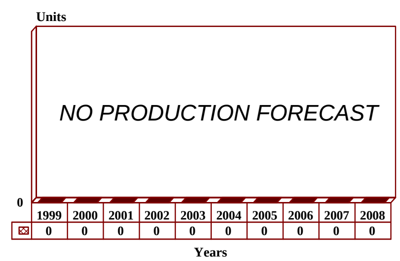
APN-59E/F - Archived 10/2000

Outlook

- In service, ongoing logistics support
- C-130s being equipped with APN-241(V)
- FMR-200X selected for C/KC-135 retrofits
- C-130 Replacement Multi-Mode Color Radar program pending

10 Year Unit Production Forecast
1999-2008



Orientation

Description. Navigation/weather radar.

Sponsor
US Air Force
Warner Robins Air Logistics Center (WRALC)
Robins AFB, Georgia (GA) 31098
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Contractors
Sperry Marine Inc
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Status. In service, in production, ongoing logistics support.

Total Produced. An estimated 2,002 units have been produced.

Application. The APN-59E/F is employed exclusively on the following United States military transports and helicopters:

USAF - AC-130A/H/U, C130A/B/C/D/E/H, DC-130A/H, E-3A/B/C, E-4A/B, EC-18B, EC-130E/H, EC-135A/C/G/K/L, HC-130H/N/P, HH-53C/H, MC-130E, KC-135, MC-130E, RC-135E/M, VC-137B/C, WC-130E/H;

USCG - EC-130E, HC-130B/H;

USMC - KC-130F/R/T, LC130; and

USN - C-130F, EC-130Q.

Price Range. Unit cost is approximately US$400,000.

Technical Data

	Metric	US
Dimensions		
Weight:	84 kg	185 lb
Characteristics		
Frequency:	9375 MHz ±40 MHz	
Power:	70 kW	
Pulse Width:	0.35 to 4.5° sec	

Beamwidth:	3°
Scan:	360° or sector
MTBF:	215 hr
Modes:	Search Skin paint Ground map/navigation Weather map Beacon homing

Design Features. The APN-59E Search Radar is an updated version of the APN-59B, an old system first developed in the mid-sixties. The APN-59E provides greater reliability and performance through its solid-state electronics and because all line-replaceable units from the older system are directly interchangeable with those of the newer APN-59E. Changeover to the APN-59E is possible without taking an aircraft out of service. A maintainability upgrade to the APN-59(V)E produced the APN-59F.

The APN-59E/F can be configured to include single azimuth/range displays that are radar-driven as a single, independent system or as a more sophisticated three-display set-up. When connected to a dead-reckoning computer, navigation fixes are also available.

Operational Characteristics. The principal modes of operation are search, navigation, weather mapping and beacon homing. To accommodate these modes, the operator can select pencil or fan beam operation with various pulse lengths and repetition rates. The APN-59E/F can be set up for an angle sector or 360° scan.

Variants/Upgrades

The **APN-59E** is a solid-state replacement for the original APN-59B with improved performance and significantly better reliability.

The **APN-59F** upgrade includes further maintainability improvements.

Program Review

Background. The APN-59 was developed in the 1960s to equip US Air Force HH-53 helicopters and various versions of the C-130 and C-135 transport families, including the KC-135 tankers. In the mid-1980s, the USAF initiated a reliability and maintainability improvement program for the APN-59E/F, the most current versions.

This program provided the following improvements:

- Reduced the high rate of burn spots on the navigator's IF-239B indicator
- Eliminated random heading marks
- Improved the antenna gimbal cage latching mechanism
- Reduced antenna azimuth motor drive transistor failure
- Reduced magnetron failure
- Reduced receiver/transmitter, thyratron, failure/fire potential
- Suppressed transient failures on 28 volt DC line
- Made minor changes to the receiver/transmitter to reduce maintenance man-hours

The improvement program was extended, with a new contract issued in July 1988 to update repairable APN-59B end items to the APN-59E(V) configuration. The primary users of the updated APN-59E/F configuration are the US Navy/Air Force C-130 and KC-135 series aircraft, as well as those aircraft in service with other nations.

In early 1994, the Air Mobility Command issued documents saying that the service was having trouble maintaining the APN-59 radars on its aircraft. Reliability did not meet specifications and annual maintenance costs were becoming prohibitive. The officials also noted that the older radars are susceptible to detection by hostile forces and could be jammed by countermeasures.

Replacement Common Radar. In January 1994, the Air Mobility Command released a draft Operational

Requirements Document (ORD) which noted that over 2,000 radars in use 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 for service needs. This was justification to investigate a program to develop a new, common radar which could be used by all tactical and strategic airlift aircraft, as well as tankers and surveillance platforms.

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

According to the January 5, 1993, 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 3- and 5-level maintenance technicians wearing chemical, biological or nuclear protection equipment. The radar would have to be modular with a line replaceable module (LRM) construction that facilitated two-level maintenance organizational/depot.

The low-power design would also have to have color-coded and ISO echo weather detection, wind shear detection, high-resolution precision ground mapping, short-range rendezvous (40 nm), and precision position fixing and updating navigational systems that would interface with cockpit multifunction/multicolor displays (heads-up or electronic flight instrument), and be compatible with standard digital databus formats (ARINC 429 and/or MIL-STD-1553B). It would also have to interface with station-keeping equipment and providing multiple airborne targets with their range bearing at all flight attitudes. The modular design would have to facilitate technological and functional growth without major modification. This growth may be for long-range rendezvous without high-power magnetron beacon variable power management, terrain following and avoidance, electro-magnetic pulse hardening, and wind shear.

