

Mk 54 Lightweight Torpedo

Executive Summary

- Initial analysis of completed operational testing indicates that the Mk 54 Block Upgrade (BU) software provides some limited operational capability in certain scenarios and against the Urgent Operational Needs Statement (UONS) threat, but does not meet all the original program requirements.
- Reconstruction and analysis of the September 2013 testing is in progress to determine if sufficient information to assess performance has been obtained.
- In preparation for the May 2013 test, Navy operational testers uncovered inconsistencies in tactical guidance, documentation, and training for the employment of the Mk 54 BU torpedo, some of which date from the introduction of the Mk 54 Mod 0 to the fleet in 2004. These problems could prevent fleet operators from effectively presetting and employing the Mk 54 BU.

System

- The Mk 54 Lightweight Torpedo is the primary Anti-Submarine Warfare (ASW) weapon used by U.S. surface ships, fixed-wing aircraft, and helicopters.
- The Mk 54 combines the advanced sonar transceiver of the Mk 50 torpedo with the legacy warhead and propulsion system of the older Mk 46. Mk 46 and Mk 50 torpedoes can be converted to an Mk 54 via an upgrade kit.
- The Mk 54 sonar processing is an expandable, open architecture system. It combines algorithms from the Mk 50 and Mk 48 torpedo programs with the latest commercial off-the-shelf technology.
- The Navy designed the Mk 54 sonar processing to operate in shallow-water environments and in the presence of sonar countermeasures.
- The Navy has designated the Mk 54 torpedo to replace the Mk 46 torpedo as the payload section for the Vertical Launched Anti-Submarine Rocket for rapid employment by surface ships.
- The High-Altitude Anti-Submarine Warfare Weapons Capability program will provide an adapter kit to permit long



range, high-altitude, GPS-guided deployment of the Mk 54 by a P-8A Multi-mission Maritime Aircraft.

- The Mk 54 BU is a software upgrade to the Mk 54 baseline torpedo designed to correct deficiencies identified during the 2004 Mk 54 IOT&E.
- The Mk 54 must be interoperable and compatible with the analog or digital combat control systems and software variants installed on all ASW fixed-wing and helicopter aircraft, and on the surface ship combat control system variants used for torpedo tube or ASW rocket-launched torpedoes.

Mission

Navy surface ships and aircraft employ the Mk 54 torpedo as their primary anti-submarine weapon:

- For offensive purposes, when deployed by ASW aircraft and helicopters
- For defensive purposes, when deployed by surface ships
- In both deep-water open ocean and shallow-water littoral environments
- Against fast, deep-diving nuclear submarines; and slow moving, quiet, diesel-electric submarines

Major Contractors

- Raytheon Integrated Defense Systems – Tewksbury, Massachusetts
- Progeny Systems Corporation – Manassas, Virginia
- Boeing Company – St. Charles, Missouri
- Northrop Grumman – Annapolis, Maryland

Activity

- The Navy started operational testing of the Mk 54 BU torpedo in FY12, but fielded the software in January 2012 to address a Fifth Fleet UONS threat. In FY12, the Navy conducted testing involving 34 weapons deployed from surface ships, fixed-wing aircraft, and helicopters targeting U.S. attack submarine targets.
- In FY13, the Navy conducted seven Mk 54 BU test events off Kauai, Hawaii, in conjunction with fleet training to satisfy

Mk 54 deep-water regression requirements. P-3C aircraft delivered four weapons and MH-60R helicopters delivered three weapons.

- Following an in-progress review of completed Mk 54 operational tests, DOT&E identified a problem with how a surrogate target portrayed the threat that could have biased the results, requiring some test events to be repeated. However, due to budget constraints, resources were limited. Since

performance in legacy scenarios was similar to IOT&E results, DOT&E agreed to utilize the limited remaining Mk 54 BU resources to further examine the UONS scenario to assess homing-to-hit performance and to repeat the compromised test scenario. The remainder of the planned tests were deferred to the next torpedo version (Mk 54 Mod 1).

