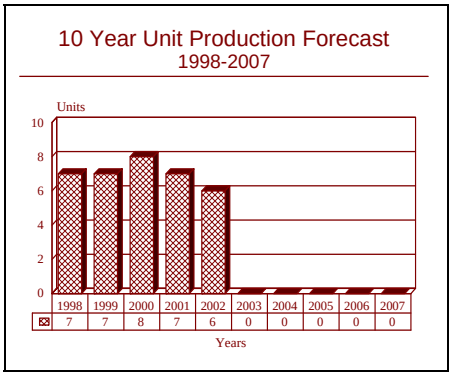
APS-125/145 - Archived 1/98

Outlook

- Surveillance radar of the carrier-based E-2C Hawkeye
- Production extended through turn of the century
- Will be the airborne heart of the Cooperative Engagement Capability being fielded by the Navy
- Evaluating radar installations on other aircraft to enlarge market
- Upgrades to radar and aircraft continue



Orientation

Description. The advanced airborne surveillance radar for the E-2C Hawkeye; the Navy's all-weather, carrier-based tactical warning and control system aircraft.

Sponsor

US Navy
Naval Air Systems Command
NAVAIR HQ
47123 Buse Rd Unit IPT
Patuxent River, Maryland 20670-1547
Tel: +1 301 342-3000

Contractors

Lockheed Martin Corp
Ocean, Radar & Sensor Systems
Syracuse, New York (NY)
USA
Tel: +1 315 456 1554
Fax: +1 315 456 0130
(Radar Prime)

Northrop Grumman Corp
Surveillance & Battle Management Systems
P.O. Box 9650 M/S J06-218
Melbourne, Florida 32902-9650
Tel: +1 407 951-5447
Fax: +1 407 951-6876
(Aircraft Prime)

Status. In service, ongoing logistics support.

Total Produced. Through 1997 an estimated 190 systems had been produced.

Application. E-2C, P-3 AEW&C, and C-130.

Price Range. Approximately US$3.0 million for the radar subsystem. The antenna system, including the radome, costs over US$1.0 million.

Technical Data

Dimensions	**Metric**	**US**
Rotodome:	0.76 x 7.32 m	2.5 x 24 ft
Antenna weight:	772 kg	1700 lb

Characteristics

APS-145

Frequency:	400 to 450 MHz (in 16 selectable bands)
Peak Power:	1 MW
Pulse Width:	13 µsec
PRF:	300 pps (3 variables to reduce "blind speed" problems)
Scan rate:	5 rpm
Beam:	7° X 20°
Radar range:	350 nm- (large target)
145 nm- (cruise missile)	
Target capacity:	2,000 simultaneously
Sortie duration:	4.5 hours typical
E-2C	
Speed:	300+ knots (552 km. per hour)
Ceiling:	30,000 feet (9,100 meters)
Crew	Five

Design Features. The APS-125/138/139/145 family of airborne surveillance radar systems is carried by the E-2C Hawkeye carrier-based surveillance aircraft. An improved version combined the basic radar and a new antenna system known as the Total Radiation Aperture Control — Antenna (TRAC-A) into a configuration designated the APS-138. Installation of TRAC-A enabled the E-2C to maintain its effectiveness in heavier jamming.

The APA-171 antenna system is housed in a rotating radome above the aircraft. An IFF array is incorporated into the radome. The existing three-channel rotary joint was replaced with an eight-channel unit to permit more access to antenna signals, providing automated cues to the operators on the best radar mode for different jamming levels, and directional information on the jamming sources — information that aids interception by battle group fighters. The APS-138 radar and automated data processing could handle more than 600 tracks.

Another upgrade involved a series of minor hardware and software changes. It operationally bridged the gap between the APS-138 and introduction of the APS-145. It was not retrofitted to all APS-138-equipped platforms.

A key to the Navy's Group 2 Upgrade program is the APS-145 radar. Design improvements increased operating range by 40 percent, surveillance space volume by 96 percent, and made it possible to monitor, track, and display more than 2,000 tracks simultaneously.

The APS-145 includes more sophisticated ECCM and an adaptive signal processing provides effective target detection and tracking in complex target environments. The advanced radar incorporates an automatic performance optimization system which automatically adapts to operating conditions over varied terrain. It monitors the radio frequency environment and selects the clearest operating frequency.

