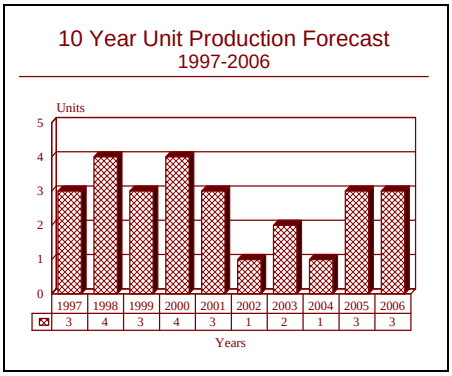
SPY-1(V) (AEGIS) -Archived 5/98

Outlook

- In production
- Ongoing logistics support and upgrades
- Production supports DDG-51 destroyer construction
- Japanese production for Kongo class complete
- Variant selected for Spanish frigate program



Orientation

Description. 3D, multi-function, phased-array naval radar system. It is part of the AEGIS Anti-Air Warfare weapons system.

Sponsor

US Navy
Naval Sea Systems Command (NAVSEA)
2531 Jefferson Davis Highway
Arlington, Virginia (VA) 22202
USA
Tel: +1 703 602 3381

Contractors

Lockheed Martin Corp
6801 Rockledge Drive
Bethesda, Maryland (MD) 20817
USA
Tel: +1 301 897 6711
Fax: +1 301 897 6800
(Prime)

Sanders, a Lockheed Martin Co
95 Canal St
Nashua, New Hampshire (NH) 06061-0868
USA
Tel: +1 603 885 4321
Fax: +1 603 885 3655
(AIMS IFF/CIS system)

Computer Sciences Corp (CSC)
2100 E. Grand Ave
El Segundo, California (CA) 90245
USA
Tel: +1 310 615 0311
Fax: +1 310 640 2648
(Software/technical support)

Litton Industries
Electron Tube Division
Williamsport, Pennsylvania (PA)
USA
(Double-duty cross-field amplifier tubes)

Raytheon Co
Equipment Division
1001 Boston Post Rd
Marlborough, Massachusetts (MA) 01752
USA
Tel: +1 508 490 1000
FaxRadar amplifiers, single and double-duty microwave tubes, radar transmitters, technical support, product improvement)

Teledyne Microwave Inc
1290 Terra Bella Ave
Mountain View, California (CA) 94043
USA
Tel: +1 415 968 2211
Fax: +1 415 960 8689
(Traveling wave tubes for SPY-1B/D)

Tracor Inc
1400 Georgia Ave
Silver Spring, Maryland (MD) 20906
USA
Tel: +1 301 231 1000
Fax: +1 301 231 2277
(Engineering & analytical support)

Varian Associates Inc
Crossed Field & Receiver Protector Products
Div 150 Sohier Rd
Beverly, Massachusetts (MA) 01915
USA
Tel: +1 508 922 6000
Fax: +1 508 922 8914
(Crossed field amplifiers)

Varian Associates Inc
Microwave Tube Div
3050 Hansen Way
Palo Alto, California (CA) 94304
USA
Tel: +1 415 493 4000
Fax: +1 415 493 0307
(Continuous wave illuminator traveling wave tubes and solenoids for SPY-1D)

Status. In production, ongoing logistics support and upgrades.

Total Produced. Through 1996, 27 SPY-1A/B and 23 SPY-1D systems had been delivered.

Application. US Navy CG-47 AEGIS class cruisers, DDG-51 AEGIS class destroyers, and Japanese DDG-173 Kongo class destroyers, Spanish F-100 Frigates.

Price Range. Approximately US$20 million (single unit cost as part of a US$57.8 million three-unit purchase of the SPY-1A/1B transmitter group and Mk 99 Mod 1 fire control system).

Technical Data

Dimensions	**Metric**	**US**
Array face:	3.5 x 3.5 m	11.5 x 11.5 ft
Weight (Above Decks)		
SPY-1A:	5,915 kg	13,030 lb
SPY-1B:	3,587 kg	7,900 lb
Weight (Below Decks)		
SPY-1A:	59,739 kg	131,584 lb
Characteristics		
Frequency:	3.1 to 3.5 GHz	
Power out:	4 to 6 MW peak 58 kW average	
Pulse Width:	6.4, 12.7, 25.4, 51 ☞sec	
Pulse Compression:	128:1	
Bandwidth:	10 MHz (sustained coherent) 40 MHz (instantaneous)	
System Gain:	42 dB	
Antenna elements:	4,480 per face	
Faces per ship	4 (2 fore, 2 aft)	
Coverage:	110☜ (each face) 360☜ total	
Range:	463 km	250+ nm
Track capacity:	100+ Increased in Baseline 4 ships	

Design Features. The AEGIS anti-Air weapons system is made up of the SPY-1(V) sensor, a core command & decision element, fire control system, control consoles and large-screen displays, air search and fire control radars, missile launchers, and RIM-66 Standard MR and ER anti-aircraft missiles.

The SPY-1(V) is configured with four phased arrays each, two mounted fore and two aft. Each antenna is subdivided into 140 array modules, each with 32 radiating elements. There are 4,096 transmitting elements and 4,352 receiving elements. The phase shifters include ultra-precise, temperature-resistant synthetic garnet crystals, and are driven by four-channel driver boards, of which there are eight identical ones to ensure redundancy and survivability.

The SPY-1(V) is connected to the AEGIS weapons system via UYK-7 digital computers. These are upgraded with UYK-43/44s in Baseline 4 ships to increase target capacity and processor speed. The UYK-() controls the radar beams for search, detection and tracking. In addition, the UYK-7 provides guidance information for the ship's own missiles. The use of parallel redundant transmitter channels results in graceful degradation instead of sudden system failure.

Four UYA-4 or -21 3' X 6" square large screen displays (LSD)(3" 6" square) project processed anti-surface, anti-air, and anti-submarine warfare information. There are two console sets facing the LSDs and five Automated Status Boards (ASBs) mounted above the LSDs.

The SPY-1 can change frequencies automatically to avoid countermeasures and interference. Advanced digital signal processing techniques suppress jamming, chaff, and sea clutter.

One limitation of the system was that the radar data display could not distinguish the head-on cross-section of a target. The shooting down in the Persian Gulf of the Iranian Airbus in July 1988 by the USS *Vincennes* was partly the result of the inability to get an accurate size ID on the oncoming aircraft. IFF identification was not part of the original SPY-1, and problems with the operation of an older transponder caused a false-hostile track to be assigned to the Airbus.

Sanders, a Lockheed Martin Company developed their AIMS antenna system to work with the UPX-29 Central Identification System to provide ATC Radar Beacon, IFF, Mk XII combat identification capability. It installs the OE-120/UPX circular array of 64 radiating elements on AEGIS ships to enhance the identification capability of the AAW system.

