

The Market for Surface-to-Air Missiles

Product Code #F657

A Special Focused Market Segment Analysis by:



Analysis 2

The Market for Surface-to-Air Missiles

2011 - 2020

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PROGRAMS

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ASTER 15/ASTER 30
Barak
Chinese SAMs
Chun Ma
Chu-SAM
Israeli Missile Defense
MEADS
MIM-104 Patriot
Mistral
NASAMS
PAC 3
R.440/R.460/VT-1
Rapier/Tracked Rapier
RBS23 BAMSE
RBS70
RBS90
RIM-66/67 Standard
RIM-116A RAM
RIM-161 Standard Missile-3
RIM-162 Evolved SeaSparrow
Russian SAMs
Seawolf/Landwolf
Starstreak
THAAD
Tien Kung I/II
Trishul
Type 81 Tan-SAM
Typ 91 Keiko
Umkhonto

Introduction

Surface-to-air missiles first appeared on the battlefield during the Second World War. As the Allied air offensive against Germany intensified, Germany called on its scientists to provide countermeasures. The *wunderwaffen* or "wonder weapons" were more appealing to Germany because they held out the promise of rapidly gaining a technological edge over its enemies. This effort included a number of ground-based anti-aircraft weapons such as the Rheintochter and Wasserfall.

None of Germany's air defense missiles was ever fielded in quantities that could have affected the outcome of the war. These projects did help lay the groundwork for what would develop into a worldwide surface-to-air missile market.

Many countries (especially those influenced by the former Soviet Union) began to build intricate, dense networks based around newly developed surface-to-air missiles (intermixed with various ordnance systems). Many of those countries could not be expected to match the capabilities of the major powers or the quality of their aircraft and, in some respects, their pilots. The first to do so was North Vietnam, during its long war with the United States. It was during this conflict that the capabilities of such a network were first felt.

The next major conflict in which air defense missiles played an important part was the 1973 Arab-Israeli war. The air defense missile systems for the Arab alliance in the 1967 Six-Day War were mostly destroyed by surprise Israeli airborne attacks, and played little role in the fighting.

In 1973, the Israeli Air Force far outclassed its Arab opponents in air-to-air combat capabilities, but suffered unexpected losses from the large number of SAM batteries. The Egyptians, in particular, had established a thick air defense system that the Israelis found difficult to penetrate without high casualties. Yet the extensive deployment of SAMs could not stop the eventual collapse of the Egyptian front during an Israeli counterattack.

The 1982 Falklands War, the 1979-1988 Iran-Iraq Gulf War, and the 1990-1991 Operation Desert Storm graphically illustrated the need for effective air defense systems, especially missiles. The most significant requirement to evolve from these wars was for an anti-tactical ballistic missile system.

Conclusion. For many years, the steady development of more capable combat aircraft resulted in growing demand for ground-based and shipborne defensive systems. This demand was initially met with anti-aircraft artillery, but eventually SAMs were developed to supplement these guns.

As the Cold War progressed, sales of SAMs grew ever higher, peaking in 1988 when more than 29,000 missiles were produced in a single year. By 1991, hundreds of thousands of surface-to-air missile sites dotted the globe, protecting cities and military installations in almost every nation. It was hard to find a country that did not possess at least a small number of man-portable SAMs.

By the end of the Cold War, production of SAMs had been falling for a few years. The Soviet Union was the largest single producer of SAMs, accounting for nearly 75 percent of all produced, by some estimates. But the strain of competing with the West and maintaining its massive military forces was proving too much for the Soviets and their allies. Ever so slowly, the collapse began, and once it started, it progressed like a snowball descending from Mount Everest.

Yet demand for SAMs did not disappear with the end of the Soviet threat. The surface-to-air missile market was merely evolving to meet changing demands.

The surface-to-air missile market is being driven by the demands of customers for more effective defensive systems. As strike missiles and combat aircraft have become more capable, potential customers have demanded more sophisticated SAMs to meet the challenge. Recently, air defense systems that can engage ballistic missiles have been added to the wish list of many customers.

The SAM market will be worth \$34.6 billion over the next 10 years. The companies with the largest market shares and greatest hold on this market will be located in North America (Raytheon) and Europe (MBDA). Of course, this situation will not last indefinitely. Already, companies outside of the U.S. and Europe are winning more contracts. Denel of South Africa won a contract in Europe's backyard, to provide missiles to Finland, while demand for Israeli SAMs is growing.

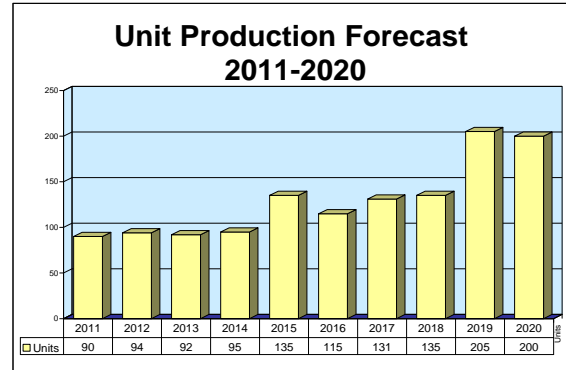
American and European companies will dominate this market for another decade at least, but the share held by companies from other regions of the world will grow.