The radar will have to be interoperable between all major command/service aircraft, excluding airframes requiring fire-control type systems. The radar must be capable of operating in the same environmental conditions as the aircraft on which it is installed.

Planners anticipated that a 30-50-unit-per-month production rate would be required for a total of up to 2,000 units.

In September 1994, a second announcement called out an anticipated acquisition for a KC-135 color weather radar. Sources were being sought for a system with the same basic requirements set out 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 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 nm with wind shear detection, and skin paint capability to 15 nm. 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.

It was anticipated that a 15-30-unit-per-month production rate would be required for a total of up to 600 units. There have been no further announcements relative to the new radar(s).

In late 1995, Rockwell Collins Avionics was awarded a contract as prime contractor for the upgrade to the avionics suite on up to 600 C/KC-135 aircraft under the PACER CRAG Block 20 cockpit upgrade. Enhancements will include the FMS-800 Flight Management System, FDS-255 color flat panel 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-700 weather/wind shear radar. The specialized version has a “skin paint” capability which can be used for aircraft separation during multiple-tanker refueling operations. First deliveries took place in mid-1996.

In an October 11, 1996, market survey, the Air Force reiterated the requirements of a replacement for the APN-59(V) on C-130 aircraft. They included, but were not limited to: increased reliability and maintainability; ballistic wind sensing; radar landing display aids; NVIS compatibility; wind shear detection; skinpaint; mission computer undatability; and ground mapping modes. The radar system would be integrated with the C-130 Self Contained Navigation System (SCNS) and be capable of displaying navigation and formation positioning information.

The Air Force planned to minimize new development costs and improve delivery lead time by maximizing the use of commercial off-the-shelf and non-developmental item acquisition possibilities.

In January 1997, the Air Force released a draft Request for Proposals (RFP) and performance specification for a C-130 multi-mode color radar to replace the APN-59(V). This was followed by an acquisition strategy conference in February. The announced plan called for an 18-month fielding and five- year production program for over 300 radars.

Funding

Funding is from O&M and aircraft modification accounts.

Recent Contracts

No recent DoD contracts over US$5 million recorded.

Timetable

Month	Year	Major Development
	1964	First APN-59(V) radar systems delivered
	1977	Development of solid-state APN-59E model begun
	1977	Contract to update 2,000 units awarded
	1985	Reliability improvement program for the APN-59E commenced
	1990	USAF modification program completion
Nov	1993	First deliveries of APN-241(V) radars
Sep	1994	First APN-241(V) international sales
	1995	Rockwell Collins FMP-200X selected for C/KC-135 avionics upgrade
Jan	1997	Draft RFP for C-130 replacement radar (MMCR)
Feb	1997	MMCR Acquisition Strategy Conference
May	1997	Planned MMCR Mission Need Statement approval
Summer	1997	Draft MMCR Operational Requirements Document
	2000	Estimated MMCR first production

Worldwide Distribution

Earlier versions of the APN-59(V) are common among international C-130 users.

The USAF upgraded its APN-59(V) radars to the E/F standard. A limited number of the more advanced systems are in use with select operators internationally.

Forecast Rationale

The APN-59(V) has been a faithful and effective sensor, but advances in technology and changes in the missions of carrying aircraft makes installing a new radar a wise decision. Wind shear detection has become a critical need for civilian and military aircraft alike. Older radars, like the APN-59(V), cannot be modified to add this capability. New systems are capable of meeting this requirement, so replacement with a totally new system is the only choice.

The 1994 ORD reflected the transition from one radar generation to another. Once state-of-the-art, these radars now seem woefully inadequate because new technology and processing advances have made a new breed of radars possible. This is a normal leap of progress.

The introduction of the APN-241(V) made a state-of-the-art, high-reliability navigation and weather radar with various tactical modes available to military tankers and transports. This included high mean time between failures (MTBF) and a good ground mapping capability, as well as the new and all-important wind shear detection and prediction capability. The new sensors have become the radar of choice for US C-130 aircraft. Since the wind shear capability represents a generational change, the new radars will eventually preclude selection of the APN-59(V) for all but a few applications. Selection of the FMR-200X for the PACER CRAG upgrade furthers this trend. The C-130 Multi-Mode Replacement Radar highlights the need to add modern sensors to older war-horses.

New radars can do things not dreamed of when the APN-59(V) was developed. Age has taken its toll and the estimated US$80,000 per year in maintenance costs is considered excessive. This is especially undesirable given the reliability and maintainability of modern equipment. New capabilities have generated new requirements, and weather detection and prediction is now a must, as is advanced mapping and terrain following. Electronic counter-countermeasures (ECCM) and LPI performance are major considerations as well.

As the type of missions flown and the environment in which aircraft must operate change, so do the requirements for radar. The Middle East, Bosnia, Somalia, and other operations are examples of the new missions, the new environment, and the new needs. But this runs headlong into the problem of cost. A new family of advanced, capable, reliable radars is a good idea. The replacement plan will put new systems on just over 300 C-130 aircraft, giving the fleet new capabilities.

A spares and repairs market will continue to support the number of APN-59(V) systems in operation. Periodic updates are likely as technological improvements evolve. These improvements will be in the form of modification kits.

Ten-Year Outlook

No further production expected.

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