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SMART - Archived 4/2008

Outlook

- Forecast International will archive this report in April 2008. It is being replaced with the following reports on the individual radars encompassed in the SMART family: SMART-L, S1850M, MW08 and SMART-S/SMART-S Mk 2

Orientation

Description. SMART is a family of multi-beam, 3-D, naval long-range volume-search radars, each with slightly differing missions.

Sponsor

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Licensee. ITT signed an exclusive agreement with Thales to build and market the SMART-S Mk 2 radar in the United States.

Status. In production and service.

Application. SMART-L is used for early detection and tracking of very small aircraft and missiles. SMART-S is capable of automatic detection of targets in the medium to long range, featuring automatic track initiation and accurate multi-target tracking.

Platform. The SMART family radars are used on warships of frigate size and larger. The SMART-L radar, however, is also suitable for patrol-craft-size vessels.

Price Range. There is no published information on SMART pricing. Forecast International therefore can only estimate a speculative range of between \$10 million and \$12 million for SMART-L, S1850M and SMART-S radars. The SMART-S Mk 2 and MW08 radars are believed to cost in the speculative range of \$6 million to \$8 million.

Contractors

Prime

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SMART

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Contractors are invited to submit updated information to Editor, International Contractors, Forecast International, 22 Commerce Road, Newtown, CT 06470, USA; rich.pettibone@forecast1.com

Technical Data

	<u>Metric</u>	<u>U.S.</u>
Specifications		
<i>SMART-S</i>		
Range (0.1m ² target SW3)	45 km	25 nm
Frequency band	F-band (10 cm)	
Antenna system weight	1,500 kg	3,300 lb
Antenna size	5.3x2.1 m	
Antenna rotation speed	27 rpm	
Vertical beamwidth (receiving antennas)	9 degrees	
Horizontal beamwidth	2 degrees	
Transmitter cabinet weight	1,300 kg	2,860 lb
Processing cabinet weight	710 kg	1,564 lb
Hydraulic power unit weight	450 kg	991 lb
Waveguide drier weight	83 kg	183 lb
<i>SMART-L</i>		
Range	400 km	216 nm
patrol aircraft		
fighter plane	220 km	
stealth missile	55 km	
Tracking capacity		
air targets	1,000	
surface targets	40	
jammer tracks	32	
Frequency band	D-band (formerly L-band)	
Antenna system weight	6,200 kg	13,650 lb
Antenna size	9.2 x 4.4 x 3.7 m	33 x 14.5 x 12.1 ft

Design Features. Generally, SMART is a family of three-dimensional radars for detection and surveillance purposes against anti-ship missiles and aircraft.

SMART-S. SMART-S is designed to provide data-handling and weapons system control against anti-ship missiles. It is intended to cope with missiles with radar cross-sections as small as 0.1 square meter, approaching at low altitude and in a steep dive at speeds of up to Mach 3. The targets can be either sea-skimming or approaching at angles of up to 70 degrees.

The main characteristics of the SMART-S system are gapless elevation coverage from horizon to zenith; automatic target detection followed by automatic initiation and 3-D target tracking; prompt delivery of accurate target track at a high refresh rate, which enables lock-on of associated weapon control trackers;

direct control of guns against surface targets; direct control of continuous wave illuminators in combination with semi-active homing missiles; advanced processing techniques such as digital Fast Fourier Transform (FFT), Doppler processing, and automatic target detection, initiation and tracking; Built-In Test Equipment (BITE), ensuring automatic diagnostics and failure reporting; and databus compatibility.

The antenna is hydraulically stabilized. The transmitting part of the antenna consists of a squint-free, single-element-array radiator with a vertical coverage of 90 degrees.

SMART-L. The SMART-L currently forms the primary sensor for the next-generation Dutch air defense systems. It also includes the Evolved SeaSparrow Missile (ESSM) and the Thales APAR

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(Active Phase Array Radar). SMART-L is a D-band pulse-Doppler radar that has 16 simultaneous receive beams in elevation and 360-degree azimuth scanning, providing automatic long-range air target location and tracking.

