

ARCHIVED REPORT

For data and forecasts on current programs please visit

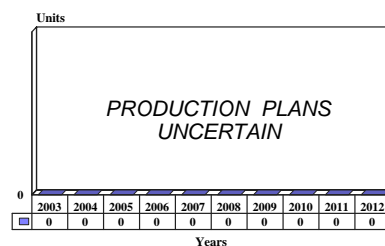
www.forecastinternational.com or call +1 203.426.0800

C-130 AMP Radar - Archived 7/2004

Outlook

- Multimode weather radar replacement for the C-130
- APN-241(V) radar selected for AMP
- Features forward-looking windshear detection capability
- Overall AMP program restructured

10 Year Unit Production Forecast
2003 - 2012



Orientation

Description. Replacement multimode, windshear radar to replace the APN-59(V), APN-122(V), APQ-170(V), and APQ-175(V) radars on USAF C-130s.

Sponsor

US Air Force
Warner Robins Air Logistics Center (WRALC)
215 Page Road, Ste 106
Robins AFB, Georgia (GA) 31098
USA
Tel: +1 912 468 1001
Web site: <http://www.robins.af.mil>

Contractors

Boeing Military Aircraft and Missile Systems
PO Box 516
St. Louis, Missouri (MO) 63166
USA
Tel: 1+ 314 232 0232
Web site: <http://www.boeing.com>
(C-130 AMP prime contractor)

Northrop Grumman Corp
Electronic Systems Sector
PO Box 17319
Baltimore, Maryland (MD) 21203-7319
USA
Tel: +1 410 765 1000
Fax: +1 410 993 8771
Web site: <http://www.northgrum.com>
(APN-241(V) prime contractor)

Status. USAF developing acquisition strategy.

Total Produced. C-130 AMP prime selected, program in EMD. Potential radar production for 500+ units.

Application. C-130E/H, MC-130H, AC-130U, HC-130P/N (64-69), MC-130E, EC-130H, MC-130P, AC-130H, HC-130N (88-93), EC-130E (ABCCC), LC-130H.

Inventory: Active force – 186
Air National Guard – 217
Air Force Reserve – 107

Price Range. Estimated cost of the APN-241(V) is from US\$350,000 to US\$425,000, depending on installation and ancillary equipment that must be acquired to interface with the radar.

Price is based on an analysis of contracting data and other available cost information, and on a comparison with equivalent items. Individual acquisitions may vary depending on program factors.

Technical Data

The APN-241(V) radar is the required AMP sensor. Technical details are included in that Market Intelligence Report.

Design Features and Operational Characteristics. The C-130 Avionics Modernization Program (AMP) consolidates and installs the mandated DoD Navigation/Safety modifications, the Global Air Traffic Management (GATM) systems, and the C-130 Broad Area Review requirements on the US Air Force's 519 C/AC/EC/HC/LC/MC-130s that are not being replaced with new C/EC/WC-130Js. These mandated mods are incorporated in conjunction with various other Reliability, Maintainability, and Sustainability (RM&S) upgrades to include TCAS, TAWS, replacement of APN-59(V) and APQ-175(V) radars, N-1/C-12 compass, dual autopilots, dual flight management systems, and HF/UHF/VHF datalink to constitute the C-130 AMP. The AMP will give the Air Force's 519 C/AC/EC/HC/LC/MC-130s complete access to the GATM-controlled international airspace.

The USAF C-130 fleet consists of 15 different mission design series (MDS) to be modified by the AMP. Within each MDS are multiple variants (C-130H2, etc.) to be modified by the AMP. These multiple models and cockpit configurations create significant logistics support and aircrew training inefficiencies. Also, these differences greatly complicate unit/aircraft interoperability at forward operating locations. C-130 AMP standardizes the cockpit configurations and avionics for these different variants by installing a core avionics package and a single cockpit configuration, eliminating many significant logistics, interoperability, and training problems. (**Note:** The new C/EC/WC-130J aircraft are not included in this C-130 AMP program.)

The funding listed those portions of USSOCOM's Common Avionics Architecture for Penetration (CAAP) modification that are incorporated into the AMP. However, SOCOM's CAAP-unique portion is funded in MFP-11, and these funds are not included in this report.

The Boeing Company was awarded the AMP contract on July 30, 2001. Each variant or group of variants will require a specific kit development and test. Then, each will proceed through development and production serially. This waterfall approach will result in an orderly development and production sequencing for the 15 different C-130 MDSs.

The C-130 Avionics Modernization Program Request for Proposals (RFP) established the following requirements for the new radar:

Identification. The specification established the design, performance, installation, integration, and verification requirements for a C-130 Multimode Color Radar (MMCR) system to replace all variants of the APN-59 radar systems and associated pilot, copilot, and navigator displays and controls currently installed on C-130E/H, HC-130P/N, WC-130H, LC-130H, MC-130P, AC-130H, EC-130E, and EC-130H aircraft. The MC-130P is substantially different from the other aircraft.

