support assessment of the SSDS Mk 2 Mod 6 combat systems performance.

3. Conduct SSDS Mk 2 Mod 1 testing outlined in the 2018 SSDS Mk 2 TEMP to assess force-level interoperability when integrated into a carrier strike group.

4. Complete cybersecurity evaluation onboard CVN 78 in FY24 to assess SSDS Mk 2 Mod 6 resilience to cyberattack.

5. Address all recommendations for SSDS Mk 2 Mod 6 performance in the classified USS *Gerald R. Ford* (CVN 78) – Air Warfare Self-Defense Interim Assessment and the classified USS *Gerald R. Ford* (CVN 78) Early Fielding Report.

6. Continue to develop the Air Warfare Ship Self-Defense Enterprise TEMP in support of SSDS Mk 2 Baseline 12 platforms and submit for DOT&E approval in FY24.

7. Complete SSDS Mk 2 Mod 5 testing to characterize ship self-defense performance of LSD 49 ship class.

8. Validate with operational testing the correction of SSDS Mk 2 Mods 1 and 3 with Baseline 10 integration issues discussed in the FY22 Annual Report.