Ship Self-Defense for LHA(6)

Executive Summary

- The Navy's Commander, Operational Test and Evaluation Force (COTF) conducted a missile firing exercise on the Self-Defense Test Ship (SDTS) in April 2016. The SDTS was configured with the USS *America* (LHA 6) Ship Self-Defense System (SSDS)-based combat system. COTF conducted the test in accordance with a DOT&E-approved test plan. Results of testing completed to date continue to indicate that LHA 6 has some ship self-defense capability against older anti-ship cruise missile (ASCM) threats. LHA 6 ship self-defense performance against newer ASCM threats remains undetermined pending completion of the LHA 6 Probability of Raid Annihilation (PRA) modeling and simulation (M&S) test bed tests for IOT&E in late-2017.
- COTF conducted cybersecurity testing for the LHA 6 IOT&E and SSDS FOT&E on the LHA 6 in August 2016. Testing was conducted in accordance with a DOT&E-approved test plan. The test began with many known problems discovered during developmental testing in 2014 uncorrected. Data from the operational test are still being analyzed.

System

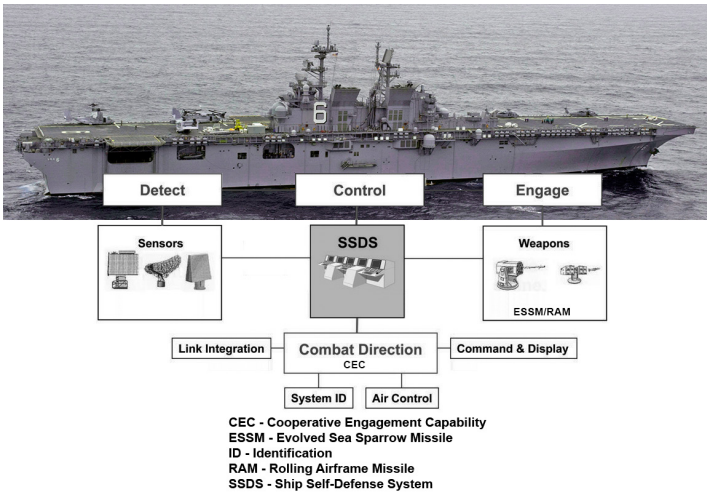
- Surface ship self-defense for the LHA 6 is addressed by several legacy combat system elements (including the AN-SPS-49A(V)1, AN/SPS-48E(V)10, and AN/SPQ-9B radars that are the primary self-defense radars) and five acquisition programs:
  - Ship Self-Defense System (SSDS)
  - Rolling Airframe Missile (RAM)
  - Evolved Seasparrow Missile (ESSM)
  - Cooperative Engagement Capability (CEC)
  - Surface Electronic Warfare Improvement Program (SEWIP)

SSDS

- SSDS is a local area network that uses open computer architecture and standard Navy displays to integrate a surface ship's sensors and weapons systems to provide an automated detect-track-engage sequence for ship self-defense.
- SSDS MK 1 is the legacy command and control system for LSD 41/49 class ships.
- SSDS MK 2 has six variants:
  - Mod 1, used in CVN 68 class aircraft carriers
  - Mod 2, used in LPD 17 class amphibious ships
  - Mod 3, used in LHD 7/8 class amphibious ships
  - Mod 4, used in LHA 6 class amphibious ships
  - Mod 5, used in LSD 41/49 class amphibious ships
  - Mod 6, in development for CVN 78 class aircraft carriers

RAM

- The RAM, jointly developed by the United States and the Federal Republic of Germany, provides a short-range, lightweight self-defense system to defeat ASCMs.



- There are three RAM variants:
  - RAM Block 0 uses dual-mode, passive radio frequency/infrared guidance to home in on ASCMs.
  - RAM Block 1A adds infrared guidance improvements to extend defense against ASCMs that do not emit radar signals.
  - RAM Block 2 adds kinematic and guidance improvements to extend the capability of RAM Block 1A against newer classes of ASCM threats.

