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APY-1/2(V) (AWACS) - Archived 01/2008

Outlook

- On July 15, 2006, Boeing conducted a successful first test flight of an AWACS aircraft upgraded under the Block 40/45 program, the largest enhancement in the history of the U.S. Air Force's 707-320B-based E-3 AWACS fleet
- While E-3 Sentry AWACS aircraft will remain in service for years to come, systems that are newer and more economical, such as Boeing's own MESA radar, are becoming available that will replace the aircraft and radar in the international marketplace
- No further production of the AWACS radar planned; upgrades and improvements will continue

Orientation

Description. Airborne early-warning surveillance and control (AWACS) radar.

Sponsor
U.S. Air Force
AF Systems Command
Aeronautical Systems Center
ASC/PAM
Wright-Patterson AFB, OH 45433-6503
USA
Tel: + 1 (513) 255-3767
Web site: http://www.wpafb.af.mil

NATO Airborne Early Warning & Control (AEW&C) Program Management Organization (NAPMO)
Brunssum, the Netherlands
USA
Tel: + 1 (405) 884-1110
(ESM Cooperative Development Program joint sponsor)

Status. In service; ongoing logistics support and upgrades.

Application. The APY-1/2 intelligence, surveillance and reconnaissance radar equips 707- and 767-based AWACS aircraft. It is also involved with weapons control operations, command and control relay, and ESM operations.

Price Range. $111.9 million per aircraft (in FY83 dollars); APY-2 retrofit, $17 million; Radar System Improvement Program upgrade, $24 million per aircraft.

Contractors

Prime

Northrop Grumman Electronic Systems	http://www.es.northropgrumman.com, 1580 W Nursery Rd, Linthicum, MD 21090 United States, Tel: + 1 (800) 443-9219, Email: ES_Communications@ngc.com, Prime

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Technical Data

	Metric	U.S.
Dimensions		
Weight		
Radar	3,632 kg	8,000 lb
Processor	829 kg	1,826 lb
Antenna	7.3 x 1.5 m	24 x 5 ft
Radome	9.1 x 1.8 m	30 x 6 ft
Height above fuselage	3.4 m	11 ft
Characteristics		
Frequency	2 to 4 GHz (10 cm)	
Downlook range to horizon (E-3 at 30,000 ft)	400 km	245 mi
Antenna		
Slotted planar array	30 slotted waveguide sticks	
Antenna rotation rate (operational)	6.0 rpm	
Radome weight	13,000 lb (including struts)	
Processor		
Performance	2.7+ Mips 2.0+ Mflops	
Main memory storage	2.5 M words	
Bulk memory	4 M words	
Growth potential		
Main	22 M words	
Bulk	16 M words	
MTBF	4,300 hr	
MTTR	36 min	
Useful life	15 yrs	

Design Features. The E-3 AWACS aircraft is a modified Boeing 707-320B airframe with a dorsal radome that houses the rotating surveillance radar system antenna. The antenna is mounted back-to-back with a complementary Identification Friend or Foe (IFF)/secondary surveillance radar antenna. The fuselage houses the radar transmitters, computers, displays, and associated communications and electronics equipment.

The radome antenna has a normal rotation rate of 6 rpm. A non-operational rate of 0.25 rpm prevents rotodome bearings from freezing up during flight. The radar operates in the 10-centimeter frequency band and has seven operating modes. On any azimuth scan, the surveillance volume can be divided into 32 subsectors, each with its own operating modes and conditions. These modes can be accommodated on subsequent scans or rearranged to vary the types of coverage in any particular area of interest to suit changes in operating conditions.

The first 24 of the 34 USAF AWACS aircraft were equipped with the APY-1(V); the remaining 10 were delivered equipped with the APY-2(V). The newer radar has an enhanced maritime surveillance mode, enabling the E-3 to detect large and small surface ships, either moving or stationary. The lookdown AWACS radar performs satisfactorily in all kinds of weather and above all types of terrain.