- The Navy conducted seven, set-to-hit Mk 54 BU firings by MH-60R helicopters against the Steel SSK surrogate target off the coast of Southern California in May 2013 and seven delivered by P-8A aircraft in the Cape Cod operating areas in September 2013.
- The Navy also reran the compromised test scenario but was only able to launch four set-not-to-hit Mk 54 BU torpedoes against manned submarine targets due to poor weather in the Cape Cod operating area in September 2013.
- The Navy plans to continue Mk 54 development with the Mk 54 Mod 1 torpedo. The Navy started development of the Mk 54 Mod 1 torpedo and plans to approve a new set of requirements documents and the Test and Evaluation Master Plan (TEMP) in FY14.
- DOT&E is participating in the Navy's Torpedo Target Strategy Working Group to identify and develop test target surrogates for the Mk 54. The Navy proposed a short term strategy that utilizes three separate targets, each appropriate for specific limited scenarios and a long-term strategy that develops a mobile set-to-hit submarine surrogate that will permit realistic testing. Currently, the strategy is not funded.
- The Navy conducted all testing in accordance with a DOT&E-approved test plan.

Assessment

- Initial analysis of completed operational testing indicates that the Mk 54 BU software provides some limited operational capability in certain scenarios and against the UONS threat, but does not meet all the original program requirements. Reconstruction and analysis of the September 2013 Cape Cod testing is in progress to determine if sufficient information to assess performance has been obtained with the reduced number of shots conducted or if another event must be scheduled.
- In preparation for the May 2013 test:
 - Navy operational testers uncovered inconsistencies in the operator's tactical guidance, documentation, and training for the employment of the Mk 54 BU torpedo, some of which date from the introduction of the Mk 54 Mod 0 to the fleet in 2004. The inconsistent documentation, tactical guidance, and training could prevent fleet operators from effectively presetting and employing the Mk 54 BU.
 - Testing also discovered some required weapon presets were not selectable by crews using the MH-60R combat control system introduced to the fleet in 2010. The Navy's early fielding and Quick Reaction Assessment processes did not

identify these critical shortfalls. The Navy investigated and found it had a problem in communication between the torpedo developers, platform fire control system developers, tactics developers, the training community, and the fleet users. The Navy is instituting new processes intended to rectify this situation.

- In August 2013, the Navy updated and issued interim Mk 54 BU employment guidance to MH-60R fleet operators and trainers.
- Almost two years after the early fielding, the Navy has not yet provided fleet operators and trainers adequate employment guidance or completed required operational testing.

Recommendations

- Status of Previous Recommendations. All of the previous recommendations remain outstanding. The Navy still needs to:
 1. Conduct mobile target set-to-hit testing. The Navy completed an initial terminal homing assessment against the set-to-hit Steel SSK static target surrogate; however, the Navy deferred the mobile testing due to the lack of a suitable target surrogate.
 2. Continue to develop a lethality strategy that includes the firing of the Mk 54 against appropriate targets. The Navy has identified the plan to conduct this testing with the Mk 54 Mod 1 torpedo upgrade.
 3. Fund an operationally realistic mobile set-to-hit target to complete the terminal homing testing of the Mk 54 torpedo. The Navy continues to investigate possible surrogates; however, the proposals are unfunded.
 4. Propose alternatives, such as the use of a portable range, to minimize or eliminate the test and safety limitations that minimize operational realism in Mk 54 testing.
- FY13 Recommendations. The Navy should:
 1. Complete development of the Mk 54 Mod 1 requirements and TEMP. This TEMP should include all the necessary resources or plans to develop the necessary resources, including target and range needs, to complete the remaining testing.
 2. Pursue development of an evasive mobile set-to-hit target and threat representative countermeasures to support operationally realistic development and test of the Mk 54 Mod 1 torpedo. The targets identified by the Navy's Torpedo Target Strategy Working Group will support some Mk 54 development and testing.
 3. Institute processes to verify the incremental upgrades to the Mk 54 are interoperable with the variety of combat systems on surface ship, aircraft, and helicopter platforms.
 4. Institute processes to update the operator's tactical guidance, documentation, and training when implementing upgrades to the Mk 54.