

# ARCHIVED REPORT

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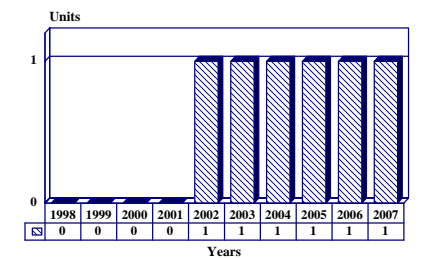
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## EMPAR - Archived 6/99

### Outlook

- Italian offering for the Project Horizon frigate
- Mid-generation system likely to be rapidly outdated
- Test version in use on frigate *Carabinieri*
- Sales now expected for France's Horizon as well
- Future seems relatively secure, regardless of Horizon's fate

10 Year Unit Production Forecast  
1998 - 2007



### Orientation

**Description.** EMPAR is a multifunction G-band, phased array naval radar.

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**Licensees.** No production licenses have been granted.

**Status.** In development. Field trials have been carried out and sea trials are being performed on test ship.

**Total Produced.** One prototype and one operational unit are believed to have been produced thus far.

**Application.** EMPAR is intended to provide future air defense ships with three-dimensional air surveillance and search, multiple tracking and missile guidance functions simultaneously, within a single masthead sensor. It will be used by Italy and probably also

France, for the Principal Anti-Air Missile System (PAAMS).

**Platform.** The system is expected to be installed on the CNGF Project Horizon frigate's Italian and probably also French versions.

**Price Range.** A unit cost of US\$12 million is projected, based on the known values of similar systems.

## Technical Data

	<u>Metric</u>	<u>US</u>
<b>Specifications</b>		
Air surveillance tracking range		
Normal:	80 km	50 miles
Dedicated:	150 km	94 miles
Radiating aperture:	1.5x1.5 m	60 x 60 in
Antenna type:	Passive phased array	
Azimuth scan angles:	+/- 45 degrees	
Elevation scan angles:	+/- 60 degrees	
Side lobes:	Better than -45 dB	
Transmitter type:	Driven TWT	
Frequency:	G-band (5.6 GHz)	
Number of antenna elements:	2,200	
Rotation rate:	60 rpm	
Peak power:	120 kW	
Maximum number tracks:	More than 250	
Tracking accuracy:	3-5 mrad	
<b>Dimensions</b>		
Above-decks weight:	2500 kg	5,500 lb
Below-decks weight:	5000 kg	11,000 lb

**Design Features.** EMPAR is configured as a passive phased array antenna operating in the G-band, combining a central high-power traveling wave tube transmitter, a two-stage super-heterodyne receiver, a fully adaptive array signal processor and a digital pulse compressor administered by a comprehensive real-time computer.

A rotating antenna has been selected to provide full azimuth coverage with rates being specified to meet required update rates. The general design incorporates spare capacity which provides stretch potential for future requirements. A modular design approach allows the system to grow by the use of multiple array faces.

The antenna consists of a corporate-fed phase-phase scanning planar array. A single pencil beam is formed in space and electronically scanned by the use of pin diode phase shifters, controlled from pulse to pulse by a beam steering computer. The feed network has been designed to provide a sum and two difference channels for monopulse beam formation.

The array is capable of scanning over a wide angle with low sidelobe levels. ECCM capability is provided by

the inclusion of automatic frequency selection modes, jammer analysis and mapping, low antenna and sidelobe levels, a frequency-agile mode and by the use of narrow transmit and receive beams.

The radar management computer (RMC) is responsible for all real-time task scheduling in EMPAR. Its roles include radar command and control, data handling, BITE monitoring and all external interfacing and communications. The software has been jointly developed by Marconi Radar and Alenia and hosted on the proven MARA computer developed by Alenia.

**Operational Characteristics.** EMPAR is intended for autonomous and simultaneous medium- to long-range air and surface surveillance, tracking all targets within the mission envelope and acquiring up to 50 targets simultaneously, for prosecution within a local area defense system. EMPAR will seek to obviate the requirement that exists today for several discrete systems to perform search correlation, acquisition and tracking individually.

The hemispheric mission envelope takes in all surface and airborne targets, and will be able to display 300+

targets, tracking 168 priorities and simultaneously engaging up to 50. Design options include a single rotating array, back-to-back dual array and static array configurations. In UKRN and Italian service EMPAR

will be paired with the Franco-Italian ASTER 30 missile to give the Family of Anti-Air Missile system (FAMS) local area missile defense system.

## Variants/Upgrades

There are no variants of or upgrades available yet to this system.