SMART-L uses spread-spectrum techniques to defeat electronic countermeasures. Tracking capacity includes up to 1,000 air targets and 40 surface contacts. It has the demonstrated capability of tracking stealth targets in the F-117 category at ranges out to 55 kilometers. A large, electronically stabilized 8.2-meter antenna that rotates at 12 rpm is part of the system. The vertically polarized antenna is built out of layered composite materials and weighs 6.2 tons. Its stack of 24 horizontal stripline arrays is used for reception; 16 of those are used for transmission.

SMART-L is also equipped with an integral I-band frequency-modulated continuous wave (FMCW) radar that uses technology derived from the Scout covert navigation radar program. This is used for low-probability-of-intercept surface search. An Identification Friend or Foe (IFF) antenna is mounted on the primary array.

SMART-L uses the new solid-state D-SSTX transmitter unit. This transmitter consists of seven solid-state units in parallel, each having up to 216 parallel transistor junctions. This arrangement can produce a total of 300 W peak power. When employed in a one-driving-four configuration, terminating in 16 transistors in parallel, a basic amplifier designated the PA module produces 4 kW. Combining up to 32 PA modules enables power to be boosted to 100 kW peak power. Since this power is generated by 512 transistors, a single failure is inconsequential, while the failure of 10 of the 32 PA modules reduces range by only 10 percent. The transmitter unit is microprocessor-controlled and offers remote status and control by serial datalink.

Front-end processing electronics architecture is based on a Texas Instruments C-40 digital signals processor with application-specific integrated circuit technology concentrating the 16 parallel processing channels into a confined area. Back-end processing comprises com-

mercially available Sun SPARC boards in Signal's SigMA/Splice architecture.

SMART-L is the version used for medium-range detection of small stealth air targets and long-range detection of conventional aircraft. SMART-L provides high electronic counter-countermeasures (ECCM) performance and guidance support for patrol aircraft, and carries out surface surveillance.

Operational Characteristics. The SMART radar ensures a favorable compromise between range and low-level performance, clutter rejection, and antenna size. Both SMART-S and SMART-L have multiple low-noise receiving channels.

The target echoes are received by an array of 16 stripline squint-free receiving antennas, each of which receives signals from the complete elevation coverage. An accurate elevation measurement is produced by means of a digital beam former, which combines all outputs of the receiving antenna. Beam-forming results in 12 virtual beams, together covering 90 degrees in elevation. The output signals of the beam-forming circuit are handled further by an FFT processor for target speed information, clutter rejection, and jamming suppression. Target-track initiation and tracking of all surface and air targets within the detection envelope is performed automatically by means of two general-purpose computers. Tracking data are transferred to the ship's command and control system via computer interfaces.

Anti-clutter and ECCM features of the SMART-S radar include fully coherent chain, broadband operation with possible burst agility, high RF power output, automatic RF and Pulse Repetition Frequency (PRF) selection, very low antenna sidelobes in both transmission and reception, 3-D radar with pencil beams, Doppler FFT processing, automatic thresholding of clutter and jamming, an automatic jamming analysis sensor, pulse compression, automatic sensitivity time control (STC), and possible sector transmitting and emission control. SMART is able to track 160 air targets, 40 surface targets, or two surface targets for designation to guns. For the complete integration of any type of IFF, an IFF antenna, rotary joint, and extractor are incorporated.

Variants/Upgrades

SMART-S. SMART-S is the F-band, medium- to long-range version of the SMART family of radars. It was tested at sea in 1990 and is now fully operational. It is capable of automatic detection of targets, followed by automatic track initiation and accurate tracking of the targets.

SMART-S has a unique multi-target tracking capability, and deals simultaneously with high-priority targets such as small and fast low-flying or high incoming anti-ship missiles, as well as all other types of air and surface targets.

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MW08. This is the short- to medium-range 3-D radar choice for installation on the MEKO class frigates being built for the export market. Fundamentally, the MW08 is a G/H-band version of SMART-S.

SMART-L. A D-band version of SMART-S tasked with long-range 3-D air surveillance. It forms the primary sensor for the new-generation Dutch air defense systems.

