Ship Self-Defense for LHA(R)

Executive Summary

- The Navy's Commander, Operational Test and Evaluation Force (COTF) conducted at-sea testing for the LHA(R) IOT&E on the USS *America* (LHA 6) in May 2015 and the Ship Self-Defense Test Ship (SDTS) from December 2014 through March 2015. At-sea testing is scheduled to complete in mid-2016. Testing was conducted in accordance with the DOT&E-approved test plans.
- Results of testing completed to date indicate that the LHA(R) has some ship self-defense capability against older anti-ship cruise missile (ASCM) threats. The LHA(R) ship self-defense performance against newer ASCM threats will remain undetermined until the LHA(R) Probability of Raid Annihilation (P_{RA}) modeling and simulation (M&S) test bed runs for IOT&E are completed in mid-2017.

System

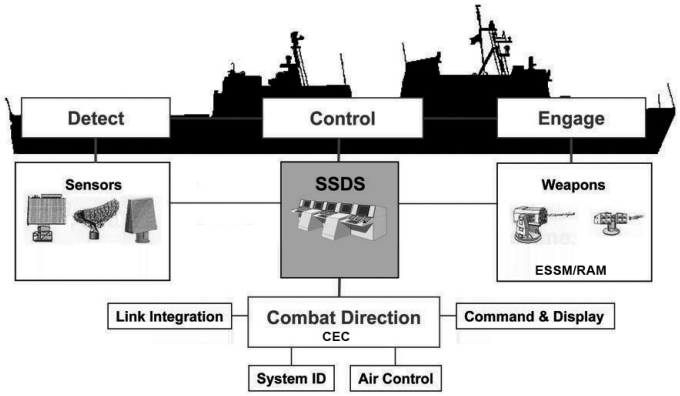
- Surface ship self-defense for the LHA(R) is addressed by several legacy combat system elements and five acquisition programs:
  - Ship Self-Defense System (SSDS)
  - Rolling Airframe Missile (RAM)
  - Evolved Seasparrow Missile (ESSM)
  - Cooperative Engagement Capability (CEC)
  - Surface Electronic 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 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(R) 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, light weight, 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 non-radio-frequency-radiating ASCMs.



  - RAM Block 2 is intended 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(R) 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(R) 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(R) 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 (EW) System to address critical capability, integration, logistics, and performance deficiencies.
- There are three major SEWIP block upgrades:
  - SEWIP Block 1 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 EW capability.
  - SEWIP Block 3 is in development and will incorporate a new transmitter antenna system intended to improve the AN/SLQ-32's active EW capability.

Mission

- Naval Component Commanders use SSDS, RAM, ESSM, SEWIP, and CEC, and 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 EW sensor and 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 at-sea testing for the LHA(R) IOT&E on USS *America* (LHA 6) in April 2015 and the SDTS from December 2014 to March 2015, in accordance with DOT&E-approved test plans. Completion of these at-sea test phases is scheduled for mid-2016.
- COTF continued planning for conduct of the LHA(R) P_{RA} M&S test bed phase scheduled to commence in late-2016.

Assessment

- The results of testing completed to date indicate that the LHA(R) has some ship self-defense capability against older ASCM threats. The LHA(R) ship self-defense performance against newer ASCM threats will remain undetermined until IOT&E is completed.
- Deficiencies in RAM Block 2 integration with the LHA(R) SSDS-based combat system caused several RAM Block 2 missiles to miss their targets during one of the IOT&E missile firing scenarios on the SDTS. The Navy has initiated a formal Failure Review Board to determine the required corrections.
- SSDS MK 2 failed to properly evaluate its engagement doctrine for an inbound raid of ASCM surrogates. This issue resides within SSDS's Local Command and Control functionality and can result in missed engagements against ASCM threats. The Navy is still investigating this issue.
- An ESSM pre-detonated on debris before approaching its intended target. This issue also occurred during an earlier (non-LHA(R)) ESSM FOT&E event. When this issue occurs, the missile will fail to destroy its intended target.
- Inactive target emitters continue to be reported as valid by the AN/SLQ-32 Electronic Warfare System (EWS) with the SEWIP Block 1 upgrade after the target was destroyed. These false detections contributed to the SSDS re-engaging the already-destroyed target. This problem will accelerate the depletion of the ship's missile inventory and waste combat system resources that might be needed for engaging other ASCM threats.
- LHA 6 class ships defend themselves against ASCM by first using the medium-range ESSM and then the shorter-range RAM. RAM uses radio frequency and/or infrared terminal guidance to home on ASCM threats. Hot debris from prior intercepts and warhead detonations can therefore interfere with RAM's infrared guidance. While the SSDS is designed to schedule RAM and ESSM engagements to avoid this type of interference, it failed to do so during testing.
- The AN/SLQ-32 EWS with the SEWIP Block 1 upgrade was not able to timely detect certain types of ASCM emitter signals. The late detections negatively affected the performance of RAM missiles that the SSDS employed

