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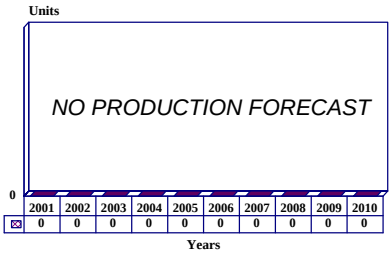
Sea Archer 30 (GSA.8) –Archived 12/2002

Outlook

- Production for all known orders complete
- Remote possibility of export orders
- Barring any future activity, this report might be archived next year, December 2002

10 Year Unit Production Forecast
2001-2010



Orientation

Description. Electro-optical fire control system for naval guns.

Sponsor
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Status. In operational service.

Total Produced. It is estimated that a total of 37 systems were produced through 2000.

Application. The Sea Archer 30 is the export version of the GSA.8. The latter is installed on the UK Royal Navy Type 22 and Type 23 frigates. The Sea Archer 1A is an older, less capable version, which has been installed on Fast Attack Crafts (FAC), Off-Shore Patrol Vessels (OPV) and amphibious warfare ships.

Price Range. The unit cost of a UK Royal Navy standard GSA.8/GPEOD is estimated to be US$3.1

million (based on contract cost averaging and using 2001 US dollars).

Technical Data

Characteristics		
Wavelength:	8-12 microns	
Output:	CCIR 625 lines, 50 Hz	
Magnification:	x3.6 to x20	
Elevation limits:	+75/-35 degrees	
Training/elevation rate:	90 deg/sec	
MTBF:	175 hours	
	Metric	**US**
Dimensions		
Height:	110 cm	43.7 in
Swept radius:	44.8 cm	18.4 in
Weight (total):	585 kg	1,290 lb

Design Features. The Sea Archer 30 system comprises the following units:

- An electro-optical director with associated power unit
- A gun control console, including the director electronics units manned by an operator in the operations room
- A predictor located near the gun
- Subordinate units include the emergency fire control panel (which duplicates the essential functions of the gun control console in case the console is disabled, and can also accept information from manned look-out aiming sights) and the data-recording and analysis unit (which supplies both video and digital records of engagements).

Dedicated data pathways are used so that all units can communicate with each other. Sea Archer 30 has been designed to interface with the CACS command system using a combat data highway. In the Type 23 frigates, it will interface with the DNA(1) command system via fiber-optic local area networks (LAN).

The thermal imager consists of UK Thermal-Imaging Common Modules (TICM) Class II modules with a 240 mm objective lens and a Barr & Stroud zoom telescope with magnification from 3.5x to 20x (with fields of view from 3 to 17 degrees). The imager's detectors are cooled by a Philips USFA closed-cycle Stirling engine that needs no onboard maintenance or inspection between major overhauls. The compact daylight charge coupled device (CCD) is assembled from outside-sourced components and provides zoom ratios matching those of the thermal imager.

An Ericsson Radio Systems neodymium-YAG laser rangefinder supplies range information at a 12.5 Hz data rate. In order to prevent eye damage, the laser transmits only after target acquisition. Moreover, transmissions are limited to areas that would not illuminate those parts of the ship's upper decks that are manned. A removable filter gives further protection in peacetime.

Sea Archer Design Features. The basic Sea Archer 1 is an optical fire control system based on a dedicated digital computer that includes two basic modules. The optical fire director module combines a laser rangefinder with a variety of electro-optical sensors. The gun control console includes a predictor operator control panel and system communications. Sensor fits can include electro-optical sensors, television tracking cameras, or infrared (IR) sensors, with a TV auto-tracker also available for those requiring such a capability.

Mission requirements for the system include day and night observation and recognition (with target detection out to the horizon in advantageous atmospheric conditions), passive weapon-aiming in conditions of electromagnetic silence, and the ability to distinguish among cluttered targets such as aircraft flying in echelon. Minimum weight was specified in order to facilitate installation of the sensor head as high on a mast as possible.

The primary role of the GSA.8 in UK Royal Navy service is to control the Vickers 4.5 in L55 Mk 8 gun. Anti-aircraft capability is also included. The combat system data pathways integrate the GSA.8 into the ship's action-information system, with the GSA.8 getting target data from the vessel's other sensors and the electro-optical director. The fire control system is highly computerized (in order to allow one-man control) and accepts incoming information, acquires and

tracks the target, executes the gun computations, and then carries out the engagement.

