SSDS (Ship Self Defense System) & ACDS Block I

Status: In Production
System Type: Naval C4I System & Naval Electronic Warfare System

Program Briefing

The US Navy's ***Ship Self Defense System (SSDS)*** provides non-Aegis ships with an integrated self defense capability against anti-ship missiles and aircraft attack, originally optimized for close ranges and cluttered littoral environments where reaction times are extremely short. SSDS was mandated by Congress in 1991 following the attack on the USS *Stark*, building on the earlier Quick Reaction Combat Capability (QRCC) program.

But by 2018, SSDS had evolved with improved blue-water and long-range shore-based anti-ship missiles, and now consolidates numerous efforts related to the integrated control of ship self defense (SSD) and multi-warfare combat direction for aircraft carriers and amphibious class ships. The Navy's analysis and demonstration has established that surface SSD based on single-sensor detection point-to-point control architecture is inadequate against current and projected Anti-Ship Cruise Missile (ASCM) threats. The supersonic sea-skimming ASCM reduces the effective battle space to the horizon and the available reaction time-line to less than 30 seconds from first opportunity to detect until the ASCM impacts its target ship. Against such a threat, multi-sensor integration is required for effective detection, and parallel processing is essential to reduce reaction time to acceptable levels and to provide vital coordination/integration of hard-kill and soft-kill assets.

Thus, though ***SSDS Mk 1*** production is now complete and systems are in service aboard most planned ships, the ***SSDS Mk 2*** continues as a major program aboard, in production, or planned for CVN-68/78, LHA-6, LHD-1, LPD-17, and LSD-41/49 surface ship classes.

The ***Advanced Combat Direction System (ACDS) Block I*** is an earlier ship self-defense system, also developed by Naval and Maritime Systems (was Hughes, then Raytheon). ACDS had been in development since the mid-1980s, but was never fully developed and functional, and SSDS Mk 2 is replacing ACDS on the LHD-1 class.

Executive

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Naval Sea Systems Command (NAVSEA)
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Manufacturers

Primes

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Integrated Defense Systems
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San Diego, CA 92123
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Subcontractors

- Johns Hopkins University Applied Physics Laboratory, Laurel, MD: product development (much early development)
- Raytheon, Maynard, MA: product development
- Unisys, St. Paul, MN: ADS equipment, LAUs, fiber optic cable

Functional Description

SSDS Configuration (2018)

PE# 0604755N Ship Self Defense (Detect & Control) consolidates efforts related to the integrated control of Ship Self Defense (SSD) and multi-warfare Combat Direction for Aircraft Carriers and Amphibious Class ships. Analysis and demonstration have established that surface SSD based on single-sensor detection point-to-point control architecture is inadequate against current and projected Anti-Ship Cruise Missile (ASCM) threats. The supersonic sea-skimming ASCM reduces the effective battle space to the horizon and the available reaction time-line to less than 30 seconds from first opportunity to detect until the ASCM impacts its target ship. Against such a threat, multi-sensor integration is required for effective detection, and parallel processing is essential to reduce reaction time to acceptable levels and to provide vital coordination/integration of hard-kill and soft-kill assets.

Proj. #2178 Quick Reaction Combat Capability (QRCC) provides for the evolutionary acquisition of the ***Ship Self Defense System (SSDS)***, the core combat system control element for the Quick Reaction Combat Capability (QRCC) in aircraft carriers and amphibious class ships. In addition, the project provides for Combat System Integration (CSI) with the central system engineering and software for the integration of advanced sensor, weapon, and C4I upgrades, and for the test and evaluation and certification of the Integrated Combat System (ICS).

SSDS Mk 2 integrates a diverse set of fire control loop sensors and weapons, and C4I systems, for each ship class (CVN-68/78, LHA-6, LHD-1, LPD-17, and LSD-41/49).

SSDS Mk 2 provides the capabilities for integrated air and missile defense, multi-warfare situational awareness and combat direction, and joint interoperability via the Cooperative Engagement Capability (CEC) and Tactical Digital Information Link (TADL)-J. SSDS Mk 2 is being fielded with the new construction carriers (CVN-78 class) and amphibious ships (LHA-6, LPD-17 classes). SSDS Mk 2 is replacing the ***Advanced Combat Direction System (ACDS)*** in the LHD-1 class and ***SSDS Mk 1*** in the LSD-41/49 class as fleet modernization initiatives.

In addition, with the decision to replace the Dual Band Radar (DBR) with an Enterprise Radar Suite (ERS) for CVN-79/80 and Amphibious Class Ships (LHA-8), consisting of the new Enterprise Air Search Radar (EASR) and an X-Band Illuminator, SSDS will require development of system and software changes for ERS CSI.