## Program Review

**Background.** EMPAR (European Multifunction Phased Array Radar) was originally conceived as an alternative approach to the requirement for a NATO Frigate radar system. A consortium for its development was formed in 1986. As such it provided the primary sensor for the FAMS solution to the NFR-90 local area defense system. The alternative to this, the Plessey-developed MESAR, formed the prime sensor to the rival NAAWS system.

The Local Area Missile System (LAMS) sought to effectively combine the role of area and point defense. The LAMS was crucial to the overall NFR 90 concept, and conceptual disputes over the system caused its development program to trail behind NFR 90. This dispute was a major driving factor behind the collapse of the NFR-90 project.

The NATO Frigate program virtually collapsed in October 1989 when the UK withdrew from the scene. This example was quickly followed by the majority of the consortium members. A series of national designs were inaugurated to fulfill each nation's view of its NFR-90 requirement. In the case of Britain, Italy and France, this envisaged an area defense ship employing the FAMS system. While a standard missile (the French ASTER-15) was selected for this purpose, opinions were divided on the radar fit. Britain and Italy opted for the G-band EMPAR solution, while France selected the H/I-band Arabel.

Alenia has a contract to develop and supply one version of the EMPAR to the Italian Navy. The Italian requirement is for an experimental single faced phased array, comprising 2,500 elements to be installed on a Maestrale class frigate for trials. GEC-Marconi has been awarded a development contract by the UK Ministry of Defence to provide a version of EMPAR suitable for UK Royal Navy (UKRN) requirements. By August 1993, EMPAR had passed its initial field trials and had started an exhaustive sequence of extended tests. These were completed in December 1993 and preparations undertaken to transfer trials to the frigate *RIM*

*Carabinieri*. This ship entered service for EMPAR trials in 1995.

Design studies for the UKRN Air Defense Frigate (then designated the Type 84 Destroyer) covered a wide range of single- and double-ended options. In January 1993, France, Italy and the UK undertook to design a standard air defense warship to fulfill their fleet requirements. This program is designated the Common Next-Generation Frigate, indicating a multirole ship rather than one purely orientated toward anti-air warfare. The new design was designated Project Horizon. The project office is in London and, although the project director will be French, the final design authority will be the UKRN Directorate of Naval Construction (DNC) at Bath. A total of 22 ships will be ordered, 12 British, six Italian and four French.

In late 1993 and early 1994, the role of EMPAR in CNGF came under increasing question from the British project authorities. The root cause of the problem is that long delays in the formulation of the basic design of the CNGF had pushed the entry to service date back by almost four years, to 2002. These problems were resolved by the British side of the program threatening to leave the project if British requirements were not met in full. As a result, the joint indicative design of CNGF was effectively that originally proposed by the UKRN.

Although a successful means of breaking the existing design impasse, this action left a high level of ill will. This came to a head when the UK side of the design program pointed out that the delays incurred now meant that the time schedule for the program would permit the use of the active array Sampson (previously known as TRISAR) radar as the multi-functional radar, a change which would greatly increase the capability of the ships at little increase in cost.

Both France and Italy were reported to be dissatisfied with this suggestion, Italy since EMPAR was the only major system of Italian origin in the program and France because the change in radar threatened the use of the entire ASTER-30 missile system. In order to

pressure the British into withdrawing the suggestion, France and Italy blocked the start of work on the command system for CNGF until EMPAR was confirmed as the MFR. Italy followed this action by threatening to drop out of CNGF completely.

Discussions during the early part of 1994 centered around this dispute with the Joint Project Office in London pledging to find a solution by the end of May 1994. As projected, this solution was the introduction of transparent interface technology. The adoption of a command system transparent interface could be selected which would permit each of the three partners to select a radar of its choice. This would, naturally, be EMPAR for the Italian ships, Arabel for the French and Sampson for the British. As a result of these disagreements, the in-service date of the new ships has been pushed back by a classified number of years and is not now expected before 2005-2006.

The requirement for EMPAR now appears limited to fulfilling the needs of the Italian and French portions of the Anglo-French-Italian Project Horizon. The early stages of this program were dogged by technical and political disagreements between the French and British. Eventually, the logjam was broken in a series of meetings held in October and November of 1992. A compromise was established, resulting in the foundation of Project Horizon.

The hull size issue (the French insisting on a hull less than 3,500 tons and the British believing that a satisfactory design could not be produced on less than 6,000 tons) was solved by a hull solution of 6,500 tons.

In addition, it was agreed that common systems would be used throughout the ship. This included the replacement of Arabel on the French ships with EMPAR.