Sea Archer can control two guns of differing caliber at the same time, such as a US 5-inch and an OTO Melara 76 mm gun. The system can be used to sequentially engage two surface targets that are within the optical field of view. A typical engagement would see a burst fired at one target. With these shells in flight, the system would find and launch a burst at another target, then return to the first to observe accuracy. Necessary corrections would be made and another burst fired, still leaving enough time to observe and redirect fire at the second target.

Variants/Upgrades

Sea Archer 1A (GSA.7). In this variant, a TV subsystem completely integrated with below-decks joystick control (with the option of a manned or unmanned director on deck) results in an enhanced surveillance capability. It is possible, using this variant, to alternately control two different types of gun-mountings, with ballistic data for both programmable into the 1412A computer. The integration of IR sensors is also an option.

Sea Archer 1A Mod 1. This variant is different from the previous generation in that it includes three sensors – LLTV, thermal imager, laser rangefinder – mounted in Laurence Scott's Mk 5 director. The new Mk 5 allows for above- or below-decks system control, and results in enhanced tracking accuracy and in greater stiffness for better stability.

Sea Archer 1A Mod 2. Little information is available about this variant, although it seems to differ from the 1A in that it allows for simultaneous control of two different types of guns.

Sea Archer 1B. This version was announced in 1983 and has an unmanned director and autotrack.

Program Review

Background. The Sea Archer system has its roots in an electro-optical tracker that was already under development by BAe's Stevenage Division for the Field Standard B2 variant of the Rapier surface-to-air missile system (export version known as Rapier – 90). The British Army carried out extensive proving trials with three prototypes, and the UK Royal Navy took advantage of the development work (already funded by the Army) in order to benefit from spares commonality and joint financing of future modifications.

The Army specifications for the Rapier electro-optical tracker made it readily adaptable for marine use. These included the use of light alloys that are resistant to salt-water corrosion. The specified sealing against sand and dust penetration also proved to be compatible with naval salt-spray resistance specifications. The modifications needed to marinize the unit were limited to repackaging of the electronics, the addition of stabilization gyros to the sensor platform, the cooling of the thermal imager's detectors with a cooling engine instead of gas bottles, and the inclusion of additional sensors (a laser rangefinder and a TV camera).

Sea Archer 1 development began in 1974. The system was ordered by the Royal Brunei and Omani navies in 1976. Oman subsequently ordered the Sea Archer 1A system and this was standardized for UK Royal Navy use in 1980 under the designation GSA.7. It equipped the Peacock class offshore patrol vessels. Subsequently, a GEC V3800 thermal imager was added to GSA.7. These early models of the Sea Archer used manned optical fire directors instead of the Electro-Optical Director (EOD) fitted to the Sea Archer 30. Some 40 Sea Archer 1As are in service with several navies.

A further sequence of improvements to Sea Archer 1A could have resulted in the introduction of Sea Archer 2, but this proved abortive, since Sea Archer 1A had clearly reached the limits of its development potential. An entirely new unit was required. In 1982, BAe (now BAE Systems) developed a General Purpose Electro-Optic Director (GPEOD). Then, a further development and product improvement program led to the Sea Archer 3 system in 1985. For marketing purposes this was redesignated Sea Archer 30, and it was adopted the same year by the UK Royal Navy under the designation GSA.8.

The Sea Archer 30 is the current model in the Sea Archer family. The UK Royal Navy has equipped its four Type 22 Batch 3 frigates and 16 Type 23 frigates (first commissioned in December 1989) with the GSA.8. This order marks the first fitting of a wholly autonomous digital fire control system in major units of the UK Royal Navy ,and is also the first significant use of thermal imaging sights for the Royal Navy. Included in the fixed-price contract were requirements for a high level of system availability and reliability, management

responsibilities for overall performance, integration into the ship, and initial in-service logistics support.