* * *

Seawolf/Landwolf

Outlook

- Production continuing
- U.K. and other European defense budgets under pressure
- Seawolf in service with British Royal Navy and foreign clients
- U.K. to procure all-new multimission missile
- New missile may appear around 2016 or so



Orientation

Description. Quick reaction, short-range, supersonic, anti-missile and anti-aircraft missile.

Sponsor. U.K. Ministry of Defence for the Royal Navy.

Status. In production. The Seawolf Block 2 missile entered service in 2005. The United Kingdom may keep the Seawolf in service through 2025 and is considering the development of a further improved missile, possibly a Block 3.

Total Produced. Approximately 2,106 Seawolf, 1,782 Seawolf Vertical Launch, and 437 Seawolf

Block 2 missiles were built or in production as of the end of 2010. By 2005, 1,000 Seawolf missiles were fired by the U.K. Royal Navy.

Application. Shipborne, quick reaction, short-range supersonic missile used against supersonic aircraft and anti-ship cruise missiles.

Price Range. The Seawolf has a per-unit price of approximately \$319,000. The price for the entire GWS 25 Mod 0 system is approximately \$12 million.

Contractors

Prime

MBDA, Corporate HQ	http://www.mbda-systems.com , 11 Strand, London, WC2N 5RJ United Kingdom, Tel: + 44 207 451 6000, Fax: + 44 207 451 6001, Email: contact.css@mbda-systems.com , Prime
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Subcontractor

Repaircraft plc	http://www.repaircraft.com , The Common, Cranleigh, GU6 8LU Surrey, United Kingdom, Tel: + 44 1483 273536, Fax: + 44 1483 278078, Email: hq@repaircraft.co.uk (Propulsion Components)
Roxel UK	http://www.roxelgroup.com , Summerfield, Kidderminster, DY117RX Worcestershire, United Kingdom, Tel: + 44 1562 82 40 61, Fax: + 44 1562 8281 26 (Seawolf Rocket Motor)

Seawolf/Landwolf

Thales Missile Electronics Ltd	http://www.thalesgroup.com/Markets/Defence/Home/ , Mountbatten House, Basing View, Basingstoke, RG21 4HJ Hants, United Kingdom, Tel: + 44 1256 387 200, Fax: + 44 1256 387 650 (Proximity Fuse)
Thales Nederland BV	http://www.thalesgroup.com/netherlands , Haaksbergerstraat 49, Hengelo, 7554 PA Netherlands, Tel: + 31 74 2488111, Fax: + 31 74 2425936, Email: info@nl.thalesgroup.com (VM40 System Radar Equipment)

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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> Seawolf	<u>Metric</u> VL Seawolf	<u>U.S.</u> Seawolf	<u>U.S.</u> VL Seawolf
Dimensions				
Missile Length	196 cm	300 cm	6.43 ft	9.84 ft
Missile Diameter	18 cm	18 cm	7.08 in	7.08 in
Missile Wingspan	56 cm	45 cm	1.83 ft	1.48 ft
Missile Weight	80 kg	140 kg	176 lb	308.7 lb
Performance				
Speed	Mach 2+	Mach 2+	Mach 2+	Mach 2+
Altitude(a)	0-10,000 m	0-10,000 m	0-32,808.33 ft	0-32,808.33 ft
Range (max)	6.44 km	6.44 km	3.48 nm	3.48 nm
Operational Reliability	95%	95%	95%	95%

(a) Estimated data.

Propulsion. Solid propulsion rocket, designated Blackcap, which burns two to three seconds and accelerates the missile to speeds in excess of Mach 2; the Blackcap is built by Bristol Aerojet (BAJ Ltd), Banwell, Avon, England, in conjunction with Royal Ordnance, Bishopstone. A Royal Ordnance Cadiz cast double-base propellant with spoiler-blade thrust vector control is added to the Seawolf missile as part of the GWS 26 Mod 1 Vertical Launch Systems. Roxel is now providing the Seawolf rocket motor.

Control & Guidance. System uses semi-active command-to-line-of-sight guidance incorporating electro-optic and radar technology. The Type 910 radar is produced by Marconi Space and Defence Systems. The electro-optic system is produced by V+BAE Systems. Type 967 and 968 surveillance radars provide high and low coverage. The radar or electro-optic system directs the line of sight to the target. Error signals produced by missile deviations are measured 100 times a second, and processed and coded corrections are transmitted to bring the missile to the indicated track. The corrections are a function of the BAE Systems (formerly Ferranti Computer Systems Ltd) FM1600B computer. IFF technology is also provided. BAE Systems also manufactures the 805SW tracking and guidance radar.

