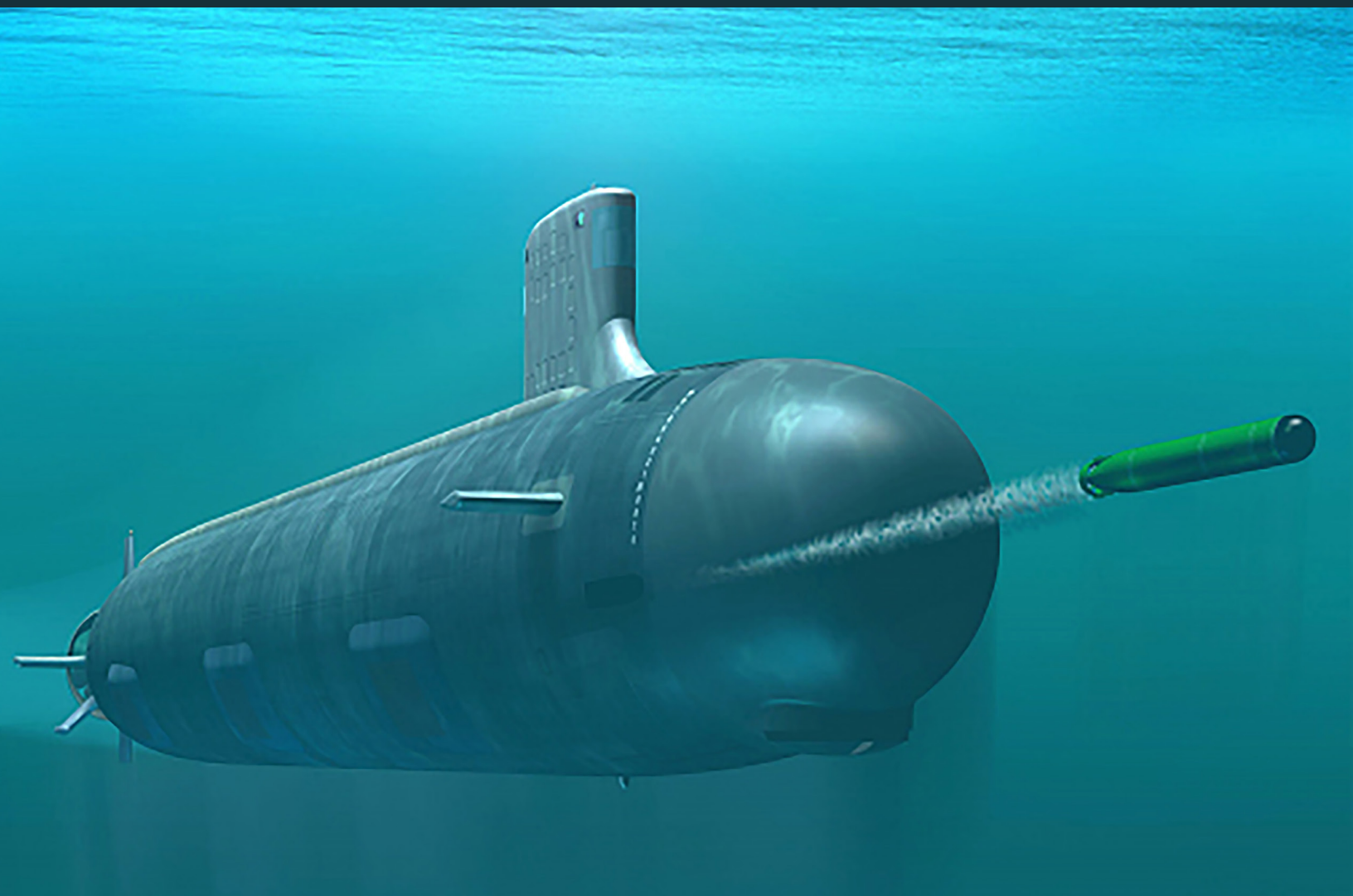


Mk 48 Torpedo Modifications



In February 2024, DOT&E published a classified early fielding report (EFR) on the Mk 48 Heavyweight Torpedo with Shallow Water Urgent Build (SWUB) software to support a subsequent Navy fielding decision in the following month. In FY24, the Navy conducted two test events to evaluate Mk 48 torpedo performance within more representative scenarios to assess SWUB features. The Navy expects to complete FOT&E of the Mk 48 Mod 7 APB 6 torpedo in FY25.