Operational Characteristics. The SPY-1(V) radar is the heart of the AEGIS weapons system for US Navy CG-47 guided missile cruisers and the DDG-51 guided missile destroyer. In a carrier battle group, fighter aircraft provide an outer-layer of defense while the AEGIS system provides the inner layer. AEGIS was designed to protect naval battle groups from aircraft, missile, and surface threats. AEGIS employs a number of separate weapons systems, including Harpoon anti-ship missiles, Standard-ER (SM-2) surface-to-air missiles and the Phalanx Close-In Weapons System.

By borrowing the hull design of the Spruance class destroyer (DD-963) for the CG-47, the Navy was able to cram a great deal of electronic equipment, including the SPY-1(V) radar, into a vessel that the Navy felt would be capable of meeting almost any potential threat.

The AEGIS system can track over a hundred targets simultaneously (ranging from surface to subsurface to airborne) at ranges of over 250 nautical miles. This range limit is specifically set, with the radar receiver unable to accept returns from outside this range limitation since the radar is only able to generate a set number of beams or dwells per second. The AEGIS computer assigns high rates of dwell coverage to new targets until tracks are established. There is immediate digitization of any signal sent out and returned so it can be identified.

The information from AEGIS is a major input to the Navy's Cooperative Engagement Capability which fuses data from multiple sources to provide all ships in a battle group into a comprehensive picture of the naval situation. AEGIS is the main surface sensor while the E-2C Hawkeye is the key airborne radar.

Variants/Upgrades

SPY-1A. AEGIS cruisers up to and including CG-58.

SPY-1B. AEGIS cruisers from CG-59 onward. The B model features a new antenna design with lower sidelobes and an improved signal processor. The new transmitter has the same peak power but double the duty cycle.

SPY-1D. DDG-51 AEGIS destroyers. The Arleigh Burke class ships are being built to boost the Navy's guided missile destroyer force. The SPY-1D radars are smaller and lighter than those on the CG-47 guided missile cruisers. The destroyers carry a single radar transmitter instead of two, and in place of the four target illuminators on the CG-47 ships, there will be only three. Use of VLSI

technology has resulted in a considerable space savings. The ECCM capabilities have been enhanced.

An **SPY-1C** was proposed for use on aircraft carriers, but the program was canceled.

The **SPY-1E** was developed from the Littoral Warfare Radar, the engineering model for the EDM 4B. It features an enhanced ability to detect, track, and target sea-skimming cruise missiles. The upgrade includes some ballistic missile tracking upgrades. Testing was planned to begin 1996 with first deployment on DDG-87 sometime in 1999..

The upgraded AEGIS suite includes the Joint Tactical Information Distribution System (JTIDS)/Command and Control Processor (C2P), TADIL J, Combat Direction Finding, Tactical Data Information Exchange System (TADIX B), SLQ-32(V)3 Active Electronic Countermeasures, and Standard Extended Range (ER) Missile.

SPY-1F proposed as the identifier for the international version of the radar.

Baselines. The Navy Baselines refer to improvements to the AEGIS system as a whole.

Baseline 2 (CG-52 through 58) consists of the vertical launch system, Tomahawk weapons system, and anti-submarine warfare upgrades.

Baseline 3 (CG-59 through 64) includes the SPY-1B and UYQ-21 console.

Baseline 4 (CG-65 through 73) converts computer programs to the UYK-43/44 computers and supplies increased battle group capability in the AEGIS display system.

Baseline 5 is the version installed on DDG-51 class ships with the Flight III production lot. The EDM-4B (Engineering Development Model 4B) variant features computer program upgrades and equipment modifications which will enhance the capability to deal with anti-ship missiles.

Baseline 6 was planned for the last ship in FY94 that included embarked helicopters, Evolved Sea Sparrow Missiles (ESSM), fiber optics as applied to Data Multiplexing System (DMS) and Interior Voice Communications System (IVCS), and implementation of affordability initiatives. The Radar Set Controller Environment Simulator (RSCES) and Battle Force Tactical Trainer (BFTT) will be integrated into the Baseline 6 system.

Baseline 7 upgrades will include upgrades to the SPY-1D radar system, integration of Cooperative Engagement Capability, and Anti-Tactical Ballistic Missile capability, along with distributed fiber-optic computer architecture.

Program Review

Background. In the early 1960s, it became obvious to naval planners that self-defense sensors based on the rotating radar antennas was no longer adequate. Such radars and their fire control systems could not cope with high-speed anti-ship missiles, especially the developing sea-skimmers, or Mach 2 aircraft. Emerging technology was creating the ability to field a phased-array radar that could project a pencil-thin beam out to great distances (250+ nm). By incorporating advanced computer software, also emerging during that period, a phased-array-based weapons system could spot, track, and illuminate multiple targets nearly simultaneously for a ship's defensive weapons. In addition, the phased-array design allowed the radar to defeat hostile electronic countermeasures (ECM) by "burning through," that is, channeling as much power as necessary into pencil-thin beams to overcome jamming. The new beam patterns were not limited by the same power density considerations as rotating antennas. Advanced in processing capabilities helped by improving the way radar return data could be analyzed and used.

Following a contract award for the AEGIS weapons system in 1969, RCA began testing of an SPY-1 phased-array radar in 1972. In 1973, the SPY-1 was transferred to Long Beach, CA, for installation aboard the weapons system test ship, USS *Norton Sound* (AVM-1).

During tests in 1974, the SPY-1 aboard the *Norton Sound* detected and automatically tracked 20 aircraft flying over the Pacific Ocean. At the Navy's Combat System Engineering Development facility in Moorestown, NJ, a series of tests pitted an AEGIS system and similar SPY-1 radar housed in a land-based CG-47 bridge mockup against a host of airborne targets and threats. Navy EA-6B aircraft with their jamming pods at full power could not successfully jam the SPY-1 AEGIS radar. A USAF KC-135 outfitted with TREE SHARK, one of the most powerful jammers available at the time (reportedly equivalent to 32 EA-6B aircraft at full jamming power), also couldn't completely jam the SPY-1. In each case, the SPY-1's radar beams were able to "burn through" the jammers and simulate the launching of defense missiles.

While hundreds of weapons firings at a variety of targets, including drones, missiles, and aircraft using the AEGIS system have taken place during tests, few misses were attributed to the performance of the SPY-1(V) radar itself. The misses that did occur tended to be the result of

computer problems, missile launcher difficulty, or human error.

