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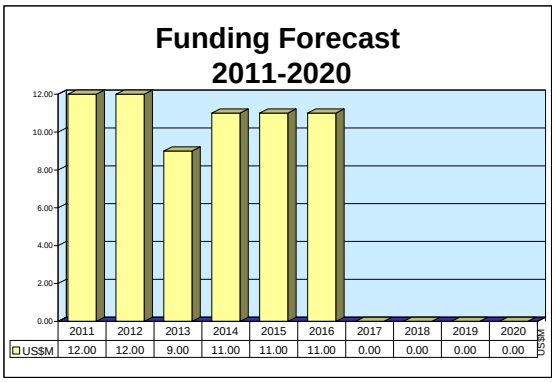
APS-137(V)

Outlook

- In December 2006, the U.S. Navy signed a logistics support contract with Raytheon for the APS-137 that runs through 2011, with options that could extend through 2016
- With naming of Raytheon's APY-10 radar, the APS-137 is believed to be defunct
- Raytheon delivered four APY-10 radars



Orientation

Description. Maritime inverse synthetic aperture radar (ISAR) search and detection, multimode radar.

Sponsor

U.S. Navy
Naval Air Systems Command
NAVAIR HQ
47123 Buse Rd Unit IPT
Patuxent River, MD 20670-1547
USA
Tel: + 1 (301) 342-3000
Web site: http://www.nawcad.navy.mil

Status. In service, ongoing logistics support.

Application. P-3C, S-3B, ES-3A, Boeing 737-800ERX, C-130H (USCG), New Surveillance Aircraft (Canadian helicopter).

Price Range. When the APS-137(V)5 was in production, the average cost per system was estimated to range between $1.75 million and $2.3 million, depending on ancillary and installation requirements.

Contractors

Prime

Raytheon Network Centric Systems	http://www.raytheon.com/businesses/rncs/, 2501 W University Dr, McKinney, TX 75071 United States, Tel: + 1 (972) 952-5999, Prime

Comprehensive information on Contractors can be found in Forecast International's "International Contractors" series. For a detailed description, go to www.forecastinternational.com (see Products & Samples/Governments & Industries) or call + 1 (203) 426-0800.

Contractors are invited to submit updated information to Editor, International Contractors, Forecast International, 22 Commerce Road, Newtown, CT 06470, USA; rich.pettibone@forecast1.com

APS-137(V)

Technical Data

	Metric	U.S.
Dimensions		
Weight	250 kg	551 lb
Antenna width	100 ft, 30 ft, 10 ft, R1, R2	3.5 ft
APS-137(V)5		
Frequency	SAR – 9.3 to 10.1 GHz	
	Other – 9.5 to 10.0 GHz	
Pulse width	SAR – 13.2 µsec	
	Periscope – 5.0 µsec	
	Other – 10.0 µsec	
Peak power	50 kW	
Average power	SAR – 350 W	
	ISAR – 230 to 500 W	
	Periscope mode – 460 W	
	Search/Navigation – 200 W	
PRF	SAR – resolution dependent	
	ISAR – 500 or 1,000 Hz	
	Periscope mode – 1,854 Hz	
	Search/Navigation – 388 Hz	
Range	250 nm	
1,000 ft altitude (RCS – range)	1 m^2 – 24 nm	
	5 m^2 – 39 nm (radar horizon limited)	
	10 m^2 – 39 nm (radar horizon limited)	
5,000 ft altitude	200 m^2 – 87 nm (radar horizon limited)	
13,000 ft altitude	1,000 m^2 – 115 nm	
21,000 ft altitude	10,000 m^2 – 178 nm (radar horizon limited)	
Resolution		
SAR	100 ft, 30 ft, 10 ft, R1, R2	
ISAR	6 ft, 3 ft	
Scan rate	6, 60, 300 rpm	
Modes	Sector and Searchlight	
Antennas		
Flat plate	1.05 deg x 15 deg beam, 32.5 dB gain	
Parabolic	1.3 deg x 4.5 deg beam, 35 dB gain	
Stabilization	± 15 deg in pitch	
	± 25 deg in roll	
	Integral IMU for motion compensation in SAR modes	
Units	Power Supply	
	Receiver Exciter Processor	
	Transmitter	
	Antenna	
	Signal Data Converter	
	Radar Set Control Interface	
	Radar Set Control	
	Radar Set Computer	
	Control Indicator	
Modes	SAR strip map and spot format	
	ISAR	
	Maritime surface surveillance	
	Periscope detection	
	Navigation, weather avoidance	
	IFF capability	
Features	Precision targeting	
	On-line/off-line selectable operation	
	ISAR classification aids	
	Video recording	