Following selection of a tracker and launcher to engage an incoming target, data from the surveillance radar is passed by the fire control computer to the tracker, which slews to the bearing provided and commences a search in elevation. When located, the tracker locks on, and the computer, with bearing, range, and velocity information, launches a missile (having calculated the correction necessary to steer the missile into the tracker gathering beam). With both missile and target in the tracker's view, the computer calculates the angular error between the two and issues steering commands to the missile, via a microwave link, which brings the missile onto a collision course. Because the missile needs no seeker and all its aeriels are rear-facing, it is extremely resistant to electronic countermeasures (ECM). Control is by means of four movable rear fins, powered by hot gas actuators. The flares for TV tracking and the microwave control link are mounted on the tips of mid-mounted fixed fins.

If necessary, a second missile can be launched against the same target a few seconds after the first and controlled as before. If a radar lock-on cannot be achieved due to ECM or the extremely low altitude of the target, a TV link is switched on automatically. The camera is slaved to the tracker and a picture is presented to the operator, who can then guide the missile by using

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a joystick to position crosswires on the TV image of the target, angular error being calculated as before. The Type 911, STIR, and STING do not use flare tracking of Seawolf or TV tracking of the target. All tracking is carried out automatically in one of two radar frequencies (I-band or K-band).

Launcher Mode. The manually loaded launcher contains six rounds in individual cells with double doors at the front and rear. A loaded launcher weighs about 5 tons, and the complete system, including 24 reloads, has a weight of approximately 28 tons. The six-barrel launcher was developed and built by Vickers

Shipbuilding and Engineering Ltd. This launcher is used on the Type 22 frigates. The Seawolf-specific vertical launch system has a magazine capacity of 32 missiles and is used on the Type 23 frigates.

Warhead. Fragmentation-type high-explosive warhead weighing approximately 14.09 kilograms (31 lb). It can be detonated on impact or with a proximity fuze. A new dual-action fuze, designated the Mk 4 Seawolf Enhanced Low Level (SWELL) fuze, will be installed on the Seawolf missiles. The fuze is being developed by MBDA and Thales.

Variants/Upgrades

The Seawolf program involves seven missile system versions: the GWS 25 Mod 0; the GWS 25 Mod 3; the GWS Mod 4; the GWS 26 Mod 1 Vertical Launch Seawolf; the GWS 26 Lightweight Seawolf; the GWS 27; and the Landwolf/Wolverine.

Seawolf Mid-Life Upgrade. In November 2000, Alenia Marconi Systems (AMS) was awarded the Seawolf Mid-Life Update (SWMLU) contract by the Ship Missile Integrated Project Team, based in Abbey Wood, Bristol. The SWMLU program, valued at GBP260 million, is a prime contract for the upgrading of the Seawolf Naval Point Defense Missile System.

In October 2004, the successful completion of the SWMLU Critical Design Review marked the end of the design phase of the program and heralded a period of intensive integration, testing, and the launch of initial production. The work undertaken by AMS for the SWMLU program will significantly improve system performance against the most demanding threat environment, allowing ships of the Royal Navy to be defended against defined threat cases well into this century and provide a technology platform for future upgrades as the threat cases evolve.

The SWMLU will see obsolete equipment removed and major upgrades to the tracking subsystem, missile guidance, and weapon management system. This upgrade will be applied to the GWS 25 Mod 3s on board the Type 22 Batch 3 frigates and the GWS 26 Mod 1 systems installed on Type 23 frigates.

This upgrade package is expected to be introduced into service in 2008. The program will be completed before the end of 2011.

Seawolf Block 2. The Block 2 missile is designed to operate with existing in-service Seawolf air defense systems while benefiting from new technologies introduced by MBDA and AMS (now BAE Systems).

Technology developments include the following: a new electronic fin actuation system to replace the former gas actuation system, resulting in improved missile control and extended range; a new fuze incorporating IR/RF sensors to improve engagement success against very low sea-skimming, low signature targets; and the ASRAAM's multichip module to provide more in-flight computing power in a much smaller package. Other enhancements serve to reduce cost and component package size. This upgrade package has significantly improved the performance of the Seawolf missile.

The Block 2 missile will be compatible with the Seawolf ship system installations in service with the Royal Navy and other Seawolf users. The conventional and vertical launch versions of the Block 2 missile now share a common modularity, with vertical launch being provided to the standard missile by the simple addition of a boost and turnover pack.

The Seawolf Block 2 was test fired for the first time on September 4, 2003, at the Vidsel missile test range in Sweden. This successful firing cleared the way for further tests of both conventional and Vertical Launch Seawolf Block 2 during 2004.

The Seawolf Block 2 missile entered service with the U.K. Royal Navy in 2005. This missile will be installed on Type 23 warships equipped with the Vertical Launch Seawolf system and on Type 22 Batch 3 frigates outfitted with conventional launch versions (those without the turnover booster).