The radar's reliability and ease of maintenance are the result of several initiatives, including the use of highly reliable components throughout the system, digital technology, proven integrated circuits and functional groupings of circuits, redundancy of critical circuitry with automatic switchover, built-in test with fault isolation to an individual circuit board, and in-flight maintenance capability. Radar operation is constantly monitored by software-controlled, built-in test equipment.

Fault detection tests provide an approximate 98.5 percent probability of detecting on-line faults. Redundant circuitry automatically reconfigures the system in case of malfunction. Replacement of many non-redundant units can be accomplished while airborne.

Operational Characteristics. The modes of operation are as follows:

Pulse Doppler Non-Elevation Scan (PDNES). This mode provides aircraft surveillance down to the surface using pulse Doppler, with narrow Doppler filters and a sharp beam to eliminate ground clutter. Target elevation is not measured in this mode.

Pulse Doppler Elevation Scan (PDES). This mode is similar to PDNES, but target elevation is derived from electronically scanning the beam in the vertical plane.

Beyond-the-Horizon (BTH). This mode uses a radar pulse without Doppler for extended range surveillance where ground clutter is in the horizon shadow.

Interleaved. PDES and BTH can be used simultaneously with either portion active or passive. PDNES can be used simultaneously with the maritime mode.

Maritime. The radar was modified to provide a maritime surveillance capability. This involves using very short pulse widths to decrease sea clutter, enhancing the detection of moving or stationary ships.

Passive. In this mode, the radar transmitter is shut down in selected subsectors while the receivers continue to process ECM data. A single strobe line passing through each jamming source's position is generated on the display console.

Test/Maintenance. Control is delegated to the radar technician for maintenance purposes.

Standby. In this mode, the radar is kept in an operational condition, ready for immediate use.

Blanking commands in BTH and pulse Doppler modes can be used in each of the subsectors, allowing system resources to be concentrated in those subsectors of greatest interest.

The radar pulse was reshaped to prevent interference with certain ground radars in the Western European Theater. A program called Salty Net enabled AWACS to operate with the 412L, NADGE, and other systems. The NATO AWACS was designed to interface with the 407L Tactical Air Control System.

AWACS has become a major asset in peacekeeping, peacemaking, and regional conflicts. The radar surveillance capability is one mission typical of the Sentry. Improved ESM equipment is making it a valuable electronic surveillance asset, in spite of the existence of dedicated ESM aircraft. Command and control, as well as positive control of fighter forces, have been added to the AWACS surveillance role.

During operations in the Middle East and the Balkans, AWACS became a focal point for communications between ground commanders and their air forces and maritime assets.

AWACS has been used in all major conflicts since it was first fielded, including the Persian Gulf War and Bosnia. E-3s still monitor the skies over Iraq and Bosnia, and are often deployed on drug-smuggling interdiction missions off the southern coasts of the United States.

Variants/Upgrades

E-3A. NATO and Saudi Arabian standard. NATO upgraded its fleet with the Radar Technology Insertion Program. Saudi Arabia upgraded its mission computers and software to increase the ease of use and operator efficiency. The RSAF modifications began in March 1999 and were planned to be completed that November. Two ground support systems were modified in 1998 and 1999, respectively.

E-3B. Upgraded U.S. aircraft. In addition to an ongoing series of radar and datalink upgrades, the USAF added a Boeing phased-array communications antenna to support the USAF Expeditionary Force Experiment (EFX '98). This array enhanced the

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command and control capabilities by making it possible to receive large amounts of information quickly, giving operators the most current information available. The antenna consists of 1,500 elements in a 2-foot by 3-foot by 1-inch-thick surface mount. The phased-array aperture electronically directs two independent beams, which permits instantaneous connections between satellites and mobile platforms. The antenna system has a demonstrated ability to automatically acquire and track broadcast satellites and display television onboard the aircraft. The antenna was evaluated on C-135 and KC-135 aircraft as well.

The U.S. Fleet received Electronic Control Signal Programmer (ECSP) kits and A3 circuit boards for a more modern computing architecture for AWACS operators. This allowed the use of a Windows-like environment, better maps, additional colors and symbols, and an improved airborne tracker. Production of the kits was completed in 2000.

