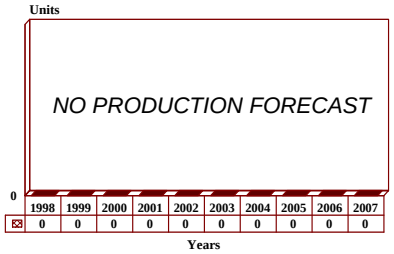
ALR-76/504 - Archived 6/99

Outlook

- Program to upgrade system capabilities will be ongoing
- The market for spare and repair parts continues
- ESM important to the focus on the littoral

10 Year Unit Production Forecast
1998-2007



Orientation

Description. Airborne Multipurpose Electronic Support Measures (ESM) System.

Sponsor
US Navy
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Contractors
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Status. In service, in production, ongoing logistics support.

Total Produced. An estimated 123 systems have been produced.

Application. S-3B, EP-3E, ES-3A, ES-3B, and Canadian EST Challenger ESM aircraft.

Price Range. The estimated cost is approximately US$1.2 million per system.

Technical Data

	Metric	US
Dimensions		
Weight:	60.9 kg	134.2 lb
Characteristics		
Frequency range:	2 through 20 GHz	

(in 5 octaves)
Antennas: 8
Coverage: 360°

Characteristics
Units: Multi-bandwidth Receivers (2)
Broadband Spiral Antennas (8)
Signal Comparator (1)
General Purpose Computer (1)
Interface: Mil-Std 1553B

Design Features. The ALR-76 replaced the ALR-47, extending the frequency range and incorporating VLSI (very large-scale integration) chips to accommodate a wide range of multi-mission capabilities. These enhancements proved popular, and the upgraded capabilities included automatic emitter classification, automatic emitter location and automatic self-testing functions.

The modular design allows for growth and makes it possible for the operator to add or delete emitter information in the prime threat library. Interest priorities and search strategies are operator changeable. A recognizable feature of aircraft carrying the system is the large number of blade antennas under the fuselage and wings and array boxes on the wingtips.

As a multi-purpose passive detection and processing system, the ALR-76 combines Electronic Intelligence (ELINT) and radar warning functions. It was designed to support the S-3B Weapons System Update Program and provided automatic omni-directional and simultaneous bearing determinations on radio frequency signals in a high-density electro-magnetic environment. The system can provide operators with aural warnings and interface directly with countermeasures dispensers. Data outputs include emitter location, identification and parametric data and are provided to the crew over digital interfaces.

The ALR-76 uses fixed, broadband spiral antennas and high-sensitivity, multi-bandwidth receivers to provide an accurate Direction Finding capability. It was optimized for detecting the short radar transmissions common to submarine radars. Digital tuning makes for rapid search and a high probability of detection (Pd). Any modulation is detectable and special analysis algorithms negate the effects of interference. The system uses a dedicated processor rather than the platform's central avionics computer. A general purpose Control and Correlation Processor (CCP) is resident in the comparator, and signal processing control comes from a high-performance pulse processor.

The pulse processor for real-time sorting and tracking in dense environments utilizes a 10-MOPS throughput capacity, ESM-specific architecture and a dedicated diagnostic microprocessor to insure system and interface integrity.

Operation is completely autonomous and includes an extensive, three-level test capability. Software algorithms determine the search strategies and control needed for the most efficient tuning of the receivers so as to produce the desired probabilities of detection for signals of interest.

Operational Characteristics. The ALR-76 monitors the radio frequency signal environment to locate and classify signals of interest. The system has a 360° field-of-view. Emitter characteristics are digitally encoded and sent to the high-performance pulse processor which compares the received signals to an established parameters library. The system automatically performs analysis needed to resolve identification ambiguities.

Classification and parameter data is provided to onboard operators and can be transmitted to Fleet Command Centers as required. The operator can add or delete parameter information in flight and modify the established search strategy based on mission requirements. A detailed signal analysis is also available for any signal received.

Unique, adaptive algorithms automatically mitigate the impact of CW/pulse Doppler or jamming signals. The Passive Ranging Subsystem (PRSS) is a cued system that provides extremely accurate location data and Specific Emitter Identification (SEI). The system can pick a single target out of a mass of targets and provide over-the-horizon or direct targeting support.

The US Navy is moving toward implementing the Cooperative Engagement Capability to integrate all available sensors in a battle group. Besides the ship and airborne radars (such as the E-2C *Hawkeye*), inputs from other sensors are included. The ALR-76 will be a major player in the CEC net and is proving invaluable to developing situational awareness for the Fleet.