Missions. The C-130 aircraft mission requires radar as a primary navigational aid, for supplemental station keeping and rendezvous, and to provide weather detection, identification, and avoidance data. The C-130's ground forces support mission requires Adverse Weather Aerial Delivery System (AWADS) capability with ballistic wind sensing in order to provide accurate radar positioning and guidance to drop zones, landing zones, and airfields. Air-refuelable and tanker-capable C-130s require radar information for positioning, rendezvous, and intercept with aircraft requiring or capable of providing in-flight refueling. A special mission variant of the C-130 also requires the radar for weather reconnaissance. The increasing use of Night Vision Imaging Systems (NVIS) requires that the radar system be NVIS compatible.

The March 31, 2000 C-130 Avionics Modernization Program (AMP) Systems Requirement Document (SRD) updated the requirements for a radar system to replace the APN-59(V), APN-122(V), APQ-170(V), and APQ-175(V) systems. The radar system would be used as a primary navigation aid, providing position updates, ground mapping, and data for overlay with flight plan displays. The system would also provide weather avoidance, beacon communication, and skinpaint information, as well as guidance for aerial rendezvous and supplemental formation stationkeeping. The radar system had to meet or exceed the capabilities and performance of radar systems installed on the C-130H.

The radar will be certified for Adverse Weather Aerial Delivery System (AWADS) capability to provide accurate radar positioning (position update) and guidance to drop zones (hot cursor), landing zones, and airfields. The radar shall be integrated to all variants of the C-130 aircraft including special mission aircraft, except for the AC-130U.



Upgraded C-130 Cockpit

Source: DoD DOTE

Variants/Upgrades

None. Some modification may be needed for select types of aircraft.

Program Review

Background. In January 1994, the Air Mobility Command released a draft Operational Requirements Document that noted that over 2,000 radars used by tanker and transport aircraft no longer met operational or supportability requirements. The Air Force found maintenance costs too high and the capabilities of the radars inadequate. This justified a program to develop a new, common radar that could be used by all tactical and strategic airlift aircraft, and by tankers and surveillance platforms as well.

Specific performance shortfalls were weather phenomena detection, target identification, tanker rendezvous, and navigational aid capabilities. Tactical aircraft need a drop/landing zone identification capability, along with the ability to support low-level contour/terrain masking flights and stationkeeping while in formation.

According to the announcement, the common radar would have to feature high reliability, be warranted to 1,000 hours without a failure, and be maintainable in a bare base operation by three- and five-level maintenance technicians wearing chemical, biological, or nuclear protection equipment. The radar would have to be modular with a line replaceable module (LRM) construction.

The new radar would have to be interoperable between all major command/service aircraft, excluding airframes requiring fire control systems. It would also need to be capable of operating in the same environmental conditions required by the aircraft on which it is installed. A production rate of 30 to 50 units per month would be required for a total of up to 2,000 units.

In September 1994, a second announcement called for the acquisition of a KC-135 color weather radar. Sources were being sought for a system with the same basic requirements specified in the common radar announcement. This announcement expanded some of the requirements. This radar would be integrated into all KC-135 aircraft.

In addition to the common radar requirements, equipment architecture would be such that the radar adhered to a "one-deep" packaging concept in which the removal of one line replaceable unit (LRU) does not require removal of another LRU. The radar would have to be capable of color-coded and iso-echo weather detection to 220 nautical miles with windshear detection, and skinpaint capability to 15 nautical miles. It would have to drive three electronic flight instrument system (EFIS) displays and be compatible with standard digital databus format (ARINC 429). It was desired but

not required that the radar have real beam ground map, NVIS-B compatibility, and a MIL-STD-1553B interface.

In October 1995, the Rockwell International Collins Air Transport Division became prime contractor for the upgrade of the avionics suite of 600 C/KC-135 aircraft under the PACER CRAG Block 20 cockpit upgrade. Enhancements would include the FMS-800 Flight Management System, EFIS-90 Flight Displays, a new embedded inertial/GPS navigation system, and the FMR-200X multimode weather radar. The FMR-200X is a missionized version of the commercial Collins WXR-n700 weather/windshear radar. The specialized version has a skinpaint capability that can be used for aircraft separation during multiple-tanker refueling operations. First deliveries were made in mid-1996.

In 1993, Northrop Grumman Electronic Systems & Sensors Division (then Westinghouse Electronic Systems Group) began delivering its APN-241(V), a modular weather radar with windshear detection capability, for the C-130J. It was also selected for installation on new-production C-130Hs, and by Australia and Portugal for installation on their C-130s. The US Special Operations Command showed interest as well.