SYSTEM DESCRIPTION

The Mk 48 is a submarine-launched heavyweight torpedo that directs itself toward a target submarine or surface ship based on an operator-developed targeting solution. The Mk 48 uses organic sensors to detect, classify, localize, and intercept its target.

The Mk 48 torpedo has hardware variants referred to as Mods. Each Mod represents a hardware improvement in capability, integrating upgraded sensors, guidance and control (G&C), and/or propulsion system. Two Mods are in use in the fleet with two additional Mods in development:

- Mod 6 integrated noise quieting in the propulsion section and commercial-off-the-shelf electronics in the G&C section. Advanced Common Torpedo (a follow-on improvement on Mod 6) integrated additional commercial-off-the-shelf electronics in the G&C section.
- Mod 7 Common Broadband Advanced Sonar System upgraded the sonar receiver.
- Mod 8 is in development and will consist of a new G&C section with an upgraded sonar array.
- Mod 9 is a five-year Middle Tier of Acquisition (MTA) rapid prototyping effort to develop several feature upgrades to include a new propulsion section.

Additionally, the Mk 48 torpedo undergoes regular software

updates, referred to as Advanced Processor Builds (APB), to supplement the hardware Mods. APBs include modifications (e.g., tactics, classification algorithms, operator interface) intended to improve torpedo performance or simplify the operator interface. APBs can operate on various torpedo Mods with some variance in performance based on Mod hardware. Current APBs in use or in development are:

- APB 5 (found on Mod 7 torpedoes) – Modifications focused on detection and discrimination of target submarines and surface ships. It also provided an alternative tactic against surface ships.
- APB 5+ (found on Mod 7 torpedoes) – Modifications focused on simplifying the interface between the submarine's combat system and the torpedo. APB 5+ is limited to Mod 7 torpedo hardware and requires the employing submarine to have the AN/BYG-1 combat control system version APB-18/TI-19 or beyond.
- SWUB – Modifications were developed in FY23 and fielded in FY24 to address a classified urgent fleet need. The capability is an add-on and will be included as a baseline in future torpedo variants.
- APB 6 (developing for Mod 7 and Mod 8 torpedoes) – Modifications will improve torpedo tactics and sonar processing while introducing new classified capabilities via software. APB 6 is scheduled

to attain initial operating capability in FY26 on Mod 7 and FY29 on Mod 8. Mod 7 APB 6 will introduce APB 6 capabilities that do not rely on the upgraded Mod 8 G&C.

MISSION

The Navy Submarine Force employs the Mk 48 torpedo to destroy threat submarines and surface ships in all ocean environments.

PROGRAM

The Navy fielded the earliest version of the Mk 48 heavyweight torpedo in 1972. Mk 48 Mod 7 and beyond are a shared development effort with the Royal Australian Navy. In FY24, the Navy completed the Acquisition Category III program for the Mk 48 with SWUB. In February 2024, DOT&E published a classified EFR on the Mk 48 torpedo with SWUB software. The Navy fielded the Mk 48 with SWUB the following month.

The Navy is completing developmental test of Mk 48 Mod 7 APB 6. The Navy expects to complete Mk 48 Mod 7 APB 6 FOT&E in FY25. The Navy initiated Mod 9 development in December 2023 as an MTA rapid prototyping effort with operational demonstration within five years.

The Navy expects to deliver the Mod 9 Master Test Strategy to DOT&E for approval in FY25. The Navy is also in development for Mod 8 APB 6 and intends

a Milestone C decision in FY26 and FOT&E in FY28.

