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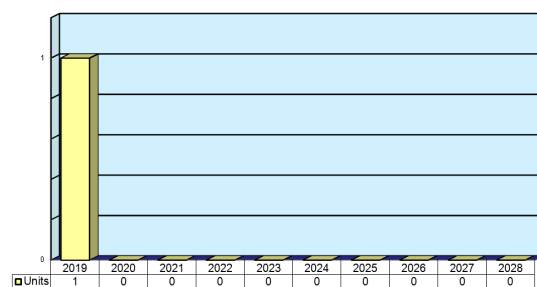
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S1850M

Outlook

- Only a single additional S1850M system is forecast before production ends; it will be produced in support of the U.K.'s final Queen Elizabeth class aircraft carrier

**Unit Production Forecast
2019-2028**



Orientation

Description. S1850M is a 3-D, multibeam, D-band (L-band), long-range volume search radar for naval applications.

Licensee. No known production licenses have been granted.

Status. In production and service.

Total Produced. As of January 2019, 12 S1850M radars had been delivered.

Application. The S1850M is used for automatic detection, track initiation, and tracking of up to 1,000 air targets at a range of 400 kilometers.

Platform. The S1850M has been specified for frigates, destroyers, and aircraft carriers.

Price Range. The price of the S1850M has not been disclosed. Forecast International estimates a price range of \$10 million to \$13 million.

Contractors

Prime

Thales Nederland BV	http://www.thalesgroup.com , Zuidelijke Havenweg 40, Hengelo, Netherlands, Tel: + 31 74 2488111, Fax: + 31 74 2425936, Email: info@nl.thalesgroup.com , Prime
BAE Systems, Defence Information, Training & Services (DITS)	http://www.baesystems.com , Grange Rd, Christchurch, Dorset, United Kingdom, Tel: + 44 1202 486 344, Fax: + 44 1202 404 221, Email: media@baesystems.com , Co-producer

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

S1850M**Technical Data**

The S1850M is a close derivative of the SMART-L radar. At this time, no technical specifications explicitly for the S1850M are available. This data table reflects the SMART-L's specifications.

Specifications	<u>Metric</u>	<u>U.S.</u>
SMART-L		
Range		
Patrol aircraft	400 km	248.5 mi
Fighter plane	220 km	136.7 mi
Stealth missile	55 km	34.2 mi
Tracking Capacity		
Air targets	1,000	
Surface targets	100	
Jammer tracks	32	
Frequency band	D-band	L-band
Antenna weight	8,000 kg	17,637 lb
Antenna size	9.2 x 4.4 x 3.7 m	30.2 x 14.4 x 12.1 ft
System weight	12,000 kg	26,455 lb

Design Features. The SMART-L forms the primary sensor for the next-generation Dutch air defense system. It includes the Evolved SeaSparrow Missile (ESSM) and the Thales active phased array radar (APAR). SMART-L is a D-band pulse-Doppler radar that has 16 simultaneous receive beams in elevation and 360° 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. The system has the demonstrated capability to track 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 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. An identification friend or foe (IFF) antenna is mounted on the primary array.

SMART-L is equipped with an integral I-band frequency-modulated continuous-wave radar that uses technology derived from the Scout covert navigation radar program. This CW radar is used for low-probability-of-intercept surface search.

SMART-L uses the new solid-state D-SSTX transmitter unit. This transmitter consists of seven solid-state units that work in parallel, with 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, and 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.

The system's front-end processing electronics architecture is based on a Texas Instruments C-40 digital signals processor, with application-specific integrated circuit technology compressing the 16 parallel processing channels into a confined area. Back-end processing comprises commercially available Sun SPARC boards.

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.

Thales reports that the S1850M has a slightly higher rotation speed than the SMART-L and improved jamming capabilities. A flexible signal processor and local consoles are used.

Operational Characteristics. This radar ensures a favorable compromise between range and low-level performance, clutter rejection, and antenna size.

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HMS *Diamond* Type 45 Destroyer with an S1850M SMARTELLO Radar

Source: Public Domain

Variants/Upgrades

SMART-L. The predecessor to the S1850M radar.

SMARTELLO. SMARTELLO was the original name for the S1850M radar. It was said to combine the best

features of the Signaal (now Thales) SMART-L and the GEC-Marconi (now BAE Systems) S-753 Martello radar.

Program Review

Background. The SMART radars have been a high priority of the Dutch Ministry of Defense since the development program was announced in 1981. That program continued through 1985. In 1991, Signaal (now Thales) announced it was developing a long-range D-band SMART version, designated SMART-L.