Other improvements include added anti-jam antennas and the upgrade features an enhanced high-speed processor that doubles the E-2C's Group 1 processor capability. The new computers use parallel processing to boost speed and capability and seven-color displays present more than 2,000 tracks on an 11-in X 11-in screen, an increase from the older 250-track monochrome system. The new displays allow operators more flexibility in overlaying maps and displaying data in moveable windows.

The upgrade includes IFF improvements. Range was extended to accommodate the radar's longer-range operation. Automatic interrogation is possible and a jamming strobe alerts operators to ECM attempts.

Operational Characteristics. The E-2C Hawkeye is the Navy's all-weather, carrier-based tactical warning and control system aircraft. It provides all-weather airborne early warning and command and control functions for the carrier battle group. Additional missions include surface surveillance coordination, strike and interceptor control, search and rescue guidance and communications relay. An integral component of the carrier air wing, the E-2C uses computerized sensors to provide early warning, threat analyses and control of counteraction against air and surface targets.

The E-2C is the only carrier-based airborne early warning command post in the world, and has been the Navy's AEW command post for over 30 years. The sensor can monitor a surveillance area of six million cubic miles. Automated features reduce operator workload and optimize radar performance without the need for operator intervention.

Over land, the radar can track aircraft over most terrain and ground vehicles when target density is relatively low. At sea, the APS-145 can track all significant naval targets (from large ships to fast patrol boats to stationary platforms) in most sea states.

High-altitude flight allows the radar horizon to extend beyond that of surface ship sensors, a significant part of naval tactical planning. The system automatically modifies track processing as required to maintain track integrity at land-sea interfaces. This beyond-the-horizon

targeting has made the Hawkeye the sensor heart of the Navy's Cooperative Engagement Capability program.

Variants/Upgrades

APS-138. This variant introduced the low side-lobe antenna (Total Radiation Aperture Control Antenna (TRAC-A)) first delivered in late 1982, and was designed to track cruise missiles at long distances (150 nm). It entered operation in the USN, to replace APS-125s, beginning in mid-1983.

APS-139. The Navy developed hardware/software changes to the APS-125/138 as part of a two-phase Update Development Program (UDP). UDP Group I updated select APS-138 radars to the APS-139 configuration by adding improved surface detection in high sea state/clutter, improved countermeasures, and an automatic channel monitor/select capability. Modifications to the tactical software program included increased active track capability, display prioritization, and new radar controls.

The improvements built on existing components, with one Weapons Replaceable Assembly being replaced and eight out of 40 WRAs modified. Group I became the operational standard until fielding of the APS-145 upgrade.

APS-145. UDP Group II modifications to the APS- 139, or combined Group I/II modifications to the APS-138, created a system re-designated the APS-145. It is replacing the older radars. Over-land performance is said to equal the E-3 AWACS radar, and it retained a superior over-water search capability. The APS-145 was designed to operate in the Western European electronic environment without causing undue disruption to friendly users of the frequency spectrum.

Tactical software modifications made as part of the E-2C Block Update II, the Radar Update II, extended the sensor's range and automatic processing capability. This block upgrade affects 50 aircraft.

Conformal Array Radar. Aside from the TRAC-A improvements, the APS-145 is being considered for a future conformal array antenna. The Naval Air Development Center awarded Grumman a US$14 million contract in 1986 to flight test a conformal antenna system that could be incorporated into the leading edges of the E-2C's wings.

Northrop Grumman has reportedly been working on a passive wing array, which could be used in conjunction with the rotating radar dome to improve the performance of the existing system.

Mission Computer Upgrade (MCU): This replaces the Hawkeye's L-304 computer. Although it does not directly impact the APS-145 radar, it improves the overall ability of the E-2C to effectively use the radar's data. The enhanced processor eliminates many data processing bottlenecks and permits the incorporation of additional functional capabilities to satisfy evolving operational requirements.

Although the L-304 has been upgraded many times, it is old technology and costly to produce and maintain. The magnetic core memory is heavy and obsolete. The 128K of core memory is less than what is found in most home PCs today. Up-to-date technology will increase performance and capability, and at the same time reduce unit weight by 400-500 pounds.

A September 1994, contract worth US$25.0 million was awarded to Raytheon for a new mission computer based on off-the-shelf technology. The Raytheon Model 940 is a hardened version of the Digital Equipment Corporation 2100 MA500MP processor. The core of the new system is based on a recently introduced chip developed by Digital Equipment known as the Alpha AXP. Raytheon will build 14 pre-production model 940 units and two commercial 2100 model units. If successful, a follow-on production contract could be worth a total of some US$100 million, as well as some foreign sales.