» MAJOR CONTRACTORS

- Lockheed Martin Sippican, Inc. – Marion, Massachusetts
- Lockheed Martin Corporation – Syracuse, New York
- Science Applications International Corporation, Inc. – Reston, Virginia

TEST ADEQUACY

In February 2024, DOT&E submitted a classified EFR on Mk 48 with SWUB. As detailed in the FY23 Annual Report, testing was adequate to evaluate a specific feature of the SWUB software. However, deviations from the DOT&E-approved test plan prevented an assessment of the end-to-end mission performance. The SWUB upgrade did not change cyber threat vectors or torpedo resilience to cyber-attack and cyber survivability was not evaluated for Mk 48 with SWUB.

The Navy conducted 18 exercise firings of the Mk 48 torpedo, in FY24 to evaluate SWUB features within end-to-end mission scenarios. The Navy's Operational Test and Evaluation Force developed a data collection plan and DOT&E observed these events for potential use of collected data in operational assessment. Testing in FY25 is required to assess operational effectiveness and suitability of Mk 48 Mod 7 APB 6.

The adequacy of future Mk 48 torpedo testing depends on representative threats and threat capability surrogates. In August 2020, the Navy began developing the Towed Array Threat Emulator (TATE) to improve the threat representation of the current surrogate for a mobile countermeasure, the Submarine Launched Countermeasure Emulator (SLACE). In July 2023, the Navy began developing the Modular Threat Countermeasure Emulator (MOTCE) to improve the threat representation for static countermeasures. The Navy expects SLACE with TATE, and MOTCE will be available for use in Mk 48 operational tests commencing in FY28.

The Navy uses a hardware in-the-loop simulator, the Environment Centric Weapons Analysis Facility (ECWAF), to test torpedoes in a simulated undersea environment. The use of ECWAF is integral in minimizing the number of actual at sea launches required to assess torpedo performance. The deferral of test events within some test environments in the Mod 7 APB 5 IOT&E reduced the live data available to validate the ECWAF for use in Mod 8 APB 6 IOT&E. Prior to Mod 8 APB 6 IOT&E, the Navy will need to collect data from fleet events conducted in these environments to validate and accredit the ECWAF for its full use. The full use of the ECWAF reduces live tests required to evaluate Mod 8 APB 6 to approximately half of those required for the Mod 7 APB 5 test design.

PERFORMANCE

» EFFECTIVENESS

Mk 48 with SWUB demonstrated a specific SWUB feature which operates as designed, but the end-to-end mission performance for SWUB intended use could not be determined. Details are in the classified EFR published in February 2024. Analysis of FY24 tests of the Mk 48 torpedo to evaluate SWUB features remain in progress. DOT&E will report Mk 48 operational effectiveness, including SWUB features, after completion of FOT&E that the Navy expects to occur in FY25.

» SUITABILITY

The Mk 48 Mod 7 remains operationally suitable. Torpedoes employed in FY23 to evaluate SWUB features on Mk 48 continued to meet operational availability and reliability needs. DOT&E will report Mk 48 Mod 7 APB 6 operational suitability, to include SWUB assessments, after completion of FOT&E that the Navy expects to occur in FY25.

» SURVIVABILITY

The SWUB software update was not designed to change the cyber resilience of the MK 48 torpedo, so the Navy did not conduct a cyber survivability assessment. MK 48 torpedoes with the SWUB software update remain not survivable to cyber-attack. Details are in the classified April 2022 APB 5 IOT&E report.

RECOMMENDATIONS

The Navy should:

1. Address all recommendations in the classified April 2022 APB 5 IOT&E report, the August 2023 APB 5+ FOT&E report, and the February 2024 SWUB EFR.
2. Obtain performance data from test environments deferred in APB 5 IOT&E to support validation of the ECWAF and its use in Mod 8 APB 6 IOT&E, as recommended in the FY22 and FY23 Annual Reports.
3. Complete development and validation of surface ship models and reverberation models in the ECWAF and validate their use for Mod 8 APB 6 IOT&E, as recommended in the FY23 Annual Report.
4. Complete development of the TATE and MOTCE prior to FY28. Include SLACE with TATE, and MOTCE in testing for Mod 8 APB 6 IOT&E.