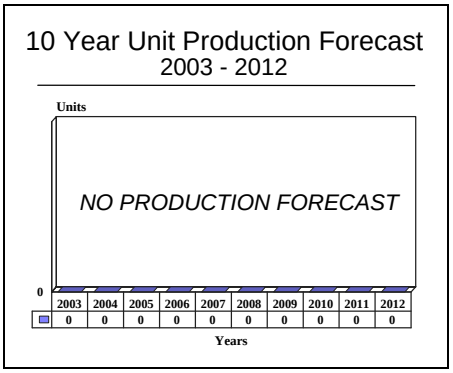
APECS II/III - Archived 4/2004

Outlook

- No new information on the APECS systems has been published
- Reportedly, production of APECS II/III has been halted
- Barring the release of any new information, this report will be archived in the near future



Orientation

Description. Programmable electronic surveillance and countermeasures system for surface ships.

Sponsor
EDO Reconnaissance and Surveillance Systems
(formerly Condor Systems)
18705 Madrone Parkway
Morgan Hill, California 95037
USA
Tel: 408-201-8000
Fax: 408-201-8010
Web site: www. nycedo.com

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Licenses. No known production licenses have been granted.

Status. Production has been halted.

Total Produced. An estimated 29 systems had been produced through 2002.

Application. Radar detection and jamming on ships.

Platform. The APECS family of systems is modular, thus making it suitable for surface ships ranging from fast patrol boats to destroyers.

Price Range. Cost ranges from US$3.5 to US$4.75 million, depending on configuration.

Technical Data

Specifications
APECS II/III

Frequency Range	0.5 to 18 GHz
ERP (ECM)	81 dBm average
Jamming	16 targets simultaneously

Switch Time	1 µsec

APECS II – AR-700 S1 to S5 (cost-based variants)

Frequency Range	2 to 18 GHz (E- to J-band)
Frequency Resolution	
S1 (2 - 18 GHz	E- to J-Band
S2 (2 - 8 GHz)	E- to H-Band
(8 - 18 GHz)	H- to J-Band accuracy 2 MHz
S3 to S5 (2 - 8 GHz)	E- to H-band accuracy 2 MHz
(8 - 18 GHz)	H- to J-band accuracy 3 MHz
Sensitivity	
S1 to S3	-40 dBm
S4 & S5	-60 dBm
DF Accuracy	
S1 & S2	10º RMS
S3 & S4	8º RMS
S5	5º RMS
Signal Tracking	200 signals
Signal Types Processed	Conventional
	Frequency agile (+/- 5%)
	Stagger (up to 8 positions)
	Jitter (+/- 10%)
	Chirp
	CW
Threat Library	990 emitter modes
	100 platforms
Alarms	Audio/Visual
Interfaces	Weapon control system
Outputs	Analog signal video
	Selected signal audio
	Digital display data

APECS III – AR-900

Frequency Range	2 to 18 GHz (E- to J-band)
Frequency Resolution	1 MHz
Frequency Accuracy	
2 - 6 GHz	3 MHz RMS
6 - 18 GHz	6 MHz RMS
Sensitivity	-65 dBm
DF Accuracy	
2 - 6 GHz	3.5º RMS
6 - 18 GHz	2º RMS
Dynamic Range	>70 dB
Receiver Recovery Time	<100 ns
Pulsewidth Measurement	0.1 to 99.9 µsec
Amplitude Measurement	>60 dB
PRI Measurement	2 to 10,000 µsec
Reaction Time	1 sec max
Signal Tracking	500 signals
Threat Library	5,000 emitter modes
	500 platforms
Pulse Density Capacity	1,000,000 pps
Polarization	Horizontal
	Vertical
	Slant linear
	Circular

APECS III – AR-900 (continued)

System Alarms	Threat
	Steady illumination
	CW

CLOAC

Frequency Range	7.5 to 18 GHz (H to J-band)
Coverage	360º
	64 overlapping, time-shared beams
ECM Reaction Time	1 sec max
ERP	+78 dBm (cross-band average)
Signal Tracking	16 threats
Operating Modes	Fully automatic
	Semi-automatic
	Manual
	Battle override
ECM Techniques	Time-shared SPOT
	Barrage
	SSN
	Cover pulse
	Range-Gate Pull-Out (RGPO)
	Range-Gate Pull-In (RGPI)
	RGPI/RGPO false targets
	SSR
	LFN

