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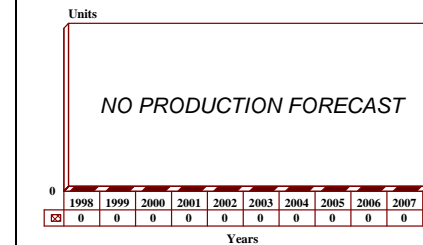
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SPN-46(V) - Archived 6/99

Outlook

- In service, on-going logistics support
- Upgrades planned for many years
- Spares base assured well into next century

10 Year Unit Production Forecast
1998-2007



Orientation

Description. Precision Approach and Landing System (PALS).

Sponsor

US Navy
Space & Naval Warfare Systems (SPAWAR)
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2451 Crystal Drive
Arlington, Virginia (VA) 22202
USA

Tel: +1 703 602 8954

US Navy

Naval Air Systems Command
NAVAIR HQ
47123 Buse Rd Unit IPT
Patuxent River, Maryland (MD) 20670-1547
USA

Tel: +1 301 342-3000

Contractors

Textron Inc
Defense Systems Division
2385 Revere Beach Parkway
Everett, Massachusetts (MA) 02149
USA
Tel: +1 617 389 3000
Fax: +1 617 381 4295
(Prime: Development/production)

Status. In service, last year of production.

Total Produced. Through 1997, 12 systems have been produced.

Application. CV and CVN class aircraft carriers.

Price Range. Estimated unit cost is US\$17.4 million.

Technical Data

Characteristics

Radar Frequencies

ACLS beacon:

Ka-band 33.2 ± 0.2 GHz

X-band 9310 GHz ± 35 MHz

Characteristics

Non-ACLS aircraft:	33.2 ± 0.2 GHz
Peak power:	50 kW peak
Pulse width:	0.2 μsec
PRF:	2000 pps
Automatic Search	
Elevation:	1.0 degree
Azimuth:	25.0 degree
Range:	1,200 ft
Scan Rate:	12 scans/minute
Minimum range:	150 ft
Maximum range:	10 nm
Range resolution:	2.0 ft
Azimuth coverage:	±155°
Azimuth resolution:	0.00274°
Elevation coverage:	+ 30.15°
Elevation resolution:	0.00274°
MTBF:	400 hr

Design Features. The SPN-46 Precision Approach and Landing System (PALS) provides automatic navigational and approach guidance simultaneously to two aircraft during the final approach and landing phase of aircraft carrier operations. The automatic control capability enables pilots to make a “hands-off” landing during Instrument Flight Rules (IFR) conditions and automatically land their carrier-based Navy aircraft in severe sea states and weather conditions.

The system is comprised of four groups of equipment:

- The radar/ship motion sensor subsystem
- The central computer subsystem
- The display subsystem
- Ancillary equipment

The SPN-46(V) features pilot-selectable mode control and is equipped with a precision dual-band automatic acquisition and tracking radar to provide cross-band beacon and aircraft skin tracking. Ship motion is compensated to ensure optimum flight-path computation by the AYK-14(V) processor. The SPN-46(V) has a self-monitoring capability to prevent the transmission of erroneous control and error signals in Modes I and II. The antenna configuration consists of: 4 ft dual-band parabolic,

Ka-band conical scan, X-band monopulse cassegrain feed, and circular and linear polarization elements. The SPN-46(V) is a replacement for the Vietnam-era SPN-42A system formerly used on US carriers.

Operational Characteristics. The SPN-46 provides a safe, positive means of handling high-performance aircraft during landing operations at night and in unfavorable weather. It has three modes of operations: ACLS approach Modes I, II, and III.

- **Mode I** is an autopilot/autothrottle closed-loop control approach. It is a basically hands-off automatic landing mode.
- **Mode II** is a manual Carrier Controlled Approach (CCA) in which ACLS information is provided to the pilot by cockpit display.
- **Mode III** is a manually controlled approach in which information is provided to the pilot from the SPN-46(V) air traffic controller by “talk-down” voice communications.

Although carrier aircraft differ with respect to approach mode availability, all carrier aircraft are capable of performing Mode III approaches. The ACLS radar systematically tracks the target aircraft from a minimum range of 4 nm.

Variants/Upgrades

There are no identified variants to this system.