S1850M (SMARTELLO). The SMARTELLO was the new system selected by the Joint Project Office for the Anglo-Italian-French Common New Generation Frigate (CNGF) Project Horizon. This radar replaces Astral, originally specified as the long-range radar for these ships. SMARTELLO (later renamed S1850M) was developed by Thales Nederland and BAE Integrated System Technologies (Insyte). Essentially, SMARTELLO is a very long-range radar (LRR) that combines the technologies of the SMART-L with those that were offered by GEC-Marconi (now BAE Systems) on its Martello.

S1850M uses the SMART-L antenna combined with solid-state transmitters. As a result, the need for below-decks space is significantly reduced and a complex rotary joint is not needed. That, in turn, simplifies the phase shifter design.

SMART-S Mk 2. This newest design operates in the E/F-band and is optimized for medium- to long-range surveillance and target designation in littoral environments. SMART-S Mk 2 is designed to match the full performance range of surface-to-air missiles (SAMs), such as the ESSM. It has two main modes: medium range up to 150 kilometers at 27 rpm and long range up to 250 kilometers at 13.5 rpm. It also has a special helicopter mode, and surface fire channels. The system features a smaller below-deck footprint with just two small cabinets. The solid-state transmit modules are integrated into the antenna, meaning no separate transmitter cabinet and waveguide are required.

Program Review

Background. The SMART radars have been given a high priority by the Dutch Ministry of Defense since the development program was announced in 1981. The system was under continued development through 1985. The success of the SMART radar series grew as the Royal Netherlands Navy installed SMART-S on board the Karel Doorman class of frigates and retrofitted two Jacob van Heemskerck class anti-air warfare (AAW) frigates, where it is used to target Standard SM-1 missiles. SMART-S was also specified for the German F-123 Brandenburg class frigates. Since then, installations have spread to a wide range of other ships.

MW08 for Corvettes and Fast Attack Craft

This is the short- to medium-range 3-D radar choice for installation on the smaller class frigates, corvettes and fast attack craft being built for the export market. Fundamentally, the MW08 is a G/H-band version of SMART-S. The MW08 derivative of SMART-S was selected for the Portuguese Vasco da Gama class (MEKO 200s) in 1987 and the Greek Hydra class (also a MEKO 200 version) in 1989.

Missile-Firing Helicopters Prompt Buy from Oman. Orders placed in 1992 included two MW08 systems to equip the Vosper 83-meter corvettes bought by Oman. The decision to mount a powerful 3-D radar on these relatively small ships resulted from Omani insistence on acquiring a capable defense against missile-firing helicopters. The resulting effort involved

the installation of the modular Crotale-NG missile system, and made essential the provision of a 3-D air surveillance capability. The project was completed in just over four years.

Greece Wants More MW08 radars. Three more MW08 radar systems were ordered for the Greek Super Vita-class guided missile patrol craft. The first of these, laid down in 2000, had entered service by 2003. At the launching ceremony of the second ship of this class, Greece's minister of national defense announced that Greece intended to exercise its option to procure two more Super Vita vessels. This apparently occurred, as Thales later received two contracts from the Hellenic Navy in the fall of 2003. The first contract is for the supply of radar and fire control equipment, including MW08 radar for two additional Super Vita fast attack craft. The second contract is for the mid-life modernization of four Combattante III fast attack ships. New radar and fire control systems will also be provided under this contract. Although a SMART radar system was not specifically identified in the Combattante press release, it is possible that a variant of the SMART radar will be included.

Turkey is Doubtful. Turkey ordered three Yildiz class fast patrol boats (Ships 3-5) in May 1993 equipped with MW08 radar. The first two ships of the class were equipped with Siemens Plessey Dolphin radar instead. Turkey had planned to build two more MW08-equipped Kilic-class guided missile patrol combatants. Whether

Turkey will execute this plan remains extremely doubtful, however.

South Korea Buys More from Thales. The MW08 variant of the SMART radar family is being produced for the Republic of Korea's KDX-II destroyers. All three ships are scheduled to be in service by 2005. The first of the South Korean KDX-II class destroyers, the *Chungmogong Yi Sun-shin*, conducted its first live-firing tests with the SM-2 Block III missiles in the fall of 2004. During the tests, the ship's MW08 radar detected the threat and handed it off to the STIR long-range fire control radar system. The two missiles fired during the test both scored direct hits.