In order to meet the Navy's war fighting capabilities and modernization concepts described in SEA POWER 21, Navy Open Architecture (OA) is being introduced in conjunction with SSDS Commercial off the Shelf (COTS) Technology Refresh initiatives. This is the first step in unifying a set of war fighting functions into a common architecture shared among many ship classes. This principle of commonality is a major mechanism for cost control and avoidances in the Navy's future war fighting systems. Starting in 2008, SSDS Mk 2 re-hosted existing tactical computer program applications into the Open Architecture Computing Environment (OACE) specifications with equipment suites concurrent with COTS Technology Insertion (TI) cycles, prior to migration and integration with other Navy OA applications for implementation on future new construction ships or during future ship modernization.

SSDS Configuration (Legacy)

The US Navy's Ship Self Defense System (SSDS) will provide non-Aegis ships with an integrated self defense capability against anti-ship missiles and aircraft attack, especially optimized for close ranges and cluttered littoral environments, where reaction times are extremely short. SSDS is a physically distributed open architecture system that comprises the crucial integration and control segment of the Quick Reaction Combat Capability (QRCC). SSDS integrates existing and planned Anti-Air Warfare (AAW) weapons, coordinates sensor information, provides threat identification and evaluation, assesses own-ship defense readiness, and recommends optimal defensive tactical responses.

SSDS system architecture centers on a distributed processing concept using a fiber optic Local Area Network (LAN), LAN access units, and AN/UYQ-70 workstation.

The initial SSDS effort (Mk 1) is focusing on the Whidbey Island (LSD-41/LSD-49) class of dock landing ships, to integrate existing LSD-41/49 sensors, the Rolling Airframe Missile (RAM), the Phalanx Close-In Weapon System (CIWS), and electronic countermeasures (AN/SLQ-32). Ship support, navigation, and Identification Friend or Foe (IFF) will also be incorporated via the LAN.

SSDS Mk 2 will integrate ACDS Block I, AN/SPS-48E, and AN/SPS-9B, and AN/SPS-49A(V) radars, CEC offboard cueing, Phalanx CIWS, AN/SLQ-32, RAM, Nulka, RNSSMS Sea Sparrow. SSDS Mk 2 will eventually integrate AIEWS, TISS, IRST, and ESSM (Evolved Sea Sparrow).

The Advanced Combat Direction System (ACDS) Block I is an earlier ship self-defense system, also developed by Naval and Maritime Systems. It is being integrated into SSDS Mk2. ACDS has been in development since the mid-1980s, hosted on AN/UYK-43 computers, but is still not fully developed and functional (as of mid-1999). It is now being rewritten into the SSDS open systems architecture (off the UYK-43) and software code (off obsolescent CMS-2Y computer language).

Platforms

SSDS Mk 1 was originally intended for the LHA-1, LHD-1, LSD-41/LSD-49 (dock landing ships), LPD-17, and FFG-7 classes. Now only the LSDs will get the system.

SSDS Mk 2 was originally intended for *Nimitz*, *Spruance*, *Wasp* (LHD-1), and AOE-6 classes.

By February 2018, SSDS Mk 2 was aboard or planned for the CVN-68/78, LHA-6, LHD-1, LPD-17, and LSD-41/49 surface ship classes. SSDS Mk 2 is being fielded with the new construction carriers (CVN-78 class) and amphibious ships (LHA-6, LPD-17 classes). SSDS Mk 2 is replacing the Advanced Combat Direction System (ACDS) in the LHD-1 class and SSDS Mk 1 in the LSD-41/49 class as fleet modernization initiatives.

Variants/Related Systems

AN/SLQ-32(V)—This is the US Navy's primary shipboard EW system, with more than 400 systems produced in several versions.

QRCC—The Quick Reaction Combat Capability (QRCC) is replacing manual controls of several different USN ship self defense systems with a single integrated capability under the computer aided control of ship operators. SSDS is a physically distributed open architecture system that comprises the crucial integration and control segment of the Quick Reaction Combat Capability (QRCC).

RAIDS—The Rapid Anti-ship Missile Integrated Defense System (RAIDS) is essentially SSDS Mk 0. It will reportedly be installed on 24-25 destroyers by the end of FY97.

SSDS Mk 1—SSDS Mk 1 was developed for the LHA-1, LHD-1, LSD-41/LSD-49, LPD-17, and FFG-7 classes. It will integrate existing sensors, the Rolling Airframe Missile (RAM), the Phalanx Close-In Weapon System (CIWS), and electronic countermeasures (AN/SLQ-32).

