

Mk 54 Lightweight Torpedo Upgrades Including the High Altitude Anti-Submarine Warfare Weapon Capability (HAAWC)



The Navy ended the Mk 54 Mod 1 Increment 1 IOT&E in October 2022 without completing many tests in the DOT&E-approved test plan. In April 2023, DOT&E published a classified IOT&E report that assessed the Mk 54 Mod 1 Increment 1 as operationally effective with no apparent degradation from the Mk 54 Mod 0 variant, but no assessment could be made about its performance in an acoustically challenging environment. The Mk 54 Mod 1 is not operationally suitable due to low reliability and availability.

The Navy conducted no operational test of the High Altitude Anti-Submarine Warfare (ASW) Weapon Capability (HAAWC) in FY23.

SYSTEM DESCRIPTION

The Mk 54 lightweight torpedo is the primary anti-submarine weapon employed from U.S. surface ships, aircraft, and helicopters. Navy convention is to designate the Mk 54 with Mods when significant changes are made to the Mk 54 hardware:

- Mod 0 is being phased out of existing inventories as they are converted to Mod 1.

- Mod 1 adds a new sonar array and processing hardware. Mod 1 has two increments:

- Increment 1 incorporates Advanced Processor Build 5 software from the Mk 48 heavyweight torpedo program to improve target detection and discrimination.
- Increment 2 will include additional updates focused on improving performance within a classified set of scenarios. Increment 2 has two phases of delivery:

- Phase 1 introduces Advanced Processor Build 6 software to enable multi-band sonar processing.
- Phase 2 includes hardware obsolescence upgrades needed to optimize performance with the new software.

- Mod 2 will incorporate a new warhead and engine to improve lethality, speed, endurance, and operating depth.

HAAWC is a combined Mk 54 torpedo and Air Launch Accessory

wing kit. P-8A aircraft operators can employ HAAWC from much higher altitudes than conventionally released Mk 54s. The Air Launch Accessory glides the Mk 54 down to an acceptable deployment altitude and then releases it to enter the water at a location assigned by the aircraft's combat system.

MISSION

Commanders employ naval surface ships, aircraft, and helicopters equipped with the Mk 54 torpedo to defeat threat submarines. Operators place the Mk 54 in the vicinity of a threat submarine through either aircraft release or firing the Vertical Launch Anti-Submarine Rocket (VLA) missile. The Mk 54 autonomously seeks and attacks the threat submarine upon water entry. Surface ships may expeditiously deploy the Mk 54 torpedo from a surface vessel torpedo tube, in the general direction of the submarine, when identifying a submarine that is too close to offensively target.

Commanders employ HAAWC to conduct ASW from P-8As by enabling torpedo release across a larger range of P-8A altitudes.

PROGRAM

The Mk 54 first fielded in 2004. Mk 54 Mod 1 is an Acquisition Category (ACAT) III program and Increment 1 entered full-rate production in April 2023. The Navy plans to submit a Test and Evaluation Master Plan (TEMP) update for Mod

1 Increment 2 in 2QFY25 and commence FOT&E in 1QFY26.

Mk 54 Mod 2 is an ACAT IB program and a joint development effort with Australia. DOT&E approved the Mod 2 Milestone B Joint TEMP in January 2023. The Joint TEMP requires set-to-hit in-water tests, but the Navy has yet to approve a method to conduct this testing. The Navy plans to begin IOT&E of Mod 2 in FY27.

The Navy has not approved the Mod 1 Increment 1 or Mod 1 Increment 2 for VLA missile applications.

The HAAWC is an ACAT III program and entered full-rate production in August 2022. DOT&E submitted classified IOT&E and FOT&E reports in June 2021 and July 2022, respectively. The HAAWC Air Launch Accessory and VLA missile will require redesigns to integrate the Mk 54 Mod 2 torpedo. The Navy requested proposals for a new HAAWC design from industry, with selection planned for late FY24.

» MAJOR CONTRACTORS

- Aerojet Rocketdyne, a subsidiary of L3Harris Technologies, Inc. – Huntsville, Alabama
- Boeing Defense, Space & Security – St. Charles, Missouri
- Northrop Grumman Corporation – Minneapolis, Minnesota
- Progeny Systems LLC, a subsidiary of General

Dynamics Mission Systems – Manassas, Virginia

- Raytheon, a subsidiary of RTX (formerly Raytheon Technologies) – Portsmouth, Rhode Island

TEST ADEQUACY

The Navy ended the Mod 1 Increment 1 IOT&E in October 2022 without completing the DOT&E-approved test plan. IOT&E was adequate to evaluate performance in a limited set of scenarios, but not in the acoustically challenging environment of shallow water for which improvements were expected to have the greatest effect on torpedo performance. DOT&E observed the IOT&E test events and submitted a classified IOT&E report for Mod 1 Increment 1 in April 2023.

The Navy conducted two live fire tests between February and May 2023 to characterize the Mod 2 warhead performance and both were observed by DOT&E. Testing was planned and conducted as proof-of-design tests by the warhead design contractor.

Test adequacy of Mk 54 Mod 2 depends upon representative threats and threat capability surrogates. In August 2020, the Navy commenced development of the Towed Array Threat Emulator (TATE) that the Navy intends to use to improve the threat representation of the current surrogate for a mobile countermeasure, the Submarine Launched Acoustic Countermeasure Emulator

(SLACE). In July 2023, the Navy commenced development of the Modular Threat Countermeasure Emulator (MOTCE) that the Navy intends to use to improve the threat representation for static countermeasures. The Navy plans to use the TATE and MOTCE in operational tests of the Mk 54 Mod 2.

PERFORMANCE

» EFFECTIVENESS

The Mod 1 Increment 1 torpedo is operationally effective and showed no degradation in torpedo effectiveness from Mod 0. However, no assessment of performance could be made for the Mod 1 Increment 1 torpedo operating in an acoustically challenging environment. A detailed assessment is in the classified IOT&E report for Mod 1 Increment 1 dated April 2023.

» LETHALITY

Mod 1 torpedo lethality is addressed in the classified IOT&E report for Mod 1 Increment 1 dated April 2023. No assessment of Mod 2 warhead lethality can be made due to ongoing analysis.

» SUITABILITY

The Mod 1 Increment 1 torpedo is not operationally suitable due to low availability and reliability. Mod 1 torpedoes are more likely to shut down early compared to Mod 0. A detailed assessment is in the classified IOT&E report for Mod 1 Increment 1 dated April 2023.

» SURVIVABILITY

Assessment of cyber survivability of the Mod 1 Increment 1 torpedo is classified; details are in the classified IOT&E report for Mod 1 Increment 1 dated April 2023.

RECOMMENDATIONS

The Navy should:

1. Continue to address all recommendations in the classified FOT&E report for HAAWC and the classified IOT&E report for Mk 54 Mod 1 Increment 1.
2. Prioritize opportunities to test the Mod 1 Increment 2 torpedo in an acoustically challenging shallow water environment to estimate torpedo performance.
3. Identify and approve a method to conduct Mod 2 set-to-hit testing that supports the required determination of torpedo lethality and effectiveness in the Mod 2 IOT&E.