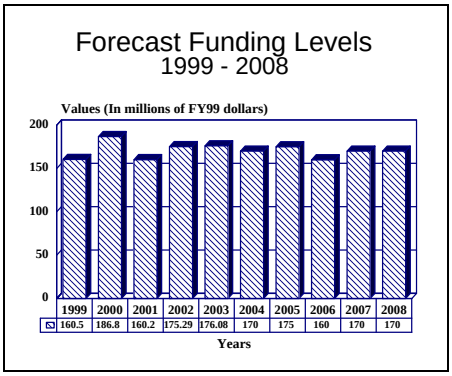
SSDS (Ship Self-Defense System) - Archived 2/2000

Outlook

- A technology development to support ship self-defense improvement
- Cooperative Engagement Capability development moved to separate program element
- Concentrates on sensor, command and control, data processing, and weapons improvements against anti-ship missiles
- More emphasis on contingency operations rather than anti-Soviet deep-water threats



Orientation

Description. This effort combines PE#0603755N and PE#0604755N, Ship Self-Defense. These program elements fund efforts to develop a self-defense capability against anti-ship missiles. Sensors, command and control, data processing, and weapons are integrated into a single combat/protection system.

Sponsor

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Contractors. Contractors vary with R&D effort changes.

Status. Technology base, engineering, and advanced system development.

Total Produced. This is a technology development program only. Production of an operational system has been approved.

Application. This program element provided funds for the development and upgrade of defensive systems for surface ships.

Price Range. Indeterminate.

Technical Data

PE#0603755N. This program funds efforts dedicated to the enhancement of ship self-defense against anti-ship threats. Its primary focus is on the development of technologies, systems and procedures necessary to defeat the evolving anti-ship cruise missile threat. These projects focus on ship defense improvements through the development of advanced concepts and capabilities which will enhance both the depth of defense of ships in a force and the self-defense of individual ships in a littoral war fighting environment.

Cooperative Engagement Capability (CEC), Project U2039, was a major effort to develop concepts for coordinating all battle force sensors into a single, real-time, composite track picture having fire-control quality. It has become a stand-alone program element.

Project U2133 is a Quick Reaction Combat Capability (QRCC) development of multi-sensor integration and kill coordination efforts which will improve the performance of current systems. U2184 Force Anti-Air Warfare Coordination Technology (FACT) also involves development of technology improvements for current systems.

PE#0604755N. This program element became effective in FY94 and consolidated ship self-defense (SSD) efforts. The unified approach improved planning for and management of these efforts, exploiting the synergistic relationship inherent in each. These projects are directed by a single program manager in Program Executive Office for Theater Air Defense.

Analysis and demonstration established that surface defense based on single-sensor detection, point-to-point control architecture is marginally effective against the current and projected Anti-Ship Cruise Missile (ACM) threats. The supersonic sea-skimming missile reduces the effective battle space to the horizon and the available reaction time is less than 30 seconds from first opportunity to detect until the ACM impacts its target ship.

Against such a threat, multi-sensor integration is needed for effective detection. Parallel processing is essential to reduce reaction time to acceptable levels and to provide vital coordination/integration of hardkill and softkill assets. Improvements in terminal gun system effectiveness and in missile kinematics, control and homing accuracy are required for successful hardkill engagement.

These projects address and coordinate the detect, control, and engage functions necessary to meet rigorous self-defense requirements within a development structure dedicated to systems engineering.

Detection: Coordinated sensor performance will increase the probability of detecting low-altitude, observable targets through the synergism gained from the integration of dissimilar sensor sources. Multi-sensor integration is addressed through the efforts of QRCC (U2178), while sensor improvements are addressed through the SPS Improvements (U0166), Infrared Search and Track (U0665), and Shipboard Electronic Warfare Improvements (U0954) projects.

These improvements to both active and passive detection capabilities are complementary to the ship signature reduction technology also being pursued through project U0954.

Control: Multi-sensor integration, parallel processing and the coordination of hardkill/softkill capabilities in an automated response to the ASCM threat are the cornerstones of the Ship Self-Defense System (SSDS) being developed through QRCC (U2178) efforts. In addition, that project provides for the central system engineering management of SSD developments.

Engagement: Both missile and terminal gun system requirements are being addressed via NATO Sea Sparrow Missile System (NSSMS) (U0173), 5 inch Rolling Airframe Missile (RAM) (U0167), and CIWS (PHALANX) (U0172). Missile improvements include improved kinematic performance plus advanced seeker and low- elevation fuzing/warhead capabilities. Gun system improvements address system detection, rate of fire, number of rounds on target, first round accuracy, and reliability and maintenance.

The engagement area is further supported by NULKA decoy development (U2190) and the Semi-Active Fuze project (U2256). U2176, the SSD Engagement Improvements project, was programmed to begin in FY98.

Variants/Upgrades

These programs develop technology that can be used to upgrade existing systems and incorporate them into developing systems.

Program Review

Background. Ship self defense is one of the Navy's highest priorities. The program will integrate ship, force and other service sensors in order to achieve 24-hour, extended-range coverage and improve early detection and sharing of hostile target information. The self-defense effort had been less than optimally coordinated in the past, so consolidating management and focusing attention on the efforts improved the overall effectiveness of the program significantly.

Details of the planned efforts from the Navy's Program Element Descriptors follow.

PE#0603755N Ship Self-Defense

U2039 Cooperative Engagement Capability (CEC). The Cooperative Engagement Capability program is developing significant improvements in the battle force Anti-Air Warfare (AAW) capability by coordinating all Battle Force AAW sensors into a single, real-time, composite track picture having fire-control quality. CEC distributes sensor data from each ship and aircraft, or cooperating unit (CU), to all other CUs in the battle force through a real-time, line of sight, high-data-rate sensor and engagement data distribution network.

CEC must be highly resistant to jamming and provide accurate gridlocking between CUs. Each CU independently employs high-capacity parallel processing and advanced algorithms to combine all distributed sensor data into a fire-control quality track picture which is the same for all CUs. CEC data are presented as a superset of the best AAW sensor capabilities from each CU, all of which are integrated into a single input to each CU's combat weapon systems. CEC will significantly improve battle force defense in depth, including both local area and ship defense capabilities against current and future AAW threats.

CEC is designed to enhance the AAW warfighting ability of ships and aircraft and to enable coupling of the force into a single, distributed AAW weapons system and toward more effective use of tactical data and the cooperative use of all the force sensors and weapons. These capabilities will provide the ship defense flexibility needed to meet the threat brought about by increasing numbers of highly sophisticated weapons held by potentially hostile Third World countries.

CEC consists of the Data Distribution System (DDS), the Cooperative Engagement Processor (CEP), and Combat System Modifications. The DDS encodes and distributes ship sensor and engagement data, and is a high-capacity, jam-resistant, directive system providing precision gridlocking and high throughput of data. The CEP is a high-capacity distributed processor which is able to process force levels of data in a timely manner that allows their output to be considered real-time fire-control data. This data are passed to the ship's combat system as fire- control quality data with which the ship can cue its onboard sensors. The data can also be used to engage targets without actually tracking them.

In FY96, US$3.050 million was spent to complete IOC certification for the shipboard CEC system and US$159.186 million was put into the continued development of the shipboard Common Equipment Set. US$24.768 million was budgeted for the continued development of airborne CES for integration with E-2C aircraft and US$7.240 million went into the continued assessment of system performance and development of tactical applications during active fleet exercises.

US$22.137 million was used for developing organic infrastructure for CES Integrated Logistics Support (ILS), with US$23 million used to initiate engineering studies to integrate CEC with joint service weapon systems. US$12.295 million was used to initiate the modification of Naval Research Laboratory and Fleet-owned P-3 aircraft to provide dedicated airborne support for the CEC test program.

In FY97, the Navy spent US$125 million on development of the Shipboard Common Equipment Sets, US$60 million on airborne integration development and US$22.2 million for integration with naval systems. US$17.1 million went to field support.

In the FY98 plan, CEC became PE#0603658N.

Project 2133 - Quick Reaction Combat Capability. The QRCC project implements evolutionary improvements of ship self-defense capabilities against anti-ship cruise missiles for selected non-AEGIS ships by integrating existing and programmed anti-air warfare stand-alone systems. It provides an automated quick reaction and multi-target engagement capability that emphasizes performance in the littoral environment.

Integration focuses on coordinating existing sensor information, providing threat identification and evaluation, assessing defensive readiness, and recommending an optimized defensive tactical response to counter single and multiple anti-ship cruise missile attacks. Subsequent modifications and upgrades will optimize the Ship Self-Defense System and provide enhanced self-defense capabilities while allowing for insertion of advanced technologies during engineering and manufacturing development and production and deployment Phases.