E-3D. United Kingdom version, Sentry AEW.1. The RAF upgraded its seven aircraft from nine to 14 mission consoles. This created a common configuration with U.S. E-3Bs.

E-3F. French version. The French Air Force has installed a $16.5 million set of ESM upgrades on its four aircraft. The modification began in early 1999 and was completed in December 2000.

E-767. The Japanese version. Four have been acquired, with the first two delivered in mid-1998 and the second pair a year later.

Block 30/35. This upgrade added a 360-degree passive Electronic Support Measures (ESM) system (AYR-1(V)) to support detection and identification, added a global positioning system navigation capability, replaced the Class I JTIDS terminal with a Class 2H (High-Power Amplifier, modified) terminal, and added memory capacity to the central mission computer to support ESM and JTIDS.

Radar System Improvement Program (RSIP). This upgrade improved the overall performance of the APY-1/2(V) radar against small airborne targets, improves ECCM capability, and increases reliability and maintainability. The upgraded system can detect and identify non-cooperative targets out to 300 nautical miles. The modification replaced the aging AWACS radar subsystem computer, the airborne radar technician workstation, other selected radar system hardware, and radar subsystem software to improve pulse-Doppler radar sensitivity and resistance to electronic countermeasures, as well as increase reliability and maintainability of the modified components.

It increased the E-3's radar sensitivity, including the development of new waveform and processing algorithms, and restored target tracking standoff ranges that were decreased by the reduction in radar cross-section signatures of fighters and airborne cruise missiles.

Improved E-3 reliability and availability are increasingly important as theater commanders continue to rely heavily on the E-3's surveillance and control capabilities to provide the information superiority required to control the battlespace.

New radar algorithms and other software enhanced the system's performance, as did a new general-purpose computer that replaced the existing radar data correlators. The new processing computers were based on COTS hardware. The digital Doppler processor was replaced by a new signal processor. A pulse-compressed radar waveform improved the sensitivity of AWACS to low-radar-cross-section targets. Rewritten software is easier to maintain and upgrade.

On October 23, 1997, Boeing delivered the first radar system improvement kit to DaimlerChrysler Aerospace in Manching, Germany. Boeing and its subcontractors, Northrop Grumman, OGMA of Portugal, and ATA of Greece, contracted to build 18 kits for NATO, four for the USAF, and eight for the United Kingdom. DASA began installing the kits on NATO aircraft in mid-November.

Air Force personnel at Tinker Air Force Base, Oklahoma, were charged with installing the RSIP kits for the U.S. fleet. A 1996 contract procured 13 kits for U.S. AWACS. USAF plans were to award a follow-on contract for 18 kits to complete the buy in FY00, with the contract extending through FY05. The delivery schedule planned included three kits in FY02 and five kits each year from FY03 to FY05. The agreement would require continued contractor support for software maintenance, and possibly the redesign of hardware and software without degrading system performance, because of diminishing manufacturing sources.

British Aerospace retrofitted the U.K. fleet, receiving the first kits in 1998.

Common Large Area Display Set Program (CLADS). In September 1999, the Raytheon Marine Company Digital Display Group was awarded a firm fixed-price contract, with options, to replace the CRT-based crew station monitors with variations of the Raytheon 21-inch digital ruggedized display. This was part of the USAF CLADS Program started in 1995 to address the reduction in manufacturing sources for the large display systems used aboard AWACS, JSTARS, and ABCCC aircraft.

The program replaced cathode-ray-tube technology with digital display systems that have greater reliability and image clarity. AWACS, JSTARS, and ABCCC are the initial aircraft to be retrofitted under the CLADS program. A $29 million contract called for up to 1,071 displays; initial deliveries began in the fourth quarter of FY99.

The CLADS program defined requirements for a common display that could be used in multiple platforms. Testing took place from 1996 to 1998.