against these ASCM threats. The Navy is addressing this deficiency with the SEWIP Block 2 upgrade to the AN/SLQ-32 EWS.

- The LHA(R)'s AN/SPQ-9B surface search radar demonstrated integration problems with the ship's SSDS-based combat system such that not all AN/SPQ-9B detections were used by the combat system when tracking targets. Since the AN/SPQ-9B is the ship's primary radar for detecting sea-skimming ASCMs, these missed detections significantly degrade the combat system's ability to schedule self-defense missiles against this type of ASCM threat.
- The LHA(R)'s AN/SPQ-9B surface search radar, which is this ship's primary radar for detecting sea-skimming ASCMs, demonstrated late detections of certain types of ASCM threats at distances much closer to the ship than predicted from historical data. Late detections of these threats resulted in reduced engagement times.
- Two BQM-74 aerial targets failed to maintain operationally realistic flight parameters in one of the IOT&E missile firing scenarios.
- Due to the lack of a Multi-Stage Supersonic Target (MSST), no assessment of the LHA(R) ship self-defense capability against MSST-like ASCM threats is possible.
- Three of four ESSM missiles failed to defeat their assigned targets during the two missile firing exercises on USS *America*. The Navy is investigating the causes of these failures.

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(R) ship self-defense:
  1. Optimize SSDS MK 2 weapon employment timelines to maximize weapon Probability of Kill.
  2. Develop a credible 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. Continue to implement the Program Executive Office for Integrated Warfare Systems' plan for more robust, end-to-end systems engineering and associated developmental/operational testing of ship self-defense combat systems.
  7. Improve the ability of legacy ship self-defense combat system sensor elements to detect threat surrogates used in specific ASCM raid types.
  8. Develop adequate and credible target resources for ship self-defense and EW operational testing.
  9. 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.
  10. Improve the SSDS MK 2 integration with the MK 9 Track Illuminators to better support ESSM engagements.
  11. Develop combat system improvements to increase the likelihood that ESSM and RAM will home on their intended targets.
  12. Continue to implement and demonstrate with adequate operational testing the ship self-defense Fire Control Loop Improvement Program improvements.
- FY15 Recommendations. The Navy should:
  1. Correct the identified integration deficiencies with the LHA(R) SSDS-based combat system and the RAM Block 2 missile. Demonstrate these corrections in a phase of LHA(R) operational testing.
  2. Correct the cause of the ESSM missile failures and demonstrate the correction in a future phase of operational testing.
  3. Correct the SSDS Local Command and Control functionality issue. Demonstrate the correction in a future phase of SSDS operational testing.
  4. Investigate means to mitigate the chances of an ESSM pre-detonating on debris before approaching its intended target.
  5. 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.
  6. 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.
  7. 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.
  8. Investigate the late detections by the AN/SPQ-9B radar of certain types of threats at distances much closer to the ship than predicted from historical data. Demonstrate any corrections in a future phase of operational testing.
  9. Investigate why the BQM-74 aerial targets failed to maintain operationally realistic flight parameters. Demonstrate any corrections prior to using these targets in similar operational test scenarios.
  10. Complete the LHA(R) IOT&E at-sea test phases and the planning for the LHA(R) P_{RA} M&S test bed IOT&E test phase.
  11. Update the LHA(R) Test and Evaluation Master Plan to include at-sea and P_{RA} test bed operational test phases to enable evaluation of ship self-defense capabilities on the LHA-8 equipped with new radar systems.