

Ship Self-Defense

Executive Summary

- The ship self-defense mission for aircraft carriers and amphibious warfare ships coordinates several legacy shipboard systems, as well as four major acquisition programs: Ship Self-Defense System (SSDS), Rolling Airframe Missile (RAM), Evolved SeaSparrow Missile (ESSM), and Cooperative Engagement Capability (CEC). These comprise a self-defense capability for in-service ships as well as the LPD 17, LHA 6, and CVN 78 ship classes still in acquisition.
- While the integration of sensor and weapon systems with the command and decision system enhances the ships' self-defense capability over non-integrated combat systems, the ability to effectively complete the self-defense mission against the types of threats for which the overall system was designed has not been successfully demonstrated. In addition, reliability problems further degrade the ships' ability to complete this mission.
- The Navy must complete the currently planned operational test program and conduct additional operational testing to demonstrate the correction of significant deficiencies with SSDS Mark 2, RAM, ESSM, CEC, and legacy ship self-defense combat system elements.

System

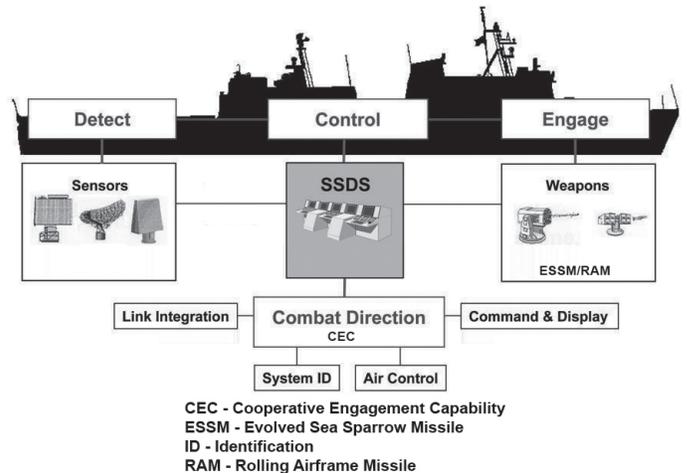
- The ship self-defense mission area is addressed by several legacy combat system elements (ship class-dependent) and four major acquisition programs: SSDS, RAM, ESSM, and CEC.

SSDS

- SSDS is a local area network that uses open computer architecture and standard Navy displays to integrate a surface ship's sensors and weapon systems to provide an automated detect track-engage sequence for ship self defense. SSDS Mark 1 is the command and control system for LSD 41/49 class ships.
- SSDS Mark 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 1 class amphibious ships
 - Mod 4, in development for LHA 6 class amphibious ships
 - Mod 5, in development for 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 anti-ship cruise missiles (ASCMs). RAM is currently installed in all aircraft carriers and amphibious ships (except LPD 4 class).



- There are four RAM variants:
 - RAM Block 0 uses dual mode, passive radio frequency/infrared guidance.
 - RAM Block 1 adds infrared guidance improvements to extend defense against non-radio frequency radiating ASCMs.
 - RAM Block 1A extends the capability of RAM Block 1 against non-ASCM targets, including helicopters, slow aircraft, and surface (HAS) threats.
 - RAM Block 2 is in development and will 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 designed to defeat ASCMs. The ESSM is currently installed on DDG 51 Flight IIA Destroyers and on CVN 68 class aircraft carriers equipped with the SSDS Mark 2 Mod 1 Combat System. The Navy is planning for future ESSM installations in CG 47 Class Cruisers, LHA 6 Class Amphibious Assault Ships, and the DDG 1000 Class Destroyers.

CEC

- CEC is a sensor network with 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 (CEP), which collects and fuses radar data and the Data Distribution System, which exchanges the CEP data. CEC is an integrated component of, and serves as the primary air tracker for SSDS Mark 2-equipped ships.

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- There are four major variants of CEC:
 - The CEC USG-2 is used in selected Aegis cruisers and destroyers, LPD 17/LHD amphibious ships, and CVN 68 class aircraft carriers.
 - The CEC USG-2A, an improved version of the USG-2, is used in selected Aegis cruisers and destroyers.
 - The CEC USG-3 is used in the E-2C Hawkeye 2000 aircraft.
 - The CEC USG-3B is in development for use in the E-2D Advanced Hawkeye aircraft.
- Naval surface forces use RAM to provide a short-range hard kill engagement capability against ASCM threats.
- Naval surface forces use ESSM to provide a medium-range hard kill engagement capability against ASCM, surface, and low velocity air threats.
- Naval surface forces use CEC to provide accurate air and surface threat tracking data to SSDS.

Major Contractors

- SSDS: Raytheon – San Diego, California
- RAM: Raytheon – Tucson, Arizona
- ESSM: Raytheon – Tucson, Arizona
- CEC: Raytheon – St. Petersburg, Florida

Mission

Naval surface forces use SSDS, RAM, ESSM, and CEC as well as many legacy systems to provide faster, more effective accomplishment of ship self-defense missions.

- Naval surface forces use SSDS to provide automated and integrated detect-to-engage ship self-defense capability against ASCM, air, and surface threats.