Block 40/45 replaces AWACS 1970s-vintage mission systems that are experiencing Diminishing Manufacturing Sources (DMS) issues, were difficult and expensive to upgrade, and limit overall AWACS system performance. The upgrade will improve quality and timeliness of sensor data to the shooter, improve Combat Identification (CID), provide sensor fusion capability in support of the single integrated air picture via multi-sensor integration, improve AWACS contribution to time critical targeting via datalink infrastructure, resolve radar electronics DMS, and enable more effective, faster upgrades via an open systems architecture.

Mode 5 IFF. In October 2004, the AWACS Program Office tested a new IFF system for the E-3A. The demonstrator interrogator transmitted a new waveform, Mode 5. Mode 5 is superior to Mode 4 because it reduces target variation between tracks and reduces the need for operator track maintenance. Increased code reliability will ensure more accurate identification of friendly aircraft. Encrypted identification coding will also reduce congestion in communication-intensive environments.

Command & Control, Intelligence, Surveillance, and Reconnaissance (C^2ISR) architecture improvements provide timely enhancements that improve critical areas of the AWACS mission system, particularly in four areas:

1) Worldwide deployment and airspace access: Increasingly restrictive International Civil Aviation Organization (ICAO) and Federal Aviation Administration (FAA) standards require the AWACS to achieve navigational and communications enhancements to retain its worldwide deployment commitment. Programs focus on risk reduction, EMD, and fielding.

2) Mission capable (MC) rate improvement: Reliability, maintainability, and availability analysis and development projects provide system improvements that boost the MC rate of this critical C2 platform and increase airframe longevity in order to support its planned operational life. Efforts focus on increasing reliability of the air vehicle, command, control and computer, and sensor systems and infrastructure improvements, as well as providing solutions to diminishing manufacturing sources. Efforts also focus on reducing the number of maintenance man-hours and improving periodic depot maintenance improvements to increase aircraft availability. Programs focus on risk reduction, development, and fielding.

3) C^2ISR enhancement and integration: AWACS seeks to fulfill the requirements of Joint Vision 2010/2020, Real Time Defense Information Infrastructure Common Operating Environment, and the Expeditionary Air Force Concept of Operations, as well as supporting the needs of the warfighter. AWACS seeks to achieve horizontal integration through network-centric collaborative targeting.

4) Sensor and communications improvements: Enhancements include the ability to send and receive the air and ground picture via datalink to fighter aircraft and record mission data for timely and accurate debriefings. They are being developed through rapid prototyping, modeling, and simulation, participation in joint live and simulated exercises (e.g., Joint Distributed Engineering Plant), and collaboration with other sensor platforms through tools such as NCCT. Some near-term efforts are required by the warfighter to improve the timeliness and accuracy of information passed to and from fighter aircraft in the engagement zone and to provide consistent and re-playable mission data once the mission is complete. Quick-reaction programs are developed and fielded to support future mission needs.

The program includes concept exploration and technology development, and system development and continuous improvements and implementation of C2ISR capabilities to support a joint global strike task force. This effort includes manned and unmanned platforms, space, datalinks, and advanced Battle Management Command, Control and Communications (BMC3) concepts.

UAV Links. Engineers are working to integrate the Predator and other unmanned air vehicles (UAVs) with AWACS and the AH-64 Apache attack helicopter. This is part of a collaboration on network-centric operations development. A Memorandum of Understanding signed in the spring of 2003 covered developing the communications links between the E-3 and AH-64 and the Predator. There is a need to write new UAV control software. The goal was to demonstrate command and control of the UAV from both platforms as part of an effort to develop wider interoperability between manned and unmanned systems. Laboratory demonstrations will help develop and simulate the links using the new software and communications systems.

NATO E-3 AWACS

Source: NATO

Program Review

Westinghouse Chosen to Supply Radar for AWACS in 1972

Boeing received a contract to develop AWACS in July 1970. Westinghouse (now Northrop Grumman) was selected in 1972 to supply the radar. Full-scale development began in January 1973, with four FSD aircraft produced for mission avionics and airworthiness testing that was completed at the end of 1976. The first production E-3A delivery to the U.S. Air Force took place in March 1977, and the last delivery in June 1984. In FY94, the USAF canceled plans to procure any more aircraft beyond the planned 34.