Upgrade Program. The US Navy continues to be interested in further upgrades to the E-2C, with the emphasis on improvements that would result in an ability to more fully meet the AEW mission in the years 2000 to 2015, as well as enhancing the drug-interdiction mission. Among the various modifications being examined are improved avionics such as multifunctional cockpit displays, the addition of an infrared search-and-track system, a new central computer, in-flight refueling, an updated or new electronic surveillance system, self-protection systems, as well as further radar improvements.

Radar Modernization Program. This is a new-start RDT&E effort begun in FY98. It initiates the application of new radar technologies which can be common to both sea-based and land-based airborne early warning platforms, E-2C and E-3, to provide a definitive cruise missile defense capability. Focused technologies developed in association with the RMP will be cost shared by the Navy and Air Force.

Key technologies to be applied are Space-Time Adaptive Processing, an electronically scanable radar antenna with a multichannel rotary coupler, a solid state radar transmitter and high dynamic range digital receivers. The resulting detection system will specifically provide an improved overland capability for CMD, advanced auto detect and track, a single beam cue to a shooter, Non-Cooperative Target Recognition classifi-

cation technologies, and enhanced E-2C CEC capabilities.

These technologies and resultant equipment will be demonstrated in the ground environment in FY98 and FY 99 and flight tested in FY00 and FY 2001, leading to a potential Engineering and Manufacturing Development start in 2001.

Program Review

Background. The Navy issued the initial APS-125 contracts to General Electric and Grumman in 1972. The Navy sought greater sensitivity and detection of targets in noise and clutter, with a reduction in the number of false alarms. The analog portions of the original APS-120 were replaced by digital components, and better electronic counter-countermeasures characteristics were also to be incorporated.

Modification to convert APS-120 radars to APS-125 standards started in 1977. The APS-125 was modified beginning with production E-2C aircraft No. 34 to provide fully automatic overland detection and improved ECCM characteristics. The changes involved the substitution of Line Replaceable Units which reduced space and weight. The total cost of the modification program, completed under FY82 funding, was approximately US$100 million. This kit installation program was completed in 1983.

The APS-139 update production began in 1987 and continued until 1989. It was not retrofitted into aircraft equipped with the APS-138. APS-145 installations began in 1991.

In 1986, Lockheed used the APS-138 to develop a surveillance version of the P-3 Orion, the P-3B AEW&C. On-station time would be up to 12 hours, covering up to 3,840 miles. Coverage volume triples from 0.5 million square miles (on a standard E-2C mission) to 1.5 million square miles. Duration would be approximately eight hours, with a 200-250 nautical mile radar range for small targets.

The US Customs Service procured four of the P-3B AEW&C. The Service previously borrowed US Navy E-2Cs to meet its anti-narcotics surveillance requirements, but required an aircraft with longer range and on-station time. As a result, the Customs Service took delivery of its first "Blue Eagle" aircraft in September 1988, six months ahead of schedule. The second delivery took place April 1989.

In June 1989, the US General Accounting Office issued a report on the P-3B AEW aircraft being used for drug interdiction operations. The findings, which could be applied to military maritime search missions, indicated that the radar performance was as specified, but the P-3B (when compared to the E-2C) was less costly to operate per square mile of area covered, because of the higher cruising speed and longer endurance. The P-3B had at least twice the in-flight endurance of the E-2C.

By late 1993, the US Coast Guard, which had been using the aircraft on drug interdiction missions, decided that the US$2.5 million annual maintenance costs were more than they wanted to spend. They offered the program back to the Pentagon, which was not interested. The airframes were turned back to the Air Force for cargo use.

In June 1991, (Northrop) Grumman and Lockheed (Martin) announced a teaming agreement to jointly market an airborne early warning and control platform which would mount an APS-145 surveillance system on a customer's own P-3 or C-130 aircraft.

Marketers were targeting the international market with the new surveillance platforms. By selecting the C-130 and P-3 airframes, the contractors hoped to establish a market for the new system.

The first flight of an EC-130V took place on July 31, 1991. The US Coast Guard expressed interest in this version as a command and control platform. Three operators' positions were mounted on a pallet that could be easily installed and removed for maintenance or reconfiguration.