	Metric	U.S.
Auxiliary group hardware	26.3 kg	58 lb
	GPS antenna/fill panel/preamp	
	Video converter unit	
	Video tape recorder/control	
Video outputs	EIA-343 RGB Raster	
	EIA-170 Monochrome Raster	
	Digitized Raster	
	ASA-70A compatible	
Video outputs	EIA-343 RGB Raster	
	EIA-170 Monochrome Raster	
	Digitized Raster	
	ASA-70A compatible	
MTBF	>500 hr	
	Built-In Test (BIT)	

Design Features. The APS-137(V)5 was designed as a search radar to detect and track surface vessels, submarine periscopes, and snorkels in high sea states. The radar's inverse synthetic aperture design provides high-resolution imaging and can classify small, fast-moving vessels operating close to shore, with SAR for imaging stationary ships and boats as well as for coastal and overland surveillance. The SAR mode provides multiple resolution strip map and spot operation. It has a high-resolution capability for target ID, battle damage assessment, and targeting.

The APS-137(V) periscope detection features a digital scan converter and low-noise preamplifier. Maritime surveillance and multiple target tracking capabilities are improved, and frequency hopping is added to counter tactical jamming.

Standard synthetic aperture radar (SAR) is not suited for imaging moving targets, including ships or aircraft that exhibit rotational motion. The differential Doppler shifts are not predictable, and so cannot be compensated for, resulting in a blurred image.

The inverse synthetic aperture radar (ISAR) mode displays the profile contours of a surface ship, enhancing its long-range identification by type and class. By using different algorithms, these motion-generated shifts (rather than those due to the radar's velocity relative to the target in SAR) generate angular resolution that is adequate for imaging targets.

For ISAR to be fully effective, the aircraft must electronically remain at a fixed point in space while transmitting and receiving the signal. It must remain a constant distance from the ship so that the aircraft's forward motion has no major effect on the Doppler shifts that the radar receives. Precise range tracking and Doppler tracking circuits can stabilize the radar reference point electronically in both dimensions, compensating for aircraft motion. The ship's forward velocity and the aircraft's velocity are made to appear equal, and the radar will only register the Doppler shifts of the ship's pitch, yaw, and roll components.

When a radar operates in the ISAR mode, its antenna no longer scans, but constantly illuminates the target in a searchlight mode.

Operational Characteristics. Primary system features include the following:

- Long-range detection and target imaging
- Improved periscope detection
- High-altitude maritime surveillance
- Multiple target tracking
- Dual-channel digital scan conversion
- High resistance to jamming and decoy countermeasures
- Software mode control
- Range-independent image shape
- Capability to generate images at any aspect angle
- Compatible with advanced Harpoon, Tomahawk, and related seekers
- Direct interface to weapon system computers
- Battle damage assessment available in real time

APS-137(V)

APS-137(V)

Source: Raytheon

Variants/Upgrades

APS-137(V)1. Used on the S-3B.

APS-137(V)2. Carried by the P-3C Update III aircraft.

APS-137(V)4. Considered for Coast Guard or similar maritime surveillance aircraft.

APS-137(V)5. The latest variant of the radar is being procured for the Navy's Anti-Surface Warfare Improvement Program (AIP). It can do both maritime and over-land range surveillance and has a selectable ISAR/SAR-MTI resolution for target detection. It allows the P-3C and S-3B to provide real-time data, including targeting information, to battle group commanders.

APS-137D(V)5. It was selected for the Navy's new Multimission Maritime Aircraft (MMA). Upgrades for this program include reduced weight, improved MTBF, a color weather display, joint technical architecture compliance for network-centric operation, and full integration with the Boeing mission systems. The system was recently renamed the APY-10.

APS-137(V)6. This version is an APS-134(V)6 upgraded to ISAR capability. The initial efforts were for the Republic of Korea P-3C Update III aircraft.

APS-137H. A lightweight, multimission maritime surveillance radar with four components: transmitter, receiver/exciter/synchronizer, radar data converter, and antenna.

Automatic Radar Periscope Detection and Discrimination (ARPDD) System. This is a variant of the APS-137(V) radar for the P-3.

Program Review

Design of the APS-137 began in the late 1970s, with a prototype system delivered in 1983. In 1986, the S-3A Block Update I began to bring S-3A aircraft up to the S-3B configuration. Weapons System Improvement Program (WSIP) modifications included the APS-137(V).