After studying radar and software improvements, the USAF Electronic Systems Division awarded modification full-scale development contracts to Boeing and Westinghouse on September 25, 1989. Efforts were completed in September 1994. Modification costs were approximately $20 million per aircraft, with the costs shared between the U.S. and various NATO operators.

Engineers replaced the digital Doppler processor with a new adaptable signal processor and provided a new general-purpose processor to replace the radar data processor. The enhanced processing capabilities would improve the radar's ability to track targets with smaller radar cross-sections. Contract requirements called for a tenfold increase in system reliability, with processor enhancements improving onboard maintenance capabilities.

An addendum Multilateral MoU (MMoU) for NATO AWACS Modernization was signed by all 12 NATO nations on December 7, 1990. This MMoU included NATO participation in the Radar System Improvement Program (RSIP) program and other U.S. E-3 improvements (CC-2E memory upgrade, color consoles, HAVE QUICK communications, JTIDS TADIL-J COMSEC, self-protection, and mobility support equipment).

U.S. and NATO Cooperatively Develop E-3 RSIP

The U.S. and NATO cooperatively developed the E-3 RSIP under an agreement signed on May 7, 1992. The United Kingdom and France indicated a desire to participate in the effort and in other U.S. E-3 improvements. A NATO CC-2E memory upgrade production contract was awarded in June 1991.

The acquisition phase of the RSIP program began in earnest in FY96. A cooperative agreement struck in mid-1995 would upgrade the 18 NATO aircraft and provide for two U.S. LRIP upgrade kits, with options for 11 additional U.S. kits. There was a follow-on RSIP contract in 2000. The U.S. would carry roughly 65 percent of the estimated $487.9 million upgrade cost. Congress and NATO were favorably disposed toward AWACS and continued funding of the upgrades.

The United Kingdom received the first of eight RSIP kits (seven aircraft, one support) in December 1999.

In August 2004, NATO AWACS aircraft were deployed to Greece to help provide security for the Summer Olympic Games. They supported Greek combat aircraft flying patrols over the games.

Boeing Shut Down 707 Line in 1991

Boeing shut down its 707 line in the middle of 1991 when orders were insufficient to keep the facility open. Boeing selected the 767-200ER airframe with GE CF6-80C2 engines to carry the APY-1/2. The new aircraft has a 10- to 20-percent range advantage over the 707-based AWACS.

Aside from structural upgrades, modifications to the radar included increased electrical power to support the electronics equipment carried by the airborne early warning (AEW) aircraft. This was accomplished by installing two 150-kVA generators per engine. With this capability, a 767 AWACS can operate on-station with one engine out. The new aircraft also has an in-flight refueling capability. The radar configuration did not change, but the aircraft was configured to carry improved communications and JTIDS terminals.

Japan placed an order for two 767-based AWACS aircraft, dubbed the E-767, and APY-2 radar systems in November 1993. The aircraft would have 14 mission consoles, a crew of 20, and a flight duration of 12 hours. Patrols would be conducted off the central and western coasts. The APY-2(V) radar would have a maritime surveillance mode. After delays caused by budget problems, Japan ordered two more E-767s in October 1994, a sale worth $773 million to Boeing. The first two aircraft were delivered in 1998, while the second two were delivered in 1999.

NATO Upgrades AWACS Fleet

The NATO Airborne Early Warning and Control Program Management Agency (NAPMA) implemented a variety of AWACS upgrades to make the NATO aircraft interoperable with U.S., British, and French AWACS.

In early 1993, Boeing received a contract for the NATO Mod Block 1 contract from the NATO AWACS Program Management Organization. The contract involved production and installation of new color displays to improve the form and usability of incoming situational information, HAVE QUICK radios to enhance UHF communications by adding security and anti-jamming features, and a version of JTIDS (called Link 16) to increase the amount of information that could be collected and distributed among AWACS airplanes, allied aircraft, and ground stations. The contract was amended in 1994 to include ESM upgrades. The upgrades were jointly funded by NATO and the U.S. Air Force.