The DoD terminated the E-2C production line for the US Navy in FY93, citing a declining defense budget. This was a year earlier than the originally scheduled date. The Navy had planned to seek six E-2Cs in FY93. Without continued production, the Navy have to continue with massive upgrades and re-work of the shop-worn Hawkeyes.

In April 1994, the Navy reversed its production termination decision and announced it was considering buying another 16 E-2Cs beyond the year 2000, in addition to an extra 20 aircraft between 1995 and 2000. The Navy determined that procurement of the new-production E-2Cs was more cost effective than a massive upgrade of the existing fleet

In the 1993/1994 time frame, Northrop Grumman and the Navy became engaged in a series of additional upgrades. Enhancements investigated or initiated include: a new mission computer (MCU); an improved APX-100 IFF, a Global Positioning system, a satellite communications terminal, the Joint Tactical Information Distribution System (JTIDS); new workstation-based mission displays;

and the integration of a Cooperative Engagement Capability (CEC).

The Navy expects to demonstrate the ability of an E-2C to acquire over-the-horizon targeting information and relay that information to ships within a battle group, hopefully before the turn of the century. Such enhancements establish the E-2C as the airborne link in the Navy's Cooperative Engagement Capability (CEC) program, which is designed to weave together sensor and weapon systems from several ships to act as a single distributed anti-air warfare net.

At the September 1996 Farnborough Air Show, Lockheed Martin and Northrop Grumman announced that they had agreed on a basic teaming arrangement to try and capture business in the international airborne early warning/command and control (AEW&C) market. The two companies had signed a memorandum of understanding and agreed in principle to the details of the teaming arrangement that would market a variant of the C-130J outfitted with an AEW system.

The new system would use both existing and open architecture approaches to system development. The team would deliver AEW&C systems to meet the specific requirements of individual customers, with Lockheed Martin as the team's prime contractor manufacturing and modifying aircraft platforms Northrop Grumman serving as the principal subcontractor responsible for the integration of the AEW prime mission system, and Lockheed Martin's ocean Radar & Sensor Systems unit providing the radar.

In mid-1997, Japan requested the modification and upgrade of thirteen E-2C Update Group II Mission Suite retrofit kits, to include the APS-145 (Category XXI) radars to replace APS-138 radars in service.

Cooperative Engagement Capability (CEC): The Navy is fielding an internetted system to provide a battle group with improved anti-air protection. CEC weaves together sensor and weapons systems from several ships to act as a single distributed anti-air warfare net.

CEC improves Battle Force Anti-Air Warfare (AAW) capability by coordinating all Battle Force AAW sensors into a single, real-time, composite track picture which has fire control quality. It 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 is highly resistant to jamming and provides 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 is 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 weapons system. CEC will significantly improve Battle Force defense, including both local-area and ship defense capabilities against current and future AAW threats.

The system consists of the Data Distribution System (DDS), the Cooperative Engagement Processor (CEP), and Combat System Modifications. The DDS encodes and distributes own-ship sensor and engagement data; it is a high-capacity, jam-resistant, directive system providing a precision gridlocking and high throughput of data.

The E-2C is the heart of the Cooperative Engagement Capability program. The ability to acquire over-the-horizon targeting information and relay it to ships within a battle group is key to the success of the concept. The E-2C would become the "airborne warfare commander." Data would be data-linked to surface ships to be blended with data from throughout the battle group.

The CEC effort is funded and controlled under Program Element 0603755, Project U2039.

FY94 accomplishments included developing and demonstrating a cued and remote data missile firing engagement with AEGIS and new threat upgrade class ships (US$91.965 million). Program personnel demonstrated an Airborne Early Warning Aircraft Air Cooperating Unit in a P-3 aircraft and developed and demonstrated cued self-defense missile firing engagements (US$42,625). The Navy completed Composite Identification and Cooperative Engagement Decision data collection (US$21,985). Program managers developed and tested Fleet CEC tactics and operations (US$15,358) and conducted Developmental Test/Operational Testing (DT/OT) (US$5,635) and assessed the potential contribution of airships to airborne components of CEC (US$10.0 million).

The program office initiated engineering design efforts to develop an airborne version of the Common Equipment Set (CES) for integration with the E-2C aircraft (US$11.356 million). Engineers developed self-aligned gate technology to support accelerated processor production for use in CES subsystems (US$1,500).