SSDS Mk 2—SSDS Mk 2 is intended for *Nimitz*, *Spruance*, *Wasp* (LHD-1), and AOE-6 classes. It will replace the current Sea Sparrow missile system with the Evolved Sea Sparrow Missile (ESSM), adding this to other SSDS Mk 1 systems, as well as Nulka. It will also be integrated with a ship's CDS Combat Direction System) and TAS (Target Acquisition System). SSDS Mk 2 is due to enter service in 1998.

SSDS Mk 3—SSDS Mk 3 was intended to be integrated with CEC (Cooperative Engagement Capability) and the new Advanced Combat Direction System (ACDS). It would also use a new MultiFunction Radar (MFR), AIEWS (replacing the AN/SLQ-32), the ESSM (Evolved Sea Sparrow Missile), and a new launcher to replace the Mk 29 NATO Sea Sparrow launcher. SSDS Mk 3 was rather optimistically hoped to be fielded by FY02, but the program was cancelled.

Contract Briefs

The following is a listing of contract announcements that have been made by the Pentagon involving the award of, or modification to, unclassified prime contracts with a base value of $5 million or more since the beginning of FY00 (10/1/99).

Date	Contract Number	Agency	Obligation	Details
Raytheon, Integrated Defense Systems				
12/29/2004	N00024-05-C-5110	NAVSEA	$10,041,000	CPFF contract for Ship Self Defense Systems Design Agent support to maintain technical data for all SSDS platforms, enhance reliability and maintainability of SSDS hardware.
5/10/2005	N00024-03-C-5127	NAVSEA	$5,261,996	Modification under previously awarded contract to exercise an option for one (1) MK 2 Mod 1A Tactical System and associated equipment, in support of the Navy's Ship Self Defense System (SSDS) program.
1/30/2006	N00024-05-C-5110	NAVSEA	$5,400,000	Modification to previously awarded contract for 37,253 hours of design agent engineering in support of the MK2 Ship Self Defense System (SSDS).
1/30/2008	N00024-07-C-5105	NAVSEA	$17,290,472	Modification to a previously awarded contract for Ship Self Defense System (SSDS) FY08 production of four SSDS MK 2 Tactical Ship Sets and one SSDS Special Study.

Funding History

RDT&E ($ Millions)	FY12	FY13	FY14	FY15*	FY16**	FY17	FY18	FY19*	FY20**	FY21**
PE# 0603582N Combat System Integration										
Proj. #U2178 Quick Reaction Combat Capability (QRCC)										
SSDS	68.2	72.4	91.2	50.5	145.9	—	—	—	—	—
PE# 0604755N Ship Self Defense (Detect & Control)										
Proj. #2178 Quick Reaction Combat Capability (QRCC)#	—	—	—	—	—	126.5	145.1	169.7	182.0	139.0
Proj. #3358 SSDS Training Improvement Program#	n/a	n/a	n/a	n/a	n/a	2.8	7.3	7.8	8.5	12.6

Procurement ($ Millions)	FY12	FY13*	FY14	FY15*	FY16**	FY17	FY18	FY19*	FY20**	FY21**
Navy Other Procurement (OPN):										
SSDS	54.3	55.4	51.9	—	—	54.9	68.6	89.0	90.3	95.9

Procurement ($ Millions)	FY01	FY02*	FY03**
Navy Other Procurement (OPN):			
SSDS	9.2	39.0	47.2
Navy Shipbuilding & Conversion (SCN):			
SSDS (LPD-17)	—	44.3	45.5
SSDS (CVN)	—	—	56.9
Navy Operations & Maintenance (OMN):			
QRCC	7.8	9.8	11.1

**Appropriation*
***Request*
#Primarily funds SSDS

Costs

James Whalen of NAVSEA reported that SSDS Mk 1 cost for the LSD-41/LSD-49 class dock landing ships is about $6-7 million. This includes upgrades to other systems because the LSD-41/49s do not already possess some of the advanced systems needed for SSDS.

For LPD-17s, LHDs, and CV/CVNs, SSDS unit cost was $5.2 million in 2005.

Program Overview

History

SSDS Development

The SSDS (Ship Self Defense System) was mandated by Congress in 1991, after the attack on the USS *Stark*. SSDS builds on the earlier Quick Reaction Combat Capability (QRCC) program.

The SSDS Mk 1 pre-prototype was tested aboard the USS *Whidbey Island* (LSD-41) in 1993. Critical Design Review (CDR) was successfully completed in November 1995.

SSDS Mk 1 was tested aboard the USS *Ashland* (LSD-48) between September 1996 and January 1997, with live-firing tests in the spring of 1997.

SSDS Mk 2 and Mk 3

SSDS Mk 2 is intended for *Nimitz*, *Spruance*, *Wasp* (LHD-1), and AOE-6 classes. It will replace the current Sea Sparrow missile system with the Evolved Sea Sparrow Missile (ESSM), adding this to other SSDS Mk 1 systems, as well as Nulka. It will also be integrated with a ship's CDS Combat Direction System) and TAS (Target Acquisition System). SSDS Mk 2 is due to enter service after 1998.