ESSM

- The ESSM, cooperatively developed among 13 nations, is a medium-range, ship-launched, self-defense guided missile intended to defeat ASCM, surface, and low-velocity air threats.
- The ESSM is currently installed on LHA 6 and LHD 8 amphibious ships, DDG 51 Flight IIA destroyers, and CVN 68 class aircraft carriers equipped with the SSDS MK 2 Mod 1 Combat System.
- There are two variants of ESSM:
  - ESSM Block 1 is a semi-active radar-guided missile that is currently in service.
  - ESSM Block 2 is in development and will have semi active radar guidance and active radar guidance.

CEC

- CEC is a sensor network with an integrated fire control capability that is intended to significantly improve battle force air and missile defense capabilities by combining data from multiple battle force air search sensors on CEC-equipped units into a single, real-time, composite track picture.
- The two major hardware pieces are the Cooperative Engagement Processor, which collects and fuses radar data, and the Data Distribution System, which distributes CEC data to other CEC-equipped ships and aircraft.

- CEC is an integrated component of, and serves as the primary air tracker for, non-LSD class SSDS MK 2 equipped ships.
- There are two major surface ship variants of CEC:
  - The CEC AN/USG-2/2A is used in selected Aegis cruisers and destroyers, LPD 17/LHD/LHA 6 amphibious ships, and CVN 68 class aircraft carriers.
  - The CEC AN/USG-2B, an improved version of the AN/USG-2/2A, is used in selected Aegis cruisers/ destroyers as well as selected amphibious assault ships, including the LHA 6 ship class and CVN 68 class aircraft carriers.

SEWIP

- The SEWIP is an evolutionary development program providing block upgrades to the AN/SLQ-32 electronic warfare system to address critical capability, integration, logistics, and performance deficiencies.
- There are three major SEWIP block upgrades:
  - SEWIP Block 1, which is used on LHA 6 class ships, replaced obsolete parts in the AN/SLQ-32 and incorporated a new, user-friendly operator console, an improved electronic emitter identification capability, and an embedded trainer.
  - SEWIP Block 2 is in development and will incorporate a new receiver antenna system intended to improve the AN/SLQ-32's passive electronic warfare capability.
  - SEWIP Block 3 is in development and will incorporate a new transmitter antenna system intended to improve the AN/SLQ-32's active electronic warfare capability.

Mission

- Naval Component Commanders use SSDS, RAM, ESSM, SEWIP, and CEC, as well as many legacy systems, to accomplish ship self-defense missions.
- Naval surface forces use the:
  - SSDS to provide automated and integrated detect to engage ship self-defense capabilities against ASCM, air, and surface threats.
  - RAM to provide a short-range, hard-kill engagement capability against ASCM threats.
  - ESSM to provide a medium-range, hard-kill engagement capability against ASCM, surface, and low velocity air threats.
  - CEC to provide accurate air and surface threat tracking data to SSDS.
  - SEWIP-improved AN/SLQ 32 as the primary electronic warfare sensor and soft-kill weapons system for air defense (to include self defense) missions.

Major Contractors

- SSDS (all variants): Raytheon – San Diego, California
- RAM and ESSM (all variants): Raytheon – Tucson, Arizona
- CEC (all variants): Raytheon – St. Petersburg, Florida
- SEWIP
  - Block 1: General Dynamics Advanced Information Systems – Fair Lakes, Virginia
  - Block 2: Lockheed Martin – Syracuse, New York
  - Block 3: Northrop Grumman – Baltimore, Maryland

Activity

- COTF conducted a missile firing exercise on the SDTS in April 2016. The SDTS was configured with the USS *America* (LHA 6) SSDS-based combat system. This test, originally scheduled for early FY15, was postponed due to concerns over possible poor system performance.
- COTF conducted the test in accordance with a DOT&E-approved test plan
- COTF commenced cybersecurity testing for the LHA 6 IOT&E and the SSDS FOT&E on LHA 6 in August 2016 in accordance with a DOT&E-approved test plan; it is expected to complete in March 2017.
- COTF continued planning for the LHA 6 IOT&E PRA M&S test bed phase scheduled to commence in early-2017.