In FY95, planners completed analysis of the Developmental Testing/Operational Testing (DT/OT) lessons learned to fully support continued developmental efforts in CEC system design and fleet operations and tactics, funding this at US$17.865 million. The Navy spent US$73.848 million to continue developing a shipboard Common Equipment Set (CES) and incorporated results of the DT/OT testing into system design and ship integration. A budgeted US$62.041 million went into

the continued development of airborne CES for integration with E-2C aircraft.

In FY96, the Navy completed IOC certification of the shipboard system, putting US$3.050 million into that effort, and spent US$159 for the continued development of the shipboard CES. US$24.768 went into the continued development of the airborne CES for the E-2C.

FY97 plans budgeted US$105.712 million for the shipboard CES and US$60.0 million to continue the airborne integration.

In the FY98 budget, the Navy set aside US$51.360 for the shipboard equipment and planned US$49.7 million for the continued airborne integration. The FY98 Defense Appropriation bill increased CEC funding from US$139.229 million to US$213.229 million. This included a US$10 million increase for E-2C/CEC integration.

FY99 plans include US$51.519 million for shipboard CES and US$10.7 million for airborne integration.

The Pentagon is also considering ways to incorporate CEC and the E-2C into Theater Missile Defense programs. Planners will investigate the potential for applying CEC technology to Theater Ballistic Missile Defense, integrating the system within AWACS, JSTARS, and the Patriot Air Defense System. The *Theater Netting Study* found that integrating sea- and land-based assets could create a theater-wide, seamless air defense network. Improved situational awareness will improve the ability to engage threats.

Improvements would include:

- Depth of fire (time, space, ability to engage) would be improved in both area and self-defense scenarios. CEC automatic cueing of force sensors could result in earlier acquisitions and more engagement time.
- Track continuity would reduce track starts and stops and insure longer continuous tracks.
- Contact identification could be maintained for the duration of a track.
- Positional accuracy would be automatically maintained, resulting in greater net accuracy and reduced track position conflicts around the net.

The Navy has decided to rely on the E-2C through the 2015 time frame.

PE 0204152N, E-2 Squadrons, Project E2321, E-2 Radar Modernization. The Radar Modernization Program (RMP) initiates the application of new radar technologies which can be common to both sea-based and land-based airborne early warning platforms, E-2C and E-3, to provide a definitive cruise missile defense capability. Focused technologies developed in association with the RMP will be cost shared by the Navy and Air Force. Funding shown in this program element includes the Navy cost share.

Key technologies to be applied are Space-Time Adaptive Processing, an electronically scanable radar antenna with multichannel rotary coupler, a solid state radar transmitter and high dynamic range digital receivers. The resulting detection system will specifically provide an improved overland capability for Cruise Missile Defense (CMD), advanced auto detect and track, a single beam cue to a shooter, Non-Cooperative Target Recognition classification technologies and continue to enhance E-2C CEC capabilities.

These technologies and resultant equipment will be demonstrated in ground environment in FY97 and FY99, and flight tested in FY00 and FY01, leading to a planned Engineering and Manufacturing Development start in 2001.

The effort was a new-start in FY98. The FY98 plan budgeted US$15.0 million to begin advanced sensor common component design and fabrication for CMD. US$7.322 million was planned to begin flight test and instrumentation hardware design and fabrication. Off-the-shelf instrumentation and parts will be procured, and instrumentation package evaluation and checkout capability will be developed, to include related test equipment. US$1.575 million was budgeted for flight hardware and instrumentation software development; and another US$1.575 million slated for aircraft integration design. Aircraft preparation (environmental subsystems) will be initiated as well.

The plan for FY99 sets aside US$7.5 million to complete advanced sensor common component design and fabrication as well as commence integration of components into applicable sensors. US$13.606 million is budgeted to complete hardware and instrumentation package fabrication with US$3.575 million planned to complete the software integration package. US$3.575 million will be used to install aircraft integration modifications and US$6.5 million for RMP testing at the Pacific Missile Range Facility. US$3.125 million is budgeted to conduct test and evaluation of flight tests as well as for the instrumentation system.