Design Features. The APECS II/III ECM/ESM systems use phased-array, polarization-diverse transmitters that generate 60 separate, overlapping beams for 360º coverage. The system is capable of jamming up to 16 targets at the same time, regardless of frequency or direction. The system uses power and technique management to optimize operation. In addition to the 16 threats being jammed, eight more are tracked in a standby mode waiting for assignment.

The APECS is able to intercept, process and jam frequency agile and pulse repetition interval (PRI) radars within one second of intercepting the signal. It uses cross-polarization techniques (automatic polarization tuning) in combination with jog detection to counter monopulse seeker radars.

The transmitter units are self-contained, featuring Traveling Wave Tubes, high-voltage power supplies, semi-omni antenna, and voltage-controlled oscillator (VCO) RF sources. They are mounted high on the ship's mast for optimum coverage. The transmitters are controlled by the PM/TG (Power Management/Threat Generator) unit in the remote equipment rack.

The electronic countermeasures (ECM) jamming system uses a newly developed planar array antenna with improved polarization performance and an adaptable beam shape, without reducing the effective radiated power (ERP) of the system. The Rotman-Turner lens array is made up of active and passive elements to form the output beam, radiating it through a polarizing grid, and in turn producing the required output polarization. The beam shape can be tailored to meet specific operational requirements.

The PM/TG receives emitter data on a pulse-by-pulse basis, controls the transmitter, including beam and frequency switching, and implements the appropriate jamming techniques. Each transmitter housing includes a semi-omni antenna and an FML (Frequency Management Loop) for the shortest possible delay of the repeater mode, especially valuable against leading-edge tracking radars. Each transmitter has a transponder and repeater mode transmit capability of over 180º.

The FML is time-shared so the ECM system can handle multiple simultaneous, agile, and jittered threats. The transmitters are pitch and roll stabilized to enhance their jamming effectiveness in spite of ship motion.

The receive and direction finding (DF) antenna configuration consists of two monopulse receiver units in three bands, for a total of 24 antennas. The omni antennas provide pre-amplified RF to the Digital Instantaneous Frequency Measurement (DIFM) receivers. The DF monopulse arrays provide outputs to the Bearing Receiver Units (BRUs). The BRUs convert the wide-open video signals to video signals for processing in the Bearing Processor Unit (BPU). This makes possible a pulse-by-pulse measurement of RF pulse width, amplitude, direction of arrival, and time of arrival over the entire frequency range.

The APECS II and III systems use the same ECM system but different electronic support measure (ESM) sections. APECS II uses the AR-700A ESM/DF system. It comes in five configurations which vary in performance and cost. APECS III is a newer configuration based on the AR-900 ESM/ELINT system. It is lighter, and features electromechanical stabilization and liquid-cooled transmitters.

The ESM system uses DIFM receivers and precision monopulse DF antennas (2º rms) and processors.

The Fine DF (FDF) section of the BRU is made up of RF and IF converters which convert the RF to IF signals for differential phase measurement. Such conversion is required for precision DF measurement.

The DIFM receiver output and that from the Monopulse Instantaneous DF (IDF) section of the BPU processor are sent to the ASP-2000 processor, which processes all frequency bands simultaneously. Bearing data on high-priority emitters are transmitted to the ASP-2000 by the FDF section of the BPU.

A remote equipment rack contains the ESM receivers, ASP-2000 DF processors, ESM signal processors, and ECM controller, as well as power management/ techniques generator equipment. The operator's console is a stand-alone system using a color monitor and is capable of full automatic operation. The color display unit is a 48 centimeter (19 in) diagonal raster graphics display with 1,280 x 1,024 pixel resolution. The system includes a touch-sensitive overlay.

The intercept receiver and direction-finding subsystems employ real-time, monopulse amplitude and phase processing for DF measurements. The ASP-2000 with distributed preprocessing was designed to acquire, recognize, and measure threat parameters, followed by rapid (within one second) hand-off to the jamming subsystem.