The United Kingdom is considering the development of a Seawolf Block 3 missile to meet future requirements. The Seawolf air defense system could remain in service through 2025.

For additional information on these and other Seawolf variants and upgrades, please see the pertinent entries in the **Program Review** section.

Seawolf/Landwolf



Seawolf

Source: BAE Systems

Program Review

Background. The Royal Navy first drew up a requirement for a shipborne point defense system in 1964. Following the sinking of the Israeli destroyer *Eilat* by SS.N-2 Styx missiles in October 1967, British Aerospace received a development contract for the PX430, a quick reaction, short-range missile for use against supersonic anti-ship missiles and aircraft. Seawolf, as PX430 was subsequently designated, remains the only proven naval anti-missile missile in the West.

A full development contract was awarded to British Aerospace (then BAC) in July 1968. A development contract for the electronics systems was awarded to Marconi Defence Systems Limited (then MSDS) in October 1969, by which time several firings of unguided missiles had taken place. These firings continued until 1972. In July 1972, it was announced that the in-service date of the system had slipped due to interface problems, but the project was still passed by a naval review board. The in-service date was further delayed by the late delivery of the Type 22 frigates to which the Seawolf was to be fitted.

Successful guided firings were made in 1973 and 1974, including interception of a Mach 2 Petrel target drone. However, the British Parliamentary Defence Expenditure Committee reported that costs had doubled in three years, to GBP180 million.

The complete basic system is designated Guided Weapon System 25 Mod 0 (GWS 25 Mod 0), and consists of the six-round launcher, the Marconi surveillance radars and tracker, a Ferranti FM1600B central computer, an electro-optic display/guidance console, and associated control equipment. Total weight of the GWS 25 Mod 0, including the 24 reload

rounds in the vessel's magazine, is about 25 tonnes (27.5 tons).

A preproduction Seawolf GWS 25 Mod 0 system was installed aboard the Leander class frigate HMS *Penelope*, and firing trials were completed in 1977 with outstanding results. The first ship to receive the operational system was the HMS *Broadsword*, commissioned in 1979.

Platforms. The U.K. Royal Navy is expected to deploy the Seawolf on the following warships and support vessels (in various configurations): Leander (Batch IIIA) frigates – one six-barrel launcher and one 910 tracker; Type 22 frigates – two six-barrel launchers and two Type 911 trackers; Type 23 frigates – 32 VL canisters and two Type 911 trackers; and Auxiliary Oiler, Replenishment – 32 VL canisters and two Type 911 trackers.

Deployment Scope Slowly Expands

The proposed system Seawolf fit (the GWS 26 Mod 2) for Type 42 destroyers was two or four four-barrel launchers plus two Type 911 trackers, and the Invincible class aircraft carriers were to receive four four-barrel launchers and two Type 911 trackers. Due to budget cuts, however, this program was canceled.

For the export market, the Seawolf has been integrated with the Blohm + Voss MEKO class frigates as part of an optional armament package. Smaller vessels can also be outfitted with the Seawolf, including up to 16 vertical launch canisters and one lightweight tracker.

Seawolf in the Falklands. Seawolf missiles were fitted on two vessels that formed part of the Royal Navy Task Force during the Falklands War of 1982: the HMS *Broadsword* and HMS *Brilliant*.

Seawolf/Landwolf

Seawolf/GWS 25 demonstrated its ability by destroying five Argentinean aircraft, including an entire attack wave of four A-4 Skyhawks. In addition, the system demonstrated its anti-missile capability when it destroyed an attacking AGM-12 Bullpup missile in Falkland Sound. The Seawolf missiles did feature adapted software to overcome Identification Friend or Foe (IFF) problems. No missile failures were reported.

Combat in the South Atlantic

Some flaws in the Seawolf system did become evident. It was found that since it was a point defense system, Seawolf could not engage targets unless they were approaching the ships on which the missiles were mounted. Accordingly, the two Type 22 frigates had to adopt defensive positions between the two aircraft carriers, *Hermes* and *Invincible*, and in the direction of a likely threat. Seawolf proved to be of little use when anti-ship missiles passed away from or parallel to the frigates, and it was evident that the Argentinean pilots were making efforts to fly clear of the two Seawolf-armed vessels. Software modifications were carried out in the South Atlantic to enable engagement of crossing targets at greater range. The lessons of combat would lead to some vital changes in the operational flexibility of the Seawolf system, and to the requirement for vertical launch, extended range, and superior tracking capabilities in particular.

It is generally thought that if Seawolf had been deployed in sufficient numbers in the Falklands, some of the Royal Navy losses would not have happened; in fact, no Seawolf-equipped ship was lost in the Falklands.

Seawolf Follow-On. MBDA is examining the potential development of a new multimission missile capable of use in air-to-air and surface-to-air roles. The Common Anti-air Modular Missile (CAMM) would provide a successor to certain short-range air-to-air and surface-to-air missiles. The CAMM could form the basis for the Future Local Area Air Defence System (Maritime) or the FLAADS(M). Other versions are: CAMM(L) for Land and CAMM(A) for Air.

