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Sampson

Outlook

- Sampson's only platform is the U.K. Type 45 destroyer
- The final Sampson radar left BAE Systems' Cowes facility in July 2011. It was bound for installation on the sixth and final Type 45 destroyer
- Several radar manufacturers and shipyards compete for this market

Orientation

Description. A 3-D active-array naval surveillance / fire control radar.

Sponsor

BAE Systems – Integrated System Technologies (Insyte)

Eastwood House
Glebe Rd
Essex, CM1 1QW
United Kingdom
Tel: + 44 1245 702702
Fax: + 44 1245 702700

Licensee. No production licenses have been granted.

Status. Production is complete.

Total Produced. As of January 2012, Forecast International estimates that three pre-production radars and six production radars had been delivered.

Application. Primary medium-range air and surface search radar for the provision of hemispherical search, track, and missile communications as part of a local area missile system.

Platform. Sampson has been installed on the U.K.'s Type 45 Daring class destroyers.

Price Range. Prime contractor BAE Systems Insyte has not released any unit cost information. A realistic price estimate is a range of \$10 million to \$15 million.

Contractors

Prime

BAE Systems Mission Systems

<http://www.baesystems.com>, New Filton House, Golf Course Ln, Filton, BS34 7QW
Bristol, United Kingdom, Tel: + 44 441179188000, Fax: + 44 441179188149,
Email: Herrin, Prime

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Subcontractor

**Mercury Computer Systems Inc,
Corporate Headquarters**

<http://www.mc.com>, 199 Riverneck Rd, Chelmsford, MA 01824-2820 United States,
Tel: + 1 (800) 229-2006, Fax: + 1 (978) 256-3599 (Powerstream 510)

Comprehensive information on Contractors can be found in Forecast International's "International Contractors" series. For a detailed description, go to www.forecastinternational.com (see Products & Samples/Governments & Industries) or call + 1 (203) 426-0800.

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

Characteristics	<u>Metric</u>	<u>U.S.</u>
Surveillance band	E/F-band	S-band
Rotation rate	30 rpm	

Design Features. Sampson is born out of the Multi-function Electronically Scanned Adaptive Radar (MESAR) technology demonstration program. Sampson's two arrays each have more than 2,000 radiating elements. Each array element has Gallium arsenide (GaAs) modules, transmitters and receivers with digital phase control for beam steering. According to a paper published for the 2003 IEEE Symposium on Phased Array Technology, Sampson's two active-array faces are mounted in a single spherical housing each covered with its individual radome. Extensive use of carbon-fiber composite in the housing and array face structures accounts for low mass compared with conventional antenna structures. Antenna rotation is 30 rpm and the antenna is air-cooled.

Other features include azimuth and elevation monopulse, high-pulse compression ratio, independent array processing chains, negligible microwave losses, and programmable signal, plot and track processing. Sampson has many anti-jamming features, including adaptive nulling, very low antenna sidelobes, sidelobe blanking, very high bandwidth, frequency agility, automatic waveform selection, jammer burnthrough, and jammer strobe extractor and tracking.

Operational Characteristics. Sampson is compatible with both active and semi-active homing missile systems, and provides mid-course guidance via integral missile up-link. Sampson also offers Kill Assessment. According to BAE Systems, this air defense system can track, identify and eliminate a

potential threat the size of a cricket ball (circumference 224-229 mm or 8.8-9.0 in), traveling at three times the speed of sound (1,029 m/s, or 3,375 ft/s). The speed of sound is 343 meters/second (1,125 ft/s) at sea level.

Currently, Sampson's only platform is the U.K. Royal Navy's Type 45 Daring class destroyers. Sampson provides surveillance, target tracking and missile information for the MBDA Principal Anti-Air Missile System (PAAMS), the main armament of the Type 45. The U.K. Ministry of Defence started referring to the PAAMS as Sea Viper in January 2009.

For the Type 45 application, Sampson sits nearly 40 meters (131 ft) above sea level at the top of the ship's mast. Sampson can detect tiny, fast-moving targets out to a distance of hundreds of kilometers and provide second-by-second information to the PAAMS ASTER missiles to neutralize threats. The radar provides hemispherical coverage and is capable of tracking hundreds of targets at any one time. According to BAE Systems, Sampson features excellent detection of stealth aircraft and missiles.

The Sampson radar management computer controls beam and waveforms; the system also has a local control console. Radar operation is maintained even if several subsystems fail due to the use of multiple parallel paths. Faults are diagnosed using built-in test (BIT) options. Sampson does not have high-voltage or high-power microwave parts or associated water cooling systems, so maintainability is enhanced.