One notable exception took place during a US$30 million eight-day test of AEGIS off the coast of Puerto Rico in April 1984. Using SM-2 (RIM-67B) Block 1 surface-to-air missiles, the AEGIS system aboard the USS *Ticonderoga* destroyed 10 of 11 target drones. At one point, a drone launched from 70,000 ft and part of a group of four drones launched simultaneously, managed to elude detection and slip through the AEGIS defense. Two targets during this test were "constructive ships" (one simulating a battleship and one representing an oiler) and were attacked by one drone each from the group with the USS *Ticonderoga* attacked by the remaining two. The battleship target was 17 miles away from the USS *Ticonderoga* and the oiler nine miles away.

Navy officials said that the one drone that slipped through (targeted for the oiler) was not detected and attacked because it crossed the beams of several jammers and because of the use of heavy chaff. Despite this less-than-perfect score, however, the test was in sharp contrast to an earlier one in which the USS *Ticonderoga* was able to hit only six of 18 targets. Poor crew training was cited in that case.

During 1985, the USS *Yorktown*, the second ship of the class, was subjected to rigorous shock tests. The results were excellent and there was only minor and temporary damage in spite of the severity of the shocks applied. The Navy continues to enforce a rigid shock-test program that includes all new construction.

During debate and approval of the FY93 Defense Authorization and Appropriations, Congressional conference committees approved full funding of the AEGIS combat system engineering request of US$89.9 million. This included US$28.9 million to develop an upgrade to the AEGIS radar, the Engineering Development Model 4B (EDM-4B). In the Authorization Bill the House recommended the full authorization, the Senate deleted the EDM-4B funds based on information that the Navy did not intend to proceed with the development.

When the conference members investigated and found that the Navy did intend to develop the upgraded system, they approved full funding, but with restrictions. They restricted the Secretary of the Navy from spending more than 50 percent of the EDM-4B funds until submitting a report to the congressional defense committees detailing the following information:

An estimate of the threat from anti-ship missiles.

The estimated cost and schedule for development and testing, along with estimated procurement costs, by year, to add EDM-4B to future DDG-51 destroyers.

The Navy's plan for fielding EDM-4B, as well as other ship self defense systems (including sensors and weapons).

The Appropriations conference restored EDM-4B funds deleted by the Senate, but directed that not more that US$11.6 million be obligated until the Secretary of the Navy certify to Congress that development and procurement of the radar are fully funded in the next FYDP and provides an updated threat assessment addressing the need for the system. The Navy informed Congress that the spending restriction would not impact ongoing contractor activities.

An October 1995 *Commerce Business Daily* notice announced that the Navy planned to solicit engineering analyses of the AEGIS Combat System performance in fleet defense, ship self-defense, amphibious operations, and Theater Ballistic Missile Defense missions. The analysis would include evaluating the SPY-1 radar performance, airborne fleet surveillance techniques, associated data fusion, application of the Cooperative Engagement Capability concept, and missile system performance. The effort would include FMS activities. A sole-source base year plus four nine-year options would be issued to Technology Service Corporation, Silver Spring, Maryland.

On September 11, 1996, two AEGIS cruisers, USS *Anzio* (CG-68) and USS *Cape St. George* (CG-71) took part in the Cooperative Engagement Capability (CEC) Initial Operational Capability final missile firing test. Operating near the AEGIS Combat Systems Center (ACSC), Wallops Island, Virginia, and in the Gulf of Mexico, the ships conducted successful missile firing operations, setting up the final approval of CEC for Fleet operations. The two ships shared SPY-1 data through the CEC system and proved that they were not limited to weapons operations using only own-ship sensor.

AEGIS Combat System Engineering PE 0604307N. The AEGIS Combat System R&D effort provides immediate and effective capability to counter the current and expected air, surface and subsurface threats as articulated in Naval Maritime Intelligence Center (NAVMIC) Threat Assessments #012-91 and #018-91 dated September 1991. Since the CG-47 and DDG-51 ships extend into the 21st century, changes in the threat capability and advances in technology such as fiber optics and distributed architecture, local area networks will require corresponding weapons system and combat system changes.

This program provides the combat system engineering and selected weapons development necessary for such a continued increase in the capability of the AEGIS combat system in AEGIS cruisers and destroyers. It will also

allow later ships of these classes to take advantage of maturing equipment and weapons systems being developed in other Navy research and development programs.

Modifications of AEGIS weapons system computer programs must be made to integrate these capabilities into the AEGIS combat system so that battle effectiveness will be retained against the evolving threat. Weapons and combat system upgrades will be backfitted into CG-47 class and DDG-51 class ships already in the fleet.

Project K1447 AEGIS Combat Systems Improvements. This project provides AEGIS cruiser and destroyer combat system upgrades to integrate new equipment and systems to maintain pace with the threat and to capture advances in technology such as fiber optics and distributed architecture. The ships are upgraded in blocks and the combat system in a series of baselines.

Baseline 2 (CG-52 to 58) consisted of the vertical launching system, TOMAHAWK weapons system, and anti-submarine warfare upgrades.

Baseline 3 (CG-59 to 64) included the SPY-1B radar and AN/UYQ-21 consoles.

Baseline 4 (CG-65 to 73) integrated the AN/UYK-43/44 computers with superset computer programs developed for the DDG-51. Baseline 4 is the base combat system for DDG-51 to 67.

Baseline 5 is targeted for FY92 ships and includes the Joint Tactical Information Distribution System (JTIDS)/ Command and Control Processor (C2P), TADIL J, Combat Direction Finding, Tactical Data Information Exchange System (TADIX B), AN/SLQ-32(V)3 Active Electronic Countermeasures, and AEGIS Extended Range (ER) Missile.

Baseline 5 will be developed in three steps (phases):

Phase I integrates AEGIS ER and supports the missile Initial Operational Capability.

Phase II integrates all planned upgrades except for JTIDS so they can be backfitted into Baseline 4 ships (the computer programs can operate in Baseline 4 ships whether any or all of the Baseline 5 new systems are installed). The effort includes Deceptive Electronic Countermeasures, Track Load Control algorithms, and the Track Initiation Processor.

Phase III integrates JTIDS and the O-663 color display Tactical Graphics capability into the AEGIS Combat System.

Baseline 6 will also be developed in phases. The upgrades include embarked helicopters, Fiber Optics as applied to Data Multiplexing Systems, implementation of affordability initiatives, the Radar Set Controller Environment Simulator (RSCES) and Battle Force Tactical Trainer (BFTT), Advanced Display System (Congressionally mandated but not funded), Display Simplification Initiative (DSI), Evolved SeaSparrow Missile (ESSM), Tactical Information Communications Analyzer (TICA), Identification (ID) upgrades Phase I, Advanced Tomahawk Weapon Control System (ATWCS) Phase II, and Fire Control System upgrades. Phase I was planned for the last ship in FY94 and Phase II is planned for the last ship in FY96. SPY-1D radar upgrades will be introduced for serial production in the last ship in FY98.