In November 1995, the United Kingdom requested manufacture and integration of the USAF/NATO RSIP into its E-3D AWACS aircraft. The NATO Mod Block 1 contract was completed in December 1997.

A second upgrade included replacing the Omega/VLF navigation system with GPS; improving the man-machine interface with mouse-operated, Windows-based computer technology at crew workstations, along with automatic radio tuning and switching; improving satellite communications; Mode-S IFF; rapid data fusion capability; IRST TMD upgrade; and radar improvements to include low-flying, slow targets, as well as improved non-cooperative target identification.

In 1998, production and delivery of Radar System Improvement (RSIP) kits began. The kits included an upgrade to the radar's computer, adding new, high reliability multi-processors and software re-writes. The antenna and receivers were also upgraded. Kits were delivered to Tinker AFB, Oklahoma for installation by USAF depot personnel.

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First Upgrades for NATO Completed in 2000

In November 2000, Boeing and a team of companies completed the first hardware upgrade as part of the NATO Mid-Term AWACS Modernization program. The enhancements included state-of-the-art flat-panel displays with graphic user interfaces, multi-sensor integration to improve the tracking and target identification accuracy of the new mission computing system with an open system architecture to allow for cost-effective future upgrades; digital communications systems with automatic record and replay and satellite communications capability; broad-spectrum very-high frequency radios for greater interoperability with Eastern European air forces; improved transponders for greater compatibility with international air traffic control systems; and an upgraded aircraft navigation system using GPS.

Boeing started work on the first aircraft in December 2000. With the completion of the hardware upgrade, Boeing installed the mission computer software and conducted an engineering, test, and evaluation phase that led to flight testing in January 2001.

In May 2001, the Defense Security Cooperation Agency notified Congress of a request from France for the manufacture and integration of RSIP modification kits for their E-3Fs. The requirement was for four kits, installation, system integration and ground/flight testing, software development and installation, a ground-based RSIP kit, spare/repair parts, and support.

Saudi AWACS Upgraded to American Standard

In August 2001, Boeing began installing new mission computers and other hardware/software upgrades designed to bring the five Saudi AWACS to the same level as the U.S. AWACS Fleet. The effort would include operator training. The first two aircraft were retrofitted in 2001 and the remaining three in 2002.

In August 2001, Raytheon and Boeing completed a demonstration of CEC-AWACS interoperability. The same CEC USG-3(V) suite as that carried by the E-2C Hawkeye was installed. AWACS is also considered an important part of future Joint Composite Tracking Network plans.

In November 2001, Telephonics Corp was awarded a contract to upgrade the AWACS IFF system with a technology insertion program to upgrade the IFF equipment and processing. The upgrade included new high-power, solid-state transmitters and low noise receivers. The changes also addressed the changing mission requirements of homeland defense initiatives.

In February 2002, Boeing received a contract to upgrade the four French E-3F radars to bring the fleet up to U.S. RSIP standards. Upgrades included a new radar computer, radar control maintenance panel, and software improvements to the radar and mission system programs. Modification kit delivery to Air France Industries began in spring 2004. Installation is to be complete by 2006.

In October 2002, the first NATO AWACS aircraft upgraded under the Mid-term Modernization Program successfully completed European engineering test and evaluation. Although the aircraft had been tested in the United States, this test was in the challenging European environment.

In early 2003, Boeing received a $278 million contract to modernize NATO's AWACS aircraft. The effort installed new operator consoles, flat-panel displays, a new Mission Computer with multi-sensor integration, and other specific features.

In late 2003, Saudi Arabia completed the installation of new mission computers and other hardware/software on its AWACS fleet. The effort upgraded the aircraft for current operations and also facilitated future upgrades.

In April 2004, the DoD Inspector General published a report criticizing USAF negotiations for the NATO Mid-Term Modernization Program, the "Global Solution."