Sampson



The Type 45 Destroyer HMS *Daring* Equipped with Sampson Radar during Sea Trials

Source: U.K. Royal Navy

Program Review

Background. Development of Sampson, an operational derivative of the MESAR technology demonstrator, began in 1989, and it was first publicly revealed in 1991. No prototype was constructed at that time; Siemens-Plessey (now BAE Systems) estimated that Sampson would be ready for production in 1994.

Project Horizon: Irreconcilable Differences

In 1993, France, Italy, and the U.K. wanted a standard air defense warship. The ship proposed to meet this need, the Project Horizon Common New Generation Frigate (CNGF), would sail with the EMPAR multifunctional radar for the target acquisition and fire control roles. Due to delays in finalizing the design and partner differences, the initial baseline design was delayed until 1994. This pushed the entry-to-service date to 2002, meaning that the CNGF build schedule matched Sampson's schedule. Accordingly, the British suggested that Sampson replace EMPAR in order to substantially increase the ship's combat efficiency.

The Italians and French fiercely resisted this proposal, because EMPAR was the only notable Italian system on board and the change would fundamentally alter the

ship's air warfare system, which was of French design. The partners delayed contract awards in an attempt to pressure the British into accepting the existing (EMPAR) radar.

In 1994, the Joint Project Office released the CNGF design, which reflected the British 6400 L-series design prepared prior to French/Italian involvement. The U.K. also intended to select the Sampson radar for its ships regardless of Italian/French attitudes. Disagreements became more intense, and in 1999 the U.K. backed out of the Project Horizon program.

Introducing the Daring Class

After withdrawing from Project Horizon, the U.K. decided to go it alone with the Type 45 Daring class destroyers. An order for the first batch of three Type 45 destroyers was placed by the end of 2000. In July 2001 it was announced that a second batch of three Type 45 destroyers had been ordered. This order, bringing the total of Type 45 ships to six, came three years earlier than expected. Initially, 12 Daring class ships were to be produced, but the quantity was reduced to eight vessels. The program was later capped at six destroyers.

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Sampson Testing

A dedicated Sampson test facility at the BAE Systems Insyte Cowes site was opened in September 2002. In March 2004, the first Sampson radar transmitted for the first time at the Cowes test facility. In September 2004, after extensive testing, the first Sampson radar (P1) was installed on a representative Type 45 foremast. P1 was integrated with the Principal Anti-Air Missile System (PAAMS) in 2005. In June 2006, P1 completed testing and was transferred to the Eskmeals gunnery range in Cumbria for further trials and to be integrated within the wider system. Trials began in October 2006.

A second system (P2) was completed and began testing at the antenna test facility. In summer 2006, P2 was fitted aboard a sea platform, *Longbow*, for live-fire trials. A third system (P3) was delivered to BAE Systems' Maritime Integration and Support Center (MISC) at Portsmouth in November 2006.

The Sampson radar for HMS *Daring* was installed on the test tower at Cowes and began its system-level test program in October 2006.

Thales Wins in Denmark

In December 2006, the Royal Danish Navy selected Thales APAR/SMART-L radars for its three new patrol vessels over a Sampson/CEA Technologies CEAMOUNT bid. The APAR radar has been integrated with Raytheon's Evolved SeaSparrow Missile (ESSM) and long-range Standard Missile-2 (SM-2). The SMART-L has embedded growth potential for Tactical Ballistic Missile Defense (TBMD) with the Standard Missile-3 (SM-3).

Evolution to ARTISAN

BAE Systems Insyte teamed with QinetiQ and Roke Manor Research to create a new E/F-band radar that draws on BAE Systems' Sampson and Commander radar technologies and the U.K. ARTIST technology demonstrator program. The Advanced Radar Target Indication Situational Awareness and Navigation (ARTISAN) 3D radar was first announced in April 2007 as the team's bid for the U.K. Royal Navy's future Medium Range Radar (MRR) program. ARTISAN 3D was selected for the MRR program in August 2008 and was launched for the export market at Euronaval 2008 two months later.

Type 45 Launches

The first Type 45, HMS *Daring*, was due to enter Royal Navy service in 2007. However, problems delayed *Daring's* launch until February 2006, and its Sampson radar was installed on top of the ship's mast in

April 2007. *Daring* was commissioned into Royal Navy service in July 2009 without its Sea Viper missile system.

