

## Ship Self-Defense

### Executive Summary

- The ship self-defense mission for aircraft carriers, destroyers, and amphibious warfare ships coordinates several legacy shipboard systems, as well as five major acquisition programs: Ship Self-Defense System (SSDS), Rolling Airframe Missile (RAM), Evolved SeaSparrow Missile (ESSM), Cooperative Engagement Capability (CEC), and the Air and Missile Defense Radar (AMDR). These comprise a self-defense capability for in-service ships, as well as the LPD-17, LHA-6, DDG-51 Flight III, and CVN-78 ship classes still in acquisition.
- DOT&E issued a classified report to Congress in November 2012 entitled “Ship Self-Defense Operational Mission Capability Assessment Report.”
- 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 Navy has not successfully demonstrated the ability to effectively complete the self-defense mission against the types of threats and threat scenarios for which the overall system was designed.
- The Navy must complete the currently planned operational test program and conduct additional testing to demonstrate the correction of significant deficiencies with SSDS Mk 2, RAM, ESSM, CEC, and legacy ship self-defense combat system elements.

### System

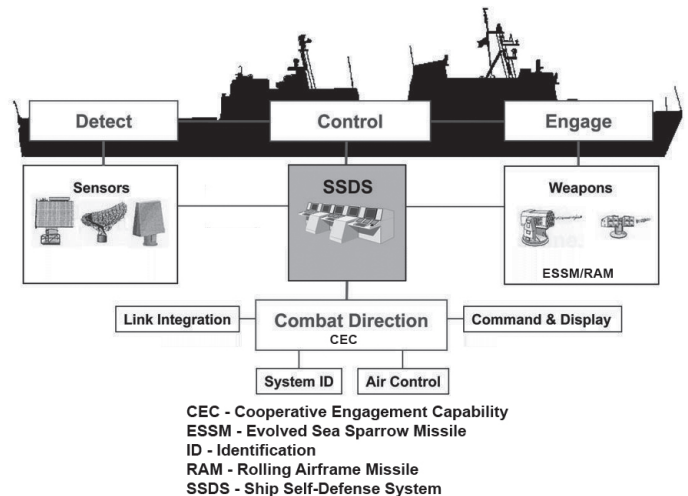
Surface ship self-defense is addressed by several legacy combat system elements (ship class-dependent) and five acquisition programs: SSDS, RAM, ESSM, CEC, and AMDR.

#### 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, 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 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 ASCM, surface, and low velocity air threats. The ESSM is currently installed on DDG-51 Flight IIA destroyers, as well as CVN-68 class aircraft carriers equipped with the SSDS Mk 2 Mod 1 Combat System. The Navy is planning for future ESSM installations in CG-47 class cruisers, LHA-6 class amphibious assault ships, CVN-78 class aircraft carriers, DDG-1000 class destroyers, and DDG-51 Flight III class destroyers.
- 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 as well as active radar-guidance.

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## 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, which collects and fuses radar data, and the Data Distribution System, which exchanges the Cooperative Engagement Processor data. CEC is an integrated component of, and serves as the primary air tracker for, SSDS Mk 2-equipped ships.
- 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.

## AMDR

- The AMDR is the Navy's next generation radar system that is being developed to provide DDG-51 Flight III Destroyer combat systems with simultaneous sensor support of

ballistic missile defense (BMD) and air defense (AD) (to include self-defense) missions.

## Mission

Naval Component Commanders 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.
- 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.
- Naval surface forces will use AMDR as a primary sensor for simultaneous BMD and AD (to include self-defense) missions.

## Major Contractors

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

## Activity

- DOT&E issued a classified report to Congress on the ship self-defense mission area in November 2012. The report covers ship self-defense related operational testing conducted from February 2008 through December 2011 aboard USS *Ronald Reagan* (CVN-76), USS *Carl Vinson* (CVN-70), and the Self-Defense Test Ship (SDTS).
- The Navy's Commander, Operational Test and Evaluation Force (COTF) completed FOT&E testing of ESSM, RAM, CEC, and SSDS on the SDTS in December 2011. Testing was conducted in accordance with a DOT&E-approved test plan.
- COTF continued planning for operational testing of the ship self defense mission area during IOT&E of the RAM Block 2 and FOT&E of the SSDS Mk 2 Mod 4 and ESSM on the SDTS. The Navy plans to continue testing in November 2012.
- COTF continued planning for IOT&E testing of the LHA-6 class ship self-defense combat system on the SDTS. The Navy plans to commence IOT&E testing in November 2012.

## Assessment

- The November 2012 DOT&E ship self-defense mission area report includes the following assessments:
  - The CVN-68 ship class combat systems continue to have difficulty defeating certain ASCM raid types. In

particular, the legacy combat system sensor elements have limited capability against the threat surrogates used in those raid types.

- The CVN-68 ship class combat system continues to have several problems that hinder it from successfully completing the ship self-defense mission. Specific problems include deficiencies in weapon employment timelines, sensor coverage, system track management, and NATO ESSM performance, as well as deficiencies with the recommended engagement tactics for use against multiple ASCM threat classes.
- The test infrastructure is inadequate to support self-defense testing on the next flight of destroyers. There is no unmanned, at-sea test capability to safely demonstrate a self-defense capability for Aegis destroyers against anti-ship missile threats. The test capability must be in place by 2020 to support DDG-51 Flight III Destroyer Combat System, ESSM Block 2, and AMDR integration self-defense operational testing.
- The classified November 2012 DOT&E report to Congress contains further ship self-defense mission area assessments.

## Recommendations

- Status of Previous Recommendations. The Navy has satisfactorily completed the majority of previous

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recommendations. The Navy has not resolved the following previous recommendations:

1. Optimize SSDS Mk 2 weapon employment timelines to maximize weapon probability of kill.
  2. Acquire range-safe supersonic sea-skimming ASCM surrogate targets for ESSM FOT&E with the Aegis Combat System.
  3. Ensure availability of a credible open-loop seeker subsonic ASCM surrogate target for ship self-defense combat system operational tests.
  4. Correct the identified SSDS Mk 2 software reliability deficiencies.
  5. Correct the identified SSDS Mk 2 training deficiencies.
  6. 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.
  7. 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.
  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 Test and Evaluation Master Plan-approved Air Warfare/Ship Self-Defense Enterprise testing planned for FY16.
  9. Improve the ability of legacy ship self-defense combat system sensor elements to detect threat surrogates used in specific ASCM raid types.
  10. Ensure availability of adequate and credible target resources for ship self-defense and electronic warfare operational testing.
  11. Take action on the classified recommendations contained in the March 2011 DOT&E report to Congress on the ship self-defense mission area.
- FY12 Recommendations. Based on the classified information contained in the November 2012 report to Congress, the Navy should:
    1. Improve the SSDS Mk 2 integration with the Mk 9 Track Illuminators to better support ESSM engagements, as well as preventing the Mk 9 Track Illuminators from contributing to the composite track during certain threat raid types.
    2. Develop combat system improvements to increase the likelihood that ESSM and RAM will home on their intended targets.
    3. Conduct additional operational testing on the CVN-68 class once the ship is equipped with additional self-defense weapons. This additional testing will determine whether the additional weapons are sufficient to meet the ship's self-defense requirements.
    4. Develop an unmanned, at-sea self-defense test capability that will allow safe demonstration of the self-defense mission of DDG-51 Flight III destroyers against anti-ship missile threats.
    5. Take action on the classified recommendations contained in the November 2012 DOT&E report to Congress on the ship self-defense mission area.

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