Report D-2004-069 said that "The Deputy Assistant Secretary of the Air Force for Contracting and the Commander, Electronic Systems Center, concurred that the Global Solution price was determined without first completing an independent cost estimate, an integrated product team analysis, a technical evaluation of hours and labor mixes, audit assistance, and weighted guidelines to establish a negotiation objective for profit. The Deputy Assistant Secretary and the Commander concurred with the intent of all recommendations and stated that the technical and cost analyses would be completed, but the Air Force needs to award production and retrofit options as an undefinitized contract action so that the NATO E-3 Mid-Term Modernization Program can proceed while the Electronic Systems Center and the NATO Airborne Early Warning and Control Program Management Agency (NAPMO) conduct technical and cost analyses."

In late 2004, Boeing conducted the first test flight of the first NATO AWACS Mid-Term Modernization aircraft. Testing is scheduled to run through March 2005.

U.S. RSIP Completed in 2005

In April 2005, the U.S. RSIP was completed with kit installation on the final of 32 aircraft. In the same month, the first of four French upgrades was started. The radar system improvements include increasing the sensitivity of the pulse Doppler radar, a new multi-processor, as well as antenna, receiver transmitter, and software upgrades. The final installations are to be completed by 2006.

In July 2005, Boeing started installing planned satellite communications and air traffic management upgrades. The first retrofit was scheduled to be completed by January 2006, with the entire Fleet enhanced by 2010.

The United Kingdom has begun a mid-life update called Project Eagle. Boeing is competing against Lockheed Martin to increase the network-centric capabilities of Britain's E-3 fleet. Boeing is using technology developed for the Block 40/45 upgrades in the United States. By July 2006, the program was running a bit slower than expected because of budget constraints in Britain and the heavy usage of its E-3s.

Significant News

Poland Joins NATO AWACS – As of October 2006, Poland intends to join the NATO AWACS program. Poland will be the 17th country to join the program, and will contribute money and airmen to operate the aircraft. In return, Poland will receive technology and work share on the surveillance aircraft. Poland hopes to host a base for the future NATO Air Ground Surveillance aircraft in the future. (*Jane's Defense Weekly,* 9/06)

Boeing Flight Tests E-3 Block 40/45 – On July 15, 2006, Boeing conducted a successful first test flight of an AWACS aircraft upgraded under the Block 40/45 program, the largest enhancement in the history of the U.S. Air Force's 707-320B-based E-3 AWACS fleet. During the three-hour flight, pilots performed a series of compatibility tests between the upgrades and the aircraft's systems and structures. The airworthiness flight-test program is scheduled for 24 flights over the next few months. Phase two of the program will include flight testing the Block 40/45 mission system. (*Defense Systems Daily,* 7/06)

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Funding

U.S. FUNDING

	FY05 QTY	FY05 AMT	FY06 QTY	FY06 AMT	FY07 QTY	FY07 AMT	FY08 QTY	FY08 AMT
RDT&E (U.S. Air Force)								
PE#0207417F								
411L AWACS	-	273.97	-	119.75	-	165.82	-	138.54
Procurement (U.S. Air Force)								
NATO AWACS Modernization	-	41.69	-	70.85	-	77.44	-	TBD
Procurement (U.S. Air Force)								
AWACS Mods	-	22.81	-	9.53	-	23.12	-	9.57

	FY09 QTY	FY09 AMT	FY10 QTY	FY10 AMT	FY11 QTY	FY11 AMT	FY12 QTY	FY12 AMT
RDT&E (U.S. Air Force)								
PE#0207417F								
411L AWACS	-	108.70	-	128.62	-	145.30	-	TBD

All $ are in millions.

Source: FY2007 U.S. Budget Documents

Note: Funding for AWACS covers all aspects of the procurement program, including the APY-1/2.

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Contracts/Orders & Options

(Contracts over $5 million.)