In May 1998, the Program Office was still working on a final requirements definition by the users. The documents being developed by HQ Air Mobility Command are being coordinated through the appropriate organizations. Upon receipt of the final, approved requirements documents, the Air Force will develop a new schedule and start the acquisition strategy process.

On April 28, 2000, the Air Force published the RFP for the C-130 Avionics Modernization Program. This document included the radar requirements. The intent was to select a single AMP integrator who would probably be allowed to pick a radar subcontractor.

In June 2001, the Boeing Company was selected as the prime contractor for the C-130 AMP. The new avionics system features six digital displays and the Flight Management System from the 737 commercial airliner. This provides navigation, safety, and communication improvements which will meet Global Air Traffic management (GATM) requirements worldwide. The upgrades will improve crew workload management and reduce overall fleet costs.

Plans were for mod kit installations beginning in 2004 and continuing through 2014, with a planned peak rate of 70 per year. In 2003, the AMP program was restructured due to funding changes. The first proposal was to cancel a planned risk-reduction effort. FY04

budget documents moved the start of AMP funding to FY06.

In FY04 Budget Justification documents, the USAF stated that the APN-241(V) was the radar selected for the C-130 and a requirement for AMP.

DOT&E FY2002 Annual Report

C-130 Avionics Modernization Program (AMP). The purpose of the C-130 Avionics Modernization Program (AMP) is to lower the cost of ownership of the US military's C-130 fleet, while complying with the Air Force Navigation and Safety Master Plan, required navigation performance requirements, and other applicable Global Air Traffic Management (GATM) requirements. This will be done through a cockpit modernization program that replaces aging, unreliable equipment, and adds equipment necessary to meet Navigation/Safety and GATM requirements. New equipment is intended to lower the Cost of ownership by reducing cockpit crew manning, increasing aircraft reliability, maintainability, and sustainability. The C-130 AMP is intended to provide an improved precision airdrop capability for the combat delivery fleet, meet Night Vision Imaging System (NVIS) requirements, and improve the C-130's precision approach and landing capability. This program provides the interfaces necessary to integrate real time information in the cockpit. A standard cockpit layout is planned allowing crewmembers to be trained to fly in one aircraft type and required to undergo mission qualification only when reaching their new units - unlike the current situation.

A C-130 AMP/Common Avionics Architecture for Penetration (CAAP) Test Planning Working Group has been established to provide a forum for all cognizant test organizations to participate in the C-130 AMP/CAAP test planning process. The using commands and the Air Force Operational Test and Evaluation Center (AFOTEC) will provide crew members, as required, to support ground and flight-tests during combined Developmental Test/Operational Test and dedicated Operational Test and Evaluation (OT&E). The Program Office will manage the Live Fire Test and Evaluation (LFT&E) program.

The Milestone II decision resulted in the Boeing Company being awarded the C-130 AMP contract in July 2001. Contractors ground tests will be conducted at the Boeing facility in San Antonio, Texas, the plant at Long Beach, California, and Edwards Air Force Base. Following a series of shakedown flights at the contractor facility, initial prototypes will transition to Edwards Air Force Base for the start of formal Developmental Test and Evaluation (DT&E). DT&E flight-tests will be accomplished by a combined government and contractor integrated test team. AFOTEC personnel will participate as part of the government contingent.

TEST & EVALUATION ACTIVITY. The program is in the very early stages of contractor development and preliminary design reviews. A Test Planning Working Group and a LFT&E integrated team have been created to formulate the specifics of the LFT&E program and the Test and Evaluation Master Plan (TEMP). The updated C-130 AMP TEMP was approved by DOT&E in September 2002.

An update will be required due to program funding changes that will impact the currently planned test schedule.

TEST & EVALUATION ASSESSMENT. The entire C-130 AMP/CAAP program is being restructured due to funding changes. The primary proposal is to cancel the previously planned Risk Reduction effort (18 months of flying a development radar in a special operations forces (SOF) Combat Talon I aircraft and tested at a government range) for feasibility studies on the new radar, new data processing algorithms, and enhanced situational awareness features for Terrain Following/Terrain Avoidance missions with Low Probability of Intercept. Elimination of the planned Risk Reduction raises the SOF C-130 AMP/CAAP from a medium risk (technical, schedule, and cost) to high risk for success. This is a change in both the acquisition and the test and evaluation strategies that were approved at Milestone B for this program.