Thales also signed a contract with the South Korean Navy in the fall of 2003. Reportedly, the new Landing Platform X amphibious ship (LPX) will carry the MW08 radar system. The LPX was launched in July 2005 and enter service in June 2007. A second LPX might be built later in the decade.

The Newest SMART Nation: Indonesia. Indonesia became the latest customer of the MW08 surveillance radar system when, in January 2004, it ordered two new corvettes from the Royal Scheide Shipyard in the Netherlands. Both of the ships will be equipped with several Thales systems, including the MW08. The two ships are to be delivered in 2007. In June 2005, Indonesia exercised a contract option for two more corvettes with the MW08. Ships three and four are scheduled to be delivered in 2008.

Long-Range Smarts: SMART-L

In 1991, Signaal (now Thales Nederland) announced that it was developing a long-range D-band version of SMART, designated SMART-L. This development was originally intended to be part of the now-defunct NATO Anti-Air Warfare System (NAAWS). It has now become the prime sensor for the new-generation Dutch air defense system, and operates in conjunction with ESSM and APAR fire control radar. SMART-L is being installed on the new Dutch De Zeven Provinciën and German Sachsen-class air defense frigates.

Also released were the first provisional diagrams of the new Dutch/German air defense ships. These have evolved as enlarged versions of the Karel Doorman class (first the F-123 Brandenburg class for the German Navy, followed by the F-124 Sachsen class), equipped with a SMART-L long-range radar, a SMART-M target acquisition system, and APAR missile guidance radar.

During 1997-98, the SMART-L system underwent land-based factory testing at the Signaal range in Hengelo, the Netherlands. A wide variety of tests were

performed on targets ranging in size from a tennis ball (to represent a stealth aircraft) to a MiG-29 going at speeds of Mach 2+.

After land testing, the engineering and manufacturing development (EMD) unit was then mounted on the RNLN HrMs *Tromp*, a guided missile frigate, for sea trials. Sea-based testing lasted through mid-1999, and the first production SMART-L was delivered in 2000.

First Customers. In 1998, the Royal Netherlands Navy (RNLN) placed an order for four SMART-L systems for installation on the De Zeven Provinciën class of air defense frigates. The first De Zeven Provinciën class was launched in December 2000 and became active in 2002. The following three ships of this class were all in-service by 2005. The first installation of the SMART-L on a German F-124 frigate, the *Sachsen*, began in January 2001 after the vessel was removed from its roofed floating dock and moved to an outfitting pier. Sea trials of the SMART-L system began in August 2001.

The SMART-L surveillance radar played a vital part in a live-fire test aboard the Dutch De Zeven Provinciën class frigate in November 2003. During the test, the SMART-L system detected the incoming targets, thus alerting the APAR fire control system to take action. All targets were destroyed. This scenario was played out again in August 2004 when the new German Type F-124 frigate, the *Sachsen*, successfully completed a series of live firings at the U.S. Naval Air Warfare Center/Weapons Division Sea Range in Southern California. Eleven ESSM, 10 SM-2 Block III and two Boeing Harpoon missiles were utilized during a total of 23 missile firings in several increasingly complex scenarios.

France, Italy and the U.K. Choose SMARTELLO (S1850M)

In 1994, the French Astral radar was de-selected as the primary long-range search radar for the Anglo-Italian-French Common New Generation Frigate, Project Horizon. Bids for a new long-range search radar were invited. As an alternative to Astral, a new radar, designated SMARTELLO, was offered by Signaal and GEC-Marconi (later Alenia Marconi). This new system was said to combine the best features of the GEC-Marconi S-753 Martello radar and the SMART-L.

The SMARTELLO system (now designated S1850M) was selected as the long-range surveillance radar for the tri-nation Horizon air defense frigate. In October 1999, the British terminated their participation in this project and invested their efforts in the Type 45 destroyer instead. However, the British, French and Italians

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continued to act together to purchase S1850M and other systems for their respective platforms. BAE Systems, prime contractor, announced the selection of the Thales and BAE Integrated System Technologies (Insyte) S1850M radar for the U.K. Type 45 destroyer program in March 2001. A Memorandum of Understanding between the U.K., France and Italy provided for two S1850M radars for the French/Italian Horizon program.