Funding

US FUNDING

	FY96		FY97		FY98		FY99(Req)	
	QTY	AMT	QTY	AMT	QTY	AMT	QTY	AMT
RDT&E (USN)								
PE0204152N								
E0463 E-2C Improvements	-	59.6	-	62.0	-	39.4	-	10.3
E2321 E-2C Radar Modernization	-	0.0	-	0.0	-	25.5	-	37.9
Procurement (USN)								
E-2C	3	216.8	4	321.2	3	257.0	4	304.8
E-2C Mods	-	18.5	-	27.4	-	49.1	-	103.9

RDT&E (US estimate)	FY00 (Req)		FY01(Req)		FY02(Req)		FY03(Req)	
	QTY	AMT	QTY	AMT	QTY	AMT	QTY	AMT
E0463	-	3.9	-	6.5	-	6.5	-	6.7
E2321	-	21.0	-	34.8	-	35.5	-	0.0

NOTE: E-2C Upgrades and mods cover a variety of enhancements to the aircraft, avionics, Cooperative Engagement Capability, and ancillary equipment; including some radar upgrades.

All US$ are in millions.

Recent Contracts

(Contracts over $5 million.)

Contractor	Award ($ millions)	Date/Description
Lockheed Martin	7.3	May 1996 – Indefinite delivery/indefinite quantity contract to repair APS-125/138/139/145 radar system components. Complete April 1998 (N00383-96-D-011F).
Lockheed Martin	26.6	Oct 1996 – Not-to-exceed ceiling-priced order for spares for APS-145 radar. Complete December 1998 (N00383-93-G-002G).

Timetable

Oct	1960	First flight
Jan	1964	E-2C operational
	1972	GE and Grumman awarded development contract for APS-125
Feb	1974	APS-125 operational
Mid	1976	Initial deliveries for production aircraft
	1982	APS-125 production completed
	1987	Last APS-138 delivered; US Customs Service ordered first Lockheed P-3 AEW&C
	1988	USN began APS-145 integration on E-2C
	1989	APS-145 production initiated
	1991	APS-145 IOC, deliveries begun, first flight of EC-130V
Jun	1991	C-130/P-3 AEW&C agreement announced
	1993	First Group 2 E-2C squadron activated at Miramar NAS, operational evaluation started
	1994	End of production on current aircraft orders, MCU Milestone II, start of CEC testing
	1995	Restart of production for CEC aircraft
	FY96	Received first CEC developmental units
	FY98	CEC LRIP, begin Radar Modernization Program

1999	End of Group 2 upgrade program
FY00	Flight test Radar Modernization technologies
FY01	EMD of Radar Modernization Program
2015	Projected life of E-2C fleet, possible replacement

Worldwide Distribution

The APS-125/138/139/145 series radar is the mainstay of the Grumman E-2 airborne early warning aircraft. In addition to carrier-based squadrons of the US Navy, the radar and aircraft are also employed by the US Coast Guard in limited numbers, while the Customs Service operates three P-3Bs equipped with the APS- 125.

The international E-2C users are:

Egypt. The Egyptian Air Force operates a fleet of five Hawkeyes equipped with the APS-138.
France. The French Navy plans for up to four.
Israel. Israel currently has five E-2Cs with APS-139 radars.
Japan. The Japanese Defense Forces operate 13 E-2Cs originally equipped with APS-125/138s.
Singapore. Singapore has four E-2Cs.
Taiwan. The Republic of China has completed an FMS order for four APS-145 radars plus a significant spares order to equip E-2C aircraft.
Thailand. The Royal Thai Air Force has signed a Letter of Intent for four APS-145-equipped Hawkeyes with options on two more. They will serve as an airborne early warning extension of the Royal Thai Air Defense System (RTADS). One scenario is to provide enhanced radar coverage of the rugged terrain in Northern Thailand, filling in problem areas for ground-based systems. The Hawkeye would provide improved maritime surveillance as well. Deliveries of the aircraft were planned to begin in 1995.
Pakistan. Wanted two, received none.

Forecast Rationale

The APS-125/138/139/145 family of radars has served its users well for over three decades, and continues to do so. The E-2C is less expensive and less labor-intensive to maintain than the E-3A AWACS, and has been acquired by nations that cannot afford or support AWACS. In addition, an export license is more readily available for the E-2C than the E-3A.

The Hawkeye is a stalwart for the US Navy, a faithful workhorse of the fleet. One or more is constantly airborne during combat operations. It is the Navy's only airborne command and control asset, and the only one the Fleet can bring with it. Because of the Navy's ability to deploy rapidly, the E-2C can often be on the scene of a crisis performing Airborne Early Warning missions before AWACS can be deployed. The Naval strategy of pre-positioning Carrier Battle Groups in areas of anticipated conflict can put the Hawkeye on the front lines first.