System design emphasizes use of non-developmental items, commercial standards, Next Generation Computer Resources, computer program re-use, and open architecture. QRCC replaces manual control of several different ship self-defense systems with a single integrated capability under the computer-aided control of ship operators. Improvements to current system performance for short-range anti-air ship self defense will implement the SSDS, incorporate multi-sensor integration of existing sensors, improve ship defense local command and control functions by automation of the detect-through-engagement sequence under the control of flexible embedded doctrine, integrate and coordinate weapon systems, and provide hardkill/ softkill integration.

The current focus of this project is the development of the SSDS which leverages recent critical experiments, the Rapid Anti-Ship Missile Integrated Defense System (RAIDS) program efforts, and the SSDS demonstration on USS *Whidbey Island* (LSD 41) in June 1993. System architecture centers on a distributed processing concept which uses a fiber optic local area network (LAN), LAN access units, advanced Display System workstations, and software to integrate existing sensors and weapons. The initial effort will focus on the LSD 41 class of ships to integrate existing LSD 41 class sensors, the Rolling Airframe Missile (RAM), Phalanx Close-in Weapon System (CIWS), and Electronic Countermeasures System (SLQ-32).

Other ship systems such as ship support, navigation and Identification Friend or Foe will also be integrated into the system via the LAN. The distributed architecture allows the incremental evolution and implementation of follow-on modification to the SSDS which will integrate other ship self defense elements, such as the NATO Sea Sparrow missile system, Target Acquisition System (TAS), and other sensors, as well as the RAM, CIWS, CIFF-SD, and SLQ-32 installations on other ship classes. On ships having a Combat Direction System (CDS) or the Advanced Combat Direction System (ACDS), those systems will be integrated with SSDS to optimize the use of offboard track data in ship self defense and transmit SSDS track data to other ships.

FY93 included completing a successful demonstration of an integrated RAM/CIWS self-defense system aboard USS *Whidbey Island* (LSD 41) in June (US$5.1 million) and a RAIDS Milestone III approval for DD 963. FFG 7 RAIDS production was pending until completion of successful Follow-on Test and Evaluation (FOT&E) (US$3.0 million). The program office accomplished programmatic risk-reduction efforts, systems analysis, testing preparations, and documentation to support MS III for RAIDS and Milestone IV/II for SSDS MK 1 (US$9.081 million).

FY94 accomplishments included progress toward achievement of Milestone IV/II for the SSDS MK 1 system (US$1.8 million) and continued transitioning to engineering and manufacturing development (E&MD) for the SSDS MK 1 version for the LSD class ship, including a Preliminary Design Review and Critical Design Review (US$13.785 million). The effort progressed toward RAIDS Follow-on Test and Evaluation (FOT&E) for the FFG 7 class ship (US$800,000) and initiated adaptations of the MK 1 system for installation aboard DD 963 and LHD class ships (US$300,000). Engineers conducted analysis of Ship Self Defense System capabilities in support of Investment Strategies and Cost and Operational Effectiveness Analyses (COEAs) (US$3.552 million). They also continued integration of a Central Identification Friend or Foe, Identification Doctrine Processor, and non-cooperative target recognition programs with SSDS (US$3.8 million), and conducted development efforts in support of Self-Defense Test Ship (SDTS) and Wallops Island Test Sites (US$3.041 million).

In FY95, the Navy spent US$2.143 million to complete transitioning of the SSDS MK 1 version to E&MD for the LSD class ship. This included risk reduction studies. Planners used US$700,000 to conduct advanced engineering studies to support the integration of SSDS with the Advanced Combat Direction System (ACDS) Block 1 Level 3 LHD variant in order to provide the LHD class with an Integrated Ship Defense (ISD) capability.

The budget included US$11.2 million for continued development efforts on the SDTS to include remoting of all combat system signals and data extract capability, and completion of outfitting for testing. US$4.335 million went into continued analysis efforts focusing on the impact of the Littoral Warfare environment on SSDS architecture/elements and required design improvements, including SSDS MK 1 system adaptation/risk reduction studies for LHD, LHA, and CV/CVN class ships.

In FY96, US$880,000 was used to complete Integrated Ship Defense (ISD) adaptation/risk reduction studies for LHD class ships, including a preliminary design. US$2.142 million went into the continued analysis efforts focusing on required upgrades to existing elements and identifying new initiatives required to pace the evolving Anti-Ship Cruise Missile (ASCM) threat, including associated upgrades to the operation of the SDTS.

US$344,000 was used to begin ISD adaptation/risk reduction studies for LHA and CV/CVN class ships, US$266,000 to investigate the DoD and non-DoD technology initiatives available to address optimization of hardkill/softkill sensors and weapons, and US$720,000 was used for forward financing of FY97 SDTS requirements due to low execution rates.

The FY97 plan budgeted US$213,000 for the ISD adaptation/risk reduction studies for LHA and CVN class ships, and US$3.098 million to continue analysis of the impact of the Littoral Warfare environment and continued ASCM evolution on ship self-defense elements, including associated upgrades to the operation of the SDTS. Planners began analysis of the Next Generation Ship Systems.

US$720,000 went into forward financing of FY98 SDTS requirements due to low execution rates in FY96, with US$1.0 million used to continue Combat Identification Friend or Foe-Ship Defense (CIFF-SD) efforts as per Congressional direction. US$2.610 was planned for conducting multi-sensor diffusion efforts in conjunction with CEC.

The FY98 plan budgeted US$1.861 million to continue the Integrated Ship Defense Modeling and Simulation Pilot and complete Phase I. US$1.551 million was used to further study the impact of the Littoral Warfare environment, threat jamming, and continued ASCM evolution on ship self-defense elements, including associated upgrades to the operation of the SDTS.

In FY99, the Navy plans to spend US$1.861 million to continue ISD Integrated Ship Defense Modeling and Simulation Pilot and complete Phase II. US$2.261 million is budgeted to continue the Littoral Warfare and threat jamming analysis and requirements update. This will include the continued ASCM evolution on ship self-defense elements, and associated upgrades to the operation of the SDTS.

Project U2136 - LINK IRON. This is a classified project.

Project U2184 - Force Anti-Air Warfare Coordination Technology (FACT). This is an advanced development effort designed to demonstrate force AAW concepts and capabilities which will significantly improve force defense in depth, including both local area and self-defense capabilities against current and future AAW threats. FACT improvements are designed to enhance the AAW warfighting ability of ships and aircraft and to enable coupling of the force into a single, distributed AAW weapons system and toward more effective use of tactical data, and the cooperative use of all the force sensors and weapons. These capabilities will provide the ship-defense flexibility needed to meet the threat brought about by increasing numbers of highly sophisticated weapons held by potentially hostile Third World countries.

FACT defines requirements and develops prototype systems or modifications to existing systems to test new concepts for the coordination of force AAW operations. Some examples of prototype systems now in production are SPS-48C Detection Data Converter, SPS-48E Environmental Control Feature, Shipboard Gridlock System Automatic Correlation (SGS/AC), and Dial-a-Track Link-11 Quality Selection.

Other FACT developments nearing production stages are the Automatic Identification System (Auto-ID) and the Multi-frequency Link-11 capability. Short- and long-term objectives will be phased in to produce higher degrees of ship defense and battle coordination and effectiveness.

In FY93, the Navy supported integration of Remote Data Engage (RDE) capability in shipboard Systems and Link interoperability between joint and allied forces (US$1.516 million) and demonstrated advanced multisensor tracking and force identification in Force Threat Evaluation and Weapon Acquisition (FTEWA) along with Geodetic SGS/AC. Engineers demonstrated the initial development of FTEWA (US$7.0 million). Planners completed a feasibility evaluation of Remote Missile Launch (RML) (US$750,000) and provided further recommendations for improving the Link-11 interoperability among force participants, joint services and allied network participants. They also provided recommendations for improving Link-16 integration into the force, including interoperability with existing Link-11 (US$1.0 million).

In FY94, the Navy supported integration of FTEWA into major AAW combatants (US$4.5 million). Program personnel provided engineering for improving Link-11 interoperability among force participants, Joint Services and Allied network participants. Recommendations for improving Link-16 integration into the force, including interoperability with existing Link-11 (US$1.626 million), were developed. Engineers continued developing the Remote Data Engage (RDE) and Remote Missile Launch (RML) systems (US$1.0 million).

FY95 accomplishments included US$8.665 million for the continued advanced development of FTEWA in support of Combat Air Patrol (CAP) and Surface-to-Air Missile (SAM) integration. US$1.150 million was programmed for developing and demonstrating Auto-ID with ESM. US$800,000 was put into continued RDE development, with US$600,000 supporting Remote Missile Launch (RML) and Forward Pass development. US$400,000 was used to determine the feasibility of integrating non-organic data to identify organic Battle Group air tracks in real time. US$400,000 supported Link interoperability between Joint and Allied forces, including multiple simultaneous links with emphasis on track identification, and command and control in support of FTEWA.