Each Type 22 Batch 3 frigate has two GSA.8 directors located on the port and starboard sides of the bridge roof. The directors have 190-degree coverage in azimuth to avoid a blind spot at the stern. This allows observation of the vessel's own helicopter during launch and recovery. The configuration for the Type 23s is a single director located about halfway up the mainmast.

Sea Archer 30 was tested at the NSWC Dahlgren between mid-September and mid-December 1988 under the Foreign Weapons Evaluation program. The targets were A-4, A-7 and F/A-18 aircraft, helicopters, surface craft and moving shore targets. In a typical run, an A-7 flying at 1,000 feet was spotted at 32,200 yards and acquired at 23,000 yards. Image processing and edge enhancement were key factors in obtaining these results. However, late in 1990, the companies McDonnell Douglas Helicopters and GEC Sensors (now BAE Systems) proposed an alternative electro-optical system to meet US requirements.

Additional orders for GSA.8 systems were placed in late 1994 and in August 1995. The last was for three systems intended to equip three Type 23 frigates. A final order for three additional systems for the last three ships of this class should conclude production for UK Royal Navy requirements.

By the end of 2001, it had become apparent that all production for Sea Archer 30 (GSA.8) had been completed, with its last known contract awarded in 1995.

Funding

The Sea Archer system was developed as a private venture using corporate funding. Subsequently, the system was upgraded to the United Kingdom's UK Royal Navy standards under a contract awarded by the UK Ministry of Defence (MoD).

Recent Contracts

No recent contracts have been identified through public sources.

Timetable

Month	Year	Major Development
Apr	1985	First order by UK Royal Navy for GSA.8/GPEOD
	1986	Thai order for Sea Archer announced
	1987	Deliveries to the UK Royal Navy Sea Archer tested by the US DoD as part of the NATO Comparative Test Program FY87
Sep	1988	Royal Thai Navy order announced for three Sea Archer 1A Mod 2s
Nov	1989	First UK Royal Navy Type 23 frigate commissioned
Aug	1995	Additional orders for UK Royal Navy Type 23 frigates
	1999	Production complete for UK Royal Navy

Worldwide Distribution

The following countries are believed to be current users of the Sea Archer system:

Brunei:	3 Sea Archer systems on Waspada FAC class
Ireland:	2 Sea Archer systems on P 41 Peacock class coastal patrol vessels
Oman:	1 Sea Archer system on the B 10 Dhofar FAC
Philippines:	3 Sea Archer systems on former Peacock class patrol vessels
Thailand:	3 Sea Archer Mk 1A Mod 2 systems on Khamronsin class corvettes
	4 Sea Archer Mk 1A systems (two systems per ship) on two Normed class LST

United Kingdom: 13 GSA.8B on Type 23 frigates, 3 for Type 23 Duke class frigates
8 GSA.8A (two systems per ship) on four Type 22 Batch 3 frigates

Forecast Rationale

Since its introduction in the mid-1980s, BAE Systems' Sea Archer 30 naval electro-optical fire control system has had an admirable production run and has been installed on many vessels of the navies of several nations. The GSA.8 (the UK version of the Sea Archer 30) was last installed on existing UK Royal Navy (UKRN) Type 22 frigates and new-build Type 23 frigates. With the end of production for this order, the prospect of new contracts from the UK or for export now seem somewhat remote.

Sea Archer 30 (GSA.8) consists of several subsystems, including an electro-optical director, a gun control console, and a predictor located near the gun. While the primary application is acting as the prime gun controller for smaller ships such as fast patrol boats, the Sea Archer 1 variant is also suitable for use as a secondary weapon controller for larger warships. This adaptability has served it well through its production history.

As the system is still in operational service and BAE Systems continues to outline its benefits on its company web site, export interest might be rekindled in the future. Without any solid indication of future orders, however, projections of future production would be too speculative at this time. While there still is an outside chance of export orders, this report will probably be archived next year, December 2002.

Ten-Year Outlook

ESTIMATED CALENDAR YEAR PRODUCTION

			High Confidence Level				Good Confidence Level				Speculative			
Designation	**Application**	**Thru 00**	**01**	**02**	**03**	**04**	**05**	**06**	**07**	**08**	**09**	**10**	**Total 01-10**
SEA ARCHER	Prior Prod'n:	37	0	0	0	0	0	0	0	0	0	0	0