Baseline 7 upgrades include upgrades to the SPY-1D radar system, integration of Cooperative Engagement Capability, and Tactical Ballistic Missile Defense (TBMD) capability, along with distributed computer architecture with fiber optics. The first forward fit implementation and funding will be provided from other sources. The upgrade includes advanced computer architecture, ID upgrades Phase II, Cueing Sensor, STANDARD Missile-2 Block IIIB, Light Airborne Multipurpose System (LAMPS) helicopter Mark III, Block II, and Mark 50 torpedo with Periscope Depth Attack. It is planned for the last ship in FY00.

The AEGIS combat system will continue to be upgraded at approved intervals.

FY92 accomplishments were to conduct SPY-1D Technical and Operational Evaluation (TECHEVAL/ OPEVAL) Development Test/Operational Test IIE (DT/ OT-IIE) in Arleigh Burke (DDG-51). The Navy also performed element test, evaluation, demonstration and qualification of OJ663 console variant of the AEGIS display system computer program in Baseline 4 Phase II ships. Program personnel conducted demo and element qualification testing.

The Program Office also conducted a Preliminary Design Review (PDR) II and Critical Design Review (CDR); completed design specifications, and commenced computer program coding, debugging and testing for AEGIS ER integration into the AEGIS weapons system (Baseline 5 Phase I) at the Combat System Engineering Development (CSED) site. They also began developing design specifications to integrate Baseline 5 Phase II (less JTIDS) into the combat system and conducted a PDR.

They commenced system definition to integrate JTIDS into the AEGIS Combat System (Baseline 5 Phase III) as well as began system definition to integrate the Evolved Sea Sparrow Missile into the AEGIS Combat System (Baseline 6) at the CSED site.

FY93 was funded at US$76.274 million. Engineers completed computer program coding, debugging, and testing of AEGIS ER integration into the AEGIS Weapons System Baseline 5 Phase I. Program personnel also

demonstrated the system at the Combat System Engineering Development (CSED) Site. These efforts cost US$4.6 million. US$16.5 million was spent to complete design specifications and conduct a Critical Design Review of Baseline II (less JTIDS). The Navy began computer program coding, debugging, and testing at the CSED Site for integration into the AEGIS Combat System. Program personnel also completed system definition, conducted a System Design Review (SDR) and Preliminary Design Review, commencing design specifications for Baseline 5 Phase III (with JTIDS), at a cost of US$12.406 million.

Also in FY93, the Navy performed the system definition to integrate Baseline 6 upgrades into the AEGIS Combat System (US$6.4 million). US$8.9 million was provided for the RDT&E share if operations and maintenance at the CSED Site, Program Generation Center, Computer Program Test Site, and Land Based Test Site. US$17.781 million was also provided for the participation of Navy laboratories and field activities to perform the engineering and scientific services necessary to monitor and direct the baseline efforts.

Development of the optical disk upgrade to the UYK-16 memory storage devices began, at a cost of US$3.0 million. Development of an adjunct processor began, to provide additional computing capacity for future post-baseline 5, Phase III Combat System upgrades, at a cost of US$6.687 million.

In FY94, the Navy resolved problems identified during Combat System Engineering Development (CSED) Site system demo of Baseline 5 Phase I, spending US$400,000 on the effort. Planners also spend US$12.6 million to complete Baseline 5 Phase II computer program coding along with debugging, testing, and performing the Systems Qualification Test (SQT) at the CSED Site. The Navy conducted the Baseline 5 Phase III Critical Design Review (CDR) and commenced computer program coding, debugging and testing at the CSED Site to integrate Baseline 5 Phase III into the AEGIS Combat System, funding the effort at US$12.2 million. The Program Office spent US$24.116 million conducting the Baseline 6 Phase I System Design Review (SDR). This funding also covered the engineers starting to re-engineer the OJ-663 Tactical Graphics Console display equipment and single cable Local Area Network (LAN) into ruggedized commercial components and standards (Display Simplification). They also began developing the Baseline 6 Phase I design specifications.

Another part of the FY94 plan included US$6.0 million for the RDT&E share of operations and maintenance of the CSED Site, Program Generation Center, Computer Program Test Site, and Land Based Test Site. US$20.643 million provided for the participation of Navy laboratories and field activities to perform the engineering and scientific services necessary to monitor and direct the baseline efforts.

FY95 accomplishments included spending US$19.519 million to complete computer program coding, debugging and testing of Baseline 5 Phase III. Engineers conducted multi-element integration of Baseline 5 Phase III at the CSED Site and conducted System Qualification Test (SQT). The Navy put US$19.50 million into continued development of the Baseline 6 Phase I design specifications and program officials conducted a Preliminary Design Review (PDR). Planners also initiated rehosting of AEGIS Display System (ADS) and Command and Decision (C&D) display related computer programs into a Commercial-Off-the-Shelf (COTS) based architecture.

Designers began system engineering and development of BFTT Phase I/AEGIS Combat Training System (ACTS) rehost. The program offices stopped work on the OJ-663 console with display simplification due to an Assistant Secretary of Navy (Research, Development and Acquisition) decision.

US$2.10 was used to start system engineering and design to integrate ESSM into Baseline 6 Phase II. US$2.60 million started integration of SPY-1D radar upgrade (SPY-1D(V), formerly known as EDM-4B) into the AEGIS Weapons System and US$1.684 million started Engineering Development Model-5 (EDM-5) for the Advanced Processing in Baseline 7 Phase I. US$1.30 million was budgeted to begin STANDARD Missile-2 (SM-2) Block IIIB and Block IV capability enhancement engineering, and begin a technical assessment and feasibility studies for cueing sensor upgrades which will be integrated into Baseline 7 Phase II.

This program continued to provide funding (US$8.70 million) for the RDT&E share of operations and maintenance at the CSED Site, Program Generation Center, Computer Program Test Site, and Land Based Test Site. US$19.678 million was used to continue to provide for the participation of Navy laboratories and field activities to perform the engineering and scientific services necessary to monitor and direct the baseline efforts.

The FY96 plan set aside US$250,000 to complete Baseline 5 Phase III and US$18.965 million was used to conduct a Baseline 6 Phase I CDR-1 and CDR-2. Designers also started computer program coding, debugging and testing and continued re-hosting the AEGIS Combat Training System (ACTS) computer programs for BFTT Phase I and development of BFTT/ACTS interface. They continued rehosting ADS and C&D display and ID related computer programs into a

COTS based Advanced Display System architecture. Engineers continued to design an ID upgrade Phase I for Baseline 6 Phase I and continued engineering the Adjunct Processor.