FY96 accomplishments included the continued advanced development of FTEWA in support of Combat Air Patrol (CAP) and Surface-to-Air Missile (SAM) integration (US$2.214 million) and development and demonstration of a Dual Net Multi-frequency Link-11 with JTIDS in USS *Kitty Hawk* (US$1.265 million). US$900,000 was used to support Remote Magazine Launch (RML) and Forward Pass, and

US$850,000 went into the continued Remote Data Engagement (RDE) development.

US$750,000 supported Link-11 and Link-16 interoperability between Joint and Allied Forces, including multiple, simultaneous links with emphasis on track ID, and command and control in support of FTEWA. US$550,000 was used to further study integrating non-organic data to ID organic Battle Group air tracks in real time, and US$1.280 million was used for forward financing of FY97 FTEWA requirements.

The FY97 program plan budgeted US$3.394 million to continue advanced development of FTEWA and plan integration with Joint Maritime Command Information System (JMCIS) and Contingency Theater Planning System (CTAPS). US$1.6 million was programmed to develop a capability to integrate JTIDS into CEC to produce a unified, coherent Battle Group picture. US$1.0 million continued RDE development and integration with FTEWA and CEC. US$500,000 went into supporting RML and Forward Pass, with US$483,000 supporting Link interoperability between Joint and Allied Forces, including multiple, simutaneous links with emphasis on track ID, and command and control in support of FTEWA. US$295,000 was budgeted to continue experiments to determine the feasibility of integrating non-organic data to ID organic Battle Group air tracks in real time.

The FY98 plan budgeted US$2.7 million to continue the advanced development of FTEWA for Theater Ballistic Missile Defense (TBMD). US$1.485 million was earmarked to continue development of the capability to integrate JTIDS into CEC to produce a unified, coherent Battle Group picture. US$1.05 million was used to continue RDE development and integration with FTEWA and CEC. US$450,000 supported RML and Forward Pass and US$500,000 supported Link-11, Link-16 and CEC interoperability between Joint and Allied Forces, including multiple, simultaneous links.

The FY99 plan budgets US$3.8 million for the FTEWA for TBMD development. US$1.717 million is earmarked for integrating JTIDS into CEC and US$1.3 million will continue RDE development and integration with FTEWA and CEC. US$470,000 will support RML and Forward Pass and US$500,000 will support Link-11, Link-16 and CEC interoperability between Joint and Allied Forces, including multiple, simultaneous links.

PE#0604755N Ship Self-Defense

Project U0166 - SPS Improvement Program. This program develops and tests performance and reliability upgrades for search radar equipment to meet the evolving threat.

FY93 accomplishments supported continuing analysis/trade-off studies and implementation of functional and performance allocations among elements comprising integrated Ship Self-Defense System (SSDS), including system interface adaptations and preparation/conduct of associated tests and demonstrations (US$200,000). Engineers completed testing of an Anti-Ship Missile Defense (ASMD) modification to SPQ-9 Radar and completed risk-reduction design efforts and tests (US$1.2 million). The Navy completed the specifications, a Statement of Work, and Request for Proposal (RfP) for design and development of an ASMD Upgrade to the SPQ-9 Radar. The RfP included Low Rate Initial Production (LRIP) (US$6.273 million). Westinghouse Norden Systems was awarded a US$16 million contract to design and develop the SPQ-9B radar system for the Theater Defense Program Office in October 1994. The program would upgrade the ability to detect and track sea-skimming, low-radar cross-section, high-speed missiles. Planners continued SSDS integration studies (US$100,000).

FY94 saw continued support for analysis/trade-off studies and implementing functional and performance allocations among elements of the integrated Ship Self Defense System (SSDS), including system interface adaptations and preparation/conduct of associated tests and demonstrations (US$200,000). Planners evaluated proposals for the SPQ-9B Radar and continued development of an acquisition documentation (Cost & Operational Effectiveness Analysis [COEA]), Operational Requirement Document (ORD), and Test & Evaluation Master Plan (TEMP) for the SPQ-9B Radar (US$1.989 million). Engineers continued integrating the radar with the MK 86 Gun Fire Control System. The Navy awarded a development contract for two SPQ-9B Radars in the first quarter of FY95 (US$5.450 million). Contract execution was to be accomplished from FY95 through FY97 due to the FY96 mark up of US$5.238 million.

Engineers continued SPQ-9(I) Advanced Development Model (ADM) Radar testing at Naval Research Laboratory's Land Based Test Site (LBTS) and at-sea test/operational assessment with the ADM Radar (US$2.045 million). Engineers continued SSDS integration studies (US$100,000).

In FY95, the Navy continued SSDS integration engineering (US$100,000) and funded the ongoing SPQ-9B Radar development contract at US$4.277 million. The program office spent US$1.132 million to manage the SPQ-9B Radar development contract, including conducting a Preliminary Design Review (PDR). Engineers continued radar integration into the MK 86 Gun Fire Control System. Engineers completed

at-sea testing of the SPQ-9B ADM Radar at a cost of US$800,000.

In FY96, the Navy spent US$300,000 to continue radar analysis/trade-off studies and implementation of functional and performance allocations among elements comprising the integrated Ship Self Defense System (SSDS), including system interface adaptations and preparation/conduct of associated tests and demonstrations. US$ 9.202 million funded the ongoing SPQ-9B Radar development contract, with US$3.076 budgeted for conducting a Critical Design Review and a Production Readiness Review and continuing radar integration task to MK 86 Gun Fire Control System. US$183,000 went to analyzing and demonstrating Digital Sidelobe Cancellation development as a product improvement to the SPQ-9B Radar. US$200,000 went to forward financing of FY97 requirements.

The FY97 plan included US$200,000 to continue the radar analysis/trade-off studies and implementation of functional and performance allocations among elements of an integrated Ship Self Defense System, including system interface adaptations and preparation/conduct of associated tests and demonstrations. US$9.284 million was budgeted to continue funding the ongoing SPQ-9B Radar development contract and conduct First Article Testing (FAT) on two production proof kits as well as support integration into the MK 86 system at the LBTS.

US$2.438 million was set aside to conduct First Article Testing at the contractor site and MK 86 integration testing at Naval Surface Warfare Center, Port Hueneme Division (NSWC/PHD). US$169,000 was used to continue Digital Sidelobe Cancellation development as a product improvement to the SPQ-9B Radar. US$7.467 million was spent to develop an EDM SPS-48 Solid State Transmitter.

The FY98 plan called for continuing radar analysis/ trade-off studies and implementing functional and performance allocations among elements comprising integrated SSDS, including system interface adaptations and preparation/conduct of associated tests and demonstrations (US$200,000). US$2.241 million was budgeted to complete contractor PPK development and to conduct developmental testing at NSWC Port Hueneme and aboard a DD-963 class ship. US$1.199 million was allocated to complete FAT at contractor site and MK 86 integration testing at NSWC/PHD. US$4.852 million was budgeted to develop an SPQ-9B lightweight antenna.

FY99 plans are to spend US$200,000 for the radar analysis/trade-off studies and implementation of functional and performance allocations among elements comprising integrated SSDS. This will include system interface adaptations and preparation/conduct of associated tests and demonstrations. US$2.470 million is planned to complete OT IIC on a DD-963 class ship.

U0167 - 5 inch Rolling Airframe Missile. The purpose of this program is to develop a surface-to-air self-defense system utilizing a dual-mode, passive Radio Frequency /Infrared 5” Rolling Airframe Missile.

Project U0172 - Close-In Weapons System (Phalanx). The Phalanx Close-in Weapons System (CIWS) is an automatic, fast-reaction, computer-controlled radar and gun system. It functions as the last segment in the Navy’s layered ship self-defense concept. Its mission is to detect, engage and destroy hostile anti-ship missiles that have penetrated the ship’s other defense systems.

The program requirements are contained in the CIWS Block I (MK 15 MODS 11-14) TEMP 142-1 (Rev 2). It automatically detects, evaluates, tracks, and engages threats and then returns to search mode for another target. CIWS Block I provides increased search elevation coverage, increased velocity coverage, and improvements to system operability test and fault isolation test programs.

On October 16, 1992, based on the results of a Cost and Operational Effectiveness Analysis (COEA) and subsequent executive review, the Assistant Secretary of Navy (Research, Development & Acquisition) directed that the Advanced Minor Caliber Gun System (AMC-GS) requirement be fulfilled via an Ordnance Alteration (ORDALT) to the Phalanx CIWS, providing a Phalanx Surface Mode (PSuM) capability.