SSDS Mk 3 is intended to be integrated with CEC (Cooperative Engagement Capability) and the new Advanced Combat Direction System (ACDS). It will also use a new Multi-Function Radar (MFR), AIEWS (replacing the AN/SLQ-32), the ESSM (Evolved Sea Sparrow Missile), and a new launcher to replace the Mk 29 NATO Sea Sparrow launcher. SSDS Mk 3 is rather optimistically hoped to be fielded by FY02.

MK1 SSDS Production Contract

In September 1996, NAVSEA issued Hughes Aircraft's Naval and Maritime Systems Div., in Fullerton, CA, a $12.8 million letter contract (L/C) (must still be definitized) for the production and deployment of the Mk1 SSDS for LSD-41/LSD-49 class ships. The work is to be conducted in

San Diego, CA, and completed by July 1997. Contract funding is expected to come from Other Procurement (OPN) and RDT&E accounts, the latter involving the engineering and manufacturing development (EMD) Ship Self Defense (PE# 0604755N) program.

GAO Criticizes Navy Reporting of SSDS Progress

In an August 15, 1997 report, the GAO claimed Navy information provided to Congress each year regarding ship self defense progress and abilities contains inaccuracies and inconsistencies. In response, the Navy claims its annual ship self defense reports have been as detailed and consistent as annual budgetary adjustments allow.

ACDS Being Phased Out

ACDS Block I went to sea with CV-67 (John F. Kennedy) in 1999, after failing its Operational Testing and drawing criticism and frustration from officers aboard. It will have to serve until SSDS Mk 2 is ready, but further production has now been cancelled after five systems. ACDS software will be written into SSDS-compliant as soon as possible (see Configuration).

CCDS Long-Term SSDS Replacement

The Navy announced the Common Combat Direction System (CCDS) in mid-1999. CCDS is planned as the SSDS follow-on, to begin replacing SSDS systems around 2012.

SSDS Mk 2 Contracts

In June 2000, NAVSEA issued Raytheon Systems a $13.6 million firm-fixed-price (FFP) contract to fund the purchase of three Mk 2 SSDS systems in support of LPD-19 and LPD-20, and a trainer. The sole source contract specified that work would be conducted in Portsmouth, RI (80%) and San Diego, CA (20%), and completed by May 2001. Contract financing for the SSDS units is expected to come from the Navy Other Procurement (OPN) account (N00024-99-C-5108).

In July 2001, NAVSEA awarded Raytheon Electronic Systems a $24.3 million modification to a FY99 cost-plus-award-fee (CPAF) action to provide improvements to the Mk 2 SSDS. The work is to be conducted in San Diego, CA, and completed in April 2004. Contract financing will come from Navy Other Procurement (OPN) and RDT&E accounts (PE# 0604755N) (N00024-99-C-5108).

SSDS Mk 2 Fiber Optic Upgrade

In December 2001, NAVSEA, Washington Navy Yard, DC, announced a requirement to develop, integrate and test a change to the SSDS Mk 2 that would (1) establish a fiber-optic interface with the Rolling Airframe Missile (RAM) Mod 3 launcher and (2) upgrade the associated communications software. This effort will also require the contractor to provide 12 SSDS Mk 2 upgrade kits for shipborne systems, 16 upgrade kits for shore-based SSDS Mk 2 testbeds, 12 upgrade kits for shore-based SSDS Mk 2 test systems, and 4 spare kits; plus integrated logistics support documentation changes.

This requirement will be issued to Raytheon Co., Naval & Maritime Integrated Systems, 8680 Balboa Avenue, San Diego, CA, as the sole designer and manufacturer of SSDS Mk 2 technology. SOL is N00024-02-R-5105, due 1/14/02. POC is John Murray, Contracting Officer, tel: (202) 781-2939.

Mk 2, Mod 1 Testing

In March 2003, Raytheon completed development and functional qualification testing of the SSDS Mk 2, Mod 1 for CVN-76 (*Ronald Reagan*). Certification for operatiuon is planned for completion in FY05.

Raytheon Contracts

In January 2004, NAVSEA issued Raytheon a $25.9 million FFP award for the procurement of five SSDS Mk 2 systems with test bed to support qualification testing. The five tactical systems are to be used with the CVN-74, CV-67, CVN-70, LHD 1, and LPD-22 ships. The work is to be conducted in San Diego, CA (55%), and Portsmouth, RI (45%), and is to be completed by November 2005. Contract financing will come from the Navy Other Procurement (OPN) account (N00024-03-C-5127).

