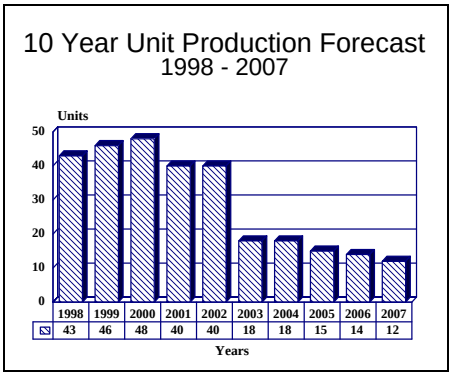
Scout and Pilot - Archived 7/99

Outlook

- Stealth navigation and covert surface search radar
- Experiencing rapid growth in sales, wide market penetration
- Basic technology likely to be expanded to other areas
- Both products share the same roots, now separate ways
- Will be discussed under individual reports in the future



Orientation

Description. Low power output, frequency modulated continuous wave radars, initially designed for naval navigational purposes but with the technology expandable to many other uses as well.

Scout is the first member of a family of stealthy radars, which, due to their low probability of detection by ESM techniques, is likely to reverse the current balance of capabilities between radar range and electronic warfare systems detection capability.

Both Scout and Pilot share a common background but are now two distinctly separate products, each by a different manufacturer. This will be reflected in the future division of this report in two.

Sponsor

Hollandse Signaalapparaten BV
Zuidelijke
Havenweg 40
NL-7550 GD Hengelo
The Netherlands
Tel: +31 74 488111
Telex: 44310

Contractors

Hollandse Signaalapparaten BV
Zuidelijke Havenweg 40
NL-7550 GD Hengelo
The Netherlands
Tel: +31 74 488111
Telex: 44310
(Scout)

CelsiusTech Systems AB
S-17588 Järfälla
Sweden
Tel: +46 8 580 84000
Fax: +46 8 580 32244
(Pilot)

Kelvin Hughes
New North Road
Hainault
Ilford, Essex
United Kingdom
Tel: +44 181 500 1020
(display and workstation)

In the original system, the above-deck sections were produced by Bofors Elektronik and the below-deck sections by Signaal.

Licensees. No production licenses have been granted.

Status. Production and service.

Total Produced. About 115 systems are estimated to have been produced through 1997.

Application. The initial Scout radar is intended for navigational purposes, while later members of the family will be used for target acquisition, fire control and anti-submarine warfare.

Platform. Scout is being installed on a number of different types of surface vessels, including frigates and missile patrol craft.

Price Range. As originally designed, the Scout radar would have cost up to US$2 million. Following the Thomson-CSF take-over of the project as part of the Signaal acquisition, a major cost-cutting program was implemented at the company. This brought the price of Scout down to only about US$150,000.

Technical Data

Characteristics:

Antenna type single or dual slotted waveguide	
Antenna gain:	28.5 dB
Operating frequency:	I-band
Horizontal beamwidth:	1.2 degrees
Vertical beamwidth:	20 degrees
Transmitter output:	1 mW to 1 W
Rotational speed:	24/48 rpm at 60 Hz
	20/40 rpm at 50 Hz

	Metric	US
Dimensions:		
Single antenna weight:	55 kg	110 lb
Dual antenna weight:	75 kg	165 lb

Design Features. Scout employs frequency modulated continuous wave (FMCW) transmission as a means of obtaining high resolution range information from very low power outputs. Although conventional CW transmissions also use low power outputs, they are unable to provide range data. To overcome this fundamental problem, Scout transmits a waveform modulated in a sawtooth pattern. Within each of these modulations the basic frequency is swept over a small bandwidth. Digital analysis of signal returns for frequency using a Fast Fourier Transform (FFT) algorithm enables the range of detected targets to be established within three meters at 0.375 nautical miles, or to within 96 m at a maximum range of 24 nm.

The solid-state transceiver can be mounted directly on the back of the antenna array, reducing power losses. Both single and dual antenna installations are possible, the latter offering a 25 percent increase in maximum range at the expense of increased top weight. At 55 kg the single antenna array is 35 kg lighter than the dual array system but does require the installation of a reflected power canceler. This permits a single antenna to be used for both transmission and reception of FMCW signals without transmitter leakage damaging or desensitizing the receiver. It works by taking a sample of the transmitted signal and subtracting it from the signal entering the receiver, canceling out the leakage while allowing legitimate returns to enter the receiver unaffected.