Contractor	Award ($ millions)	Date/Description
Boeing	7,000.0	May 2001 – Indefinite delivery/indefinite quantity contract for AWACS modernization and sustainment support efforts and effectiveness. The purpose of this contract was to lengthen the service life of the AWACS system and to sustain and improve operational capabilities. The Air Force can award delivery orders totaling up to the maximum given, though actual requirements may necessitate less than that amount. To be completed September 2007. (F19628-01-D-0016)
Boeing	524.0	Apr 2004 – FFP/IF contract mod for production and retrofit of the "global solution" for NATO AWACS Mid-Term Modernization Program. To be completed September 2008. (F19628-97-C-0112)

Timetable

Month	Year	Major Development
Jun	FY01	RSIP IOC
3Q	FY00	RSIP Kit 3
3Q	FY00	RSIP Kit 4 and 5 delivery, RSIP IOC
4Q	FY00	RSIP Kit 6 delivery
2Q	FY01	RSIP Kit 7 - 9 delivery
3Q	FY01	RSIP FOT&E
4Q	FY01	RSIP Kit 10 - 12 delivery
3Q	FY01	Last Block 30/35 Mod induction
1Q	FY02	Block 30/35 FOC; Block 40/45 risk reduction begun (1 yr slip)
4Q	FY03	Block 40/45 Milestone B; SDD begun, risk reduction completed
2Q	FY04	Block 40/45 initial design and manufacturing review
3Q	FY04	IDG ground and flight testing
4Q	FY04	IDG production contract awarded, Block 40/45 final design and manufacturing review
1Q	FY05	NAVWAR SD&D contract awarded; RSIP aircraft modifications completed
2Q	FY05	Block 40/45 test aircraft modification begun
3Q	FY05	IDG production aircraft modification begun; NAVWAR software development process review
1Q	FY06	IDG Delta testing; Block 40/45 airworthiness testing
2Q	FY06	NAVWAR flight tests
3Q	FY06	Block 40/45 installation and checkout completed; ground/flight tests started; IDG follow-on contract awarded
4Q	FY06	Block 40/45 long-lead decision
1Q	FY07	IDG IOC
2Q	FY07	AMP risk reduction and RFP
3Q	FY07	NAVWAR IOC; Block 40/45 ground/flight test completed
4Q	FY07	Block 40/45 IOT&E completed; Milestone C

Worldwide Distribution/Inventories

France. France procured four aircraft
Japan. Japan procured four E-767 AWACS
NATO. NATO has procured 18 AWACS aircraft
Saudi Arabia. Saudi Arabia operates five AWACS
United Kingdom. Britain has a fleet of seven AWACS aircraft
United States. The U.S. Air Force maintains 34 AWACS aircraft

Forecast Rationale

E-3 with APY-1/2 Capable System

The E-3 Sentry equipped with the APY-1/2 radar is an extremely capable system. It is capable of supporting operations such as anti-drug efforts, coordinating fighter and attack aircraft, and protecting national borders. After 9/11, E-3s supported military combat air patrols over key U.S. cities and were on duty 24/7. NATO provided aircraft and crews for months. NATO aircraft helped protect the 2004 Olympic Games in Greece. When teamed up with JSTARS and UAVs, AWACS is an indispensable command asset and resource manager.

While E-3 Sentry AWACS aircraft will remain in service for years to come, systems that are newer and more economical are becoming available that will replace the aircraft and radar in the international marketplace. The most prominent of these new systems is the Boeing 737-based Multi-Role Electronically Scanned Array (MESA) aircraft. It incorporates new technology to create an AEW&C platform with capabilities approaching that of AWACS, but at significantly lower purchase and operational cost. Australia was the launch customer for this new airborne C2 and sensor platform. Turkey has opted for the MESA as well. The MESA radar system has significantly reduced the APY-1/2's marketability, even when equipping newer platforms, like the Boeing 767.

Even as new systems are replacing the APY-1/2 in the marketplace, AWACS will have many more years of life in the international community, possibly with some of the U.S. aircraft renovated for use by nations that cannot afford the newest technology. This will fuel spare parts production along with modernization efforts. Even though there is no new production slated for the next 10 years, militaries around the world will continue to spend a large amount of money on the APY-1/2 radar to keep it up and running. The expense of new systems motivates many operators to maintain and upgrade older ones, rather than buy new-build systems.

Ten-Year Outlook

No further production of the AWACS radar planned. Upgrades and improvements will continue.

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