US$14.950 went toward conducting a system definition for Baseline 6 Phase II and continuing system engineering for ESSM integration efforts. US$4.90 million was spent to rehost the SPY-1D(V) radar upgrade computer program control loop into COTS based adjunct processors. Developers continued system engineering and development of an advanced processing EDM-5 to support implementation of an open system networked architecture in Baseline 7 (US$9.216 million).

Planners spent US$1.154 million to continue SM-2 Block IIIB and Block IV capability enhancement engineering, and continued technical assessment and feasibility studies for cueing sensor upgrades which will be integrated into Baseline 7 Phase II. They budgeted US$5.70 million to continue to provide the RDT&E share of operations and maintenance of the CSED Site, Program Generation Center, Computer Program Test Site, and Land Based Test Site. US$19.678 million was provided for the participation of Navy laboratories and field activities to perform the engineering and scientific services necessary to monitor and direct the baseline efforts.

US$1.518 was reserved for Small Business Innovative Research assessment in accordance with 15 U.S.C. 638.

The FY97 plan was to continue Baseline 6 Phase I computer program coding, debugging and testing. Continue rehosting of ACTS computer programs for BFTT, and for C&D and ID related computer programs into COTS based architecture (US$16.60 million). US$19.247 million was budgeted by the program office to conduct SDR and PDR for integration of Baseline 6 Phase II upgrades including ESSM into the AEGIS Combat System. Complete development of advanced processor acceptance rack (CITADEL).

US$5.10 million was reserved to complete rehosting SPY-1D(V) code into adjunct processors including interface simulation computer programs and begin system definition for full integration of the SPY-1D(V) into new construction AEGIS Combat System in Baseline 7. US$13.50 million would be used for developing a system definition to integrate Baseline 7 Phase I upgrades into the AEGIS Combat System, start system engineering and continue advanced processing EDM-5 development for open systems networked architecture in Baseline 7 Phase I ships.

The Navy planned US$1.334 million to complete engineering SM-2 Block IIIB and Block IV capability enhancements and continue technical assessment and feasibility studies for cueing sensor upgrades which will be integrated into Baseline 7 Phase II and start new equipment engineering studies for the ID upgrade Phase II to be integrated into Baseline 7 Phase II. US$7.20 million would go to the RDT&E share of operations and maintenance of the CSED Site, Program Generation Center, Computer Program Test Site, and Land Based Test Site. US$19.556 million was budgeted for continuing to provide for the participation of Navy laboratories and field activities to perform the engineering and scientific services necessary to monitor and direct the baseline efforts.

FY96 and FY97 reductions resulted in a descoping of Baseline 6 Phase II computer program. Common Data Link Work Station (CDLMS) integration, Battle Force Tactical Trainer (BFTT) integration, and AEGIS Operator Control Device (AOCD) native mode capabilities were deleted.

Project K1776 AEGIS Weapons System Mods. This program provides for modifications to the AEGIS Weapons System MK-7 to counter the threat (Naval Maritime Intelligence Center (NAVMIC) Threat Assessment #012-91 of September 1991). The modifications will be backfitted into CG-47 class and DDG-51 class ships already in the fleet.

FY92 accomplishments were to complete Phase I development of the Fire Control System (FCS) Stable Master Oscillator (STAMO). The Program Office conducted the STAMO Critical Design Review. They also conducted system design reviews for Operational Readiness Test System (ORTS) upgrade and completed the definition of the Man-Machine Interface (MMI) and prepared preliminary ORTS upgraded specifications.

Planners completed the ORTS Data Terminal Set requirements document, which specifies a full color work station and its shipboard adaptation and continued with system engineering studies to define and develop Electronic (ECCM)/Deceptive Electronic Countermeasures (DECM) design changes relative to the eventual incorporation of these changes in the SPY-1B/B(V)/D radar systems.

Engineers defined the AEGIS Weapons System requirements to support the design effort and continued to develop computer program algorithms to improve Anti-Air Warfare (AAW) system performance against various DECM threats.

FY93 accomplishments (US$6.896 million) included coding, testing, and debugging the computer program for Operational Readiness Test System (ORTS) Man-Machine Interface (MMI) upgrade, at US$3.6 million. The Navy also continued to develop computer program algorithms to improve Anti-Air Warfare system

performance against various Deceptive Electronic Countermeasures (DECM) threats (US$3.296 million).

FY94 saw US$2.15 million spent to complete Operational Readiness Test System (ORTS), Man-Machine Interface (MMI) upgrade equipment fabrication and computer program code, test, and debug. US$503,000 was allocated to conducting system testing in preparation for demonstration of ORTS MMI upgrade at the CSED Site in FY95 and SPY-1 radar system analysis support for Cruiser and Destroyer baseline upgrades and the SPY-1B/D radar system upgrades.

In FY95, the Navy spent US$334,000 to conduct an Operational Readiness Test System (ORTS) Man-Machine Interface (MMI) upgrade CSED Site demonstration. The spending plan included US$3.834 million to develop an ORTS MMI upgrade Ordnance Alteration proof-in kit for land-based integration and test. US$234,000 was used to complete development of computer program algorithms to improve Anti-Air Warfare system performance against various Deceptive Electronic Counter-Countermeasures (DECCM) threats and US$250,000 to continue SPY-1 radar system analysis support for Cruiser and Destroyer baseline upgrades and SPY-1B/D radar system upgrades.

The FY96 plan was to complete ORTS MMI upgrade implementation (US$1.5 million) and continue SPY-1 radar system analysis support for Cruiser and Destroyer baseline upgrades and SPY-1B/D radar system upgrades (US$300,000). US$2.674 million went to begin the ORTS upgrade for Baselines 3, 4 and 5.

US$94,000 was reserved for Small Business Innovative Research assessment in accordance with 15 U.S.C. 638.

The FY97 plan set aside US$300,000 to continue SPY-1B/D upgrade analysis support; US$1.355 million to continue the ORTS upgrade for Baselines 3, 4 and 5 design, development and engineering; US$549,000 to begin SPY-1B/B(V)/D Moving Target Indicator analysis, design, development, and engineering for radar enhancements.

Fielding of the planned SPY-1B/B(V)/D DECCM improvements will be delayed at least two years because of FY97 reduction. The ORTS upgrade for Baseline 3, 4, and 5 design, development engineering and testing were sharply reduced in FY97. SPY-1B/B(V)/D DECCM design and development engineering will be delayed two years because of the FY97 reduction.

Project K1937 DDG SPY-1 Radar Upgrades. This program is required to develop selected systems and subsystems for the Arleigh Burke (DDG-51) class ships. This project funds development of equipment for the AEGIS Combat System, as opposed to the costs of integrating elements into the Combat System which is funded in Project K1447.

Funding provides for development of an upgrade to the current SPY-1D radar (EDM-4B) to enhance its capability against sea-skimming targets in increasingly more severe electronic countermeasures and in near-land clutter environments. The changes are in the transmitter, signal processor, and radar control computer program.