Operational Characteristics. Scout can be supplied as a stand-alone unit or as an add-on system. The processor unit provides a video output compatible with most forms of display, a PPI or daylight raster type or a data handling system with video extractors. Three possible fits are envisaged: an all-new installation, the addition of a Scout transceiver and processor to an existing navigational radar antenna, or the coupling of a Scout transceiver to an existing antenna/receiver combination. The last possibility gives an operator the ability to switch between pulse and FMCW operation.

The key point on Scout is that in-service ESM receivers cannot decode the linear frequency modulations of an FMCW radar and thus can only detect the radar on the basis of its power level output and must therefore cover a bandwidth at least as wide as the total frequency deviation. The radar itself can integrate the returns coherently over the whole sweep period, giving it an effective bandwidth equal to the switch repetition frequency. The difference in noise bandwidths between the ESM receiver and the Scout radar is thus in the order of 10,000 to 1. Combined with the very low power output of 1 W, it has an ESM intercept range reduced by a factor of over 100. Furthermore, since anti-radiation missiles home in on peak power

transmissions, their effectiveness against FMCW radar is dramatically reduced.

Variants/Upgrades

At present, Scout is envisaged as a high-precision navigation radar. The first planned upgrade will be the addition of an MTI facility. Other members of the family are likely to be developed with special emphasis on the ASW role. The very low probability of ESM detection while periscope and snorkel hunting will be of particular value. Other potential applications for Scout technology include covert and overt minelaying, minesweeping and station-keeping.

Harbor Control And Coastal Surveillance Version. A harbor control and coastal surveillance version of Scout has been demonstrated. This utilizes specialized mini-displays and the entire system can be installed in concealed mountings on a standard pick-up truck. This permits covert radar surveillance of randomly selected strips of coastal waters and has obvious policing implications.

Pilot. Following the release of the new Scout radar, Thomson-CSF stated that contractual agreements with CelsiusTech do not permit the use of the original name Pilot for FMCW radar. Subsequently, CelsiusTech (the result of the acquisition of Nobel Industri by Celsius) released the Pilot radar onto the market under the designation Pilot Mark 2.

Pilot Mk 2. CelsiusTech says that Pilot Mark 2 differs from Scout in having an improved, and substantially more powerful, signals processor which converts the real-time output video from the radar into a format compatible with that from a conventional pulsed radar. This, in turn, permits Pilot to use existing display technology.

Program Review

Background. The Pilot technology was originally developed by Bofors Elektronik Research Laboratory at Redhill in the UK. Work started in 1986 with a demonstrator being produced in the spring of that year using the antenna and pedestal from a Goalkeeper CIWS. In August and September 1987, Bofors Elektronik and the Swedish Defense Material Administration jointly conducted trials onboard a Spica II class fast attack craft. The vessel was successfully navigated blind through an archipelago at 25 kts. Further shore-based trials were conducted in May 1988 by the UK Royal Navy.

During 1989/90 Philips disposed of most of its defense interests. The Signaal operation was acquired by Thomson-CSF, while PEAB was sold to Bofors to become BEAB, eventually becoming the Nobeltech division of Celsius Industries. Finally, the MEL division was sold to Thorn-EMI. Thus, all three groups originally working together on the Pilot program were dispersed among new parents. Subsequently, Thomson-CSF announced a new navigational radar designated Scout, which, for all practical purposes, is identical to Pilot.

The Scout technology demonstrator underwent trials between 1988 and 1991. A formal prototype navigational radar was delivered in May 1989. In 1989 the Royal Swedish Navy ordered Scout as the standard navigational radar for the four Göteborg class missile corvettes. It is not known whether these ships will be equipped with Scout as a stand-alone system or as an add-on to the originally-planned Terma PN-612 radar.

During 1991, the Netherlands Navy made a major commitment to the Scout program, ordering eight systems to equip the Karel Doorman class frigates and confirming the purchase of two systems to equip the Heemskerck class frigates. A further order for six systems to equip the six Kortenaer frigates due to undergo a mid-life upgrade is anticipated. About that time, the Dutch frigate *HrNs Tjerk Hiddes* still retained its original pair of Racal-Decca 1690/9 navigation radar. Since the ship had only recently been completed, it can be deduced that the installation of Scout had not started at that time.

In December 1992, CelsiusTech re-entered this market sector by announcing the availability of the Pilot Mark 2 radar. The company had obtained access to the basic Philips FMCW technology by its purchase of PEAB at the time of Philips' withdrawal from the defense industry. As stated above, the two products appear very much identical, being based on the same technology. CelsiusTech said it would be supplying up to 16 of its Pilot Mk 2 radars for the Swedish navy's Visby and Styrsö class programs.