Construction Begins. Construction of the first French vessel, *Forbin*, began in April 2002, and construction of the first Italian Horizon, the *Andrea Doria*, began in July 2002. The hull of the first-in-class U.K. Type 45, the HMS *Daring*, was laid in March 2003. The second Italian Horizon, the *Caio Duilio*, was laid in September 2003, and construction of the French *Chevalier Paul* started in December 2003. Production of the second Type 45, the HMS *Dauntless*, began in August 2004.

Tests and Integration. The Type 45/Horizon program tested key ship systems in parallel with the rest of the ship build. During testing, the power of the S1850M radar was demonstrated when it was able to track all aircraft coming into Heathrow, Charles de Gaulle, Schiphol and Frankfurt airports and still have spare capacity.

In March 2005, BAE reported that VT Shipbuilding had shipped the long-range radar (LRR) mast module (unit 35) for the HMS *Daring* to Thales Nederland facilities for testing. In April 2005, the first radar was in full operation at the Horizon Shore Integration Facility (SIF) in Toulon, France, and was being used to support Horizon combat system integration. At the same time, radars were delivered to the T45 Maritime Integration and Support Centre (MISC) at Portsdown, U.K., and for the recently launched *Forbin* of France. In May, the HMS *Daring's* LRR antenna and mast module were installed on top of the MISC for more testing. During these tests, power supplies, ventilation, chilled water and communications links were connected to the mast and antenna. Concurrently, construction began on the HMS *Diamond*. The fourth Type 45, the HMS *Dragon*, was laid in December 2005.

In May 2005, Thales and BAE Insyte formally signed a contract for the manufacture and delivery of seven

follow-on systems. Five will be for the U.K. and one each for France and Italy. A total of eight Type 45 destroyers are planned, with six currently under contract.

Launch Dates. The first-in-class HMS *Daring* was launched on February 1, 2006 and should enter service in 2009. The first-in-class, *Forbin* of France, was launched in March 2005, and the first Italian frigate, *Andrea Doria*, was launched in October 2005. The *Forbin* was originally scheduled for delivery in December 2006 and the *Andrea Doria* six months later. There have been reports of system integration problems, and now the service dates have pushed out 12 to 18 months. The *Forbin* should be completed in summer 2008 and the *Andrea Doria* in late 2008. The French second-in-class, *Chevalier Paul*, was launched in July 2006. Originally, the *Chevalier Pau* was scheduled for delivery in 2008 and the Italian *Caio Duilio* in early 2009, but deliveries will probably be delayed by several months.

Land Version Considered

In 1998, Signaal released information on a planned land-based, transportable derivative of the SMART-L system. This version will apparently retain its 400-kilometer detection range and maintain its performance against stealth aircraft and ballistic missile tracking. The system is initially being targeted for Hungary, which has a requirement for three D-band air defense radars.

The Latest Member of the SMART Family: SMART-S Mk 2

In September 2003, Thales Nederland introduced a new variant: the F-band SMART-S Mk 2. It re-uses technology from the SMART-L and Flycatcher Mk 2 technologies. Optimized for medium- to long-range surveillance and target designation in complex environments, the SMART-S Mk 2 is able to identify and track multiple targets, including small surface targets, helicopters and anti-ship missiles. Shortly after Thales introduced the SMART-S Mk 2, it was revealed that the Royal Danish Navy had entered a contract with Thales for the procurement of two systems for the Danish Flexible Support Ship program.

Funding

SMART-S development was sponsored by the Netherlands; the MW08 export variant was financed by corporate resources. SMART-L was developed under a government contract.

Contracts/Orders & Options

<u>Contractor</u>	<u>Award (\$ millions)</u>	<u>Date/Description</u>
Thales Nederland	N/A	Oct 2003 – Contract to provide radar and fire control equipment, including MW08, for two additional Greek Super Vita fast attack craft.
Thales Nederland	N/A	Dec 2003 – Royal Danish Navy orders two SMART-S Mk 2 radar systems for its Flexible Support Ship program. First radar to be installed in January 2007.
Thales Nederland	72.4	Jan 2004 – Indonesia orders two new corvettes from the Royal Scheide Shipyard in the Netherlands. Both of the ships will be equipped with several Thales systems, including the MW08. The two ships are to be delivered in 2007.
Thales & BAE Insyte	N/A	May 2005 – Follow-on contract for seven S1850M radars for U.K. Type 45 destroyers (5) and French/Italian Horizon program (1 radar each).
Thales Nederland	N/A	May 2005 – Indonesia exercises contract option for two further corvettes from the Royal Scheide Shipyard in the Netherlands. Both of the ships will be equipped with several Thales systems, including the MW08. The two ships are to be delivered in 2008.