The CAMM could replace the ASRAAM and MICA missiles, as well as the Rapier and Roland surface-to-air missiles (SAM).

The CAMM(M) provides 360-degree coverage out to ranges greater than 25 kilometers. The missile can also engage surface targets. The weapon system incorporates a 2-way data-link capability. CAMM can operate from SYLVER and Mk41 launchers families.

CAMM(M) is planned to be the first version to enter service. This missile will be operational in 2016 on

U.K. Royal Navy Type 23 class frigates. The CAMM(L) may arrive around 2018-2020.

Missile Models. The Seawolf system is being offered in a variety of configurations for the British Royal Navy and export customers. The following provides an overview of the various Seawolf missile systems.

GWS 25 Mod 0. Originally purchased by the Royal Navy for the Type 22 Batch 1 and two Batch 2 frigates, as well as the Batch 3 Leander class refits. The Seawolf GWS 25 Mod 0 uses a Marconi Defence Systems Ltd Type 967 D-band pulse-Doppler and Type 968 ELF-band radar for surveillance, mounted back-to-back on a pitch-and-roll stabilized masthead platform together with an IFF antenna. The system also uses the Marconi Radar Systems Type 910 tracker. Many other surveillance radars can operate with Seawolf, including the Type 996. Data are fed to a Ferranti FM1600B computer and renewed every two seconds, as the radars revolve at 30 revolutions per minute (rpm). The FM1600B performs analyses of the data and carries out track prediction, threat analysis, and allocation of target priorities and of missiles to individual targets.

It has been found that range, bearing, and velocity information from the radars is extremely accurate, particularly from the Type 967, which can detect small targets even in dense clutter conditions. As a result, the search pattern of the Type 910 tracking radar has been simplified. The Type 910, a pulse Doppler radar, tracks both the missile and the target and is backed up by a TV system, although the backup requires manual tracking of the target during missile flight. The launcher is a six-barrel unit designed to meet severe North Atlantic conditions. The missiles are loaded manually.

GWS 25 Mod 3. Fitted to the remaining Type 22 frigates, after trials in HMS *Brave*, using the same surveillance radar as the Mod 0 but introducing the Type 911(1) tracking radar. The Seawolf GWS 25 Mod 3 system incorporates a number of improvements and simplifications based on experience gained in the long proving trials of the Type 910. Also known as the Seawolf 805SW system, it combines the basic 805 series centimetric and the DN181 millimetric radars with some of the existing GWS 25 Mod 0 system for enhanced performance in tracking targets close to the sea surface. The 805 radar system also uses a Series 800 I-band radar, which enhances system performance against high-altitude targets. Both radars are situated on the same mounting. This system is one-third of the weight of the standard GWS 25 Mod 0 installation. Tracking and guidance software are combined in one Ferranti FM1600E computer. In addition to its use on the Royal Navy's Type 22 frigates, the 805SW can be mounted on naval vessels down to 800 tons. In 1983,

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the Seawolf 805SW was redesignated GWS 25 Mod 3; the tracking radar was designated the Type 911(1) by the Royal Navy.

GWS 25 Mod 4. The Seawolf GWS 25 Mod 4 offers additional improvements to those systems installed on earlier-construction Type 22 frigates. These additional improvements were incorporated into the Seawolf GWS 25 Mod 0 systems installed on board Type 22 Batch 1 frigates and the HMS *Beaver* and HMS *Boxer* of Batch 2. The Type 910 trackers will be enhanced, possibly with a thermal imager, and redesignated GWS 25 Mod 4.

GWS 26 Mod 2 Lightweight Seawolf. The evolution of the Seawolf system has made available a number of lightweight options for the system, based on a new four-barrel launcher derived from the Seacat system. In 1977, BAE started development of the lightweight Seawolf, using a Hollandse Signaalapparaten VM40 radar, which allowed operation of the system on ships down to 813 tonnes (800 tons). Tracking trials were carried out in mid-1979, followed by successful firing trials on the Aberporth range in Wales during October-December 1979. This system was originally intended for the Royal Navy's three Invincible class aircraft carriers and the Type 42 Batch 3 destroyers. In mid-1986, a contract was awarded to British Aerospace for the detailed study of retrofitting the Seawolf to the Invincible class carriers.

Several tracking and guidance options are available. Two trackers have been proven in firing trials by the Royal Navy: the Marconi Radar Systems 805SW (designated Type 911[3] by the Royal Navy) as used for the GWS 25 Mod 3, and the Hollandse Signaalapparaten VM40 tracking radar, based on the company's STIR radar and used in the Royal Netherlands Navy's Kortenaer class frigates. Smaller trackers are available that enable the system to be fitted to vessels of only 200 to 300 tonnes. All systems are well suited to operation with both Seawolf and Vertical Launch Seawolf.