Plans to re-equip existing warships with Scout or Pilot continued to be announced throughout 1994 and 1995. Canada revealed that it plans to install the Scout radar on the Halifax class frigates and Tribal-Trump class destroyers during upgrades of those 16 ships starting in 1998. France is reported to include the installation of Scout FMCW capability as an option on the navigation radar of its Cassard class destroyers and the Georges Leygues and Tourville class frigates. The Netherlands is planning to refit the Jacob van Heemskerck class destroyers with Scout during those ships' 1998-2001 major refits.

This run of success continued through 1995 and into 1996. A major sale was the supply of ten Scout radar to the UAE as part of a major package involving the supply of two Kortenaer class frigates and modernizing many other UAE warships. The Belgian Navy ordered the radar to equip three of its Weilingen class corvettes (the fourth having been stricken after running aground). Other buyers are reported to include Kuwait (on its eight Combattante I class fast attack craft), Egypt (for coast defense) and Indonesia.

Funding

Development of the Scout radar was jointly funded by Signaal and Bofors Elektronik. Ongoing funding of Scout is by Thomson-CSF; that of Pilot Mark 2 by Celsius Industries.

Recent Contracts

Contractor	Award ($ millions)	Date/Description
Egypt	N/A	*1994* – Order for 30 Scouts for their Coastal Border Surveillance System (CBSS) installed in mobile sensor stations. Deliveries completed in February 1996.
Egypt	N/A	*1995* – Request for pricing of an additional 12 CBSS units, plus amendment of the original contract to include five EO subsystems with pedestal-mounted TV cameras and thermal imagers. First deliveries in mid-1996.
Royal Belgian Navy	N/A	*May 1995* – Belgian navy contract for the modernization of three Wielingen class frigates: replacement of Raytheon 1645/9X with Scouts.
Netherlands Navy	N/A	*January 1997* – Royal Netherlands Navy's order for 11 Scouts for eight Karel Doorman frigates and future ships (presumably LCFs).
Finnish Navy	N/A	*October 1997* – Order for two Scout FMCW radars.

Timetable

Month	Year	Major Development
	1986	Development inaugurated
	1986	Demonstrator model completed
Sep	1987	Swedish Navy trials
May	1988	Royal Navy trials
Mar	1989	Prototype navigational radar ready
Dec	1989	First production deliveries
	1989	Philips begins divestment of defense operations
Mar	1991	Scout trials in the US
	1991	Scout ordered for Karel Doorman frigates
Dec	1992	CelsiusTech re-enters market, introduces Pilot Mk 2
Dec	1993	Pilot Mk 2 selected for YSM-2000 and YSB projects
May	1995	Belgium modernizing 3 Wielingens, including Scout radars
Jan	1997	Dutch navy buys 11 Scouts as part of Karel Doorman class modernization
Oct	1997	Finnish navy buys two Scout systems

Worldwide Distribution

Belgium. (three systems on Weilingen class corvettes)

Egypt. (an unknown number of systems supporting 42 mobile units for coastal defense)

Finland. (two ordered in late 1997, probably for the upcoming Rauma 2000 missile boats)

Netherlands. (two systems planned on Heemskerck class frigates, 11 systems bought for Karel Doorman frigates and future ships, presumably the De Zeven Provincien class [LCF] frigates)

Sweden. (four systems on Göteborg corvettes)

UAE. (10 systems on assorted warships

Forecast Rationale

The Scout radar program has now completed the difficult transition from an extremely promising technology demonstrator to a mature and extremely successful system. The Netherlands has ordered Scout as the navigational radar on the Heemskerck, Karel Doorman and Kortenaer class frigates. The order for 11 systems is said to suggest that the Netherlands has made a commitment to use Scout on all its future surface combatants, presumably including the De Zeven Provincien class (LCF) frigates.

The maturity that the radar has now reached does in fact raise additional sales prospects. At present Scout uses the Kelvin Hughes ARPA (Automatic Radar Plotting Aid) display and operator consoles developed for the Type 1007 navigational radar. This is the standard equipment on all UK Royal Navy (UKRN) warships. Since the UKRN has a deep appreciation for the effectiveness of ESM technology in the modern naval environment, the adoption of Scout technology as an upgrade to Type 1007 is probable and may already be in hand. The UKRN is known to have conducted extensive trials with Scout.

There is considerable speculation in defense circles that Scout technology may have been adopted even for use on UKRN submarines, and that the Type 1007 systems listed as equipping Trafalgar and Vanguard class submarines have Scout modules as an available operational option. This speculation seems highly plausible.