The APECS II and III systems can be interfaced with the ship's weapon control system and other onboard systems. They have an extensive Built-in Test and software fault diagnostic capability.

Operational Characteristics. The APECS covers the current naval threat frequency band with a 100 percent probability of intercept. Reception and processing are independent of signal source frequency or direction of travel. It can automatically track up to 200 or 500 active signals in a dense signal environment and process frequency- and PRI-agile, as well as pulse Doppler, radars. The system can identify a signal or associated platform within one second.

The system is user-friendly: one operator can control both the ESM and ECM systems, with the ESM and ECM functioning as a single compatible system. It can engage a threat instantaneously, effectively engaging threats in all directions. APECS II can handle up to eight frequency- and/or PRI-agile threats at the same time. The effective jam-to-signal ratio will protect a ship with a radar cross-section in the 1,000- to 8,000-ton range.

Full peak power is possible with both pulse and continuous wave (CW) jamming. A complete set of jamming techniques is available using both repeater and transponder modes. The polarization of a radar can be matched in any of four quadrants.

The system can operate a full range of jamming techniques:

- Spot and barrage noise can be used against acquisition and targeting radars.
- Swept spot noise can be used to effectively jam wideband or multi-frequency radars.
- Cover pulse can be used with FML to enhance the effectiveness against leading-edge tracking radars.
- Range-Gate Pull-Out (RGPO) is effective against certain PRI-agile, range-gated emitters and all frequency-agile range-gated radars.
- RGPO, VCO is used against PRI-stable radars, including sequenced stagger up to four levels.
- False targets are an alternative to noise jamming against search and acquisition radars when anti-radiation missiles are a possibility.
- Angle-deception, swept-scan rate (SSR) can be used against anti-ship missiles, sometimes combined with range deception techniques.
- Angle deception, low-frequency noise (LFN) can be used against certain conical-scan-on-receive-only (CSORO) and lobe-on-receive-only (LORO) radars which are not susceptible to SSR jamming.
- Polarization control maximizes the jamming-to-signal ratio.
- Automatic polarization tuning produces a cross-polarized signal for use against monopulse radars. It can also defeat sidelobe inhibit circuitry in some search radars.

During trials, that APECS II was able to detect radar emissions 10-20 seconds earlier than other ships were, including US Navy vessels equipped with the SLQ-32. The system is considered able to protect a ship against all opposing emitters, including state-of-the-art radars and monopulse systems.

Variants/Upgrades

APECS II. Uses the APECS transmitter and AR-700 ESM system. It was developed for ships in the 10,000+ ton class.

APECS III. ECM performance is similar to that of APECS II, but the physical configuration is lighter, and the receivers/processors use newer technology in many areas. Performance has been upgraded.

CLOAC (Compact Lightweight Omnidirectional Advanced Countermeasures). This is a smaller variant developed from the APECS II and targeted at small, high-value platforms such as missile boats. It is being marketed specifically in the Pacific Rim and Middle East. CLOAC features a lighter, simpler installation. An upgraded AR-900 ESM system is collocated with the antenna.

The system puts out slightly less power and a less sharp jamming beam. However, it is considered more than sufficient for missile boat operations. A flat-screen display is included on a compact operator's console. Power need is reduced from the APECS II to 14-15 kVa at peak load. Development was completed by 1995.

Program Review

Background. The basic hardware for APECS was developed on the basis of older systems used on US Navy submarines and some US aircraft. These earlier systems, the AR-700A and AR-900 ESM systems, are widely used on submarines throughout the world. The basic design of the surface ship system was developed in the early 1980s and the complete surface ship suite was first revealed in 1986.

Having sold at least 26 systems to six countries – Greece, the Netherlands, Norway, Pakistan, Portugal and South Korea, the APECS II system has done well on the international market. The first APECS II was delivered in 1986 for three Portuguese MEKO frigates. Later, as part of a mid-1990s modernization program, Portugal purchased three more systems for its French Commandant Riviere class frigates.