The Lightweight Seawolf is a launching system based on that of the Seacat design, which is currently in service worldwide. Tracking of the target and missile control are performed by the Marconi Lightweight 805SW radar tracker under the control of software developed by Ferranti and British Aerospace for the F2420. Development was completed, but production was not initiated.

GWS 26 Mod 1 Vertical Launch Seawolf. In the late 1970s, development began on a vertical launch system for Seawolf. The system is designed to eliminate blind engagement arcs and, with its high rate of fire, defeat saturation attacks. Modifications to the missile are

minimal, mainly involving the addition of a tandem boost motor with an integral thrust vector control that performs the pitch-over maneuver. Both the booster and the thrust vector control package are jettisoned after the transition from vertical to horizontal flight. This system saves a great deal of shipboard space. The Seawolf missiles are stowed in containers that also serve as launchers. A new radar tracker, the Type 911(2), was developed by Marconi for this system from the original Type 911(1) radar. The Ferranti F2420 computer has been designed for integration with the Type 911 radar as a more powerful successor to the FM1600 series.

In late 1982, an operational Seawolf missile was successfully fired vertically from a launcher/container during trials at the Royal Aircraft Establishment, Larkhill, United Kingdom. The trial met the operational specifications for Vertical Launch Seawolf, which included transition from vertical flight to intercept trajectory. In July 1984, the United Kingdom Ministry of Defence placed a contract with British Aerospace Naval Weapons Division, Bristol, for full development and initial production of the Vertical Launch Seawolf for the Royal Navy's Type 23 frigates. The initial contract (worth GBP250 million for development and production) was for the HMS *Norfolk*, which was expected to join the fleet in 1989.

The final stage of development of the Vertical Launch Seawolf system began in July 1985 and was to include an improved point defense variant. Trials conducted from the specially constructed barge, *Longbow*, in Cardigan Bay, were closely monitored by officials from RAE Aberporth, Marconi, and British Aerospace. The barge was fitted with two Type 911 tracking radars and three canisters for Vertical Launch Seawolf, thus simulating the GWS 26 Mod 1 system configured for the Type 23 Norfolk class frigates. Successful firing trials were carried out during 1985, demonstrating two-stage launches in the vertical mode. Launch and turnover trials were completed successfully in 1986, demonstrating all phases of flight. The first of the Royal Auxiliaries being built by Harland & Wolff to support the Type 23s will also be fitted with the Seawolf missile defense system.

VL Seawolf System Will Use Block 2 Missile

In March 1986, BAE was awarded a nine-month study contract by the United Kingdom Ministry of Defence. Worth GBP400,000, it covered the feasibility of equipping the Royal Navy's Type 42 destroyers and Invincible class carriers with Vertical Launch Seawolf. A major breakthrough in the entire program followed in June 1986, with the first complete launch-and-turnover firing of a Vertical Launch Seawolf missile. This stage represented another step toward the full development

Seawolf/Landwolf

and production of the new Seawolf system, GWS 26 Mod 1. The first full test firing using the Type 911(2) system was conducted by HMS *Brave* in November 1986. By the end of the year, BAE announced that its series of trials on the Vertical Launch Seawolf had been successfully completed (four full firings) using *Longbow* at RAE Aberporth. Reliability of more than 90 percent for the system was duly claimed.

By mid-1987, the GWS 26/Vertical Launch Seawolf trials continued to enjoy a high success rate. Additionally, more complex tests were undertaken in

1988 involving the system's full flight envelope. These tests used the improved Type 911(2) radar. Further tests included single and double missile launches prior to final installation on board the HMS *Norfolk*. Production is now under way.

Landwolf. In 1985, British Aerospace began offering a land-based version of Lightweight Seawolf, designated Landwolf. The only known fact regarding Landwolf is that it has been offered to a number of international clients.

Related News

France-U.K. Deal Includes Cooperation on UAVs, Missiles – France and the United Kingdom are increasing their military cooperation and have signed an agreement making their militaries more interoperable. Among the areas of cooperation include the development of unmanned air vehicles and missiles.

The United Kingdom and France are responsible for 50 percent of all spending on defense in the European Union. Furthermore, these two nations provide 65 percent of all research and development spending within the EU. (CNN, 11/10)

U.K. and Brazil to Sign Defense Agreement – Britain and Brazil are negotiating a new defense agreement that could lead to a multibillion-dollar contract for BAE Systems to build vessels for Brazil's Navy, according to the *Financial Times*. The deal that is under consideration involves six patrol boats and five or six Type 26 frigates. The value of such a deal would be about \$4.5 billion if the frigates are built in the United Kingdom, according to the newspaper. Acquiring the vessels would represent a significant upgrade to the Brazilian Navy's fleet and capabilities. (Reuters, 9/10)

British Government Looks to Cut Defense Budget – The United Kingdom could see its defense spending drop by 10-15 percent. This means the U.K.'s defense budget will be flat for the next six years. Experts see the U.K. having to cut at least a fifth of its armed forces' personnel and possibly being forced to reduce troop levels in Afghanistan and Germany. In addition, the British military could lose 27 percent of its aircraft and 21 percent of its naval vessels.