FY92 accomplishments were the continued systems engineering to validate performance requirements analyses and definition. Program personnel conducted a System Design Review and a Preliminary Design Review for radar upgrades and continued development of design specifications to determine equipment and firmware requirements. Engineers continued detailed radar frame, module, subassembly and cabinet design and development. The program office continued equipment procurement, begin Engineering Development Model (EDM) fabrication and assembly.

FY93 saw total funding of US$27.394 million to support the year's activities. A sum of US$3.1 million was spent completing design specifications and conducting a CDR. System engineering continued, and program code generation began. Computer program modifications were debugged and tested (US$5.8 million). US$11.9 million was spent to continue equipment procurement and EDM-4B fabrication and assembly.

In FY94, engineers completed computer program code generation along with debugging and testing, US$6.7 million. US$8.7 million went into completing EDM- 4B fabrication and completed element integration and testing. Engineers installed and performed system level integration at the CSED Site, funded at US$8.585 million.

FY95 continued system integration, spending US$1.316 million on that effort. US$2.524 million was used to conduct Electronic Countermeasures test validation at the CSED Site. US$5.890 million was budgeted for starting to rehost the radar system computer program from two UYK-43 computers to one UYK-43 and one commercial adjunct processor, including testing of microprocessors against AEGIS benchmark requirements, testing commercial operating systems, and computer architecture development.

The FY96 plan budgeted US$5.0 million to conduct Developmental Test/Operational Test-1 (DT/OT-1) at the CSED Site. The program office set aside US$5.361 million to continue rehosting the radar system computer program.

US$241,000 was reserved for Small Business Innovative Research assessment in accordance with 15 U.S.C. 638.

FY97 plans were to spend US$3.538 million to complete the radar system computer program rehosting. US$1.0 million was budgeted to conduct DT/Operational Assessment (OA) of the adjunct processor performance at the CSED Site.

Japan. The Japanese government announced in 1983 that it planned to build a class of destroyers equipped with AEGIS. From 1983 through 1987, Japan held discussions with then-contractor RCA to acquire the necessary rights and technology. Design studies of the new class began in 1985, with most of the work being completed by late 1986. An AEGIS technology- transfer request was made in mid-1987 and immediately aroused strenuous objections in Congress.

After a long and protracted struggle, Congress approved the Japanese purchase of AEGIS, to be mounted in what was to be a new class of 6,500-ton destroyers. Even though the DoD approved the purchase in 1986, approval by Congress did not come until mid-1988 for a number of reasons. Probably first and foremost was the fear that the Japanese would "steal" the technology to build their comparable systems.

This question was addressed by ensuring that production of the AEGIS system would be in the US, with no co-production or licensed manufacture. Some in Congress even wanted the platforms built in the US, but the Japanese balked at this, although they did have to increase the size of the ships since the US Navy felt that the original design was too small (at 5,200 tons) to support AEGIS. As it is, the new destroyers, at 7,250 tons (standard), are larger than Flight I and II DDG-51, although the new US Flight IIA ships will be heavier than the Japanese counterparts.

In July 1993, the DoD notified Congress of a Japanese request to procure one AEGIS system, along with a Harpoon weapons system, one Phalanx close-in weapons system, one vertical launch system, and four ASROC vertical launch ASW rocket systems. Value of the request was US$561 million.

Spain. The Spanish Navy decided to procure a version of the AEGIS SPY-1D for the four F-100 frigates they planned to build starting around the turn of the century. Spain had been expected to join the Dutch and Germans and develop an active phased array radar that would be used on the Tri-lateral Common Frigate (TCF). In 1995, Spain elected to withdraw from the program to develop the Signaal APAR radar and seek alternative solutions for the air warfare system on its new ships. US officials approached the Spanish in 1994.

Initially, the Spanish Navy investigated a downsized version of AEGIS, using the SPY-1F radar and the DANCS combat direction system. In February 1996, this was rejected in favor of a full-size AEGIS system with either the SPY-1D or SPY-1F radar. The F-100 destroyer program was then recast around a larger warship of the same size and general configuration as the DDG-51.

The F-100 would be made taller to accommodate the arrays and the Combat Information Center had to be enlarged for the Baseline 5 Phase III processors and displays. Germany has expressed some interest in AEGIS as a sensor solution for its planned Type 124 frigate. These installations were generating other European interest.

Funding

US FUNDING

	FY94		FY95		FY96		FY97	
	QTY	AMT	QTY	AMT	QTY	AMT	QTY	AMT
RDT&E (USN)								
PE0604307N								
AEGIS Combat System Engineering								
K1447 Improv	-	76.0	-	75.1	-	76.1	-	82.5
K1776 Weapn Mods	-	2.7	-	4.7	-	4.6	-	2.2
K1937 DDG Devel	-	24.0	-	9.8	-	10.6	-	4.5
RDT&E Total	-	102.7	-	89.6	-	88.0(a)	-	88.4(a)

RDT&E	FY98(req)		FY99(req)		FY00(req)		FY01	
	QTY	AMT	QTY	AMT	QTY	AMT	QTY	AMT
(USN estimate)								
K1447	-	74.2	-	114.9	-	111.5	-	94.5
K1776	-	6.2	-	7.4	-	4.4	-	4.5
K1937	-	0.0	-	0.0	-	0.0	-	0.0
RDT&E Total	-	88.0(a)	-	115.6(a)	-	115.9	-	98.0

(a) NOTE: These figures are based on the FY98 Defense Budget request. The RDT&E program details have not yet been released based on the newer budget figures. Individual elements will not add up to the listed totals as a result. In 1996, Congress and the DoD put the DDG-51 program on a multi-year procurement basis.

In the FY97 Defense Authorization, Congress added US$3 million for procuring wearable computers for deployment on AEGIS ships as well as others with Interactive Electronic Technical Manuals (ITEMs).

All US$ are in millions.