Timetable

<u>Month</u>	<u>Year</u>	<u>Major Development</u>
	1987-1989	MW08 radars purchased by Portugal and Greece for MEKO class frigates
	1991	SMART-L development program announced
	1992	Oman orders two MW08-equipped Vosper 83-meter corvettes
	1994-1995	SMARTELLO offered as an alternative to French Astral radar
	1995	Three MW08 systems for the Turkish Navy's Yildiz-class fast patrol boats
	1997-1998	SMART-L begins land-based testing at Signaal's Hengelo facility
	1998	SMARTELLO chosen for tri-nation Project Horizon frigates
	1998-1999	SMART-L installed on HrMs <i>Tromp</i> for sea-based testing
May	2000	Hellenic Navy orders three MW08 Super Vita guided missile patrol craft
	2000	Delivery of first production SMART-L system
Mar	2001	BAE Systems announces selection of S1850M radar for U.K. Type 45 destroyer program
Aug	2001	First Sachsen class sets sail for sea trials with SMART-L
Sep	2001	First De Zeven Provinciën class sets sail for sea trials with SMART-L
	2003	Delivery of first SMARTELLO (S1850M) system
	2003	Thales introduces the SMART-S Mk 2
Fall	2003	South Korea orders SMART-L for LPX ship
Nov	2003	First live-fire tests with the SM-2 Block III missiles with SMART-L
Jan	2004	Indonesia orders two corvettes equipped with MW08 radar systems
Aug	2004	German Type F-124 frigate Sachsen successfully completes a series of live firings utilizing the SMART-L
Jan	2004	Indonesia orders two new corvettes equipped with MW08 radar systems
Jan	2005	First S1850M radar shipped to France for Horizon frigate program
May	2005	Indonesia exercises contract option for two corvettes equipped with MW08
Jun	2005	Thales/BAE Insyte win follow-on contract for seven S1850M radars for U.K. Type 45 destroyers (5) and French/Italian Horizon program (1 radar each)
Jul	2005	South Korea's first LPX landing ship with SMART-L radar launched
Sep	2005	Danish Navy's SMART-S Mk 2 program successfully completes engineering and initial production phases
	2007	Type 45 first-of-class, HMS <i>Daring</i> , to launch (S1850M radar)

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<u>Month</u>	<u>Year</u>	<u>Major Development</u>
Jan	2007	SMART-S Mk 2 radar to be installed on first Danish Flexible Support Ship
Q3	2008	French Horizon first-of-class <i>Forbin</i> to be delivered (S1850M radar)
Q4	2008	Italian Horizon first-of-class, <i>Andrea Doria</i> , to be delivered (S1850M radar)

Worldwide Distribution/Inventories

Denmark. Two SMART-S Mk 2 systems for the Danish Flexible Support Ship program

France. Two S1850M systems ordered for next-generation Horizon frigates

Germany. Four SMART-S systems on F-123 frigates; four SMART-L systems on order for Type 124 frigates

Greece. Four MW08 systems on MEKO 200 Mk 3 frigates; five ordered for Super Vita vessels

Indonesia. Four MW08 systems to be installed on four new corvettes to be delivered in 2007/2008

Italy. Two S1850M systems ordered for next-generation Horizon frigates

The Netherlands. Four SMART-L systems ordered for De Zeven Provinciën frigates; two SMART-S systems on Heemskerck frigates; eight SMART-S systems on Karel Doorman frigates

Oman. Two MW08 systems on Vigilance corvettes

Portugal. Three MW08 systems on MEKO 200 frigates

South Korea. Three MW08 radars on KDX-I frigates; three more MW08 systems being installed on KDX-II frigates; one SMART-L radar system to be installed on a new Landing Platform X (LPX) amphibious ship

Turkey. Three MW08 systems on modified Yildiz class FACs (guided missile patrol combatants)

U.K. Six S1850M systems ordered for Type 45 destroyers

Forecast Rationale

The SMART family of radars is being used successfully in 13 different countries. With the different varieties available and the positive press, Thales should expect more orders for these products.