Variants/Upgrades

The system's modular architecture was designed to facilitate capability enhancement through hardware infusion and expanded processing functions. Enhancements included increased sensitivity and frequency measuring capabilities, improved direction-finding accuracy and extended frequency coverage, as well as improved performance in a spread-spectrum environment.

The software-driven system can be upgraded readily. There have been five ALR-76/504 software upgrades during the life of the system, the last major update having come in 1994.

Program Review

Background. The ALR-76 is an updated version of the ALR-47 ESM system developed for the Lockheed S-3A Viking carrier-borne anti-submarine aircraft. A contract for seven systems for E-P3 aircraft was awarded in 1986. This created a special reconnaissance version of the P-3 aircraft.

The S-3B Weapon Systems Improvement Program (WSIP) began in 1983 with a US$187 million contract award to upgrade 144 aircraft. The modification converted the S-3A to the S-3B. Development of the ES-3A battle group reconnaissance aircraft began in 1988 with plans to modify 16 aircraft.

Cooperative Engagement Capability (CEC): The Navy is fielding an internetted system to provide battle groups with improved anti-air protection. CEC weaves together sensor and weapons systems from several ships to act as a single distributed anti-air warfare net. The E-2C radar is the key airborne input to the overall CEC net; officials would like to find ways to make it possible for other sensor systems to provide inputs as well.

CEC improves Battle Force Anti-Air Warfare (AAW) capability by coordinating all Battle Force AAW sensors into a single, real-time, composite track picture which has fire control quality. It distributes sensor data from each ship and aircraft, or cooperating unit (CU), to all other CUs in the battle force through a real-time, line-of-sight, high data rate sensor and engagement data distribution network. CEC is highly resistant to jamming and provides accurate gridlocking between CUs.

Each CU independently employs high-capacity, parallel processing and advanced algorithms to combine all distributed sensor data into a fire-control quality track picture which is the same for all CUs. CEC data is presented as a superset of the best AAW sensor capabilities from each CU, all of which are integrated into a single input to each CU's combat weapons system. CEC will significantly improve Battle Force defense, including both local area and ship defense capabilities against current and future AAW threats.

The system consists of the Data Distribution System (DDS), the Cooperative Engagement Processor (CEP), and Combat System Modifications. The DDS encodes and distributes its own-ship sensor and engagement data; it is a high-capacity, jam-resistant, directive system providing a precision gridlocking and high throughput of data.

The E-2C is the heart of the Cooperative Engagement Capability program. The ability to acquire over-the-horizon targeting information and relay it to ships within a battle group is key to the concept’s success. The E-2C would become the “airborne warfare commander.” Data would be data-linked to surface ships to be blended with data from throughout the battle group.

The CEC effort is funded and controlled under Program Element 0603755, Project U2039.

Funding

US FUNDING

	FY96		FY97		FY98		FY99 (Req)	
	QTY	AMT	QTY	AMT	QTY	AMT	QTY	AMT
Modifications (USN)								
EP-3	-	31.7	-	37.3	-	4.3	-	5.4
S-3B	-	39.1	-	28.9	-	47.0	-	46.0
ES-3A	-	20.6	-	6.7	-	5.0	-	5.2

These efforts fund a wide variety of upgrades to these aircraft. The ALR-76 is just a small part. This indicated the activity trend planned by the Navy.

All US$ are in millions.

Recent Contracts

No recent DoD contracts over US$5 million recorded.

Timetable

Month	Year	Major Development
Late	1969	ALR-47 development began
Aug	1981	Initial funding of improved avionics on S-3A
	1985	First two S-3Bs delivered
	1986	S-3A Update I began
	1992	ES-3A BGPHES conversion scheduled completion, the first ES-3A entered service with the USN
	1993	S-3B modification completion

Worldwide Distribution

The **United States** is the main user.

Forecast Rationale

The Navy is actively working to bring its capabilities and equipment up to the highest level possible; especially with the emphasis on the Cooperative Engagement Capability. They are seriously pursuing CEC, with the ALR-76 as one of the sensors that could provide important inputs to the CEC network. The ALR-76 is attracting attention from other naval users. Its known applications center upon three continuing Navy conversion/modernization programs: the ELINT (Electronic Intelligence) gathering version of the Lockheed Orion, the EP-3; the Lockheed S-3 Viking; and the ES-3A BGPHES that will replace the Douglas EA-3B, the aging carrier-based electronic surveillance aircraft. Equipment adaptability, and its reputation for reliability, should insure a long and useful life for the system.

The program to encourage capability upgrades through software improvements and technology insertion is ongoing. An ongoing market for spare and repair parts will continue well into the next century, since these aircraft will carry the bulk of the Navy's ESM mission until a completely new platform is developed.

Ten-Year Outlook

Future production uncertain.

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