PSuM will modify Block I systems to counter small surface threats and low, slow-flying air threats. System upgrades will include a non-developmental item (NDI) forward-looking infrared sensor and automatic video tracker (AVT), manual acquisition controls, video monitors, and operating program modifications.

FY93 accomplishment included continued development of improved sensor capabilities which could better counter low-elevation, low Radar Cross Section (RCS) targets, be more capable in an Electronic Countermeasures (ECM) environment, and provide a detection sensor for Rolling Airframe Missile (RAM) (US$6.954 million). The Navy developed and tested the High Order Language Computer (HOLC) and Advanced Fire Control (AFC) programs which will counter the capabilities which are projected to be fielded in anti-ship missiles in the near future (US$1.940 million). Engineers continued ongoing design and engineering efforts to incorporate all FY 1993 Phalanx improvements into the Ship Self-Defense System, an element of the total ship self-defense concept (US$2.0 million). The Navy initiated

development of PSuM ORDALT on July 12, 1993 (US$5.0 million).

In FY94, the Navy continued development of Phalanx Surface Mode (PSuM) to include selection of an NDI automatic acquisition video tracker and advanced electro-optic equipment, as well as integration of this equipment to improve overall system operation in AAW (US$18.855 million). The program office spent US$7.075 million to continue development of Baseline 3 to include design and development of a Low Noise Signal Generator and Digital Signal Processor. Engineers started development of AAW improvements and SSDS integration to include: development of receiver modification to reduce electro-magnetic interference; integration of the electro-optic system into the AAW fire-control algorithms; and development of the hardware/software interfaces to allow integration into the SSDS (US$3.758 million).

In the Close-In Weapon System effort, the Navy continued Phalanx EMI mitigation testing to define the interference mechanism and determine software and hardware fixes (US$2.743 million).

In FY95, planners continued developing and testing PSuM to include: development of software, integration of NDI electro-optic hardware, and preliminary contractor testing (US$12.257 million). Engineers continued developing AAW improvements to include: design engineering and documentation of AAW subsystems, component qualification, integration of hardware modifications and EO/RF Fire Control Integration (US$3.767 million). They completed developing the initial SSDS integration with Baseline 2 to include: development magazine, augmented reliability, built-in test equipment of initial DT/OT software delivery and support of preliminary testing at a cost of US$3.375 million. Engineers completed DT/OT on the High Order Language Computer and operational program (US$3.326 million).

In FY96, the Navy planned to complete developing, and continue contractor evaluation testing of, the PSuM and the AAW improvements to include: finalizing hardware and software development and preparing for Navy testing, at a cost of US$5.703 million.

The plan for FY97 called for completing Navy test and evaluation and DT/OT testing on the Surface Mode Upgrade portion of the Phalanx Improvement Program. This is funded at US$6.116 million.

There was no funding programmed in FY98 or beyond.

U0173 - NATO Sea Sparrow. This program encompasses efforts to enhance ship self defense by enhancing the kinematic capability of the Sea Sparrow missile to counter the high-speed Anti-Ship Cruise Missile (ASCM), including associated system integration.

Project U0665 - Infrared Search & Track (IRST), Thermal Imaging Sensor System (TISS). The sophistication and diversity of threats facing naval surface combatants is increasing, with lower radar cross-section, use of passive anti-radiation missiles (ARMs), increased speed, and lower altitudes.

This program element provides funding for two infrared sensors – the Infrared Search & Track (IRST) and Thermal Imaging Sensor System (TISS). The IRST will provide passive augmentation to complement radar, electronic support measures (ESM) and visual surveillance systems for air targets. It will declare those air targets to the ship's combat system. The TISS will provide surface ships with a day/night high-resolution surveillance capability for small cross-section targets.

It also supports anti-surface warfare (ASuW), mine warfare (MIW) and anti-submarine warfare (ASW) missions. The system will be an NDI procurement.

FY93 accomplishments included a (COEA) conducted via funding provided in PE#0603755N, Project U2138 in preparation for FY94 program initiation.

FY94 saw the completion of the COEA. The Navy spent US$2.765 million to develop system specifications for the TISS and IRST system. The program office prepared an RfP (US$1.333 million) and acquisition plans and progressed toward obtaining a Milestone II decision to enter the engineering and manufacturing development phase (US$2.834 million). They also progressed toward awarding an EMD contract for TISS (US$5.454 million). IRST development was delayed one year due to FY94 reprogramming and a delay in requirements formulation. Follow-on engineering development would be slipped two years to accommodate a two-phase development approach.

FY95 accomplishments included a Milestone II decision and progress toward awarding an IRST contract. This effort was funded at US$1.225 million. Planners performed a continuing assessment of risk reduction efforts, spending US$5.398. The Navy awarded a TISS EMD contract which included integration with the LBTS, funding this effort at US$5.841 million. US$1.675 million was used to conduct a technical evaluation (TECHEVAL) and operational assessment of the TISS. US$600,000 was used to forward-finance FY96.

Planners spent US$1.865 million to achieve a Milestone II decision and began preparations for a Milestone III decision for TISS.

The FY96 plan included US$10.828 million to continue IRST EDM design development (performance, safety, reliability, environmental suitability, human factors, and combat system integration). US$1.535 million was set aside for IRST logistics support development and test and evaluation. Planners allocated US$937,000 to prepare for the IRST Preliminary Design Review. US$221,000 of the extramural program was reserved for Small Business Innovation Research assessment in accordance with 15 USC 638.

There was a Congressional appropriation increase of US$9.5 million.

The FY97 plan called for completing construction of EDM-1 and delivering it to the land-based test site (US$2.130 million). Planners targeted US$1.450 million to begin preparations for IRST installation at the LBTS. US$300,000 was allocated to conduct the IRST PDR.

IRST development was delayed one year due to FY94 reprogramming and a delay in requirements formulation. Follow-on engineering development slipped two years to accommodate a two-phase development approach.

There was no funding programmed in FY98 or beyond.

Project U0954 - Shipboard EW Improvements. The Shipboard EW Improvements Program major efforts are:

- Advanced Capability (ADCAP): Improves Active Countermeasure capability.
- SLQ-32(V) Phase E: Improves threat detection capability.
- DECM/Decoy Integration (DDI): Integration of MK 36 Decoy Launching System with SLQ-32(V) Shipboard Electronic Countermeasures System.
- Rapid ASM Integrated Defense System (RAIDS): Phased Rapid Development initiative to improve the ability of surface combatants to perform Anti-Ship Missile Defense (ASMD).
- The Advanced Torch Decoys program: Develops Ship Launched Decoys capable of seduction and distraction of IR homing Anti-Ship Missiles.
- The MK186 MOD 2 Torch: Provides improved flame characteristics.
- OUTLAW BANDIT Ship Signature management: Includes development of Radar Cross Section (RCS) reduction treatments for FFG-7, DD-963, DDG-993, CG-47 class ships and also covers RCS and Infrared (IR) measurement and control techniques.
- Advanced Integrated Electronic Warfare System (AIEWS): Provides development of an advanced EW System to operate as an integral component of a ship's combat system, provides increased ECM capability to support ship defense, and introduces the next generation of EW technology.
- Offboard Active Countermeasure (OACM): An active Decoy compatible with existing MK 36 DLS.

In FY93, the Navy completed the Phase E Full Scale Engineering Development (FSED) Program Decision Review (PDR) (US$6.285 million). The ADCAP effort concluded FSED and engineers conducted field testing (US$0.686 million). Program personnel continued developmental testing of Torch/Flying IR Torch (FLIRT) (US$1.4 million), continued the Signature Management program, conducted OPEVAL on FFG-7 (OT IIC 22-25 FEB 93), and conducted DT on the CG-47 class and Production Acceptance Test and Evaluation (PAT-&E) for the DD-963 class. The program office also initiated Radar Cross Section Control (RCSC) design for DDG-993 class ships and an IV&V effort, along with conducting modeling and simulation for FFG-7, DD-963, CG-47 and DDG-993 class EW effectiveness (US$3.416 million). The program office achieved Milestone III for OUTLAW BANDIT (US$4.8 million), conducted DDI DT-IIIE/OT-IIIB at-sea tests (US$2.772 million), and completed RAIDS DT-IIA/OT-IIA - ARB on July 19, 1993 (US$2.098 million). The Navy also made a Milestone III decision for RAIDS (US$2.438 million) and approved the AIEWS Mission Needs Statement (MNS) and COEA proposal. COEA was completed in January 1994 (US$2.412 million). It fully funded the final increment of the AEWS contract (US$1.715 million).