In March 2004, NAVSEA awarded Raytheon a $9.4 million CPIF add-on to finance the continuing development of LHD-8 Mod 3 software, integration and support for the Mk 2 SSDS. The work is to be conducted in San Diego, CA, and is to be completed in June 2005. Contract financing will come from the Navy Ship Self Defense element (PE# 0604755N) (N00024-02-C-5107).

In May 2004, NAVSEA awarded Raytheon an NTE $38.7 million letter contract (L/C), on a cost type basis, and a Government liability of $10.2 million, to finance the migration of the SSDS Mk 2 software and hardware to the Navy's open architecture computing environment. The work is to be performed in San Diego, CA (75%) and Portsmouth, RI (25%), and is to be completed by December 2005. Contract funding will come from the Navy's SSDS RDT&E program (PE# 0604755N) (N00024-04-C-5132).

In December 2004, the Navy awarded Raytheon Integrated Defense Systems, San Diego, CA, a $10 million contract for SSDS design agent support, to be completed by November 2006.

Also in December 2004, the Navy awarded a $26 million contract to provide five SSDS systems for LPD-17s, LHDs, and CV/CVNs. All ships of these classes will receive SSDS, including the *George H. W. Bush* (CVN-77).

In January 2005, NAVSEA issued Raytheon a $120 million CPFF contract to provide for SSDS Design Agent support to maintain technical data for all SSDS platforms, enhance reliability and maintainability of SSDS hardware and software, and to develop and test improvements as a result of technology refresh efforts. The work is to be conducted in San Diego, CA (55%) and in Portsmouth,

RI (45%), and completed in November 2006. Contract funding will come from the Navy RDT&E program of Surface Combatant Combat System Engineering (PE# 0604307N), and O&M (N00024-05-C-5110).

In May 2005, NAVSEA issued Raytheon a $5.3 million add-on to exercise an option for one Mk 2 Mod 1A Tactical System and associated equipment in support of the Navy SSDS program. The systems will be used aboard the CVN-75 aircraft carrier. The work is to be performed in Portsmouth, RI (70%) and in San Diego, CA (30%), and is to be completed by May 2006. Contract funding will come from Navy Other Procurement (OPN) and RDT&E (PE# 0604757N) accounts (N00024-03-C-5127).

SSDS Production Contract

In June 2007, NAVSEA awarded Raytheon Systems a $16.9 million FFP contract to procure three SSDS Mk 2 Tactical Ship Sets, four preplanned Production Improvement (P3I) kits for tactical cabinets at shore sites, and one Open Architecture Unit Tester. The work is being performed in Portsmouth, RI, and is to be completed in June 2008 for CVN-68, October 2007 for LHA-6 (Left Field-Atlanta), and January 2009 for LPD-17. Contract financing will come from OPN (N00024-07-C-5105).

First Open Architecture SSDS Mk 2 Delivered

In mid-2008, Raytheon delivered the first open architecture SSDS Mk 2 for the USS *Nimitz* CVN. This new version replaces the original SSDS Mk 2 PowerPC processors with much faster x86-based systems. It is essentially two generations newer than the SSDS Mk 2 on the CVN-76 *Ronald Reagan*.

SSDS Neither Operationally Effective or Suitable

In January 2009, the Pentagon's director of operational testing and evaluation released a report criticizing the SSDS as "neither operationally effective or suitable" and plagued with "significant deficiencies" in a wide variety of areas. It also commented that the Navy had not corrected deficiencies noted in 2006 and 2007 reports.

Upgrade Contracts

In August 2009, NAVSEA awarded Raytheon a $7.4 million modification (and another $9.6 million in September 2009) for the integration of complex war-fighting improvements for SSDS, including components associated with the Dual Band Radar (DBR) and the Rolling Airframe Missile (RAM) Block 2. The work is to be conducted in San Diego, CA (90%); Tewksbury, MA (2.5%); Portsmouth, RI (2.5%); St. Petersburg, FL (2.5%); and Tucson, AZ (2.5%), and is to be completed by September 2009. Contract funding is coming from OPN (N00024-08-C-5122).

In August 2009, the Naval Surface Warfare Center (NSWC), Point Hueneme, CA, issued CACI Technologies in Chantilly, VA, an $18.2 million modification action to continue engineering and technical support services, training, software, project and logistics services, and products necessary to support SSDS. The services are required at shore sites, land-based test facilities, shipyards, and aboard ships in port and at sea. Places of performance include Port Hueneme, CA (35%); Wallops Island, VA (20%); Crystal City, VA (20%); San Diego, CA (10%); Little Creek, VA (10%); and Pearl Harbor, HI (5%), and is to be completed in April 2010. Contract funding will come from Navy O&M and Other Procurement (OPN) accounts (N63394-04-D-1262).

