

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



In December 2021, the Navy fielded the Mk 54 Mod 1 Increment 1 torpedo prior to the completion of IOT&E. DOT&E submitted a classified Early Fielding Report in June 2022 that details demonstrated capabilities of the Mod 1 Increment 1. Data were insufficient to assess operational effectiveness and suitability, including performance in an acoustically challenging environment, a primary focus of improvement for this variant of the Mk 54 torpedo. The Navy has not yet scheduled remaining test events for IOT&E.

In January 2022, the Navy tested Operational Flight Program (OFP) software update 3.5 for the High Altitude Anti-Submarine Warfare (ASW) Weapon Capability (HAAWC). HAAWC with OFP 3.5 remains operationally effective, expands employment to lower altitudes than demonstrated during IOT&E, but remains not operationally suitable. DOT&E submitted a classified FOT&E report in July 2022 that details observed performance.

## SYSTEM DESCRIPTION

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The Mk 54 lightweight torpedo is the primary anti-submarine weapon employed from U.S. surface ships, aircraft, and helicopters. Mod 1 Increment 1 includes a new sonar array and torpedo software to provide a clearer picture of the intended target within the undersea environment. Mod 1 Increment 1 incorporates Advanced Processor Build 5 software from the Mk 48 heavyweight torpedo program. The Navy has not approved Mod 1 Increment 1 for Vertical Launch Anti-Submarine applications.

HAAWC is a combined Mk 54 torpedo and Air Launch Accessory wing kit. P-8A operators can employ HAAWC from much higher altitudes than conventional 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. The Navy updated HAAWC with OFP 3.5 to address deficiencies identified during the program's IOT&E.

## MISSION

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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/helicopter release or firing the Vertical Launch Anti-Submarine

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

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The Mk 54 is an Acquisition Category III program first fielded in 2004. The Navy has introduced incremental improvement with follow-on torpedo variants. The Navy intends to deliver the Mk 54 Mod 1 torpedo variant in two increments. The Navy commenced IOT&E of Mod 1 Increment 1 in December 2019 and released it for fleet employment in December 2021, prior to completion of IOT&E. The Navy intends to commence operational test of Mod 1 Increment 2 in FY26 and a Mod 2 variant in FY27. DOT&E approved the Mod 1 Milestone C Test and Evaluation Master Plan in February 2020. The Navy intends to submit the Mod 2 Milestone B Test and Evaluation Master Plan for DOT&E approval in 1QFY23.

The HAAWC is an Acquisition Category III program. The Navy conducted operational test of the software update, OFP 3.5, in January 2022 and the program entered full-rate production in August 2022.

## » MAJOR CONTRACTORS

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- Raytheon Integrated Defense Systems – Portsmouth, Rhode Island
- Progeny Systems Corp. – Manassas, Virginia
- Boeing Co. – St. Louis, Missouri

## TEST ADEQUACY

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Between November 2021 and January 2022, the Navy conducted 11 Mod 1 Increment 1 torpedo firings as part of IOT&E. During execution of the DOT&E-approved test plan, the fleet moved the location of the test due to an operational concern. This test event was not observed by DOT&E due to COVID travel restrictions. Post-test analysis of the test event revealed that six of the firings did not include environmental conditions required by the operational test design. As a result, six torpedo firings did not contribute test data required within the operational test design to determine Mod 1 Increment 1 operational effectiveness. The inclusion of the five valid torpedo firings in FY22 for the operational test design brings the achieved firings to 34 of the 86 planned torpedo firings. The Navy has yet to schedule remaining torpedo firings for Mod 1 Increment 1.

In June 2022, DOT&E submitted a classified Early Fielding Report that provides an interim assessment of the Mod 1 Increment 1 capability. Test data were insufficient to assess operational effectiveness and suitability,

particularly in an acoustically challenging environment for which improvements are expected to have the greatest effect on torpedo performance. Test data were sufficient to assess cyber survivability.

In January 2022, the Navy employed eight HAAWC (two with exercise Mk 54 torpedoes and six with ballistic air test vehicles) from a P-8A at the Pacific Missile Range Facility Barking Sands in accordance with a DOT&E-approved test plan. DOT&E did not observe this test event due to COVID travel restrictions. Testing was adequate to assess effectiveness and suitability of the OFP 3.5 software update. The Navy did not test cyber survivability of HAAWC with OFP 3.5 due to the software introducing no changes in the HAAWC interfaces or cyber-protective elements.

## PERFORMANCE

### » EFFECTIVENESS

The Mod 1 Increment 1 torpedo shows no degradation in torpedo effectiveness from its previous variant, the Mk 54 Mod 0 Block Upgrade, but analysis is limited

to employment in deep water environments. Details are in the June 2022 report. Preliminary analysis of shallow water performance indicates that the torpedo is trending toward meeting its requirement in some scenarios, but no data are available to assess performance in acoustically challenging environments.

The HAAWC remains operationally effective with the OFP 3.5 upgrade. OFP 3.5 introduced improved flight models that effectively expanded the operational release envelope to include lower HAAWC release altitudes from the P-8A than demonstrated in IOT&E. Details are in the July 2022 report. P-8A aircraft require certification to improve HAAWC deployment flexibility.

### » SUITABILITY

Preliminary data suggest the Mod 1 torpedo is trending towards meeting its suitability requirements, but insufficient data are available to assess operational suitability of Mod 1 Increment 1.

The HAAWC with OFP 3.5 did not demonstrate an improvement in reliability from IOT&E and remains not operationally suitable.

### » SURVIVABILITY

Mod 1 torpedo vulnerability to a cyber-contested environment is classified; details from this evaluation are in the June 2022 report.

HAAWC with OFP 3.5 retains the same cyber survivability identified in the June 2021 classified HAAWC FOT&E report.

## RECOMMENDATIONS

The Navy should:

1. Address all recommendations in the June 2022 report for Mod 1 Increment 1 and August 2022 report for HAAWC.
2. Complete Mod 1 Increment 1 IOT&E as soon as feasible, with priority placed on torpedo firings in an acoustically challenging shallow water environment.
3. Monitor HAAWC with OFP 3.5 reliability during fleet exercises.
4. Conduct P-8A certifications to maximize loadout flexibility for HAAWC and conventionally released Mk 54s.