The Netherlands selected APECS II to replace a Signaal system for its Karel Doorman class frigates in 1987. This decision was made on the grounds of cost, as the Signaal suite was substantially more expensive. Original plans were for the first four Karel Doorman class frigates to receive the Signaal equipment, with the ARGOSystems fit being restricted to the final batch of four hulls. Reportedly, comparison trials showed that the ARGOSystems equipment substantially outperformed its Signaal rivals, and the decision was made to fit all eight frigates with the US system.

In 1993, ARGOSystems introduced APECS III, which combines the APECS electronic countermeasures system with a newly upgraded receiver/processor and direction-finding subsystem. In 1995, the company also introduced its CLOAC system for small patrol vessels (300-1,500 tons). No orders for either of these systems have been identified.

Korea joined the list of customers for the APECS II system in 1994, when it decided to procure the system for its new Kwanggaeto-Daewang (KDX I) class frigates. To date, three systems have been installed. More frigates of this class were planned, 17-20 frigates, but a decision to focus efforts on improved follow-on ships has terminated any further construction of the KDX I. The planned three to six follow-on ships, the KDX IIs, appear to be likely recipients of either the APECS II or APECS III system. The first three of the new KDX II frigates will be delivered between 2003 and 2005.

It was reported in 1997 that the Royal Netherlands Navy had awarded a contract to ARGOSystems for three ESM systems to be used on frigates. No system was specified at that time, but it was suspected that the APECS II systems would be installed on the new De Zeven Provincien class frigates. Since that report, no signs of these systems have been detected. The APECS II is not listed on any of the Royal Netherlands naval ships except for the eight Karel Doorman class frigates previously mentioned. It can only be assumed that this contract was canceled.

Effective June 23, 1999, Boeing sold its electronic warfare product line, including the trade name "ARGOSystems," to Condor Systems Inc. Recently, in July 2002, Condor Systems was purchased by EDO Reconnaissance and Surveillance Systems. A spokesperson for EDO has confirmed that the APECS II is currently not in production and that the company is providing logistical support to its customers. It is unclear at this point what EDO intends to do with the APECS program.

Funding

Funding was originally obtained through corporate funding of ARGOSystems in combination with funding from international customers. It is unclear what level of funding will be provided by Condor Systems. No US procurement has been funded or planned to date.

Recent Contracts

No new contracts have been detected.

Timetable

Month	Year	Major Development
	1986	First APECS II delivered
	1987	APECS II selected by the Dutch Navy
	1993	APECS III introduced
May	1994	APECS II selected for South Korean KDX frigate
	1995	CLOAC production capability
late	1997	Contract for three systems by the Netherlands
June	1999	Condor Systems buys ARGOSystems

Worldwide Distribution

Greece. Four APECS II on MEKO 200HN frigates
Netherlands. Eight APECS II on Karel Doorman frigates
Norway. Four APECS II systems installed on Oslo class frigates
Pakistan. One APECS II on Gearing (FRAM I) destroyers
Portugal. Three APECS II on MEKO 200 (Vasco da Gama) frigates; three on French Commandant Riviere class frigates
South Korea. Three APECS II on Kwanggaeto-Daewang (KDX I) class frigates

Forecast Rationale

Capturing sales in at least six countries and being fitted to approximately 26 vessels, the ARGOSystems (now EDO Electronic Systems) Advanced Programmable Electronic Countermeasures System (APECS) II has done well on the international market. The known customers of the APECS II system are Greece, the Netherlands, Norway, Pakistan, Portugal and South Korea. In recent years, however, the APECS II has not attracted any new sales. A spokesperson for EDO indicated that export restrictions have hampered its APECS II sales efforts. Production of the APECS II has been halted, and EDO is providing logistical support. EDO is offering an upgrade of the ESM portion of the APECS II system. Barring major changes in the APECS II program, this report will be archived in the near future.

Ten-Year Outlook

ESTIMATED CALENDAR YEAR PRODUCTION

			High Confidence Level			Good Confidence Level				Speculative			
Designation	Application	Thru 02	03	04	05	06	07	08	09	10	11	12	Total 03-12
APECS II/III	Prior Prod'n:	29	0	0	0	0	0	0	0	0	0	0	0