

# Air and Missile Defense Radar (AMDR) / AN/SPY-6



In FY23, the Navy's Operational Test and Evaluation Force (OPTEVFOR) conducted an operational assessment (OA) of the Air and Missile Defense Radar (AMDR), designated AN/SPY-6(V)1, to provide early evaluation of the radar's performance and enable modifications that can optimize performance at IOT&E. DOT&E expects to deliver a classified AMDR OA report in 2QFY24 upon completion of data analysis. OPTEVFOR plans IOT&E of AMDR, designated AN/SPY-6(V)1, between FY24 and FY27.

## SYSTEM DESCRIPTION

AN/SPY-6 is the Navy's next-generation, AMDR S-Band, family

of radars. AN/SPY-6 uses a radar modular assembly (RMA) as a building block for the radar's antenna. Each individual RMA is a self-contained radar antenna built from a set of active transmit/

receive (T/R) digital modules that are electronically scanned. Each RMA block can integrate with other RMA blocks to create antenna assemblies of various size and capability. The large

number of T/R modules provides a high degree of fault tolerance through antenna redundancy and graceful degradation.

AMDR fielded on DDG 51 Flight III *Arleigh Burke*-class guided missile destroyers is designated AN/SPY-6(V)1. AN/SPY-6(V)1 uses four, fixed-antenna assemblies (faces) with each antenna having 37 RMAs. This provides a 360-degree field-of-view about the ship. AN/SPY-6(V)1 integrates with Aegis Weapon System (AWS) to provide DDG 51 Flight III ships with enhanced surveillance, tracking, and ballistic missile defense (BMD) discrimination. AN/SPY-6(V)1 is designed to operate in high clutter, littoral regions near land, and electromagnetic congested, contested, and complex environments.

AN/SPY-6 family of radars has other variants such as:

- AN/SPY-6(V)2 is comprised of nine RMAs for the single-face rotating antenna intended for the next flights of the *San Antonio*- and *America*-class amphibious ships and as a back-fit to the *Nimitz*-class aircraft carriers.
- AN/SPY-6(V)3 is comprised of three fixed-antenna faces with nine RMAs on each antenna face, intended for the *Gerald R. Ford*-class aircraft carrier and a modified version intended for the *Constellation*-class frigates.
- AN/SPY-6(V)4 is a planned back-fit modernization to the DDG 51 Flight IIA ships that will use 4 fixed-antenna

faces, with each antenna face having 24 RMAs.

## MISSION

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Navy commanders will use AMDR to detect, track, and support engagements against cruise and ballistic missiles, aircraft, and unmanned aerial vehicles in support of air warfare (AW) missions, BMD, or concurrent AW and BMD known as integrated air and missile defense (IAMD). Commanders additionally use AMDR for contact localization and situational awareness in surface warfare missions. AN/SPY-6(V)4 is expected to support similar missions as AN/SPY-6(V)1. AN/SPY-6(V)2 and AN/SPY-6(V)3 will also support similar missions, except for BMD and IAMD.

## PROGRAM

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AN/SPY-6 is an Acquisition Category IC program. DOT&E approved a combined Test and Evaluation Master Plan (TEMP) describing the testing strategy for AN/SPY-6(V)1, DDG 51 Flight III, and AWS Baseline 10 in September 2022. OPTEVFOR plans to conduct AN/SPY-6(V)1 IOT&E in FY24 with completion in FY27 in conjunction with the OT&E of DDG 51 Flight III with AWS Baseline 10. In June 2022, the Navy accepted delivery of the lead ship USS *Jack H. Lucas* (DDG 125) and has conducted various sea trials with AMDR as part of developmental testing.

The Navy expects to deliver a combined TEMP in FY24 that supports test and evaluation of

AN/SPY-6(V)2, AN/SPY-6(V)3, and the Ship Self-Defense System Baseline 12 Combat System. The Navy intends to conduct IOT&E of AN/SPY-6(V)2 and AN/SPY-6(V)3 radars between FY25 and FY28.

