

## Surface Ship Torpedo Defense (SSTD) System: Torpedo Warning System (TWS) and Countermeasure Anti-Torpedo (CAT)

### Executive Summary

- The Navy fielded the Torpedo Warning System (TWS) and the Countermeasure Anti-Torpedo (CAT) Engineering Development Model (EDM)-2 with the Stored Chemical Energy Propulsion System (SCEPS) aboard USS *George H. W. Bush* when she deployed in February 2014 to Fifth Fleet Operating Areas. USS *George H. W. Bush* returned home in November 2014. Analysis of the data collected during her deployment remains in progress.
- DOT&E issued a classified Early Fielding Report on TWS and CAT in April 2014. DOT&E determined the system demonstrated some capability to detect certain types of threat torpedoes. However, the system has not been fully tested and most TWS and CAT testing to date have been conducted in areas with benign acoustic conditions when compared to the expected threat operating areas, which may have biased the results.
- The Navy discovered an anomaly in the CAT's Safety and Arming device in March 2014, which would significantly reduce the effectiveness of the CAT. DOT&E issued a classified update to the Early Fielding Report on TWS and CAT in August 2014.
- In November 2014, the Navy conducted a new Quick Reaction Assessment (QRA) event of a temporary-installation version of TWS and CAT (designated as a roll-on/roll-off system) aboard USS *Theodore Roosevelt*.
  - The QRA event was held in conjunction with a contractor test event designated CT-2. Only two of the four planned QRA events and one of the five planned CT-2 events were accomplished due to several factors, including poor weather. This TWS installation included the new TWS active sonar.
  - During each completed event, a surrogate threat torpedo was fired at USS *Theodore Roosevelt* for the TWS system to detect and target. USS *Theodore Roosevelt*'s crew, with the contractor support that will accompany the ship on their deployment, engaged the threat torpedo surrogate with a CAT during some of the events. All CATs that were fired used electric propulsion. Analysis of the three completed events is in progress.
- The Navy plans to field the temporary-installation version of TWS and CAT installed aboard USS *Theodore Roosevelt* when she deploys in FY15.

### System

- The Surface Ship Torpedo Defense is a system-of-systems that includes two new sub-programs: the TWS program (an



- Acquisition Category III program) and CAT (will not become an acquisition program until FY16).
- TWS is being built as an early warning system to alert on and localize incoming threat torpedoes and consists of three major subsystems:
  - The Target Acquisition Group consists of a towed acoustic array, tow cable, winch, power supply, and signal-processing equipment. Data from the array and the ship's radar system are processed into contact tracks and alerts to be forwarded to the Tactical Control Group. The array will be capable of both passive and active sonar operations.
  - The Tactical Control Group consists of duplicate consoles on the bridge and Combat Direction Center (on CVNs) that displays contacts, issues torpedo alerts to the crew, and automatically develops CAT placement presets using information sent from the Target Acquisition Group. The operator will use this console to manage the threat engagement sequence and command CAT launches.
  - The Ready Stow Group will consist of the steel cradles housing the CATs.
- CAT is a hard-kill countermeasure intended to neutralize threat torpedoes and consists of the following:
  - The Anti-torpedo Torpedo (ATT) is a 6.75-inch diameter interceptor designed for high-speed and maneuverability to support rapid engagement of the threat torpedo.
  - The All-Up Round Equipment consists of a nose sabot, ram plate, launch tube, muzzle cover, breech mechanism, and energetics to encapsulate and launch the ATT.
  - The tactical CAT is powered by a SCEPS. The battery powered electric motor CAT is for test purposes only.

# FY14 NAVY PROGRAMS

- The Navy developed a temporary version of TWS and CAT (designated a roll-on/roll-off system) in addition to the permanent-installation version. The first temporary-installation version is also the first TWS system to incorporate active sonar operations. The Navy intends for this version to provide the same function as the permanent one.
  - The Ready Stow Group is eliminated by mounting the CAT All-Up Round Equipment directly to the carrier's deck.
  - The Tactical Control Group consists of two consoles contained in a container express box located on the carrier's hangar deck.
  - The towed acoustic array, tow cable, and winch are permanently installed on the carrier's fantail.