In FY94, the Navy performed the Phase E Critical Design Review (CDR) and factory tests (US$8.474 million) and conducted ADCAP/DDI testing as well as final Developmental Testing/Operational Testing (DT/OT) (US$3.181 million). The program office continued the Signature Management Program, completed a radar cross-section control (RCSC) design package for CG-47 and DD-963, completed SPG antenna reflectivity improvements, and conducted COMOPTEVFOR V&V efforts on EW effectiveness modeling and simulation as part of FOT&E preparations (US$5.378 million). The Navy also restructured Phase I of AIEWS to include SLQ-32 Phase E (US$2.5 million). Engineers conducted AIEWS multiple concept Exploration and Definition Studies (US$1.8 million). US$4.705 million was allocated to the NULKA program. The AIEWS program office prepared restructured program logistics, and AIEWS

technical and program documentation (US$1.9 million). The completion of TORCH developmental/operational testing cost US$450,000 and US$500,000 went into a special project systems test. The AIEWS program was restructured to include back-fitting to SLQ-32-equipped ships.

In FY95, engineers completed ADCAP and achieved Milestone III in the second quarter (US$1.779 million). Programmers initiated AIEWS Phase I Development, including Phase E, funded at US$16.335 million. Engineers conducted Signature Measurement DT-III on DD 963 class ships. The OT-III element of DT/OT was canceled in favor of OPTEVFOR DT III observation, Fleet applications, and additional threat-representative systems. There was a DT-III of the R&D installation on the USS *Wadsworth* (FFG 9). The program office conducted hardkill/softkill integration effectiveness modeling and simulation (US$5.8 million). US$2.4 million was used to forward-finance FY96.

In FY96, planners continued AIEWS Increment I development; conducted the AIEWS Broad Agency Announcement (BAA) study, spending US$5.457 million. They used US$3.722 million to complete the RCSC design package for the DDG-993 class of ships and conducted DT III on the CG 47 class. The Navy initiated a RAM improvement program, including maintenance and reduced installation cost initiatives. Engineers continued signature measurement tests and conducted effectiveness modeling and simulation. US$4.359 was budgeted to initiate the acceleration of an advanced ES capability.

FY97 plans were to continue AIEWS Increment 1 development by consolidating AIEWS BAA results into RfP for EMD contract award (US$5.823 million). US$2.318 million was budgeted for OUTLAW BANDIT signature measurement tests and continuing P^3I and signature improvements, including RAM improvement program.

The FY98 plan budgeted US$ 2.652 million to continue the OUTLAW BANDIT signature measurement tests and systems engineering improvements, including a test and evaluation cost reduction initiative. Designers continued the P^3I and signature/RAM improvement program.

The plans for FY99 call for using US$2.012 million for the OUTLAW BANDIT signature measurement tests and systems engineering improvements, along with the T&E cost reduction initiative, as well as for the P^3I and signature/RAM improvement program.

Project U2178 - Quick Reaction Combat Capability Improvements (QRCC). The QRCC program provides the multisensor integration and hardkill/softkill coordination to improve system performance with respect to short- range anti-air ship self defense. QRCC applies multisensor integration to existing sensors, upgrades and integrates RAIDS for support of local command and control, integrates and coordinates weapon systems, and provides first level hardkill/softkill integration.

QRCC architecture centers on the distributed processing concept and will be incrementally implemented via a MK 1 Ship Self-Defense System (SSDS) focusing on integration of RAM, CIWS and the SLQ-32 electronic countermeasures system, followed by a Mark 1 system which integrates NSSMS, CIWS, RAM, SLQ-32 and the MK 23 TAS across a broad ship class spectrum. It integrates existing system elements via a fiber optic local area network and uses an advanced display system currently under development for system operation, maintaining the form, fit and function of the OJ-194 console. This project provides for full-scale EMD of SSDS leading to production and installation.

There was no activity in FY93.

During FY94, risk-reduction engineering efforts of SSDS MK 1 for the LSD-41 (Dock Landing Ship) class were continued (US$3.091 million). The program office conducted a system requirements review and system design review and completed the system specifications (US$1.0 million). Managers initiated the design and engineering of modifications to the MK 1 system for installation aboard LHD, LHA amphibious assault ships, and aircraft carriers (US$100,000). The program office initiated Integrated Logistic Support and other efforts to prepare for Fleet support requirements (US$100,000).

In FY95, the Navy spent US$9.1 million to continue risk reduction efforts for the MK 1 Ship Self Defense system for LSD 41 class ships. The Program Office conducted a Milestone II review and began Engineering and Manufacturing Development of the MK 1 SSD (US$10.5 million). US$10 million was used to initiate Land Based Test Site development and US$5.206 million went into the continued design and engineering efforts for the MK 1 system onboard follow-on class ships. US$4.0 million was used to initiate NATO Sea Sparrow Missile System re-architecture for follow-on class ships.

FY96 saw US$16.736 million used for the continued EMD development of SSDS MK 1 for LSD 41 class ships. The program office began Developmental Testing (DT) on LSD 41 class ships (US$10.550 million). US$1.0 million was used to complete documentation to support a Milestone III deployment decision and US$4.362 million was used to complete

the logistics requirements needed to support DT/OT and MS III.

US$4.450 million was budgeted for the continued planning of Milestone III and transitioning to production of SSDS MK 1 LSD 41 class ships, US$2.021 million for engineering development of SSDS MK 1 for follow-on class ships, and US$3.614 million for developing a multisensor data fusion capability for Centralized Identification Friend or Foe (CIFF) and Non-Cooperative Target Recognition Capability for Self Defense (NCTRC-SD) to ensure proper identification.

US$2.205 million went to the continued development and testing of a Ship Self Defense System for future Non-Aegis ships as well as integration of new technologies. US$6.962 million funded modifications to the Self-Defense Test Ship (SDTS) for testing of remote operations, reduced radar cross-section targets and infrared signature reductions.

The FY97 plan budgeted US$8.1 million to complete DT and conduct OT on an LSD-41 class ship. US$14.617 million was earmarked for EMD of the SSDS MK 1 for follow-on class ships. US$750,000 supported documentation changes and US$2.129 million went toward logistics requirements for ship class adaptations.

In FY98, the Navy budgeted US$21.381 million to prepare critical item development specifications and interface control drawings, conduct logistic support analysis, and commence software coding of SSDS MK1 for follow-on class ships (CVN, LPD-17, LHD, and LHA). US$1.325 million was used to prepare updated documentation for SSDS integration with RAM BLK 1, with US$4.078 million used to conduct FOT&E on the Self-Defense Test Ship in conjunction with RAM BLK 1 testing. US$3.881 million was used to establish the Wallops Island Ship Defense Test Facility, US$9.703 million to integrate QRCC with Naval systems, and US$5.822 million to integrate QRCC with the Ship Self-Defense Test Ship.

The FY99 plan budgets US$16.424 million to complete software coding for LPD-17 and CV(N) ship classes and conduct software unit testing. US$4.572 million is planned to integrate hardware and software for LPD-17 and CV(N) ship classes. US$5.812 million is allocated to start ILS documentation (training, technical manuals) for the LPD-17 and CV(N) ship classes.

U2190 - NULKA Decoy. The Offboard Active Decoy (NULKA) is a joint cooperative program between the United States and Australia to develop an active offboard decoy which utilizes a broadband radio frequency repeater mounted atop a hovering rocket. The Decoy is designed to counter a wide variety of present and future radar guided Anti-Ship Missile (ASM) threats by radiating a large radar cross-section signal while flying a ship-like trajectory. The United States developed the electronic payload and fire-control system.

The United States is currently modifying the payload to incorporate cost savings improvements and improve reliability. The fire-control system components are being consolidated and modified. The MK 36 Decoy Launching System (DLS) is being modified to support NULKA Launches. Australia developed the hovering rocket, launcher, and launcher interface unit.

In FY90, Engineering Development Models 1 and 2 and a launcher were delivered. Developmental Test IIA was started. In FY91, the Navy completed DT-IIA and conducted a captive-carry of a NULKA payload in Australia. EMI testing was completed.

FY92 plans called for Developmental Testing IIB/E in Australia as well as DT-IIC/D in the US. Captive-carry testing continued in Australia and a Critical Design Review of the NULKA vehicle and launching system was accomplished.

By mid-1993, three at-sea test phases had been concluded. Reports indicated that significant consolidation of the electronics components could be possible.

In 1994, a Payload Improvement Program and cost reduction were accomplished at a cost of US$8.1 million. A limited production decision was made. The Royal Australian Navy contracted AWA Defense Industries to produce the NULKA system for the RAN Fleet. The US$16.9 million contract was awarded for Phase I of the Australian effort. AWADI would install the system on a selected Australian frigate, develop and build a fire- control system, and assist with the acceptance trials.

FY95 saw the continued development of NULKA development and start of launch system integration testing, a continuation of the rocket motor qualification program, and the initial fabrication and delivery of test rounds. This was funded at US$12.729 million.