Assessment

- The April 2016 missile firing exercise on the SDTS resulted in the ESSM missile failing to destroy any of the threat surrogate targets. This failure was compounded by a combat system time synchronization problem that prevented the launch of a full salvo of ESSMs.
- Results of the April 2016 missile firing exercise on the SDTS identified deficiencies in SSDS processing of threat surrogate emitters and sensor detections; both of which could affect mission success.
- Results of testing completed to date continue to indicate that the LHA 6 has some ship self-defense capability against older ASCM threats. The LHA 6 ship self-defense performance against newer ASCM threats remains undetermined pending completion of the LHA 6 PRA M&S test bed runs for IOT&E in late-2017.
- Due to the Navy's inability to develop a Multi-Stage Supersonic Target (MSST), no assessment of the LHA 6 ship self-defense capability against MSST-like ASCM threats is possible.
- Final plans for operational testing and introduction of the Fire Control Loop Improvement Program (FCLIP) improvements in the LHA 6 ship class is unknown.
- Cybersecurity operational testing began with many known problems discovered during developmental testing in 2014

that were uncorrected. Data from the completed cybersecurity operational tests are still being analyzed.
- The Navy's reluctance to proceed with operational testing when it believes the outcome will unfavorably highlight poor performance is troubling because the ability of these ships' to defend themselves in a conflict is unknown and the root causes of any performance problems and the potential for correcting those problems also remains unknown.

Recommendations
- Status of Previous Recommendations. The Navy has satisfactorily completed some of the previous recommendations. However, the Navy has not resolved the following previous recommendations related to LHA 6 ship self-defense:
  1. Optimize SSDS MK 2 weapon employment timelines to maximize weapon Probability of Kill.
  2. Develop an adequate open-loop seeker subsonic ASCM surrogate target for ship self-defense combat system operational tests.
  3. Correct the identified SSDS MK 2 software reliability deficiencies.
  4. Correct the identified SSDS MK 2 training deficiencies.
  5. Develop and field deferred SSDS MK 2 interfaces to the Global Command and Control System – Maritime and the TPX-42A(V) command and control systems.
  6. Improve the ability of legacy ship self-defense combat system sensor elements to detect threat surrogates used in specific ASCM raid types.
  7. Improve the SSDS MK 2 integration with the MK 9 Track Illuminators to better support ESSM engagements.
  8. Develop combat system improvements to increase the likelihood that ESSM and RAM will home on their intended targets.
  9. Correct the cause of the ESSM missile failures and demonstrate the correction in a future phase of operational testing.
  10. Investigate means to mitigate the chances of an ESSM pre-detonating on debris before approaching its intended target.
  11. Investigate why target emitters continue to be reported as valid by the AN/SLQ-32 EWS with the SEWIP Block 1 upgrade after the target is destroyed. Test any corrections in a future operational test phase.
  12. Correct the SSDS scheduling function to preclude interference from prior intercepts and warhead detonations with RAM's infrared guidance. Demonstrate corrections in a phase of operational testing.
  13. Correct the integration problems with the SSDS-based combat system and the AN/SPQ-9B radar to ensure that all valid AN/SPQ-9B detections are used by the combat system when tracking targets. Demonstrate the corrections in a phase of operational testing.
- FY16 Recommendations. The Navy should:
  1. Complete the LHA 6 IOT&E at-sea test phase, cybersecurity testing, and the planning for the LHA 6 PRA M&S test bed IOT&E test phase.
  2. Update the LHA 6 and SSDS Test and Evaluation Master Plans to include at-sea and PRA test bed operational test phases to enable evaluation of the ship self-defense capabilities of the LHA 8 equipped with the new Enterprise Air Surveillance Radar.
  3. Continue to take action on the classified recommendations contained in the March 2011 and November 2012 DOT&E reports to Congress on the ship self-defense mission area.
  4. Provide a plan of action and milestones for introduction and operational testing of FCLIP improvements.
  5. Investigate and correct the cause of the ESSM missile failure to destroy any of the threat surrogate targets.
  6. Investigate and correct the combat system time synchronization problem that prevented the launch of a full salvo of ESSMs.
  7. Investigate and correct the SSDS processing of threat surrogate emitters and sensor detection deficiency.
  8. Develop an adequate MSST target as well as adequate electronic warfare target surrogates for use during operational testing. See the Test Resources section in this Annual Report for further details.