In mid-1990, the U.S. and German navies drafted a Memorandum of Understanding to develop an upgraded sensor for P-3C and S-3B maritime surveillance aircraft. The inclusion of artificial intelligence and enhanced program algorithms would improve the ability of the system to identify targets being tracked.

APS-137 Chosen for P-3C Update III

The end of the Cold War, along with cost overruns and schedule slips, caused the Navy to drop plans for a P-3 Update IV program and install the APS-137(V) on P-3C Update III aircraft as part of an upgrade to 146 aircraft. Around the same time, Canada initiated a program to upgrade the radars in its CP-140 ASW aircraft with APS-137(V) to obtain ISAR capability.

In 1995, the U.S. Navy awarded a contract to procure 38 APS-137(V)5 radar systems for the AIP effort, with options that could increase the buy to a maximum of 100 for the AIP and 50 for P-3C reserve aircraft. A year later, Norway released information on plans to upgrade its P-3C fleet with the APS-137B(V)5, a UHF satcom suite, enhanced electronic support measures, a new computer, and a digital databus. Deliveries of the upgraded aircraft were completed in 1999.

The Navy budgeted $2 million to design an APS-137(V) precision targeting and enhanced SAR mode in FY98. The S-3B upgrade program featured a SAR demonstration, with the P-3 modernization program

funding APS-137(V) design work for a precision targeting and enhanced SAR mode.

In 2001, the Royal Netherlands Navy selected the APS-137(V) to be part of the P-3C Capabilities Upkeep program. Under the program, 10 aircraft would be upgraded by March 2006. In addition to the new radar, the ALE-47(V) and AAR-47(V) would be added to the aircraft. The value of the Foreign Military Sales (FMS) award was put at $74.3 million.

U.S. Navy Selects P-8 MMA to Replace P-3

In June 2004, the U.S. Navy selected the Boeing 737 Multimission Maritime Aircraft (MMA), later dubbed the P-8A Poseidon, to replace the aging P-3. Designers selected a modified APS-137 to equip the new aircraft. Originally, this modified version of the radar was known as the APS-137D(V)5. However, extensive modifications convinced the U.S. Navy that a new nomenclature was appropriate. The Navy decided to name the radar the APY-10.

Even though the P-8A will receive a new radar, the Navy has demonstrated that the service is not quite ready to get rid of its APS-137s. Under the Navy's plan, the P-3 fleet has been reduced from 227 aircraft to 148 aircraft in service. The remaining aircraft will receive extensive upgrades, allowing them to continue to serve on the modern battlefield. Following this decision, a contract was awarded to Raytheon to provide performance-based logistics (PBL) for the APS-137. The contract is worth $65.5 million for five years and provides two options which, if exercised, would bring the total contract value up to $120.7 million.

Funding

U.S. FUNDING

	FY10 QTY	FY10 AMT	FY11 QTY	FY11 AMT	FY12 QTY	FY12 AMT	FY13 QTY	FY13 AMT
Procurement (U.S. Navy)								
053800, P-3 Series								
P-3 Mission Systems								
OSIP 006-08								
APS-137 Tech Refresh/Insertion	0	0	12	0.5	12	0.5	12	0.5

All $ are in millions.

Source: Dept of the Navy, FY11 Budget Estimates, Aircraft Procurement, Navy Volume II: Budget Activity 5

Contracts/Orders & Options

(Contracts over $5 million.)

Contractor	Award ($ millions)	Date/Description
Raytheon	7.7	Jan 2004 – FFP, definite delivery/definite quantity contract for components of the APS-137(V)5 radar used by the AWIP program for the P-3L. Completed Mar 2005. (N00383-02-G-018A 5019)
Raytheon	12.0	Mar 2004 – Ceiling-priced order against a previously awarded contract to manufacture three APS-137(V)5 systems in support of P-3V AIP program. Completed Dec 2005. (N00383-02-G-018A 0001)
Raytheon	6.3	Aug 2004 – FFP, ID/IQ contract for production of APS-116/137(V) output traveling wave tubes, and repair of existing TWTs. To be completed Aug 2009. (N00164-04-D-8908)
Raytheon	103.0	Dec 2004 – Ceiling amount FFP, ID/IQ contract for the procurement of 32 APS-137D(V) radars for the P-3 Anti-Surface Warfare (ASuW) improvement program. The contract included the modification of control indicators for incorporation into the -D(V)5 radar, and non-recurring engineering to replace obsolete components. Completed Dec 2006. (N00019-05-D-0003)

APS-137(V)