The AMDR program intends to cover AN/SPY-6(V)4 testing in a future Aegis Modernization TEMP.

## » MAJOR CONTRACTOR

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- Raytheon, a subsidiary of RTX (formerly Raytheon Technologies) – Marlborough, Massachusetts

## TEST ADEQUACY

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In December 2022, OPTEVFOR conducted an OA of AN/SPY-6(V)1 at the Advanced Radar Detection Laboratory (ARDEL) on Pacific Missile Range Facility, in Kauai, Hawaii. The OA evaluated capability of AN/SPY-6(V)1 to detect and track fighter aircraft, anti-ship cruise missile surrogates, unmanned aerial vehicles, helicopters, airborne early warning and control aircraft, and small-boat targets. Test events were executed in both clear and electromagnetic-contested environments and included projection from tower-based simulators. OPTEVFOR conducted the OA in accordance with a DOT&E-approved test plan with observation by DOT&E.

The OA provides early evaluation of the AN/SPY-6(V)1 radar performance and identifies modifications that can optimize performance at system employment. The OA additionally

informs planning of IOT&E campaign test events. The OA was not intended to determine operational effectiveness and suitability of the delivered AMDR due to the AN/SPY-6(V)1 at ARDEL being an engineering development model (EDM) that uses obsolete T/R Integrated Microwave Modules from that of the delivered system and not enough test data are available on the delivered AMDR. The AMDR program did not evaluate cyber survivability due to differences that the delivered AMDR will have from the AMDR EDM version at ARDEL. DOT&E expects to deliver a classified AN/SPY-6(V)1 OA report in 2QFY24 upon completion of data analysis.

Assessment of the resident AN/SPY-6(V)1 at ARDEL is limited by the following:

- The AN/SPY-6(V)1 is an EDM version that is in a degraded state and requires upgrade to provide representative performance. The AN/SPY-6(V)1 was adequate to support OA objectives but will not be adequate for IOT&E. The AMDR program plans to address within POM 25 adjustments to their program budget.
- The current aerial anti-ship cruise missile targets do not emulate more stressing threats, including advanced electronic attack capabilities. Aerial targets are needed to demonstrate performance and validate the modeling and simulation for IOT&E.
- The operational test strategy within the AN/SPY-6(V)1, DDG

51 Flight III, and AWS Baseline 10 TEMP that supports IOT&E for all three programs depends upon using the AN/SPY-6(V)1 at ARDEL to evaluate some specific capabilities which cannot be tested in an at-sea environment. However, the OA did not fully demonstrate the intended method of test, for this specific test objective, due to the system setup and software configuration issues.

## PERFORMANCE

### » EFFECTIVENESS

The AMDR OA demonstrated radar performance in a limited set of scenarios. DOT&E expects to provide performance results and risks to IOT&E in a classified AMDR OA report in 2QFY24. DOT&E expects to report operational effectiveness of AMDR in a classified IOT&E report in FY28 after IOT&E.

### » SUITABILITY AND SURVIVABILITY

Suitability and survivability were not assessed as part of the AMDR OA due to the expected differences between the AMDR EDM and the delivered AMDR. DOT&E expects to report operational suitability and survivability of AMDR in a classified IOT&E report in FY28 after IOT&E.

## RECOMMENDATIONS

The Navy should:

1. Replace the AN/SPY-6(V)1 EDM version at ARDEL with a production representative system to support AMDR IOT&E.
2. Update aerial anti-ship cruise missile targets to better emulate more stressing threats, including advanced electronic attack, and support AMDR IOT&E.
3. Validate the method of test used during the AMDR OA at ARDEL for assessing specific AN/SPY-6(V)1 capabilities which cannot be tested in an at-sea environment during IOT&E.
4. Continue to develop and submit the combined AN/SPY-6(V)2, AN/SPY-6(V)3, and the Ship Self-Defense System Baseline 12 Combat System TEMP for DOT&E approval in FY24.