The British government will need to establish priorities and ask if increasing its unmanned air vehicle inventory is among them.

A report said an alternative to the Trident nuclear missile program is unlikely to deliver savings. (*Financial Times*, 6/10)

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Funding

The British government is cutting its defense budget. The U.K.'s National Audit Office said in 2010 the national defense budget had a GBP36 billion hole. Program terminations are occurring.

Poor management and financial control caused the Vertical Launch Seawolf program to be GBP50 million over budget. Overall funding levels for the development of Vertical Launch Seawolf are now higher than initially expected, at about GBP400 million (\$660 million), although costs of developing the GWS 25 Mod 3 system have actually fallen by GBP50 million to GBP250 million (\$412.5 million).

Program costs continue to be a problem for Seawolf, one that will get progressively worse with the anticipated cuts in the British defense budget.

Seawolf/Landwolf

British Defense Budget Figures*

	FY09 <u>QTY</u>	FY09 <u>AMT</u>	FY10 <u>QTY</u>	FY10 <u>AMT</u>	FY11 <u>QTY</u>	FY11 <u>AMT</u>	FY12 <u>QTY</u>	FY12 <u>AMT</u>
Annual Budget								
U.S. dollars	-	55.29	-	56.40	-	53.02	-	48.52
British Pounds	-	35.34	-	36.80	-	34.60	-	31.66

*Budget figures are in billions.

Contracts/Orders & Options

In Jul 2009, the United Kingdom Royal Navy announced the refit of the HMS *Westminster* under a GBP11 million (\$18.1 million) contract. This frigate will be the first in the class to receive both a major update to the Seawolf self-defense missile system and the new command system that controls the weapons at the same time. The new "brain" of the ship's weapons systems is the DNA(2).

Also in Jul 2009, Cantronic Systems Inc received a \$2.6 million purchase order from SELEX Sensors and Airborne Systems Ltd for Cantronic's proprietary QWIP infrared detectors as part of the SWISS (Seawolf in Service Support) contract. This contract was awarded to MBDA through SELEX's customer BAE Systems in the United Kingdom. The order is a follow-up of the previous \$3.75 million order to QWIPTech for the SWMLU (Seawolf Mid-Life Update) program.

In Aug 2008, MBDA won a GBP177 million (EUR224 million) contract by the U.K. Ministry of Defence to maintain the Royal Navy's Seawolf air defense system. The SWISS (Seawolf In Service Support) contract, alongside a complementary contract awarded by the MoD to BAE Systems, will sustain the capability of the Seawolf system and ensure its readiness and availability for deployment with the Type 22 and Type 23 frigates over the next 10 years.

In Dec 2007, Malaysia placed a contract with MBDA for the modernization of its Seawolf air defense missile systems. The contract is worth MYR185.5 million. The contract covers the design, build, assembly, installation, testing, integration, and commissioning of articles and refurbishment services.

In Jul 2006, MBDA was awarded a contract to supply Seawolf Block 2 missiles to the Chilean Navy. The Seawolf missiles will equip Chile's ex-Royal Navy Type 22 frigate (*Almirante Williams*) and three Type 23 Duke class frigates. This contract included the provision of Exocet anti-ship missiles.

In Jan 2005, the U.K. Royal Navy awarded Alenia Marconi Systems a GBP17 million (\$32.07 million) contract related to the SWMLU program. This award marks the start of production of spares for the SWMLU contract. The signing ceremony took place at U.K. Ministry of Defence Abbey Wood near Bristol, home of the Ship Missile Systems Integrated Project Team, which is responsible for providing available and capable missile systems to the entire U.K. Royal Navy fleet. AMS has since been broken up and its portions divided up among its former partners: BAE Systems and Finmeccanica.

In Dec 2000, Alenia Marconi Systems was awarded a GBP260 million (\$372 million) contract for the SWMLU program by the U.K. Ministry of Defence. A total of 21 Seawolf-equipped ships will receive the modernization package between 2006 and 2011.

In Feb 2000, Matra BAe Dynamics received a GBP378 million (\$607.9 million) contract for the Seawolf missile. The contract is the final buy of Seawolf missiles for the Royal Navy's Type 22 and Type 23 frigates. Deliveries started in 2004 and will be completed in 2008. This will be the final U.K. buy of the Seawolf missile. The Seawolf will remain in service on Type 22 frigates through 2012 and on the Type 23s through 2020.