The plan for FY96 called for completing NULKA development and conducting land-based testing (US$7.576 million), as well as completing the integration of a stand-alone NULKA system with the SLQ-32. Engineers began research and development of payload improvements that will be required to counter the next- generation threat and to improve EMC capability. They also began integration of NULKA with SSDS. US$175,000 was reserved for Small

Business Innovative Research assessment in accordance with 15 USC 638.

In FY96, US$7.203 million was used to complete NULKA development and conduct land-based tests. Engineers completed integration of the stand-alone NULKA system with the SLQ-32. The program office began research and development of payload improvements required to counter the next-generation threat and to improve EMC capability. Integration of NULKA with SSDS commenced. US$364,000 was used for forward financing of FY97 requirements.

The FY97 plan budgeted US$5.658 million to conduct DT testing and continue research and development of payload improvements required to counter the next-generation threat and to improve EMC capability. The integration of NULKA with SSDS continued. US$364,000 was used for forward financing of FY98 requirements due to low execution rates.

Development testing in May 1997 and Operational Testing on the USS *Ashland* (LSD 48) in June were considered successful. COMOPTEVFOR declared the system operationally effective and operationally suitable and recommended Fleet introduction. Reports indicated that the system met or exceeded all required Measures of Effectiveness in track management, engagement effectiveness, tactics, and operational availability. Maintainability and reliability criteria were met as well. One-hundred percent of 200 targets were successfully detected and tracked.

In FY98, US$9.912 million was spent to complete SSDS integration and incorporate initial P^3I enhancements into production-qualified units and conduct captive-carry testing to validate ECCM performance.

In FY99, the Navy budgeted US$2.316 million to complete the EMC upgrade and conduct FOT&E of EMC improvements.

U2256 - Semi-Active Fuze Improvement. This funds development efforts for technologies that have become available for transition into an engineering and manufacturing development program. These emergent technologies can provide improved capabilities for one or more ship self-defense programs. Development of the Evolved Sea Sparrow Missile (ESSM) under project U0173 will provide enhanced ship survivability against the current and emerging threat, but additional capability is required to pace the evolving threat. Maneuverable, low radar cross-section, anti-ship missiles can be countered by near-term fuzing system improvements and mid-term improvements, including dual-mode seekers and even greater kinematic performance.

This was a "New Start Program" to develop near-term fuze improvements to improve data processing to accurately discriminate targets in high-clutter/ECM environments and provide increased capability in high angle of attack/high closing rate engagements. The fuze design is based on an upgrade of the AIM/RIM-7 DSU-34B Fuze; accordingly, the improved fuze will be form and function compatible with ESSM and existing AIM/RIM-7P missiles.

There were no accomplishments in FY94 or plans for FY95.

In FY96, US$101,000 was reserved for Small Business Innovation Research (SBIR) assessment in accordance with 15 USC 638. US$4.332 million was budgeted to begin the development of a fuze modification for the ESSM Missile to counter the Advanced Low Altitude highly maneuverable threats.

Plans for FY97 called for spending US$5.446 million to continue the fuze modification for the ESSM.

There was no funding programmed in FY98 or beyond.

U2309 - Advanced Integrated Electronic Warfare System (AIEWS). The Advanced Integrated Electronic Warfare System (AIEWS) is the next-generation EW system and will be an integral part of the ship combat system (AEGIS and SSDS).

It will be developed using a two-phased approach. Increment 1 will introduce advanced Electronic Support (ES) consisting of precision Electronic Support Measures (ESM), Specific Emitter Identification (SEI) and special receiver, increased processing throughput, open architecture, an Advanced Display System (ADS) with new Human Machine Interface (HMI), decoy integration, and EMI improvements. Increment 2 will introduce both RF and IR advanced Electronic Attack (EA) capabilities. This development will support both backfit and forward fit.

FY97 and prior funding for AIEWS is contained in U0954.

FY98 plans budgeted US$25.317 million to initiate AIEWS Increment 1 EMD to include receiver, SEI, precision ESM and integration efforts for both AEGIS and ISDS combat systems. This effort will also implement risk reduction efforts and advanced technology demonstrations. US$793,000 was budgeted to initiate development of Increment 1 logistics efforts to include electronic technical documentation, embedded training foundation, and manpower personnel and training analysis.

FY99 plans budget US$39.225 million to continue Increment 1 EMD, US$900,000 to continue development of Increment 1 logistics efforts, and

US$750,000 to initiate Increment 2 electronic attack trade study to optimize and ensure compatibility of onboard (RF/IR) countermeasures with offboard (RF/IR) countermeasures.

U2348 - Multi-Function Radar (MFR). The Multi-Function Radar (MFR) will provide designated ships with an affordable, high-performance radar system for ship defense well into the next century. Ships employing the MFR will achieve a level of force protection that greatly enhances ship defense capability against all threats envisioned in a littoral environment.

There were no funding or activity in FY98 or FY99.

The FY99 plan budgets US$35.573 million for startup of the Multi-Function Radar (MFR) development program. Plans include selection of an EMD contractor and beginning the EMD phase of the effort.

U2349 - SSD Launcher. There is no funding planned for this effort until FY01.

U2442 - IR Search & Track. The sophistication and diversity of threats facing naval surface combatants is increasing, with lower radar cross-section, use of passive anti-radiation missile (ARM), increased speed, and lower altitudes becoming more widespread. This project provides funding for the Infrared Search & Track (IRST) System. The threat from Sea Skimming Anti-Ship Cruise Missiles (ASCMs) is increasing at a substantial rate and impacting the Navy's force protection and battle space dominance capability. The IRST program improves ships force protection capabilities by providing fully integrated passive detection/declaration of Sea Skimming ASCM threats.

Because IRST operates in the infrared portion of the electromagnetic spectrum, it is immune to radar countermeasures and is not affected by atmospheric anomalies such as surface-based ducting. In addition, IRST provides extremely accurate and precise elevation data at the horizon that allow immediate determination of hostile intent. It can also free up search radar resources by providing horizon search coverage where radar performance is marginal. The IRST provides passive augmentation to complement radar, electronic support measures and visual surveillance systems for air targets. It will declare those air targets to the ship's combat system.

The program began in FY98 with plans that budgeted US$1.981 million to complete IRST EDM design development, fabrication, and combat systems integration. US$300,000 was allocated to perform IRST data collection to support algorithm refinement, with US$1.2 million to support IRST installation, test and development at Wallops Island. US$400,000 was earmarked to prepare for IRST at-sea testing.

The FY99 plan budgets US$833,000 to perform at-sea testing. US$150,000 will be used to program IRST for extended deployment.

FY95 Congressional Action. The FY95 National Defense Authorization Act (H Rpt 103-701 to S 2182) increased funding for both Program Elements by a total of US$24.2 million. Specific additions were:

Accelerating improvements to the self-defense test ship, US$11.2 million.

Evaluating an insensitive munition, dual-thrust motor upgrade to RAM, US$5.0 million.

Procuring NULKA decoys, US$8.0 million.

The FY95 Defense Appropriations Act (H Rpt 103-747 to H 4650) added US$11.2 million to PE#0603755N for the self-defense test ship. The House/Senate conferees added US$47 million to PE#0604755N. Specific additions were:

Advanced Display System, US$25 million.

Land Based Site, US$10 million.

Sea Sparrow Integration, US$4.0 million.

NULKA, US$8.0 million.

The appropriations legislation made additions and included the following comments on ship self defense:

"The conferees agree with the House-recommended bill language with respect to incorporating its own ship-self-defense capability – including cooperative engagement capability – on the new LPD-17 amphibious ship. In approving this requirement, the conferees do not believe that the Navy will find it necessary to install on the ship the SPY-1 radar system and associated Standard missile launch capabilities to provide the required self-defense.

The conferees' goal in providing this statutory provision is to address the requirement for the LPD-17 to defend against sea-skimming cruise missiles in the final phases of flight, not to address the need for area defenses against theater ballistic missiles and other air threats.

The conferees direct the Navy to report to the Committee on Appropriations no later than May 5, 1995, on its plans and activities related to developing Infrared Search & Track systems for ship self defense.

The conferees also agree to provide additional funding of US$25,000,000 to be made available to the Naval Sea Systems Command, for use by the UYQ-70 Advanced Display System (ADS) program office only

for adaptation of the ADS for shipboard deployment in support of cooperative engagement capability, future AEGIS baseline, advanced combat direction system Block I, and ship self-defense system Mk 2, as well as for the demonstration of emerging COTS/NDI technology for future deployment."

FY96 Congressional Action. The FY96 Defense Appropriations Conference (H Rpt 104-261 to HR 2126) noted that the Department of Defense and Congress had reached agreement on the direction of ship self-defense programs. The text of the report that accompanied the legislation re-affirmed Congress's support for achieving robust self-defense capabilities on Navy ships, especially the LPD 17 class, as soon as possible.