Mk2 MOD 6C Development

In February 2011, budgeted increases in PE# 0604755N from FY12 through FY16 will fund the development of new capabilities for CVN-78 class ships, to integrate new combat system components with SSDS Mk2, designated as SSDS Mk2 MOD 6C ACB12/TI12. These combat system components include the Dual Band Radar (DBR), SEWIP Block 2 ES, ESSM with JUWL uplink, MH-60R, and common product line software components for system track management and vehicle control. In CVN 78, DBR will replace all air search/air traffic control radars and missile file control illuminators. Full integration with the SSDS Mk2 combat management system is critical to support mission requirements for situational awareness, combat direction, self defense, air control, and air traffic control. The integration effort requires comprehensive combat system integration testing and land-based developmental testing with DBR and other combat system elements.

Initial land-based integration testing will begin in FY12 and will progress to developmental testing in FY14, based on the SSDS Mk2 software build schedule. Operator and maintenance training course development for SSDS Mk2 MOD 6C Advance Capability Build (ACB)12/Technical Insertion (TI)12 will also be initiated in FY12.

Selected new capabilities that are being developed for the CVN-78 ACB12 will also be implemented in CVN-68 class ships based on their specific combat system components.

Funds were also added in FY10 to address MH-60R and SEWIP Block 2 capability integration into the SSDS Mk2 SCB12 baseline

FY10 Deliveries Completed Ahead of Schedule

In January 2012, Raytheon delivered the final SSDS Mk 2 hardware ship set from its 2010 production contract, completing all system deliveries ahead of schedule. The system is slated for installation and integration onboard the *John P. Murtha* (LPD-26). Under the FY10 contract, Raytheon provided five SSDS hardware ship sets for installation on new ships as well as for upgrades to legacy combat management systems on in-service ships, bringing the total number of systems to 30. The SSDS hardware upgrades are aligned with the Navy's scheduled maintenance

and refresh cycles, ensuring optimum ship system capabilities and performance. SSDS' open design supports upgrades throughout the full lifecycle of the fleet.

SSDS PSEA

Also in January 2012, Raytheon was awarded an $8 million modification to a previously awarded Platform Systems Engineering Agent (PSEA) contract to exercise options for FY12 SSDS PSEA efforts. The funds continue SSDS Mk 2 modifications for CVN-78 and SSDS Mk 1 upgrades to the Mk 2 OA baseline. In addition to SSDS Mk 2 OA integration, CVN-78 will also leverage technology reuse and prior investment with the integration of the Dual Band Radar, originally developed as part of the DDG-1000 program. Raytheon has been the SSDS PSEA since 2008.

FY12 SSDS PSEA Award

In February 2012, Raytheon was awarded a $21.2 million contract to exercise options for FY12 SSDS PSEA, to continue SSDS Mk 2 development and test for the future USS *Gerald R. Ford* (CVN-78) and SSDS Mk Technology refresh efforts.

New ACB-16 Baseline Delayed, Re-designated ACB-20

As reported in February 2015, the SSDS Mk 2 Advanced Capability Build (ACB)-16 was delayed 2 years due to the need to prioritize critical SSDS system improvements. ACB-16 was the designation for the next major SSDS baseline for the integration of new sensor, weapon, and C4I capabilities for anti-ship missile defense and strike group interoperability. As a result of the delay, ACB-16 has been re-designated to ACB-20. The SSDS Mk 2 ACB-12 capability baseline development, test, and fielding will continue as planned. However, with the delay in development and fielding of ACB-16, an increased number of SSDS Mk2 ships will receive ACB-12 capability baseline and specific fire control loop and interoperability improvements, in lieu of ACB-16.

SSDS Mk 2 ACB 12 Contract Extension

A CPAF/CPIF delivery order (N00178-04-D-4112-EH04) was awarded in FY05 to acquire a Systems Engineering & Integration (SE&I) agent to support SSDS Mk 2 (ACB 12) development, integration and testing for the CVN-78 Class Warfare System.

In March 2017, a five-year competitive CPIF contract with a PoP from FY17-FY22 was awarded to provide ICS Systems Engineering, Integration and Test (SEI&T) support for the development, and/or alignment of existing and future emerging technical plans and engineering products across ship classes to provide support and resources for the integration, installation, checkout, and performance acceptance of the SSDS ICS on large deck class ships.

SSDS Mk 2 Competitive Contracts Planned

In December 2013, a sole source follow-on Cost Plus Incentive Fee (CPIF) Level of Effort (LOE) contract (N00024-14-C-5128) was awarded with a Period of Performance (PoP) from FY14-FY17, for the development, test, and certification of SSDS Mk 2 (ACB 12/TI-12) for CVN-78, CVN-72, and LHD-2, and for the software migration of ACB 12 to TI-12H/TI-16 for CVN-68, LHD-1, and LPD-17 ship classes.