SMARTELLO Selected

In 1994, Astral was deselected as the primary long-range search radar for the Anglo-Italian-French common new-generation frigate, Project Horizon. As an Astral alternative, a new radar, designated SMARTELLO, was offered by Signaal (now Thales) and GEC-Marconi (now BAE Systems). This new system combined the best features of the Signaal SMART-L and the GEC-Marconi S-753 Martello radar.

In 1999, the British terminated their Horizon participation and invested their efforts in the Type 45 destroyer instead. However, the British, French, and Italians continued to act together to purchase systems for their respective platforms. BAE Systems, the prime

contractor, announced the selection of the Thales and BAE Integrated System Technologies (Insyte) SMARTELLO (now designated 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.

Ship Construction Begins

Construction of the first French vessel, the *Forbin*, began in April 2002, and construction of the first Italian Horizon, the *Andrea Doria*, began three months later. The hull of the first-in-class 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 France's *Chevalier Paul* started in December 2003. Production of the second Type 45, the HMS *Dauntless*, began in August 2004.

The Type 45/Horizon program tested key ship systems in parallel with the ship build. During testing, S1850M power was showcased when the system tracked all

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aircraft coming into Heathrow, Charles de Gaulle, Schiphol, and Frankfurt airports and still had capacity to spare.

In January 2005, Thales Nederland shipped an S1850M radar to the DCN Shipyard in France. In March, 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, the first radar was in full operation at the Horizon Shore Integration Facility 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 Center (MISC) at Portsdown, U.K., and for the recently launched *Forbin*. In May 2005, the HMS *Daring*'s LRR antenna and mast module were installed on top of the MISC for more testing.

Making It Formal

In May 2005, Thales and BAE Insyte formally signed a contract for seven follow-on systems – five for the U.K. and one each for France and Italy.

Theater Ballistic Missile Defense Needs

In spring 2006, Thales completed initial testing of an extended long-range (ELR) modification of its SMART-L radar to provide an early warning capability for theater ballistic missile defense (TBMD). In April 2006, *Jane's International Defence Review* quoted Thales' Henk Regtop as saying the ELR upgrade has the potential to provide a TBMD early warning capability on all naval vessels equipped with SMART-L or the S1850M radar. The current S1850M can detect and track targets over 400 kilometers (248 mi) away, and the ELR goal is to more than double that distance in a preset threat sector. With the ELR upgrade, approaching ballistic missiles could be detected over 800 kilometers (497 mi) away, even when they are at altitudes outside the atmosphere.

Development of the SMART-ELR was the result of a joint study by the U.S., the Netherlands, and Germany. The SMART-ELR achieved a detection range of 800 kilometers in December 2006 following some modifications in software, waveform, and pulse repetition frequency, plus the addition of a few cards to the electronic cabinet. These changes could be incorporated on SMART-L or S1850M radars already installed on ships. This information was published in the October 2008 issue of *Military Technology* (MILTECH) magazine.

Horizon Demise

France canceled its planned third and fourth Horizon frigates and opted for FREMM multimission frigates.

Notably, FREMM frigates do not carry the S1850M radar. In April 2007, Thales reported that all five radars for the Horizon program had been delivered. According to *Jane's Navy International*, the fifth radar is installed at the Shore Integration Facility at Saint-Mandrier.

Daring's Date with Destiny

The U.K.'s first-in-class, HMS *Daring*, was launched in February 2006. In September 2007, BAE Systems reported that the *Daring* had completed combat systems trials that included a series of "cooperative" aircraft trials. The tests relied on the integration of the four key radar systems: the BAE Systems Sampson multifunction radar, the S1850M long-range radar, radar electronic support measures, and an IFF system. The second phase of trials started in March 2008, and contractor sea trials were completed in September 2008. The HMS *Daring* was commissioned into the U.K. Royal Navy in July 2009.

In April 2007, the S1850M radar for *Dauntless* (second-in-class) was delivered to the BAE Systems shipyard. In 2008, *Dauntless* underwent its first set of sea trials, which were completed in December.

Sea trials of the HMS *Diamond* (third-in-class) began in October 2009. In November 2008, the fourth ship, HMS *Dragon*, was launched on the River Clyde. HMS *Defender*, the fifth Type 45, was launched in October 2009. And in March 2008, steel was cut on the sixth and final ship, HMS *Duncan*. (In June 2008, the British government announced that the option for the seventh and eighth Type 45 destroyers would not be exercised.)