Recent Contracts

(Contracts over US$5 million)

Contractor	Award ($ millions)	Date/Description
Martin Marietta	176.8	Jan 1995 — Mod to previously awarded contract to exercise an option for FY95 requirement for three AEGIS Weapons Systems and support equipment. Complete April 1999 (N00024-93-C-5108)
Martin Marietta	5.3	Mar 1995 — Basic ordering agreement for a variety of spare parts in support of AEGIS weapons systems. Complete Jan 1997 (N00104-94- G-0902)
Martin Marietta	73.5	Mar 1995 — CPAF level-of-effort contract for the AEGIS combat system Baseline Upgrade and Critical Experiment Development. Complete Mar 2000 (N00024-95-C-5159)
Vitro	21.5	Mar 1995 — Mod to previous contract to exercise option for engineering and technical services in support of AEGIS shipbuilding projects. Complete July 1996 (N00024-92-C-5115)

Contractor	Award ($ millions)	Date/Description
Raytheon	14.2	Aug 1995 — CPFF contract for the fabrication of AEGIS weapons system SPY-1 transmitter equipment. Complete Aug 1998 (N00164-95-D-0025)
Martin Marietta (LM)	6.9	Aug 1995 — modification to previous contract for FY94 AEGIS operational spares for US Navy (30%) and FMS to Japan (70%). Complete Dec 1997 (N00024-93-C-5108)
Vitro	29.4	Mar 1996 — Modification to a previously awarded contract to provide engineering services support to the AEGIS Shipbuilding Project (PMS-400). Complete Jul 1997 (N00024-92-C-5115
Lockheed Martin	14.0	Apr 1996 — Modification to a previously awarded contract to exercise an option for AEGIS Operations & Maintenance support of the Combat Systems Engineering Development Site (CSEDS), Land-Based Test Site (LBTS), Program Generation Site (PGC), Computer Program Test Site (CPTS), and AEGIS Data Reduction Center. Completed Apr 1997 (N00024-94-C-5160)
Lockheed Martin	6.2	April 1996 — Modification to a previously awarded contract to exercise an option to provide engineering services in support of the Spanish FMS F-100 Combat System Design Program. Complete Dec 1996 (N00024-95-C-5161)
Lockheed Martin	7.6	Apr 1996 — Modification to previously awarded contract for engineering services in support of Japanese FMS AEGIS Combat Weapons System. Complete Dec 1998 (N00024-95-C-5153)
Lockheed Martin	25.3	May 1996 — CPAFC contract for AEGIS Training and Maintenance support. Complete May 2001. (N60921-91-C-A025)
Lockheed Martin	110.6	May 1996 — Modification to previously awarded contract to exercise an option to provide AEGIS combat system baseline upgrade & critical experiment development. Work is expected to be completed by March 2000 (N00024-95-C-5159)
Lockheed Martin	131.2	Jun 1996 — FPI contract for production & integration testing of two FY 96 AEGIS Weapons Systems Mk 7 MOD 11, and the associated engineering & logistics support for DDG 83 & DDG 84. Work is expected to be completed by Jun 2002 (N00024-96-C-5155)
Lockheed Martin	10.0	Jul 1996 — Modification to previously awarded contract for long lead material & associated planning for production of one AEGIS weapons system Mk 7 Mod 11 for DDG 85. Complete Jun 2002 (N00024-96-C-5155)

Contractor	Award ($ millions)	Date/Description
Lockheed Martin	14.0	Sep 1996 — Modification to a previously awarded contract to exercise an option to provide continuing lifetime support engineering for AEGIS Combat System and AEGIS Weapons System. Complete Sep 1997 (N60921-93-C-0529)
Computer Sciences	17.1	Sep 1996 — Modification to a previously awarded contract to provide systems engineering support for the AEGIS Combat System and AEGIS Weapons System, including FMS requirements (US 95.1%, Japan 3.4%, Spain 1.5%). Brings cumulative value of the contract to US$ 60 million. Complete Sep 1997 (N60921-94-C-A220)
Logicon Syscon	24.9	Sep 1996 — Modification to a previously awarded contract to provide continued test and evaluation of the AEGIS Combat System and AEGIS Weapons System, including FMS requirements (US 97%, Japan 2%, Spain 1%). Brings cumulative value of the contract to US$ 137.7 million. Complete Sep 1997 (N60921-91-C-A205)
Lockheed Martin	11.5	Sep 1996 — CPAF completion contract for the activation of the AEGIS Baseline 6 Training Configuration at Dahlgren, Virginia. Complete Oct 2000 (N00178-97-C-2004)

Timetable

	1969	Contract for prototype AEGIS to RCA
	1972	SPY-1 testing began
	1973	Installation of prototype AEGIS system aboard USS *Norton Sound*
	1974	AEGIS sea trials began
May	1981	Operational Test IIID of AEGIS
Jan	1983	First AEGIS ship, the USS *Yorktown*, commissioned
	1984	The Japanese Maritime Self-Defense Forces announced that they were seeking to procure the SPY-1D for their new class of destroyers
	FY85	Conducted SPY-1B/D radar development and operational tests at the Combat System Engineering Development Site. Continued development of ORDALTS in the SPY-1A radar system
	1985	Navy announced that it would second-source most elements of the AEGIS system
	FY86	Continued development of SPY-1A ORDALTS and began production of sub-elements. Initiated system studies to determine the added value to area defense of lower-frequency cueing radars to advanced versions of the SPY-1. Began efforts to identify critical technologies for radar operation against the threat environment expected in the year 2000. Began efforts to develop and demonstrate the following: 1) partial configurations of new technologies required, 2) system integration, 3) track sharing, and 4) achievable capabilities of such a system. SPY- 1D became operational. Installed SPY-1A radar trainer
Oct	1986	Delegation of top US Navy officials called on NATO countries to persuade them to agree to a major two-year joint effort to design a weapons system using AEGIS technology for fielding on the NATO NFR-90 frigate program
Nov	1986	US approved Japanese purchase of SPY-1D to equip new class of four 6,500-ton destroyers
	FY87	Began SPY-1 ORDALT designs for the SPY transmitter and signal processor Conducted SPY-1B/D qualification tests
Apr	1987	SPY-1B/D Qualification Test

	FY88	Continued SPY-1 ORDALT designs for the transmitter and signal processor improvements. Conducted SPY-1D DT/OT-IID-2. Completed SPY-1D system engineering
Apr	1988	Unisys and its partner Westinghouse selected as second source for SPY-1D
Jul	1988	Completed and installed Radar Supervisor Controller Stress Trainer
	FY89	Completed proof kit development and fabrication of SPY-1A ORDALTS and test at ACSC. Integrated and tested Upgraded AEGIS Display System Doctrine and advanced graphics. Commenced checkout of SPY-1 transmitter and signal processor improvements
Jan	1989	First SPY-1D accepted by Navy
	FY90	Completed testing of SPY-1A signal processor ORDALTS. Continued development of SPY-1D ECCM ORDALTS. Began detailed design of AEGIS Display System force capability and OTH-T upgrades
Apr	1990	Unisys/Westinghouse removed as second sources
Feb	1991	First AEGIS DDG-51 destroyer delivered
	FY91	Began development/design of radar upgrade (EDM-4B) planned for introduction in an FY94 Arleigh Burke destroyer. Built and tested SPY-1B/D signal processor changes for ECCM. Integrated and tested AEGIS Display System force capability and OTH-T upgrades
Dec	1992	Last AEGIS Guided Missile Cruiser (CG-73) *Port Royal* christened
	1992	First AEGIS system for Japan delivered
Mar	1993	First AEGIS-equipped Japanese destroyer *Kongo* commissioned
Dec	1994	DDG-57 (7th of 29) commissioned
Feb	1995	DDG-66 (16th of 29) christened
Feb	1996	Selected by Spain for F-100 Class
	1996	Begin fielding of Cooperative Engagement Capability
Mar	1998	Last Japanese AEGIS destroyer to be commissioned
	1999	SPY-1E Littoral upgrade radar to become operational on DDG-87
	2007	Complete initial fielding of Cooperative Engagement Capability

Worldwide Distribution

Japan. The Japanese Navy uses the SPY-1D on its AEGIS class destroyer. A total of four are being built.
Spain. Four SPY-1(V) radar systems and four AEGIS combat direction systems are to be ordered for the F-100 destroyers. An additional system may be ordered as a shore training site.