## Mission

Commanders of nuclear-powered aircraft carriers and Combat Logistic Force ships will use Surface Ship Torpedo Defense to defend against incoming threat torpedoes.

## Major Contractors

### TWS

- 3Phoenix – Wake Forest, North Carolina
- In-Depth Engineering – Fairfax, Virginia
- Pacific Engineering Inc. (PEI) – Lincoln, Nebraska

### CAT

- Pennsylvania State University Applied Research Laboratory – State College, Pennsylvania
- PEI – Lincoln, Nebraska

## Activity

- The Navy has been working on a hard-kill torpedo defense system for surface ships for over 10 years, but accelerated the development and fielding of TWS and CAT as a result of the March 2010 sinking of the South Korean ship, ROKS *Cheonan*, and a Navy Fifth Fleet Urgent Operational Needs Statement. The Navy also decided to have the systems protect high-value ships (aircraft carriers and combat logistic ships) rather than destroyers as originally planned.
- In November 2013, the Navy conducted a QRA aboard USS *George H. W. Bush* in the Virginia Capes Operating Areas. During each event, a surrogate threat torpedo was fired at USS *George H. W. Bush* for the TWS system to detect and target. USS *George H. W. Bush*'s crew, with the contractor support that accompanied the ship on their deployment, engaged the threat torpedo surrogate with a CAT. During the QRA, two representative tactical CATs with SCEPS were fired; the remaining three CATs used electric propulsion.
- The Navy fielded the TWS system and the CAT EDM-2 with the SCEPS system aboard USS *George H. W. Bush* when she deployed in February 2014 to Fifth Fleet Operating Areas. USS *George H. W. Bush* returned home in November 2014, and the analysis of the data collected during her deployment is in progress.
- DOT&E issued a classified Early Fielding Report on TWS and CAT in April 2014.
- The Navy discovered an anomaly in the CAT's Safety and Arming device in March 2014. After being briefed on the anomaly, DOT&E issued a classified update to the Early Fielding Report on TWS and CAT in August 2014. The Navy developed a correction for the anomaly in the CAT Safety and Arming device but could not install the correction in the fielded CATs due to safety concerns and USS *George H. W. Bush*'s operational schedule.
- During FY14, the Navy and DOT&E started development of an enterprise Test and Evaluation Master Plan (TEMP) for the TWS and CAT systems. The Navy made their TWS Milestone B decision without a TEMP and is not planning to make the CAT system an acquisition program until FY16.
- In June 2014, the Navy and Pennsylvania State University Applied Research Laboratory conducted contractor and developmental testing of CAT at the Dabob Bay, Washington, and the Nanoose Bay, British Columbia, Canada, acoustic tracking ranges. The Dabob Bay test consisted of six structured events to develop the CAT EDM-2s ability to intercept noisy and quiet, straight-running and maneuvering targets, to collect CAT self-noise data, and to collect data where two CATs tracked a single target. The Nanoose Bay testing included four structured events to develop the CAT EDM-2's ability to detect, track, and intercept surrogate threat torpedoes in the presence of a CVN, and one event to characterize the CVN's radiated noise signature and CAT's active returns in the vicinity of the CVN's hull. Four Dabob Bay events used electrically-propelled CATs (ECATs) and two used CAT EDM-2s with the SCEPS. Three Nanoose Bay events used ECATs and two events used CAT EDM-2s with the SCEPS.
- In October 2014, the Navy and 3Phoenix conducted contractor and developmental testing of TWS's active source at Lake Pend Oreille, Idaho. TWS's active source was redesigned following the failure of an earlier demonstration model in 2011. This was the first in-water test of the redesigned active source and included data collection against static and dynamic targets to support further development.
- In November 2014, the Navy conducted a new QRA event of a temporary-installation version of TWS and CAT (designated as a roll-on/roll-off system) aboard USS *Theodore Roosevelt*.
  - The QRA event was held in conjunction with a contractor test event designated CT-2. Only two of the four planned QRA events and one of the five planned CT-2 events were accomplished due to several factors, including poor weather. This TWS installation included the new TWS active sonar.