The HMS *Dauntless* was commissioned in June 2010. Third-in-class HMS *Diamond* sailed from the Clyde and in September 2010 arrived at Portsmouth naval base, where the U.K. MoD accepted the ship off contract from BAE Systems Surface Ships. In December 2010, the U.K. MoD announced that the HMS *Dragon* (fourth ship) had successfully completed sea trials.

In October 2010, the sixth and final ship, HMS *Duncan*, was launched.

Thales Engineer Wins Award

Thales employee Gerrit Dedden won the 2008 Multinational Ballistic Missile Defense Conference Technology Pioneer Award. Dedden was awarded for his work with the ELR principle, which substantially enhances radar sensitivity at long range. In ELR mode, the SMART-L and S1850M radars can detect and track threats outside Earth's atmosphere. The ELR upgrade allows the Thales SMART-L/S1850M radars to be used for BMD applications. News of this award had the

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potential to spur future sales of SMART-L and S1850M radars.

Selected for U.K. Aircraft Carriers

In February 2009, Thales announced the formalization of a contract with BAE Systems for an S1850M radar for each of the two CVF Royal Navy aircraft carriers,

the HMS *Queen Elizabeth* and HMS *Prince of Wales*. BAE Systems began construction of the HMS *Queen Elizabeth* in February 2010.

The radar for the first ship in the class was expected to be delivered in 2017, and the second ship's radar is expected to be delivered in 2019.



The First Queen Elizabeth Class Aircraft Carrier Under Construction

Source: Rosyth Shipyard

Contracts/Orders & Options

<u>Contractor</u>	<u>Award (\$ millions)</u>	<u>Date/Description</u>
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 (one radar for each country).
Thales Nederland	N/A	Feb 2009 – Contract for two S1850M radars for the U.K. Royal Navy's new aircraft carriers.

N/A = Not Available

Timetable

<u>Month</u>	<u>Year</u>	<u>Major Development</u>
	1994-1995	SMARTELLO offered as alternative to French Astral radar
	1998	SMARTELLO chosen for trination Project Horizon frigates
Mar	2001	S1850M radar selected for U.K. Type 45 destroyer program
	2003	Delivery of first SMARTELLO (S1850M) system
Jan	2005	First S1850M radar shipped to France for Horizon frigate program
Jun	2005	Follow-on contract for seven S1850M radars for U.K. Type 45 destroyers (5) and French/Italian Horizon program (one radar each)

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<u>Month</u>	<u>Year</u>	<u>Major Development</u>
Feb	2006	Type 45 first-of-class HMS <i>Daring</i> launched (with S1850M radar)
Dec	2006	Thales completes testing of ELR mode
Q1	2007	Completion of delivery of radars for Horizon program
Feb	2009	Contract for two S1850Ms for the U.K.'s new aircraft carriers
	2012	Delivery of radars for Type 45 program completed
Nov	2015	In the 2015 Strategic Defence and Security Review, the U.K. confirms plans to acquire both Queen Elizabeth class carriers
	2019	Second (final) radar expected to be delivered for U.K. aircraft carriers

Worldwide Distribution/Inventories

France/Italy	Five S1850M systems – one for each Horizon class frigate, plus one radar for a shore facility
U.K.	Type 45 destroyers – six S1850M systems delivered Queen Elizabeth class aircraft carriers – two S1850M systems ordered

Forecast Rationale

The S1850M has few, if any prospects for sales beyond the two units ordered for the U.K.'s Queen Elizabeth class aircraft carriers. Beyond its core market of the U.K., the system has never found wide interest. Moreover, Thales has developed the SMART-L – the architectural basis for the S1850M – further than the technological levels of its spin-off system. The S1850M has been left behind in the Thales product portfolio.

In 2019, the final radar in support of the Queen Elizabeth class carriers is forecast for delivery, and the S1850M will exit production. With the S1850M's technological capabilities being superseded by other radars in the Thales portfolio, no further production is forecast.

Ten-Year Outlook

ESTIMATED CALENDAR YEAR UNIT PRODUCTION												
Designation or Program	High Confidence					Good Confidence			Speculative			
	Thru 2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	Total
Thales Nederland BV												
SMART S1850M <> United Kingdom <> Navy <> Queen Elizabeth-class Aircraft Carrier												
	1	1	0	0	0	0	0	0	0	0	0	1
Total	1	1	0	0	0	0	0	0	0	0	0	1