After resolving the differences between the House and Senate versions of the two bills, the conferees added US$87 million to PR0603755N and US$41.3 million to the Navy's request for PE#0604755N. The additions (US$ in millions) were:

PE#0603755N	+87,000	
	NLR P-3	+26.5
	Fleet P-3	+11.5
	E-2C CEC	+5.5
	Patriot/Thaad/Corps SAM CEC	+5.0
	Hawk CEC	+3.0
	AWACS CEC	+11
	National Sensors CEC	+4.0
	FACT high-definition systems	+4.5
	UYQ-70	+16
PE#0604755N	+41.3	
	Test ship	+7.9
	QRCC	+2.5
	ESM	+4.5
	IRST	+9.5
	SPQ-9	+4.8
	Multisensor integration	+4.1
	NULKA	+8.0

The FY96 Defense Authorization focused heavily on CEC. The budget request included US$180 million in PE#0603755N for development of the Cooperative Engagement Capability The House bill would have authorized the requested amount, but directed that no more than US$102 million be obligated until the Secretary of Defense notified the congressional defense committees that the test and evaluation master plan for the CEC program had been approved by the director of operational test and evaluation. The Senate would have added US$22.5 million to continue the accelerated development of the airborne component of CEC and an additional US$20 million to accelerate joint Army-Navy and Air Force-Navy exploitation of CEC for cruise missile defense and theater missile defense.

In the end, the conferees agreed to an additional US$42.5 million for CEC for the purposes described in the Senate amendment and the House receded from its funding limitation. The conferees noted House concerns regarding developmental testing and independent operational testing required to ensure that the CEC is operationally effective and suitable when deployed to the fleet. They directed the Secretary of the Navy to submit to the Congressional defense committees, by March 31, 1996, a report on the status of plans for developmental and independent operational testing of the CEC.

FY97 Congressional Action. Congress continued its interest in and adjustment of the Ship Self Defense and Cooperative Engagement Capability programs. In the FY97 Authorization, the Navy requested US$164.5 million for Cooperative Engagement Capability (U2039) in PE#0603755N and US$9.9 million in PE#0204152N for continued development of the CEC. In its report accompanying the legislation, Congress noted that funding provided by the budget request would focus on the development of shipboard and airborne Cooperative Engagement Systems (CES), initial operational test and evaluation of shipboard CES, and development of organic integrated logistic support for the CES.

Because the Navy reported that a challenging cruise missile defense exercise, "Mountain Top," that relied heavily on CEC position information, had been held earlier in Hawaii and involved over-the-horizon detection, tracking and engagement of a variety of difficult targets. As a result, the Navy projected that

initial operational capability of the system will be achieved by September 1996.

During testimony at FY97 defense posture hearings, the Secretary of Defense singled out CEC as a program of high priority that he chose to accelerate because of its great potential for linking units from more than one service together and greatly increasing their warfighting ability.

The report further noted that despite relatively robust funding for CEC in the budget request, it contains no funding to pursue joint service integration efforts that were begun in FY96. Congress felt that successful consummation of these efforts, in consonance with the Navy's baseline program, could greatly leverage the capability of the services to conduct joint operations and provide ballistic missile defense. Another area not addressed by the budget request, an issue raised in Armed Services and National Security Committee hearings, is the reported interference between CEC and other datalinks currently in use in the Fleet.

The House bill would authorize an increase of US$27 million in PE#63755N for the CEC program and urge the continued acceleration and expansion of joint service integration efforts, including application to the Airborne Warning and Control Systems (AWACS) aircraft, Patriot and Theater High Altitude Area Defense (THAAD) missile systems, Marine Corps TPS-59 radar and the HAWK missile system. The Senate amendment would have authorized an increase of US$63 million above the budget request for CEC in PE#63755N to permit continued pursuit of a number of promising efforts, including CEC integration with AWACS and national sensors, to accelerate development of an airborne capability for the system, and to address the issue of CEC interference with other Fleet datalinks, particularly the link installed on the SH-60B.

The conferees agree to an increase of US$35 million in PE#53755N for the CEC program and urged the continued acceleration and expansion of joint service integration efforts, including application to AWACS aircraft, Patriot and THAAD missile systems, Marine Corps TPS-59 radar and the HAWK missile system. The conferees also directed the Secretary of the Navy to prepare a detailed report, for submission no later than March 15, 1997, on progress made in resolving the issue of spectrum interference as a result of the reallocation under title VI of the Omnibus Reconciliation Act of 1993 of the spectrum in which CEC operates, and on steps that the Secretary had taken to address and resolve harmful interference between CEC and other Fleet weapons systems and datalinks.

FY98 Congressional Action. The FY98 Defense Appropriation increased the SSDS line from the US$132.7 million request to US$163.3 million. The appropriators added US$10 million for QRCC, US$6.0 million for Test Ship support, US$4.0 million for Wallops Island test operations, US$5.0 million for SPQ-9B, US$4.0 million for IRST, and US$2.0 million for NULKA.

The FY98 Defense Authorization increased the program element US$10 million to pursue integration of the Cooperative Engagement Capability, the advanced combat direction system (ACDS), and the Ship Self-Defense System local area networks to create a single tactical picture and a central integrated combat direction for a Quick Reaction Combat Capability. US$4.0 million was added to activate the integrated ship self-defense test site at Wallops Island, US$2.0 million for continued NULKA development, and US$4.0 million to accelerate the IRST program.

The conferees directed the Secretary of the Navy to assess the requirement for close-in defense of Navy surface ships as discussed in the House report (H. Rpt. 105 132), and to report the results of that assessment and the plans for meeting the requirement to the Congressional defense committees by February 28, 1998.

FY99 Congressional Action. The FY99 Appropriations Conference increased RDT&E funding for Ship Self Defense to US$38.944 million (+US$16 million) and other funding to US$156.665 million (+US$8.5 million). In debate over the new LPD-17 class ship appropriation, the committee directed the Navy to move toward a new, enclosed mast system. Congress would require ongoing reports from the Navy on ship self-defense improvements.

Funding

US FUNDING

	FY97		FY98		FY99		FY00(Req)	
	QTY	AMT	QTY	AMT	QTY	AMT	QTY	AMT
RDT&E (USN)								
PE#0603755N								
Ship Self-Defense								
U2039 CEC	-	224.3*	-	-	-	-	-	-
U2039 Cooperative								
U2133 QRCC	-	7.6	-	3.4	-	4.6	-	7.8
U2136 LINK IRON	-	28.2	-	3.4	-	0.0	-	0.0
U2184 FACT	-	7.3	-	6.2	-	7.8	-	7.8
RDT&E Total	-	267.4	-	13.0	-	12.4	-	15.6

* Became PE#0603658N in FY98.

	FY01(Req)		FY02(Req)		FY03(Req)		FY04(Req)	
	QTY	AMT	QTY	AMT	QTY	AMT	QTY	AMT
RDT&E (USN estimate)								
U2133	-	4.6	-	4.7	-	4.8	-	TBD
U2184	-	7.9	-	8.1	-	8.2	-	TBD
RDT&E Total	-	12.5	-	12.8	-	13.0	-	TBD

	FY97		FY98		FY99		FY00(Req)	
	QTY	AMT	QTY	AMT	QTY	AMT	QTY	AMT
RDT&E (USN)								
PE#0604755N								
Ship Self-Defense								
U0166 SPS Improvement Program	-	19.6	-	8.5	-	2.7	-	0.5
U0167 Rolling Airframe Missile	-	18.8	-	18.7	-	4.2	-	7.6
U0172 Close-In Weapons Sys (Phalanx)		4.6	-	0.0	-	0.0	-	0.0
U0173 NATO Sea Sparrow	-	44.8	-	47.1	-	32.7	-	13.1
U0665 IRST	-	7.2	-	0.0	-	0.0	-	0.0
U0954 Shipboard EW								
U0954 Ship Improv	-	8.1	-	2.7	-	2.0	-	2.7
U2178 QRCC	-	25.6	-	46.2	-	26.8	-	24.3
U2190 NULKA Decoy		6.0	-	9.9	-	2.3	-	1.4
U2309 AIEWS	-	0.0	-	26.1	-	40.9	-	53.2
U2348 MFR	-	0.0	-	0.0	-	35.6	-	71.7
U2349 SSD Launch	-	0.0	-	0.0	-	0.0	-	0.0
U2442 IRST Dev	-	0.0	-	3.9	-	1.0	-	0.0
RDT&E Total	-	134.7	-	162.8	-	148.2	-	174.5

	FY01(Req)		FY02(Req)		FY03(Req)		FY04(Req)	
	QTY	AMT	QTY	AMT	QTY	AMT	QTY	AMT
RDT&E								
(USN estimate)								
U0166	-	1.7	-	1.8	-	1.8	-	1.9
U0167	-	7.8	-	7.9	-	8.1	-	TBD
U0173	-	4.6	-	4.8	-	5.0	-	TBD
U2178	-	13.4	-	13.6	-	13.9	-	TBD
U2190	-	1.1	-	0.5	-	1.1	-	TBD
U2256	-	4.5	-	1.0	-	0.0	-	0.0
U2309	-	34.9	-	35.4	-	45.5	-	TBD
U2348	-	78.5	-	88.4	-	74.7	-	TBD
U2349	-	7.3	-	11.9	-	14.8	-	TBD
RDT&E Total	-	147.6	-	162.5	-	163.1	-	TBD

NOTE: The FY99 Defense Appropriation Conference increased RDT&E funding for Ship Self Defense to US$38.944 million (+US$16 million) and other funding to US$156.665 million (+US$8.5 million).

