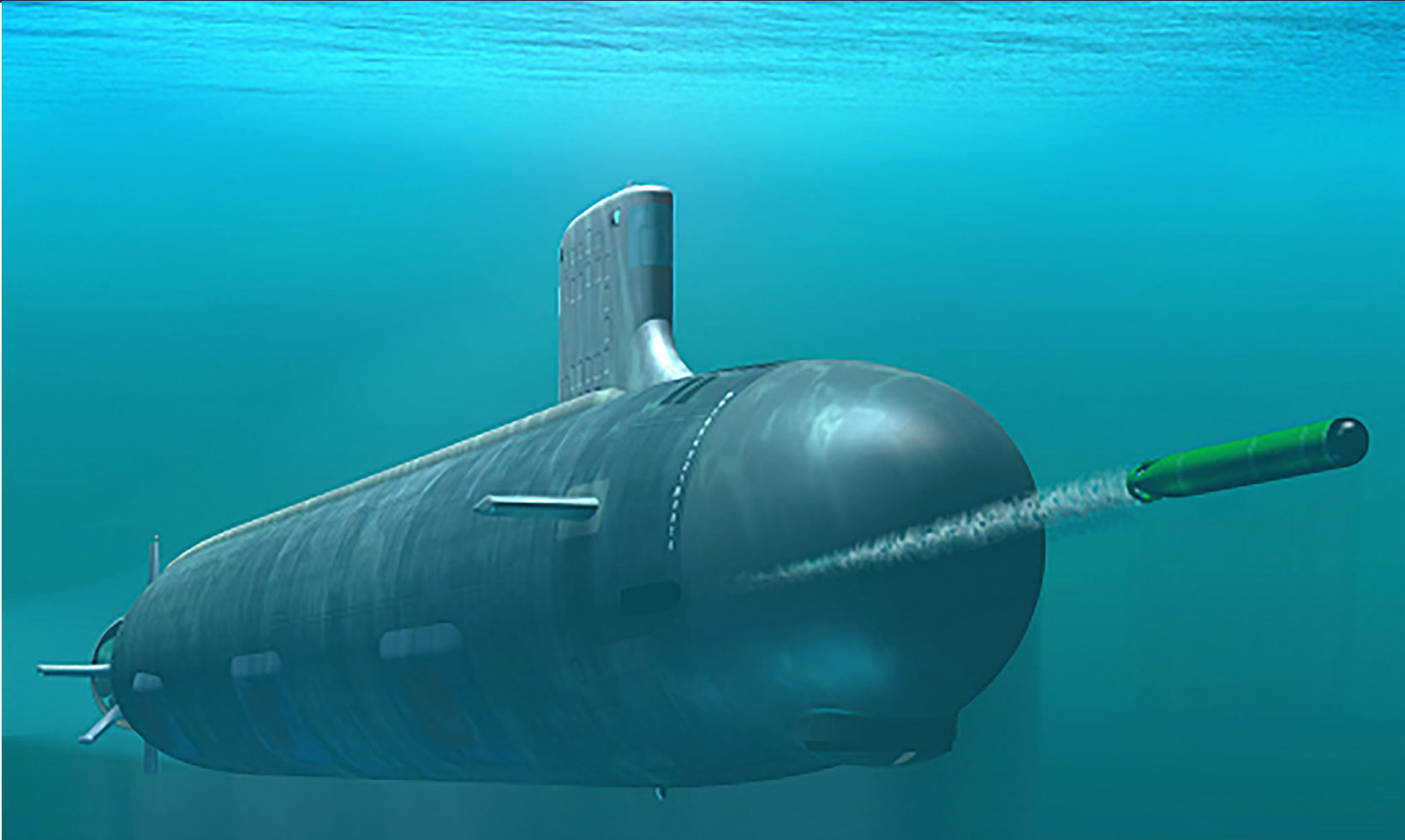


Mk 48 Torpedo Modifications



The Navy ended operational test of the Mk 48 Mod 7 torpedo with Advanced Processor Build (APB) 5+ in May 2023. In August 2023, DOT&E submitted a classified FOT&E report that determined APB 5+ is operationally effective and suitable, though Mk 48 Mod 7 torpedo reliability has degraded below Navy-defined requirements. In FY23, the Navy commenced evaluation of an urgent software build for the APB 5 and APB 5+ torpedoes for which findings are expected in mid-FY24.

SYSTEM DESCRIPTION

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

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

- Mod 6 integrated noise quieting in the propulsion section and commercial-off-the-shelf (COTS) electronics in the G&C section.
- Mod 6 Advanced Common Torpedo (ACOT) integrated additional COTS electronics in the G&C section.
- Mod 7 Common Broadband Advanced Sonar System upgraded the Mod 6 ACOT with a new sonar receiver.

The Mk 48 torpedo undergoes regular software updates referred to as APBs. 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:

- APB 5 modifications focused on detection and discrimination of target submarines and surface ships. It also provided an alternative tactic against surface ships.
- APB 5+ 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.
- APB 6 is in development for delivery in FY26 with modifications that are focused on target detection and classification. APB 6 will support an upgraded sonar array being delivered in a Mk 48 Mod 8 variant that the Navy expects to deliver in FY28.