Timetable

<u>Month</u>	<u>Year</u>	<u>Major Development</u>
	1964	Design conceived
	1964	Feasibility studies carried out by British Aircraft Corporation
Jun	1967	Initial development under code name Confessor
	1967	Naval Staff requirement outlined; PX-430 designation given to missile
	1967	British Aircraft Corporation chosen as missile contractor
Jul	1968	Full development contract awarded to BAE for PX430
	1968	Vertical launch concept tested
Jul	1968	Full development program initiated
	1974	First flight
	1978-80	Low-rate production
Feb	1982	Decision made in favor of 805SW
	1982	Seawolf proven in the Falklands War
Mid-	1982	Vertical Launch Seawolf full-scale development announced
Apr	1984	Go-ahead for Vertical Launch Seawolf
	1990-92	Vertical Launch Seawolf firing trials
	1992	First export order: Malaysia
Aug	2005	U.K. takes delivery of Seawolf Block 2 missiles
	2007	Malaysia to upgrade Seawolf SAMs
Apr	2009	British Type 23 frigate tests Seawolf SAM
	2015-2020(a)	New shipborne air defense system introduced

(a) Estimate

Worldwide Distribution/Inventories

Export prospects for Seawolf appear to be few. **Algeria** may receive the Seawolf SAM via the purchase of Type 23 class frigates from the United Kingdom. The British government said in 2007 that this might be a sizable contract. **Canada** has mentioned an interest in the Seawolf for its surface ships, as has the **United Arab Emirates**.

Chile will receive the Seawolf air defense system via its purchase of ex-Royal Navy Type 22 and Type 23 frigates. These frigates are being provided by the United Kingdom from the Royal Navy's inventory. A contract for the procurement of Seawolf SAMs by Chile was awarded to MBDA in July 2006.

The United Kingdom may provide new warships to **Malaysia**, perhaps equipped with the Seawolf SAM.

BAE Systems has been chosen as prime contractor to manage the regeneration and upgrade of two ex-Royal Navy Type 22 frigates being transferred to **Romania** under a government-level agreement. The agreement covers two phases. Phase 1, worth GBP116 million, is being undertaken in the U.K., and Phase 2 in Romania.

Romania will receive the HMS *London* and HMS *Coventry*, both Type 22 Batch 2 frigates. As part of the regeneration program, these ships will receive an upgraded command system, new guided weapons, and a new medium-caliber gun system. So far, what weapons these frigates will carry has not been revealed. The Seawolf air defense missiles will be removed, as well as the frigates' Exocet anti-ship missiles.

The *Coventry* served in the 1990-1991 Gulf War.

Other countries that have mentioned an interest in ex-Royal Navy Type 23 frigates are **Belgium** and **Pakistan**. If these ships are sold, the deal could include the transfer of anti-ship and air defense missiles.

User Countries. The U.K. Royal Navy, **Malaysia**, **Brazil**, **Brunei** (VL Seawolf), and **Chile** are the only operators of the Seawolf air defense missile system.

Seawolf/Landwolf

Forecast Rationale

European defense budgets are under pressure, but not all programs will fall victim to the spending axe. The United Kingdom is feeling the strain of the economic crisis and sustained overseas operations. The U.K. just cannot afford the military it has without budget increases. Instead of increases, the squeeze on the British armed forces is tightening.

The Royal Navy is already facing some unpleasant budget choices. The Strategic Defense and Security Review calls for a smaller fleet. The Royal Navy will lose an aircraft carrier, an amphibious landing ship, multiple frigates and destroyers, and several support vessels. The shrinking of the British fleet will hurt demand for shipborne air defense missile systems.

The Seawolf surface-to-air missile arms numerous British surface combatants. This system is approaching its production end, although it will remain in service well after the final unit is built. MBDA hopes to find a few more export customers for the Seawolf SAM, but prospects are few. This system could enter service with a foreign navy via the transfer of Seawolf-equipped

warships to third parties. For now, demand is sufficient to keep the line active for perhaps another 10 years.

British defense budget pressure could make the introduction of a replacement problematic. The United Kingdom is working to acquire a new shipborne missile for its warships. Instead of a Seawolf Block 3, the British government appears to favor the procurement of an all-new multimission surface-to-air missile.

New Missile to Replace Seawolf SAM

The Common Anti-air Modular Missile program could provide a replacement for the Seawolf. This program is to be a cooperative effort involving continental allies. If successful, this new multimission missile may provide a replacement for multiple SAMs and perhaps existing air-to-air missiles. Again, continental budget shortfalls will make the development and introduction of a new multimission missile at the very least difficult.

Our production forecast is for all applications, including exports, with the exception of Wolverine and Landwolf. Outyears could include remanufactured units.

Ten-Year Outlook

ESTIMATED CALENDAR YEAR UNIT PRODUCTION												
Designation or Program	High Confidence					Good Confidence			Speculative			Total
	Thru 2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	
MBDA												
CAMM(L)	0	0	0	0	0	0	0	0	0	70	70	140
CAMM(M)	0	0	0	0	0	47	63	81	85	90	90	456
Seawolf Block 2	437	90	94	92	95	88	52	50	50	45	40	696
Subtotal	437	90	94	92	95	135	115	131	135	205	200	1,292
Total	437	90	94	92	95	135	115	131	135	205	200	1,292

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