The second Type 45, HMS *Dauntless*, was launched in January 2007 and its Sampson radar was installed in late 2007. *Dauntless* was formally commissioned into Royal Navy service in June 2010. The third, HMS *Diamond*, was launched in November 2007. HMS *Dragon* was then launched in November 2008, and sea trials started in late 2010. HMS *Defender* was launched in October 2009 and the final Type 45 ship, HMS *Duncan*, was launched in October 2010.

PAAMS Sea Viper Trials – Problems

Sampson is part of the Royal Navy's Sea Viper, which is a principal anti-air missile system. Vice Adm. Sir Trevor Soar, Chief of Materiel Fleet, formally announced in January 2009 that Sea Viper was the name that had been selected by the Royal Navy for its Principal Anti-Air Missile System (PAAMS).

The first round of test firings took place on the PAAMS(S) platform *Longbow*. The MoD reports that the *Longbow*, a barge, had a full replica of the air defense equipment that the new Type 45 destroyers will carry, including long-range and missile-directing radars, a combat control center, and missiles in their vertical launcher silos.

This test demonstrated the system's capability in the medium-range air-defense role. The second test firing, which took place in February 2009, saw the missile system successfully fired from the *Longbow* off the French coast. The Mirach target was flying at a low level at very short range and the test was checking for performance in a self-defense scenario.

Later tests were not as successful. *Jane's International Navy* reported in January 2010 that the two Sea Viper tests conducted in May and November 2009 to demonstrate local area air-defense capabilities did not go well. The problems were traced to the MBDA ASTER missiles. MBDA is the prime contractor for the Sea Viper (PAAMS) system. In June 2010, MBDA announced the successful completion of a series of ASTER 30 trials that concluded a complex investigation launched after the May and November 2009 firings.

The first firing of a Sea Viper on board a Type 45 took place in September 2010. The system successfully fired an ASTER 30 missile from HMS *Dauntless* and hit a moving target drone. In May 2011, the HMS *Daring* successfully fired its Sea Viper for the first time during a training exercise.

Contracts/Orders & Options

<u>Contractor</u>	<u>Award (\$ millions)</u>	<u>Date/Description</u>
AMS (now BAE Systems)	268.5	Oct 1999 – Contract to supply Sampson multifunction radars as part of the advanced air defense system for the U.K. Royal Navy's new Type 45 destroyers. Contract includes full-scale engineering development and production of the first 12 systems.

Timetable

<u>Year</u>	<u>Major Development</u>
1989	Sampson development starts
1991	Sampson publicly revealed
1998	BAE Systems acquires Siemens-Plessey
2004	First transmission of Sampson unit at Cowes test facility
2004	Second prototype begins testing at Cowes test facility
2004	First prototype fitted to a representative foremast of the Type 45 ship
2006	Second prototype fitted aboard a sea trial platform for live-fire trials
2006	Third prototype installed at BAE Systems' Maritime Integration and Support Center (MISC)
2007	Sampson radar installed on the HMS <i>Daring</i> (first-of-class)
2007	BAE offers ARTISAN 3D instead of Sampson for U.K.'s MRR program
2008	HMS <i>Daring</i> undergoes sea trials
2008	HMS <i>Daring</i> turned over to MoD
2009	HMS <i>Daring</i> commissioned
2010	A Sea Viper system on board the HMS <i>Dauntless</i> successfully fires an ASTER 30 missile and hits a moving target drone
2011	Sampson production complete for U.K. Type 45 destroyers

Worldwide Distribution/Inventories

Sampson has been installed on six **Royal British Navy** Type 45 destroyers.

Forecast Rationale

Production Complete

Approximately 30 years of work culminated in the final Sampson multifunction radar (MFR) leaving BAE Systems' Cowes facility in July 2011. The radar was bound for installation on board the sixth and final Royal Navy Type 45 destroyer, HMS *Duncan*, at Scotstoun. The Type 45 destroyer program was capped at six vessels.

Competition Hinders Sales

So far, the Sampson system has only been selected for the Type 45 destroyers. Although Sampson is a very

capable radar, heavy competition from other vendors has hindered sales. Several advanced multifunction radar systems are on the market. In heated competition with Sampson are Finmeccanica's EMPAR system, Lockheed Martin's SPY radar, and Thales' Herakles, Arabel, and APAR/SEAPAR radar systems. At the same time, Australia's CEA Technologies is producing its CEAFAR system for this market. Finally, BAE Systems Insyte now offers the ARTISAN 3D radar to customers. The new *Queen Elizabeth* aircraft carrier will sail with the ARTISAN radar. Sampson's life could be prolonged if the U.K. sells Type 45 destroyers abroad, but this seems highly unlikely.

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