All US$ are in millions.

Recent Contracts

No recent contracts identified.

Timetable

PE#0603755N

Month	Year	Major Development
QRCC		
Jun	1993	SSDS Mk 1 Demonstration
Aug	1993	RAIDS Milestone III
2Q	FY95	Mk 1 Milestone II, EMD
2Q	FY96	Mk 1 Procurement
4Q	FY96	OA
1Q	FY97	DT-IIA/B
4Q	FY97	OT-IIB, LSD Operational Capability
2Q	FY98	Milestone III
4Q	FY98	Self Defense Test Ship FOT&E, SDTS DT-IIIA/B
2Q	FY99	Program Review
1Q	FY00	CVN 76 hardware delivery
2Q	FY01	LPD 17 software delivery
4Q	FY01	CVN 68 software delivery, CVN/LPD/LHD/LHA Operational Capability
2Q	FY02	CVN 76, LPD 17 software delivery, CVN 68 DT-IIIC Techeval
3Q	FY02	CVN 68 OT-IIIB, Program Review
1Q	FY03	LPD 17 delivers
2Q	FY03	CVN 76 delivers

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Month	Year	Major Development
SPS Improvements		
1Q	FY95	SPQ-9 Milestone IV/II, contract award for 2 PPKs
1/2Q	FY95	SPQ-9(I) ADM at-sea test
3Q	FY95	SPQ-9B PDR
	FY96	SPQ-9B CDR
4Q	FY96	SPQ-9B PRR
3Q	FY97	SPQ-9B FAT
Jun	1997	Two SPQ-9B LRIP option awarded
1Q	FY98	SPQ-9B integration at LBTS, contract lightweight antenna development
2Q	FY98	Four LRIP, one production system contract award planned
4Q	FY98	Complete lightweight antenna development
2Q	FY99	SPQ-9B MS III, production contract award (5 units)
2Q	FY99	SPQ-9B last LRIP delivery
May	2000	First SPQ-9B production delivery
4Q	FY00	Last production unit delivery (initial contract)
CIWS Improvement		
2Q	FY95	PIP PDR
4Q	FY95	PIP CDR
4Q	FY95	HOLC DT/OT
3Q	FY97	Milestone III
IRST/TISS		
3Q	FY95	TISS MS II
4Q	FY95	IRST MS II
3Q	FY95	TISS EMD
4Q	FY95	Award IRST EMD Phase 1
1Q	FY96	Milestone II
4Q	FY96	IRST PDR
	FY98	Award IRST Phase 2 EMD
2Q	FY98	IRST PDR
3Q	FY98	Start build
QRCC		
Aug	1993	RAIDS Milestone III
2Q	FY95	Mk 1 Milestone II, EMD
2Q	FY96	Mk 1 Procurement
4Q	FY96	OA
1Q	FY97	DT-IIA/B
4Q	FY97	OT-IIB, LSD Operational Capability
2Q	FY98	Milestone III
4Q	FY98	Self Defense Test Ship FOT&E, SDTS DT-IIIA/B
2Q	FY99	Program Review
1Q	FY00	CVN 76 hardware delivery
2Q	FY01	LPD 17 software delivery
4Q	FY01	CVN 68 software delivery, CVN/LPD/LHD/LHA Operational Capability
2Q	FY02	CVN 76, LPD 17 software delivery, CVN 68 DT-IIIC Techeval
3Q	FY02	CVN 68 OT-IIIB, Program Review
1Q	FY03	LPD 17 delivers
2Q	FY03	CVN 76 delivers
NULKA Decoy		

Month	Year	Major Development
	1972	Australian study of effective anti-ship missile countermeasures study
	1975	Rocket development begins
	1981	First flight of WINNIN carry system
Aug	1986	US/Australian Memorandum of Understanding for development signed
Oct	1988	Joint TEMP Rev. 1 signed
	FY90	Begin NULKA engineering development model testing began
	1992	US Techeval/Opeval complete
3Q	FY93	Begin US launch subsystem development
	1995	Australia began to install NULKA on one *Adelaide* frigate
4Q	FY95	Complete US launch subsystem development
	1996	Australia completes *Adelaide* installation
1Q	FY96	System qualification tests began
1Q	FY96	US Developmental Test
2Q	FY96	US Operational Test, Milestone IIA
3Q	FY97	Decoy LRIP award
Jun	1997	Canada procures NULKA
4Q	FY98	Milestone III (Decoy)
2Q	FY00	Deliveries begin

AIEWS

	FY94	Phase E CDR
4Q	FY94	ADCAP/DDI DT/OT II
2Q	FY95	ADCAP MS III
	FY95	AIEWS Phase I development
3Q	FY95	AIEWS Phase 1 award
	1996	Concept exploration and definition studies
Dec	1997	SLY-2(V) EMD contract award Increment 1
3Q	FY98	Increment 1 SRR
1Q	FY99	Increment 1 PDR
2Q	FY99	Increment 1 CDR
3Q	FY00	Increment 1 CS integration
	FY01	Increment 1 EDM deliveries
3Q	FY01	Increment 1 OT IIA (At Sea OA)
4Q	FY01	LRIP Option
1Q	FY02	Increment 2 EOA
4Q	FY02	Increment 1 Milestone III, 1st LRIP delivery, Increment 2 option award
1Q	FY03	Increment 2 SRR
3Q	FY03	Increment 2 PDR
4Q	FY03	Increment 2 CDR
2Q	FY04	Increment 1 production delivery

Worldwide Distribution

These are **US** only programs, except for the Rolling Airframe and NATO Sea Sparrow missile projects.

Forecast Rationale

Ship self defense is a Navy priority and equipping ships with effective protection is generating significant RDT&E and procurement into the next century. This effort is multifaceted and concentrates on weapons upgrades, sensor enhancements, and data communications and processing innovations. A key to the program's success is more centralized management and increased priority.

The USS *Stark* incident in the Persian Gulf was Capitol Hill's trigger and remains the benchmark. Congressional prompting is critical to preventing another *Stark* incident. Legislative and programmatic emphasis have been converted into appropriations additions.

A major change in emphasis on these programs developed out of the Navy's strategic and tactical switch from deep sea/blue-water operations to operations in the littoral area close to shore. In the littoral, ships face far more deadly threats from surface-skimming missiles which can be launched without warning from shore sites or ships that are difficult to detect because of shore line and small boat clutter. Reaction time will be limited and early detection/rapid reaction critical.

The Cooperative Engagement Capability effort was the largest effort in this program through the forecast period, but it has become a stand-alone program element (PE#0603658N).

Because the development of effective self-defense for the fleet is a high-interest item in Congress, funding should remain robust until systems Capitol Hill favors have been developed. For the next several years, this will probably be the trend, and the Navy will get most of or more than what it asks for, as long as Congress continues to have confidence in the program.

One criticism has been that the US ship defense philosophy and tactics were conceived with a Soviet deep water threat in mind. As "friendly" export weapons become more commonplace in the Third World, and as the likelihood of combat in the Third World increases, enhanced protection becomes even more important. Another concern grows out of the philosophical difference between US and European, specifically British, naval EW. The Royal Navy incorporates its shipboard electronic warfare systems more as an integral part of the vessel's overall combat capability than the US does. A major thrust of the ship self-defense programs has been to better integrate the systems on a ship as well as integrate the data from multiple ships in a battle group.

The forecast combines projected funding for both program elements. The decline in outyear funding reflects the movement of the Cooperative Engagement Capability effort into a separate program element.

Ten-Year Outlook

ESTIMATED CALENDAR YEAR FUNDING ($ in millions)

			High Confidence Level				Good Confidence Level				Speculative		
Designation	Application	thru 98	99	00	01	02	03	04	05	06	07	08	Total 99-08
SHIP SELF DEFENSE	SURFACE SHIPS (USN)	1953.49	160.50	186.80	160.20	175.29	176.08	170.00	175.00	160.00	170.00	170.00	1703.87