Program Review

Background. In July 1980, Bell Aerospace Textron of Buffalo, NY, was awarded a contract to develop the SPN-46(V) Automatic Carrier Landing System. The company successfully developed three Engineering Development Models (EDM) for environmental tests, land-based tests, and sea trials on the carrier *John F. Kennedy* (CV-67). System verification tests and shore-based flight tests continued in FY85, and approval for limited production of the first three systems was obtained.

In November 1985, the Navy awarded a US\$16 million firm fixed-price contract for limited production of three SPN-46(V)s. Initial technical and operational evaluations of the system were conducted in FY86 and FY87. Following completion of these tests in FY87, the Navy obtained approval for the limited production of three additional systems.

In FY90 the Navy completed OPEVAL of the SPN-46(V) and obtained Full Rate Production approval. System software was recompiled in FY91 with delivery of full documentation set for the following year.

Recent years have seen the continuation of work to address shortcomings in the radar's acquisition in rain. Related activity, under Navy PE#0604504N, Air Control/Project W0993, Carrier ATC, has focused on development of Moving Target Detection (MTD) technology. This effort was scheduled for completion last year (1997). A GPS datalink looms in the future as a next-generation improvement to enhance ship-to-aircraft transfer of precise positioning information.

Funding

US FUNDING									
	<u>FY96</u>		<u>FY97</u>		<u>FY98</u>		<u>FY99 (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>	
<u>RDT&E</u> (USN)									
PE#0604504N									
Air Control (Engineering):									
Project W0993									
Carrier ATC	-	4.0	-	5.9	-	6.7	-	2.0	
<u>Other Program Funding</u> (USN)									
Automatic Carrier Landing									
System	-	9.4	-	7.3	-	11.9	-	10.1	
	<u>FY00</u>		<u>FY01</u>		<u>FY02</u>		<u>FY03</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>	
<u>RDT&E</u>									
Project W0993	-	1.9	-	1.9	-	1.9	-	2.0	

All US\$ are in millions.

Recent Contracts

Award		
<u>Contractor</u>	<u>(\$ millions)</u>	<u>Date/Description</u>
Textron	15.8	Jun 1995 – FFP contract for two SPN-46(V) automatic carrier landing systems. Completed March 1997 (N00019-94-C-0149).

Timetable

<u>Month</u>	<u>Year</u>	<u>Major Development</u>
Jul	1980	Development contract awarded
	FY85	Limited production approval granted
	FY87	Phase II development approved
	FY89	TECHEVAL Phase I completed
	FY90	OPEVAL completed, production approved
	1992	Software recompiled and environmental qualification testing commenced
	FY93	Completed software development
	FY94	Improve performance in rain by incorporation of Moving Target Detection (MTD) into radar; work to have been completed in 1997

Worldwide Distribution

This is a US only program.

Forecast Rationale

The landing systems on aircraft carriers are crucial for operation in less-than-favorable conditions, such as stormy weather and/or limited visibility. It is important that accurate, reliable approach information be provided to the aircraft, so it can be accurately vectored to the aircraft carrier. The SPN-46(V) has added the capability to perform a fully automatic carrier approach and landing to its provision of standard datalinked landing information and voice control.

New technology is under investigation by the Navy. For example, the possibilities of developing a low-probability-of-intercept landing system by the end of the decade are being explored. The Navy is also investigating many ways of decreasing the detectability of ships at sea by a variety of factors, including reducing the electronic emissions from on-board equipment. In the out years, such new technology will become operational; however, it will supplement rather than replace the SPN-46(V). Fully automatic carrier landings are not always appropriate; manual and datalink backup will remain a requirement.

Designers are investigating a variety of independent landing aids, including GPS. But this and other approaches do not have the fine three-dimensional control needed for precision approach operations. These techniques may be useful on landing fields; but a moving aircraft carrier pitching in weather is more than such technology can handle safely.

Despite the value of the SPN-46, a shrinking defense budget has shrunk the system's procurement level significantly from the 20 once estimated. The US carrier force is 11 active carriers. Two new Theodore Roosevelt class nuclear carriers, the USS *Harry S. Truman* (CVN-75) and USS *Ronald Reagan* (CVN-76), are under construction, due to be commissioned in 1999 and 2002, respectively, replacing older, retiring conventional carriers.

A series of upgrade efforts is underway, so it appears that the SPN-46(V) precision approach landing system will hold a place in the US fleet for many years to come, ensuring a spares base well into the next century.

Ten-Year Outlook

No further production planned in the near future.

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