MISSION

The 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. The Navy's latest torpedo improvement program, the Mk 48 Mod 7 APB 5/5+, is an Acquisition Category III program and a shared development effort with the Royal Australian Navy.

The Navy completed operational testing in May 2023 and fielded APB 5+ in FY23. DOT&E submitted a classified FOT&E report in August 2023.

In 1QFY23, the Navy requested a software update for APB 5 and APB 5+ to address an urgent need torpedo capability, referred to as the Shallow Water Urgent Build (SWUB). The Navy conducted a limited in-water test in July and August 2023. DOT&E expects to submit a classified SWUB Early Fielding Report in mid-FY24.

The Navy is in engineering testing for APB 6 software and expects to begin operational testing in FY25 on the Mk 48 Mod 7 variant. APB 6 is being designed to support the future Mk 48 Mod 8 variant.

» MAJOR CONTRACTORS

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

TEST ADEQUACY

The Navy completed operational test of APB 5+ in May 2023 with DOT&E concurrence. APB 5+ testing was adequate to assess operational effectiveness and suitability. Cyber survivability was not evaluated due to no expected change from the previous test on APB 5. The Navy executed all tests in accordance with DOT&E-

approved test plans; DOT&E attended most but not all test events due to COVID-19 travel restrictions. Assessment included the following tests detailed in the FY21 and FY22 Annual Reports:

- Live Virtual Construct testing that incorporated fleet operators, a representative combat system, and the Navy's Environment Centric Weapon Analysis Facility (ECWAF). This test characterized the warfighter utility of operational interface improvements.
- Modeling and simulation data using the ECWAF confirmed that APB 5+ modifications did not degrade its effectiveness against submarines when compared to APB 5.

The Navy completed in-water evaluation of APB 5+ in February 2023. Data were collected from 8 antisubmarine and 12 anti-surface warfare scenarios that occurred in one dedicated test event and three fleet training events. Data were sufficient to evaluate torpedo effectiveness and suitability.

The Navy conducted a test event in July 2023 that consisted of seven torpedo firings to evaluate the SWUB on APB 5 torpedoes. The Navy conducted a follow-on test event in August 2023 consisting of 11 torpedo firings with SWUB on APB 5 torpedoes. SWUB testing was adequate to evaluate a new feature provided by SWUB, but testing was not adequate to assess end-to-end performance of the intended mission because of limited threat representation.

Test adequacy of future APBs 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 future Mk 48 torpedoes in FY28.

The Navy intends to accredit the ECWAF to evaluate the effectiveness of Mk 48 Mod 7 APB 6 against both submarines and surface ships and reduce live tests by approximately half compared to the Mk 48 Mod 7 APB 5 live fire test shots that were part of IOT&E. Limited test in some ocean environments during recent torpedo variant testing may require fleet training and certification events to include these environments to provide sufficient live data for verification and validation. Additionally, the Navy must complete development of some surface ship and reverberation models intended for use in anti-surface warfare scenarios in the ECWAF.

PERFORMANCE

» EFFECTIVENESS

APB 5+ is operationally effective and provides an improvement in the operator interface between the combat system and torpedo. APB 5+ simplifies operator guidance provided to the torpedo prior to launch (i.e., torpedo presets) to include more intuitive safety features that protect ownership from the torpedo, and operator updates to the torpedo after launch. The Navy determined that some new features were less useful than those included in APB 5 and adjusted tactical guidance appropriately. Classified details are in the August 2023 FOT&E report.

Testing demonstrated that a specific SWUB feature operates as designed and that SWUB can improve single torpedo performance in the intended scenario given equivalent crew targeting. However, testing does not support comparison of performance to the legacy torpedo for an overall scenario with multiple torpedoes employed. DOT&E expects to submit a classified early fielding report in FY24.

» SUITABILITY

APB 5+ is operationally suitable. However, reliability of the Mk 48 Mod 7 torpedo is now below the Navy-defined requirement. Failure to correct reliability issues will lead to the Mk 48 Mod 7 torpedo (all APB variants) becoming not operationally suitable.

» SURVIVABILITY

The Navy did not complete a cyber survivability assessment of APB 5+ because results are unchanged from APB 5. APB 5+ remains not survivable to cyberattack with details 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 and August 2023 APB 5+ FOT&E report.
2. Determine and correct causes of degraded reliability of the Mk 48 Mod 7 torpedo.
3. As recommended in FY22, obtain performance data from test environments deferred in APB 5 IOT&E to support validation of the ECWAF and its use in APB 6 IOT&E.
4. Complete development and validation of surface ship models and reverberation models in the ECWAF and validate their intended use in Mod 8 APB 6 IOT&E.
5. Complete development of the TATE and MOTCE prior to Mod 8 IOT&E.
6. Continue to evaluate SWUB performance in FOT&E with a combination of in-water testing and modeling and simulation.