Contractor	Award ($ millions)	Date/Description
Raytheon	96.4	Dec 2005 – Ceiling-priced modification to a previously awarded FFP, ID/IQ contract to exercise an option for the development, testing, and incorporation of enhanced precision targeting in support of the APS-137D(V)5 radar system. Work was completed in Nov 2006. The Naval Air Systems Command, Patuxent River, MD, was the contracting activity. (N00019-05-D-0003)
Raytheon	120.7	Dec 2006 – FFP long-term PBL contract for repair of the APS-137 radar units on P-3C AIP aircraft. Contract includes a base period of five years, plus one three-year option period and one two-year option period which, if exercised, would bring the total estimated value of the contract to $120.7 million. Work to be completed by Dec 2016. (N00383-07-D-003H)

Timetable

Month	Year	Major Development
	1979	APS-137(V) SDD
	1983	First APS-137(V) prototype delivered
	1985	Competitive contract for APS-137(V) production
	1986	S-3B Update I and P-3C Update IV decision
	1987	APS-137(V) chosen for USN EP-3E CILOP and U.S. Coast Guard HC-130Hs
	1992	ES-3A joins the fleet
Oct	1993	Update IV for U.S. P-3s terminated
Sep	1993	Multimode Radar selected for LAMPS III Block II upgrade
Apr	1995	Navy announces requirement for 150 APS-137(V)5 radars for active and reserve P-3Cs
	1996	Start of P-3C SRP and AIP upgrade programs
Sep	1997	First APS-137(V)5 delivered
May	1998	First squadron deployed with APS-137(V)5
2Q	FY98	Radar ISAR upgrade
1Q	FY99	Radar PDR
2Q	FY99	Radar CDR
	1999	Completion of most SRP and AIP upgrades
1Q	FY00	Radar IOC, Radar D&T
4Q	FY00	Radar upgrade contract awarded
1Q	FY01	Radar upgrade IOC
	2004	Last AP-3C deliveries
	2005	Selected for new Boeing 737 MMA
Jun	2006	MMA radar renamed APY-10
Dec	2006	Logistics support contract signed for APS-137
	2016	All U.S. Navy P-3 aircraft and their APS-137 radars expected to be retired from service

Worldwide Distribution/Inventories

The APS-137(V)5 is used by the **U.S. Navy** on the S-3B, P-3C, and Boeing 737 MMA.

The **Republic of Korea's** APS-134(V)6 radars on its eight P-3 aircraft are being upgraded to the APS-137(V)6.

The **Netherlands** has 10 P-3Cs for its capabilities upkeep program. **India** could purchase modified surplus P-3Cs from the U.S. Navy.

Forecast Rationale

U.S. Navy Selects P-8 MMA to Replace P-3

The U.S. Navy is replacing its P-3C Orion aircraft with the P-8A Poseidon Multimission Maritime Aircraft (MMA). The P-8A is equipped with the latest generation of the Raytheon APS-137 family. This new radar was given the nomenclature APY-10 following significant upgrades. As of July 2010, Raytheon had delivered four APY-10 radars.

Money for Logistics Support

The P-8A design is expected to achieve Initial Operational Capability in 2013. The Navy must therefore keep its P-3C Orions flying in the meantime. In December 2006, the U.S. Navy signed a contract with Raytheon that covers logistics support for the APS-137 through 2011, with options that could extend support for the program through 2016. The contract, potentially worth $120.7 million if all options are exercised, will allow the Navy to maintain its anti-surface warfare radar until the P-8As begin to assume the role currently filled by the P-3 aircraft. The contract covers radars for 72 P-3C aircraft under the Anti-Surface Warfare Improvement Program.

Through 2016, Forecast International expects $66 million to be spent on APS-137 maintenance. Although funding levels will fluctuate slightly from year to year, they are expected to remain reasonably stable. The contract runs through 2016, at which time the P-8 should be ready to supersede the P-3. At that time, the U.S. will most likely retire any P-3s remaining in service.

Because the APS-137 is no longer being produced, this report will be archived in January 2012.

Ten-Year Outlook

ESTIMATED CALENDAR YEAR O&M FUNDING (in millions $)												
Designation or Program	**High Confidence**					**Good Confidence**			**Speculative**			
	Thru 2010	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**Total**
Raytheon Network Centric Systems												
APS-137 5 <> United States <> Navy <> P-3 C												
	54.00	12.00	12.00	9.00	11.00	11.00	11.00	.00	.00	.00	.00	66.00
Total	54.00	12.00	12.00	9.00	11.00	11.00	11.00	.00	.00	.00	.00	66.00