This contract was subsequently extended to December 2018.

In February 2018, an additional extension through FY20 was planned, to provide continued support of the SSDS Mk 2 to execute and complete development of the existing contract scope requirements for CVN and Amphibious Modernization ACB 12 on TI-12 and TI-12 Hybrid (TI-12H) (SSDS Software Build 10), and TI-16 (SSDS Software Build 11).

For SSDS Mk 2 TI-12H/TI-16 equipment, the SSDS program will use *competitive build to specification production contracts*, and leverage common enterprise COTS Open Architecture Computing Environment (OACE) products for computing, storage, display, network, conversion, and cyber security.

In February 2018, *a new competitive contract* for a SSDS Combat System Engineering Agent (CSEA)/Software Design Agent (SDA) was planned to be awarded in FY19 with a ten-year PoP from FY19-FY29. This contract will provide support for the CVN and Amphibious Ship Class SSDS Combat System (CS) element and any future surface combatant based on evolution of the SSDS Mk 2 Combat Systems Post-Advanced Capability Build (ACB) 12/TI-12/TI-12H/TI-16/TI-16 Tech Refresh, and for ACB 20 and follow-on SW and HW technology upgrades. The anticipated requirements to be provided include systems and software engineering support, development of engineering products to support combat system integration, configuration control, developmental test/operational test (DT/OT) support, training and logistics support, and field technical support for the SSDS ICS.

SSDS RDT&E Plans

In February 2018, US Navy plans in PE# 0604755N Ship Self Defense (Detect & Control), ***Proj. #2178 Quick Reaction Combat Capability (QRCC)*** were for SSDS Mk 2 to implement new combat system warfighting capabilities and improvements on a phased basis via Advanced Capability Builds (ACB) and Technology Insertion (TI). Proj. #2178 efforts are divided into three major functional areas: SSDS Product Development, Combat Systems Integration, and Test and Evaluation/Certification.

SSDS Product Development under Proj. #2178 encompasses systems engineering efforts, technology insertion, and cyber-security, including the development and integration of ACB-12 with an Open Architecture Computing Environment (OACE), product line System Track Manager, and phased technology insertion configurations.

CVN-78 is the lead ship for ACB-12. For the CVN-78, FY18-FY19 work requires collaborative Combat System efforts to support CSSQT and DT/OT/OPEVAL and achieve requisite deployment capabilities for Ship Self Defense and Strike Group interoperability through extensive Integrated Combat System (ICS) testing and software updates.

For Cyber-Security, the Boundary Defense Capability (BDC) initiative under Proj. #2178 will provide SSDS Mk 2 and Combat Systems-level cyber-security protection based on system of systems risk assessment. Cyber Security BDC is a phased multi-year development to define, develop, and integrate enterprise Combat System cyber-security solutions. These solutions will provide a set of boundary defense capabilities for the SSDS Mk 2 ICS, a set of centralized Combat Systems-level cyber-security capabilities, and a set of element-level cyber-security protections.

Combat System Integration under Proj. #2178 encompasses CS (combat system) modeling and simulation, system analysis/engineering, and system/software development for integration of sensors, weapons, and C4I systems with SSDS Mk 2 in the CVN and Amphibious Class Ships for integrated air and missile defense, ship self-defense, multi-warfare combat direction, and strike group interoperability. Combat System Integration includes the Fire Control Loop Improvement Project (FCLIP), Far-Term Interoperability Improvement Project (FTIIP), and ACB-20 warfighting improvements, including the integration of EASR/ERS and integration of the Joint Strike Fighter (JFS) F-35 variance B&C (Link 16 integration).

Test and Evaluation/Certification under Proj. #2178 includes the SSDS Mk 2 Developmental Test/Operational Test (DT/OT) efforts and Combat System certification efforts.

SSDS Training Systems RDT&E Plans

In February 2018, US Navy plans in PE# 0604755N Ship Self Defense (Detect & Control), ***Proj. #3358 SSDS Training Improvement Program*** were to develop enhancements and upgrades to the SSDS Total Ship Training Capability (TSTC) components within the combat system, combat system elements, Battle-Force Tactical Training (BFTT), and Advanced Training Domain (ATD) to address needs for increased training capability and functionality in conjunction with SSDS Mk 2 Advanced Capability Builds (ACB)/Fire Control Loop Improvement Project (FCLIP), Far-Term Interoperability Improvement Project (FTIIP), Task Force Cyber Awakening (TFCA) Boundary Defense Capability (BDC), and Technical Insertion efforts under Proj. #2178 (QRCC). These enhancements will address current and future training requirements by implementing new functionality to enable the individual warfighter through distributed battle group events to engage in more complex training requirements to support fleet required training certification events.