The FY94 Defense Appropriations bill (PL 103-139) direction that the Navy develop a viable airborne CEC component. This "encouragement" made it possible for the Navy to justify more aircraft and improvements for what would be the heart of the Cooperative Engagement Capability program. Planners were able to justify and receive funding for new production aircraft.

Mission computer upgrades will make it possible to consider more advancements in radar capability than is now possible. The L-304 cannot fully support the APS-145. CEC is going to break this logjam. Distributed processing makes it possible to do much of the heavy-duty processing onboard ships with advanced computer resources.

The efforts in the development of an Advanced Phased Array Radar (APAR) technology will be the next major upgrade for the APS-145. The enhancement will be so extensive, however, that the result could possibly be considered a completely new radar.

By introducing the C-130 or P-3 version, Lockheed Martin and Northrop Grumman hope to establish an international market for the APS-145 (or approved export variant) through the forecast period and beyond. The introduction of a C-130 platform could make procurement possible for some users. Nations that cannot afford to purchase a new aircraft could modify existing airframes. So far, this variant has not proven very successful in the marketplace.

Pacific Rim forces have been a lucrative market for the Hawkeye. The E-2 is considered ideal for operations in the area. It is a rugged airframe because of the carrier operations design, making it tough enough for operating from small, local airstrips. The small crew size and

system maturity (hence reliable, low-maintenance operations) lessens the strain on already scarce resources, electronic technicians and support personnel. Planners in the region felt that the E-3 would have to operate from a single airfield, would create an impossible drain on skilled technicians, and would be a complete budget buster for most forces.

Procurement for the APS-145 is directly tied to production of the E-2C Hawkeye. Production will also support upgrade kits to bring current aircraft to the Group 2 standard. The US Navy has restarted new aircraft procurement in 1995 and continue to acquire E-2Cs through the end of the decade, until a goal of 136 Group II aircraft is met. Any replacement aircraft will not develop into a viable program until after the forecast period.

International Hawkeye sales will continue on a selective basis, with many receiving the APS-145. The list of users is expected to expand as the world climate changes from one of superpower confrontation to increased regional disputes.

The proposal of a C-130 or P-3 AEW&C option as a less costly alternative to AWACS was hoped to garner orders from various quarters around the world, but the market has not developed.

Following the Forecast is a chart reflecting the Navy's latest CEC fielding schedule. The CEC reflected is not a single system or specific piece of equipment, but rather the installation of the appropriate capability in the ships and aircraft listed. It does not convert directly to a particular system forecast as do other outlooks. This chart is included for information, since it provides a general roadmap of the Navy's approach to the Cooperative Engagement Capability.

Ten-Year Outlook

ESTIMATED CALENDAR YEAR PRODUCTION

			High Confidence Level			Good Confidence Level				Speculative			
Designation	Application	thru 97	98	99	00	01	02	03	04	05	06	07	Total 98-07
APS-139/145	E-2C (USN)	148	4	5	5	6	5	0	0	0	0	0	25
APS-145	E-2C (FRANCE)	1	1	1	1	0	0	0	0	0	0	0	3
APS-145	E-2C (VARIOUS)	5	2	1	2	1	1	0	0	0	0	0	7
APS-125/145	Prior Prod'n:	36	0	0	0	0	0	0	0	0	0	0	0
Total Production		190	7	7	8	7	6	0	0	0	0	0	35

CEC Fielding Schedule

Ship Class	FY 97	FY 98	FY 99	FY 00	FY 01	FY 02	FY 03	FY 04	FY 05	FY 06	FY 07	Total
CG-47 Aegis	2		3	3	3	4	3	2	2	2		22
DDG-51 Aegis					1	4	8	12	12	13	7	57
DDG-993 NTU				2	2							4
CV/CVN	1		4	2	1	2	2	2		1		14
LPD-17				1		2	2	2	2	2	1	12
LHD/LHA	1		2	1	1	2	1	2	2			11
LSD-41								2	3	3	4	12
DD-963								3	3	3	3	12
E-2C	2				1	3	1	11	12	11	8	47
LETS/Training Site	4		3	2	1		3					9
Total	10		12	11	10	17	20	36	36	35	23	200