With the split-up of the original Pilot production group between separate parents, the Pilot FMCW technology has gained much wider exposure. This is both a positive and negative development. The positive side is that with more numerous companies involved, each developing the system as it sees fit, technical progress should be faster and take place over a wider front. The negative side is that a number of FMCW sets will be competing for similar markets, as is already happening with CelsiusTech Pilot Mark 2 radar and Scout, possibly leaving each individual set with an uneconomically small slice of the market. However, in any such competition, Scout has established a commanding lead that will mitigate adverse effects.

The covert and stealthy characteristics of the Scout system give it great market potential. Steadily increasing computer processing power placed in ever-lighter ESM systems has made the use of radar hazardous to the point where the value of active radar has been seriously questioned. The sad fact is that a conventional radar can be detected, identified and isolated from three times the range that it can detect and process its own return echoes. Scout technology offers an escape from this dilemma. As the potential of the system becomes better known, it can expect a bright future.

A number of nations have expressed interest in Scout derivatives as upgrades to existing programs. These include Norway and Denmark, as a land-based harbor entrance radar; and Germany, Sweden, Canada and Australia as a submarine-based system. There are three separate programs presently under way to integrate Scout into a submarine periscope assembly. These include IKL in Germany, Riva Calzoni in Italy, and Barr & Stroud in the UK. It is probable that the products of these programs will all find places in future submarine construction.

With Scout now established and holding firm production orders, the ten-year forecast has been revised to cover production for known and likely clients. These include the Netherlands and German navies (confirmed orders) and the British Royal Navy and French Navy (projected). In the British case, the adoption is likely to take the form of an upgrade (possibly already in service) to the existing Type 1007

radar, exploiting the fact that the two systems already use the same displays and work stations. The forecast assumes that a covert program to provide Scout capability to Royal Navy Type 1007 radar is already in place.

A Scout-derived airborne ASW radar has been postulated for introduction in the mid-term. This is predicted to achieve considerable market penetration. Finally, it is assumed that a periscope-mounted version of Scout became available in 1994 and features prominently (although covertly) in submarine sensor fits. Due to the nature of Scout, such fits may never be formally announced.

The CelsiusTech Pilot Mark 2 radar was expected to achieve most success in the Nordic market, then spread outward as a result of integration with the CelsiusTech 9LV453 command system. This process has started with the orders for 16 systems to equip the Royal Swedish Navy's Styrsö (YSB) and Visby (YS-2000) class vessels. In the longer term, the promotion of Pilot Mark 2 will draw many sales from the Scout radar, and the unspecified lines in the forecast should be interpreted to reflect the combined prospects of the two systems.

However, the Finnish procurement of two Scouts throws this prediction off the track, suggesting that more of those radars could be bought for Finland once that country is able to expand its shipbuilding programs, i.e., when the Rauma class gets underway.

Separate reports will be issued for Scout and Pilot in the future, due to their increasingly diverging characteristics and, consequently, user applications. For the sake of this report, both products have still been discussed together.

Ten-Year Outlook

ESTIMATED CALENDAR YEAR PRODUCTION

			High Confidence Level				Good Confidence Level				Speculative			
Designation	**Application**	**thru 97**	**98**	**99**	**00**	**01**	**02**	**03**	**04**	**05**	**06**	**07**	**Total 98-07**
SCOUT	ASW (VARIOUS)	30	10	10	10	10	10	8	8	6	6	4	82
SCOUT	DD/FF (FRANCE)	4	2	2	2	2	2	1	1	0	0	0	12
SCOUT	DD/FF/FAC-M (UNSPECIFIED)	26	12	12	12	10	10	8	8	8	8	8	96
SCOUT	FAC-M (SWEDEN)	10	2	2	2	2	2	0	0	0	0	0	10
SCOUT	FF (GERMANY)	4	0	1	2	1	1	0	0	0	0	0	5
SCOUT	FF (NETHERLANDS)	13	3	1	2	1	1	1	1	1	0	0	11
SCOUT	FF (UK)	6	4	4	4	4	4	0	0	0	0	0	20
SCOUT	MPA/ASW AIRCRAFT (VARIOUS)	0	0	4	4	8	8	0	0	0	0	0	24
SCOUT	SSBN/SSN/SSK (VARIOUS)	18	8	8	8	0	0	0	0	0	0	0	24
SCOUT	SSK (GERMANY)	4	2	2	2	2	2	0	0	0	0	0	10
Total Production		115	43	46	48	40	40	18	18	15	14	12	294