Capability Development and integration are related to Self Defense, Underwater, Surface, and other warfare areas. Capability enhancements and upgrades include development of re-useable common components that can be leveraged by SSDS Mk 2 combat systems, and/or integration of reusable common components developed by the TSTC/BFTT Program and AEGIS Advanced Training Domain (ATD)/TSTC Total Ship Training Capability (TSTC) projects to meet AEGIS combat system training requirements. TSTC continues to integrate and update, as new tactical capabilities are being introduced, to enable crew operator proficiency training for basic and sustainment level training events, through distributed strike group certification fleet synthetic training (FST) events and including COMPTUEX FST at Sea integration into a Live, Virtual and Constructive (LVC) environment. Continued development is required to integrate new capabilities and interfaces to provide training for AEGIS and SSDS combat system capability upgrades, and to address the Fleet's Live, Virtual and Constructive (LVC) Fleet Training Wholeness initiative. Additionally, modernization is needed to support the DoD Training Transformation Plan, the Chief of Naval Operations Fleet Response Plan, and the Commander United States Fleet Forces Command Fleet Readiness Training Plan.

Current Developments

SSDS Contract Extensions and Planned Competition

In March 2019, US Navy plans in PE# 0604755N Ship Self Defense (Detect & Control) discussed the SSDS Acquisition Strategy. A sole source follow-on Cost Plus Incentive Fee (CPIF) Level of Effort (LOE) contract, N00024-14-C-5128, was awarded in December 2013 with a Period of Performance (PoP) from FY14-FY17, for the development, test, and certification of SSDS Mk2 (ACB 12/TI-12) for CVN-78, CVN-72, and LHD-2, and the software migration of ACB 12 to TI-12H/TI-16 for CVN-68, LHD-1, and LPD-17 ship classes.

This contract was extended to June 2020 and an additional extension to 2QFY21 is planned to provide continued support of the SSDS Mk 2 to complete the contract scope requirements for CVN and Amphibious ship Modernization ACB 12 on TI-12 and TI-12H (SSDS Software Build 10), and TI-16 (SSDS Software Build 11).

A new competitive contract for a SSDS Combat System Engineering Agent (CSEA)/Software Design Agent (SDA) is planned to be awarded in 3QFY19 with a ten (10)-year PoP from FY19-FY29. This contract will provide support for the Aircraft Carrier and Amphibious Ship Class SSDS Combat System (CS) ele-

ment development of ACB 20 (SSDS Software Build 12) and follow-on technology upgrades based on the evolution of the SSDS Mk 2 Combat Systems ACB 12/TI-12/TI-12H/TI-16. The requirements include systems and software engineering support, development of engineering products to support combat system integration, configuration control, developmental test/operational test (DT/OT) support, training and logistics support, and field technical support for the SSDS ICS. For SSDS Mk2 TI-12H/TI-16 hardware, the SSDS program uses competitive build to specification production contracts, and leverages common enterprise COTS products for computing, storage, display, network, conversion, and cyber security.

Teal Group Evaluation

Throughout its development, the SSDS (Ship Self Defense System) has often been obscured by "bigger" programs such as AEGIS, CEC, and DD-21/DD(X)/DDG-1000. SSDS initially experienced funding cuts and delays, but after testing in 1996 it finally reached deployment readiness. With the essential failure of ACDS (Advanced Combat Direction System) Block I, SSDS finally received the funding it needed to be a major program.

SSDS Mk 1 has now been procured for the LSD-41/49 class, and continuing contracts have been awarded for SSDS Mk 2 for all CVNs, the LPD-17, LHD-1, and LHA-6 amphibious warfare ships, and to replace the SSDS Mk 1 on the LSD-41/49 class.

Though there have been continuing problems with SSDS, the Navy has not indicated any plans to slow or stop production, and planned funding remains healthy. We forecast continuing production, along with continuing upgrades.

Funding Forecast

RDT&E (FY19$ Millions)	FY19	FY20	FY21	FY22	FY23	FY24	FY25	FY26	FY27	FY28
All RDT&E										
SSDS	180.0	190.0	150.0	160.0	150.0	150.0	160.0	150.0	170.0	160.0
Procurement (FY19$ Millions)	FY19	FY20	FY21	FY22	FY23	FY24	FY25	FY26	FY27	FY28
All Production and Upgrade & Support										
SSDS	**90.0**	**90.0**	**100.0**	**90.0**	**100.0**	**100.0**	**80.0**	**90.0**	**90.0**	**85.0**

July 2019