The latest series of disputes reflected a general problem with mid-generation systems. Such equipment is very attractive in that it can offer a substantial advance over existing equipment without the great expense and technical risk of introducing an entirely new generation of equipment. The problem is that any delays in such programs mean that the mid-generation system does not enter service until the next-generation equipment is available. This situation will make the mid-generation system obsolete even before entering service. This appears to be the situation facing EMPAR. While it was the only choice when the original project schedule applied, the compounding delays with CNGF have made the adoption of an active array radar based on MESAR technology virtually inevitable.

Another, perhaps even more fundamental, problem has been the existing ASTER-30 missile system, which has been subject to severe operational criticism because of its short range. It was described as a situation where it makes little sense to design an air-defense warfare ship whose size and capability exceed those of the US CG-47 and DDG-51 classes, then equip it with a missile with barely more than point defense capability. Pressure to replace ASTER-30 with a longer-range weapon, either a radically updated Sea Dart or (more likely) Standard SM-2 Block 4, could become irresistible. However this would, in turn, eliminate EMPAR, which has too short a range to exploit the range of the new missiles.

## Funding

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The EMPAR consortium members have combined to make available US\$75 million for the development program. Although the majority of this is private venture capital, some funding has been provided by the governments concerned.

## Recent Contracts

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No contractual information has been made publicly available.

## Timetable

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<u>Month</u>	<u>Year</u>	<u>Major Development</u>
	1980	Initial NF-90 outline presented by NNAG
Oct	1982	Pre-feasibility study conducted by NNAG
Apr	1983	NFR-90 MoU drawn up
Apr	1984	NFR-90 MoU signed
Oct	1985	NFR-90 feasibility study evaluation completed
Jul	1986	EMPAR consortium announced

<u>Month</u>	<u>Year</u>	<u>Major Development</u>
Jul	1987	Statement of intent for NF-90 project definition
Jun	1988	Franco-Italian SAM-90 working group formed
Jun	1989	EUROSAM (FAMS) consortium formed
	1989	NFR-90 project definition/design completed
Oct	1989	Britain withdraws from NFR-90
Dec	1989	RN selected FAMS as next air defense missile
Jan	1990	NFR-90 collapses
Jan	1993	Project Horizon inaugurated
Dec	1994	Factory Acceptance Tests completed
Jan	1995	Shipborne sea trials performed
Jul	1996	Validation trials begin
	1997	Validation trials concluded
	1998	First air defense frigates to be ordered
	2002	First EMPARs probably ready in production
	2006	Project Horizon ships to enter service for Italy

## Worldwide Distribution

**Italy.** (One prototype has been installed on the Italian navy frigate *Carabiniere* for the evaluation program. The Italian and French navies are scheduled to use EMPAR on their versions of the Horizon tripartite frigate.)

## Forecast Rationale

The following forecast includes contingencies for both Italian and French Common New Generation Frigates (CNGF Project Horizons). France and Italy both agreed in 1997 to go ahead with the development of PAAMS, setting up a joint venture EUROPAAMS. This means that both are virtually locked in to use also the same radar system, i.e., the EMPAR, for that missile. Both countries are cash strapped, however, and it does not seem likely that France will buy more than two of these ships at first, and the same will probably be true for Italy, despite their earlier statements which predicted a procurement of four, even six Horizons.

It is possible, though, that once France's economic straits become less dire, around the middle of the first decade in the next century, an order for more Horizons or a derivative of the same may come through. For that

reason, the chart contains another sale to France in the out years. An extra unit is also forecast for Italy, in case the country does stick to its guns and orders at least three of the Horizons, perhaps followed by more in the decade after that.

Export requirements seem less likely. The air attacks on British ships during the Falklands war and the campaigns waged against merchant ships in the Iraq-Iran war in the Persian Gulf demonstrated the need for adequate air defenses. The fact remains that area defense air warfare ships are very expensive and difficult to justify outside the environment of a major-power fleet. Outside the US, Japan and Europe, current stress is on general purpose and ASW frigates. This situation is likely to continue with little funding being available for the more sophisticated warship.

## Ten-Year Outlook

ESTIMATED CALENDAR YEAR PRODUCTION													
Designation	Application	thru 97	High Confidence Level			Good Confidence Level			Speculative			Total 98-07	
			98	99	00	01	02	03	04	05	06		07
EMPAR	DDG (FRENCH NAVY)	0	0	0	0	0	0	1	0	1	0	1	3
EMPAR	DDG (ITALIAN NAVY)	1	0	0	0	0	1	0	1	0	1	0	3
Total Production		1	0	0	0	0	1	1	1	1	1	1	6