Activity

- The Commander, Operational Test and Evaluation Force (COTF) conducted operational testing of the ship self-defense mission during FOT&E of the SSDS Mark 2 Mod 2 on the Self-Defense Test Ship (SDTS) in conjunction with the IOT&E of the LPD 17 class ship in December 2009.
 - COTF completed an operational test of the ship self-defense mission during FOT&E of the SSDS Mark 2 Mod 3 on USS *Makin Island* (LHD 8) in February 2010.
 - COTF continued to operationally test the ship self-defense mission during FOT&E of the SSDS Mark 2 Mod 1 and ESSM on USS *Carl Vinson* (CVN 70) in July 2010. Testing is scheduled to continue in July 2011.
 - COTF conducted all testing in accordance with DOT&E-approved test plans.
- employment timelines, sensor coverage, and system track management. COTF also discovered deficiencies with North Atlantic Treaty Organization (NATO) SeaSparrow Missile System performance and with the recommended engagement tactics provided for use against multiple ASCM threat classes.
- Due to the similarities between the CVN 70 and LHD 8 ship self-defense combat system elements and software commonality, most of the problems observed during FY10 and prior operational tests are applicable to all CVN 68, LHD 1, and LPD-17 ship class combat systems.

Assessment

- Ship self-defense mission area assessments are:
 - The completed operational testing on the SDTS indicates that the LPD-17 class combat system continues to have difficulty defeating certain ASCM raid types. Specifically, one of the legacy combat system elements, the AN/SPQ-9B Radar, had limited capability against the threat surrogates used in those raid types.
 - The completed operational testing on LHD 8 indicates that some elements of the ship class combat system continue to have reliability problems. In addition, the LHD 8 combat system had difficulty engaging certain classes of asymmetric threats.
 - The completed operational testing on CVN 70 revealed several problems with the ship's combat system's ability to successfully complete the ship self-defense mission. Specific problems included deficiencies in weapon
- Program specific assessments are:
 - SSDS Mark 2 performance has improved; however, significant deficiencies remain with weapon employment timelines, training, and software reliability. While the FY09 Annual Report stated that SSDS Mark 2 software reliability was improved, new data collection systems/ techniques uncovered new software reliability failures that were previously undocumented.
 - RAM performance against stream raids of supersonic sea-skimming ASCMs remains undetermined.
 - ESSM in-flight reliability as well as performance against supersonic high-diving ASCMs, stream raids of supersonic, sea-skimming maneuvering ASCMs, raids of several simultaneous subsonic ASCMs, low velocity air threats, and maneuvering surface craft remains undetermined. Additionally, ESSM performance in the presence of electronic jamming remains undetermined.
 - CEC performance shows continued deficiencies in tracking certain ASCM threats in support of the ship self-defense mission.

Recommendations

- Status of Previous Recommendations. The Navy has not resolved the following previous recommendations:
 1. Optimize SSDS Mark 2 weapon employment timelines to maximize weapon probability of kill.
 2. Ensure development and procurement of a threat representative anti-ship ballistic missile target to support demonstration of CVN 78 ship self-defense capability against this threat during operational testing.
 3. Update the CEC Test and Evaluation Master Plan (TEMP) to include details of FOT&E testing with the Joint Lightweight Elevated Sensor System and the Navy Integrated Fire Control-Counter Air capability.
 4. Acquire range-safe supersonic sea-skimming ASCM surrogate targets for ESSM FOT&E with the Aegis Combat System.
 5. Ensure availability of a credible open-loop seeker subsonic ASCM surrogate target for ship self-defense combat system operational tests.
 6. Correct the identified SSDS Mark 2 software reliability deficiencies.
 7. Correct the identified SSDS Mark 2 training deficiencies.
 8. Develop and field deferred SSDS Mark 2 interfaces to the Global Command and Control System-Maritime and the TPX-42A(V) command and control systems.
- FY10 Recommendations. The Navy should:
 1. Demonstrate through operational testing the correction of identified problems with CVN, LHD 1, and LPD-17 ship class self-defense combat systems, supporting the deployment schedule of those ships.
 2. Ensure adequate funding is available to complete all Navy-approved plans for FY11 ship self-defense operational testing.
 3. Ensure required ESSM and RAM missile assets are available for all planned FY11 ship self-defense operational testing.
 4. 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.
 5. Update the SSDS TEMP to show FOT&E test details of the SSDS Mark 2 Mod 4, Mod 5, and Mod 6 variants.
 6. Update the RAM Block 2 TEMP to show details of the RAM Block 2 IOT&E in addition to details of testing against stream raids of supersonic sea-skimming ASCMs.
 7. Update the ESSM TEMP to show details of the ESSM/Aegis modernization testing and information assurance testing. In addition, the TEMP update should include details of tests against supersonic high-diving ASCMs, stream raids of supersonic, sea-skimming maneuvering ASCMs, raids of several simultaneous subsonic ASCMs, low velocity air threats, and maneuvering surface craft.
 8. Provide a capability to launch a raid of four supersonic sea-skimming targets at the Naval Air Warfare Center/ Weapons Division, Point Mugu, California, test range to support TEMP-approved Air Warfare/Ship Self-Defense Enterprise testing planned for FY14.

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