# FY14 NAVY PROGRAMS

- During each completed event, a surrogate threat torpedo was fired at USS *Theodore Roosevelt* for the TWS system to detect and target. USS *Theodore Roosevelt*'s crew, with the contractor support that will accompany the ship on their deployment, engaged the threat torpedo surrogate with a CAT during some of the events. All CATs that were fired used electric propulsion. Analysis of the three completed events is in progress.
- The Navy plans to field the temporary-installation version of TWS and CAT installed aboard USS *Theodore Roosevelt* when she deploys in FY15.

## Assessment

- The prototype TWS and early engineering developmental model CAT installed on USS *George H. W. Bush* and USS *Theodore Roosevelt* demonstrated some capability to detect certain types of threats. However, the system has not been fully tested and the Navy conducted most TWS and CAT testing to date in areas with benign acoustic conditions when compared to the expected threat operating areas, which may have biased the results high. Additionally, most threat surrogates were not executing operationally realistic threat torpedo profiles due to safety constraints.
- The Navy's decision to add a highly-trained contractor as the acoustic operator to supplement the automated detection and alerting functions of TWS improved threat detection performance during the 2013 QRA. However, the test areas did not offer the same number of opportunities for false alerts as expected in the threat area; thus, it is not known if the presence of the operator could also reduce the false alert rate. For safety reasons, the QRA testing was highly structured and allowed the operators to focus on torpedo detections and firing the CAT. Therefore, QRA testing was inadequate to resolve the rate of false alerts or their impact on mission accomplishment.
- USS *George H. W. Bush*'s deployment was useful in identifying TWS false alert sources, but system development done using these data needs to be assessed in testing that includes the presence of both threat torpedo surrogates and assets that may cause false alerts simultaneously.
- During developmental testing and the 2013 QRAs, a properly targeted CAT EDM-2 demonstrated a capability to detect and home on some surrogate torpedoes. However, all of the surrogate threat torpedoes and CATs were operating deeper than most expected threat torpedoes due to safety reasons. Shallower scenarios that force the CAT to track and attack the surrogate threat torpedo in the challenging areas of the water column were only investigated during limited contractor test events at Dabob Bay and during a single event in Nanoose Bay

in June 2014; the Navy has not collected adequate data to assess CAT's overall ability to neutralize these threats.

- The Navy developed a correction for the anomaly in the CAT Safety and Arming device, but has not yet implemented a way to verify the device's correct operation in sea tests.
- Completed testing indicates the new active source has both hardware and software reliability deficiencies, which the Navy is investigating. The temporary-installation system exhibited other reliability deficiencies with interfaces to ship's power, operator display consoles, and the array-handling equipment. Should the Navy field the temporary-installation prototype TWS and EDM-2 model of the CAT aboard USS *Theodore Roosevelt* in FY15, this will be the first fielding of a TWS that incorporates active sonar operations. Additional information on the testing of TWS and CAT performance will be included in DOT&E's classified Early Fielding Report in 2QFY15.
- The ATT warhead tests indicate that the ATT should be lethal against select representative torpedo threats provided that both the CAT's closest point of approach to the threat torpedo and the CAT's fuzing occurs within the explosive kill zone. Further test and analysis is required to determine the comprehensive lethal capability of the ATT.

## Recommendations

- Status of Previous Recommendations. The Navy has made limited progress on the FY13 recommendations. The Navy should still:
  1. Develop TEMPs for the TWS and CAT system and an LFT&E strategy for the ATT lethality as soon as possible.
  2. Conduct additional testing in challenging, threat-representative environments.
  3. Conduct additional CAT testing using operationally realistic threat target profiles closer to the surface to assess the CAT's terminal homing, attack, and fuzing within the lethality range of the warhead.
- FY14 Recommendations. The Navy should:
  1. Implement a way to verify the correct operation of the CAT's Safety and Arming device in all future sea tests.
  2. Investigate test methods designed to reduce or eliminate the safety limitations that have previously prevented testing against operationally realistic target scenarios. The Navy should consider using geographic separation, range boundaries, and shallower draft ships for future TWS and CAT testing.
  3. Investigate, correct, and retest deficiencies identified with the active source and other components of the temporary-installation system before fielding these aboard USS *Theodore Roosevelt*.

# FY14 NAVY PROGRAMS