The successful testing of AMP components across a broad range of aircraft configurations and mission requirements (see table below) will always be a significant challenge. The concept is feasible; however, it is essential that the various users commit to a unified fleet management approach for the modification of all aircraft. Fleet management of more than 700 aircraft is one of the keys to success. A tentative plan calls for some aircraft being retired, others being moved from one unit to another to manage structural life, some sent to depot, and still others used for test purposes. In addition, concurrent development of different mission design series modifications will add risk to the schedule.

The following lists the different Mission Design Series (MDS) of the C-130s to be modified and some of the special test requirements for them:

Quantities of C-130 and Special Test Requirements by MDS

MDS	Nomenclature	Special Tests
C130E/H/H1/H2/H3	Combat Delivery	GATM, TCAS, TAWS, NVIS, FMS
AC-130H/U	Gunship	Gunfire Accuracy, ESA, Defensive
EC-130E	ABCCC	Mission Unique
EC-130H	Compass Call	Mission Unique
HC-130N/P	Combat Rescue	Mission Unique
MC-130E	Combat Talon I	TF/TA Navigation
MC-130H	Combat Talon II	TF/TA Navigation, ESA, Defensive
MC-130P	Combat Shadow	Mission Unique
LC-130H	Ski	Mission Unique

Funding

US FUNDING

	<u>FY02</u>		<u>FY03</u>		<u>FY04(Req)</u>		<u>FY05(Req)</u>	
	<u>QTY</u>	<u>AMT</u>	<u>QTY</u>	<u>AMT</u>	<u>QTY</u>	<u>AMT</u>	<u>QTY</u>	<u>AMT</u>
C-130 AMP	-	-	-	18.7*	-	-	-	-
	<u>FY06(Req)</u>		<u>FY07(Req)</u>		<u>FY08(Req)</u>		<u>FY09(Req)</u>	
	<u>QTY</u>	<u>AMT</u>	<u>QTY</u>	<u>AMT</u>	<u>QTY</u>	<u>AMT</u>	<u>QTY</u>	<u>AMT</u>
C-130 AMP	-	111.6	-	156.9	-	247.3	-	424.3

Note: This funding covers a variety of C-130 modifications and upgrades, not just the replacement radar.

* FY03 funding was required for the C-130H program to complete necessary modifications displaced by the re-structuring of the C-130 AMP program.

All US\$ are in millions.

Recent Contracts

<u>Contractor</u>	<u>Award (\$ millions)</u>	<u>Date/Description</u>
McDonnell Douglas	1,000.0	Jul 2001 – FFP contract to provide aircraft modifications, integration support, and other services outside the scope of the avionics modernization program. Funds will be obligated as individual delivery orders are issued. The first delivery order will be for performance of a study on the air data system on the C-130. To be complete September 2013. (F09603-01-D-0045, 0001)
McDonnell Douglas	484.7	Jul 2001 – CPAF contract to provide for EMD of avionics modernization kits for the C-130. To be completed September 2007. (F33657-01-C-0047)

Timetable

<u>Month</u>	<u>Year</u>	<u>Major Development</u>
Jan	1994	Draft ORD for replacement common radar
Jan	1997	Draft RFP release
Feb	1997	Acquisition Strategy Conference
May	1997	Planned approval of Mission Need Statement
Summer	1997	Draft Operational Requirements Document
Apr	2000	RFP for C-130 Avionics Modernization Program
Jul	FY01	C-130 AMP contract award
1Q	2002	C-130 System Requirements Review
2Q	FY03	C-130 AMP PDR, AC-130, and HC-130 development activities
3Q	FY03	C-130 AMP SOF PDR, CDR AMP hardware
	FY06	Beginning of re-structured AMP effort

Worldwide Distribution

To be determined. FMS is possible for those C-130 users who can afford to upgrade their fleets to this extent.

Forecast Rationale

The APN-59(V) has been a faithful sensor and continues to serve the C-130 fleet, but advances in radar technology and changes in the use of the aircraft make getting a new radar necessary. Windshear detection is now a critical need for civilian and military aircraft alike. Because older radars cannot be modified to add this capability, a totally new system is required.

The APN-241(V) was chosen as the required radar for the AMP effort. It has the performance called for, especially the weather modes, and is a proven form-fit match.

The AMP program documents call for installation of the upgrade on more than 500 C-130 aircraft. The

installation schedule calls for a throughput rate at the rework facility of 65 to 85 aircraft a year through 2015. Radar production will be driven by these requirements, but the extent of aircraft modifications impacts the complexity and time it takes to update an aircraft. It is not simply a form-fit replacement of the radar units. The Avionics Modernization Program prime contractor, according to Solicitation F33657-99-R-0033, will be limited to US and foreign-owned US companies.

The 10-year outlook is uncertain until officials establish a program plan. Production details are being carried in the APN-241(V) Market Intelligence Report.

Ten-Year Outlook

Production plans are being restructured. AMP funding now begins in FY06.

* * *