The **US** Navy uses the SPY-1A/B on its CG-47 class Guided Missile Cruiser and the SPY-1D on its DDG- 51 Guided Missile Destroyer. Twenty-seven cruisers have been built and 29 destroyers approved.

Forecast Rationale

The AEGIS system is the US Navy's premier fleet air defense system, providing fleet air defense over a wide area, and is the only present solution in cases where air cover is not available. Alternatives such as electro-optics are limited by line-of-sight. It will be the key sea-based sensor for the Navy's Cooperative Engagement Capability and work with the E-2C to create "The Big Picture" for the fleet. CEC testing has proven that the data fusion system works well.

Pentagon planners are developing ways to tie AEGIS in with E-2C Hawkeyes, adding AWACS and JSTARS to an integrated sensor network for the combat theater during operations in the littoral arena. This Cooperative Engagement Capability (CEC) system is the next major adjustment to the fleet's operational hardware, software, and defense tactics. Initial concept tests are under way. The first development involved upgrades to data transmission and processing. Sensor upgrades will come later. The late 1996 trials of CEC and two AEGIS cruisers validated the operational concept and much of the hardware and software. CG-68 and CG-71 used their AEGIS sensors effectively and cross-linked the data effectively, proving that missiles could be fired based on off-board, netted data.

AEGIS continues to be upgraded and is expected to be fully capable of dealing with the threat well into the 1990s. The newest upgrade, being fielded on the DDG-51s in mid-decade, features an enhanced capability against sea-skimming targets.

The Navy and DoD continue to consider AEGIS as a probable key sensor for theater missile defense. This idea has been prompted by Persian Gulf experience, which showed that potential adversaries may well possess a theater missile capability. The Navy is working to develop an inherent capability to go it alone in guarding against a missile threat. Upper tier defense will combine AEGIS, which will be called Navy Theater-Wide, and the THAAD program.

AEGIS is a capable system. Its design and architecture have become the baseline for sensors of tomorrow. The system is not perfect, but ongoing upgrade and improvement efforts are addressing design and operational concerns. The original radar was developed for open-water operations and anti-aircraft, anti-air-launched missile operations. The improvements are making the sensor more capable of detecting missiles fired from launchers onshore, where they must be picked out of heavy clutter.

One significant upgrade is the Navy's effort to improve the radar for operating in a coastal environment. The littoral warfare radar features an enhanced ability to detect, track, and target sea-skimming cruise missiles. The upgrade will also include ballistic missile tracking upgrades. The Pentagon is making AEGIS the Navy's front-line ballistic missile detection system in the near term and plans to make it a key part of theater missile protection. Testing the new capability was planned to begin in 1996. Estimates put the per-ship cost goal at US$25 million. R&D costs have been put at roughly US$80 million per ship.

There are no future AEGIS cruisers planned. The Navy said it needs 49 destroyers, but budget constraints have raised affordability questions about this goal. The US Navy is authorized to procure 29 Flight I/II guided missile destroyers. The Navy has instituted the DDV development program for a new, lower-cost destroyer as an alternative to a Flight III DDG-51. The original Flight III's per-unit cost was estimated between US$1 billion and US$1.2 billion. The DDV is also referred to as the Flight IIA. SPY-1 production will be in direct support of these ship programs.

In releasing the FY97 defense spending plan, the secretary of defense announced a plan to increase FY97 funding to US$3.4 billion for four ships. From FY98 to FY01, US$11.8 billion was planned to support the construction of 11 ships. The US forecast provides for the 26 ships authorized and assumes more will be approved. The plan anticipates hull construction and the systems are produced at the most economical and workable rate.

The SC-21 may well carry an AEGIS variant; the Arsenal Ship will not. The operational concept is for the latter to be a weapons rather than a sensor platform. The Arsenal Ship will carry a sophisticated command system with extensive data and voice communications as well as the systems needed to maintain and operate its weapons. Off-board tracking and targeting information will come from a netted combat system where other control systems, such as CEC, will detect, track, target, launch, and guide the Arsenal Ship's weapons. There is an ongoing debate about the Arsenal Ship. As the concept and design evolves, planners are seriously evaluating the needs of the future Navy and how these needs can be met.

In the out-years, 2008 to 2010, SC-21 may develop as an Arsenal Ship variant that will have sensors and a command system. It would operate in a battle group that includes non-sensor, command-netted Arsenal Ships as needed, based on the mission at hand. The radars for these ships will be based on the underlying SPY-1 architecture updated to state of the art.

Given the current pressures on the Japanese economy, the Japanese Self-Defense Forces are expected to limit their requirement for the Kongo class destroyer program to four ships. If the Japanese want to procure another four destroyers, they will have to wait until after the turn of the century.

Spain's decision to put AEGIS on its F-100s is significant. It breaks the ice on interest from the European/ NATO community. In spite of the pressure to go with a European-developed sensor suite for the Tri-Lateral Frigate (or equivalent) program, selecting a proven, available system is tempting and could result in some future orders. The number would be small, though, because of cost and the fact than AEGIS is much more radar than many navies need.

Ten-Year Outlook

		ESTIMATED CALENDAR YEAR PRODUCTION											
		High Confidence Level				Good Confidence Level				Speculative			
Designation	Application	thru 96	97	98	99	00	01	02	03	04	05	06	Total 97-06
SPY-1A/B	CG-47 (US NAVY)	27	0	0	0	0	0	0	0	0	0	0	0
SPY-1D	DDG-51 (US NAVY)	33	3	4	3	4	2	0	0	0	0	0	16
SPY-1D	DDG-173 (JAPAN)	4	0	0	0	0	0	0	0	0	0	0	0
SPY-1D	F-100 (SPAIN)	0	0	0	0	0	1	1	1	1	0	0	4
SPY(V)	SC-21 (US NAVY)	0	0	0	0	0	0	0	1	0	3	3	7
Total Production		50	3	4	3	4	3	1	2	1	3	3	27