South Korea: Win One, Lose One

The MW08 variant is produced for the Republic of Korea's KDX-II destroyers. All three ships were scheduled to be in service by 2005, although this has not been confirmed.

Another possible sale emerged in October 2001 when the Republic of Korea announced that the SMART-L system had been shortlisted as a candidate for its new KDX-III destroyer program. However, Thales' SMART-L system lost the final phase of the competition in 2002 to the Lockheed Martin AEGIS.

On a positive note, Thales signed a contract with the South Korean Navy in the fall of 2003 for the sale of a SMART-L radar system to be installed on a new Landing Platform X (LPX) amphibious ship. The LPX launched in July 2005 and should enter service in June 2007. Reportedly, the LPX will also carry the MW08 radar system. A second LPX might be built later in the decade. If the second LPX is built, it would most likely carry SMART-L radar.

Danish Progress

In September 2005, Thales announced that the engineering and initial production phases of the Danish Navy's SMART-S Mk 2 program had been successfully completed. The two Danish SMART-S Mk 2 systems remain in testing. The Final Acceptance Test (FAT) for System 001 was scheduled to be completed in December 2006 and the radar was then to be delivered to Denmark. Once in Denmark, System 001 was to be installed on the HDMS *Absalon* by February 2007 to complete Harbor Acceptance Testing (HAT) by May 2007. Sea trials are scheduled to be completed by August 2007. System 002 is scheduled to complete FAT in September 2007, with installation on HDMS *Esbern Snare* in October 2007. Sea Acceptance Trials should be completed in the February 2008 timeframe.

Type 45/Horizon Program

In March 2001, BAE Systems, prime contractor, announced the selection of the S1850M radar for the U.K. Type 45 destroyer program. A Memorandum of Understanding between the U.K., France and Italy provided for S1850M radars for the French/Italian Horizon program.

A total of eight Type 45 destroyers were planned, with six currently under contract. The procurement of the last two Type 45 destroyers is in jeopardy owing to budget problems. The first-of-class, HMS *Daring*, was launched in February 2006 and final contract acceptance is due in May 2009. The second Type 45, HMS *Dauntless*, was launched from the Govan Shipyard on January 23, 2007.

The first-in-class French Horizon, *Forbin*, was launched in March 2005, and the first Italian Horizon, *Andrea Doria*, was launched in October 2005. The *Forbin* was originally scheduled for delivery in December 2006 and the *Andrea Doria* six months later. There have been reports of system integration problems, and now the service dates have pushed out 12 to 18 months. The *Forbin* should be completed in summer 2008 and the *Andrea Doria* in late 2008. The French second-in-class, *Chevalier Paul*, was launched in July 2006. Originally, the *Chevalier Paul* was scheduled for delivery in 2008 and the Italian *Caio Duilio* in early 2009, but deliveries will probably be delayed by several months.

Good Potential for New Business

Denmark's OPV Program. The Thales APAR/SMART-L combination won the Danish offshore patrol vessel (OPV) program contract. Three ships are scheduled to be handed over to the Royal Danish Navy between 2011 and 2013. The other contender was BAE Insyte, teamed with Australia's CEA Technologies. This team was offering the Sampson E/F-band radar and the CEAMOUNT I/J-band illuminator.

German F-125 Contract. The SMART-S Mk 2 is a contender for the German new-build F-125 frigate competition. Four ships are being built by the team of ThyssenKrupp Marine Systems and Friedrich Lürssen Werft. The first-in-class is expected to be delivered around 2012. News on whether this radar suite has been selected for this program has not been released. Because Germany has already purchased SMART-S and SMART-L systems, the SMART-S Mk 2 radar may have the edge in this competition.

Ten-Year Outlook

Because this report will be archived in April 2008, Forecast International has **deleted** the Ten-Year Outlook chart.

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