

# ARCHIVED REPORT

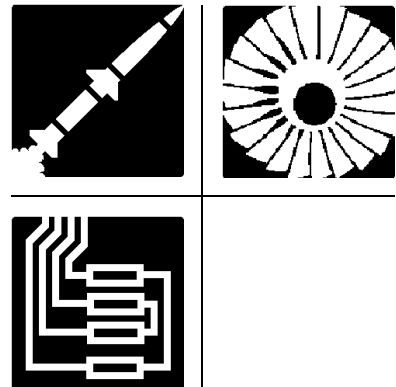
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## British Aerospace Harrier/AV-8A Series - Archived 06/2003

### Outlook

- Re-engining with Pegasus 11-61 initiated on 10 FA.2s
- Defensive EW refits under study, funding may not be available
- To be replaced by upcoming Lockheed F-35 Joint Strike Fighter

Note: Icons indicate area(s) of current retrofit/modernization activity



### Orientation

**Description.** Single-engine, single-seat V/STOL (vertical/short take-off and landing) ground attack/fighter aircraft. Two-seat trainer versions also produced.

**Developer/Primary Manufacturer.** British Aerospace Plc, Kingston upon Thames, Surrey, UK.

**Current Status.** Production completed in 1998.

**Total Produced.** Through 1998, BAe produced 393 Harrier/Sea Harrier aircraft (does not include Harrier IIs).

**Application.** Ground attack/fighter.

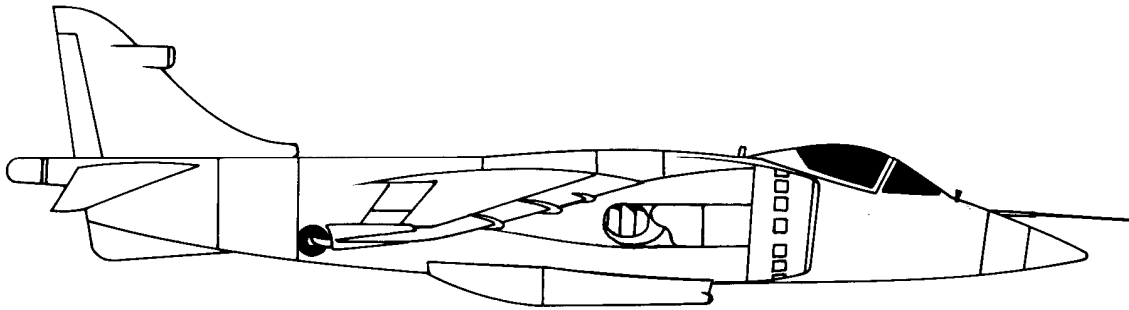
**Price Range.** Sea Harrier upgrade, £170 million program target price.

### Technical Data

	(FRS.Mk 1)	
	<u>Metric</u>	<u>US</u>
<b>Dimensions</b>		
Length overall	14.5 m	47.56 ft
Height overall	3.71 m	12.17 ft
Wingspan	7.7 m	25.26 ft
<b>Weight</b>		
Operating weight empty	6,374 kg	14,052 lb
Max T-O weight	11,880 kg	6,191 lb
<b>Performance</b>		
Max Mach number at high altitude	Mach 1.25	
Max level speed at low altitude	1,185+ km/hr	640+ kt

**Propulsion**

One Rolls-Royce Pegasus Mk 104 vectored thrust turbofan



B Ae Sea Harrier

Source: Forecast International

Thrust	95.6 kN	21,500 lbst
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**Armament.** One underfuselage and four underwing pylons capable of carrying gun pods, bombs, rockets and flares. AIM-9 Sidewinder or Matra Magic air-to-air missiles can be carried on outboard underwing pylons, and air-to-surface missiles of Sea Eagle or Harpoon type can also be carried. The two strake fairings under the fuselage can each be replaced by 30 mm Aden gun pod and ammunition.

## Program Review

**Background.** In 1967, the British Aerospace Harrier GR.Mk 1 became the world’s first operational fixed-wing, V/STOL strike fighter. The Harrier grew out of the P.1127 and Kestrel programs. The Harrier was designed to operate with maximum effectiveness from small, unprepared fields and forward sites on land, and from ships at sea, in the fighter, ground attack and reconnaissance roles. Over the years, the Harrier has evolved into a number of various types, including the

Harrier II (see separate report, “Boeing/B Ae Harrier II Series”).

The Royal Air Force (UK) currently flies the Harrier GR.Mk 3 and the T.Mk 4 two-seat trainers, and has begun taking delivery of the improved Harrier II GR.Mk 5s. The maritime version of the Harrier, the Sea Harrier FRS.Mk 1, has been in operation with the Royal Navy since 1979. Changes from the RAF Harrier



B Ae Sea Harrier

Source: Royal Navy

series include: the elimination of magnesium components; the introduction of a raised cockpit; revised avionics; the installation of a multimode Ferranti Blue Fox radar in a reconfigured nose section; and the utilization of the Rolls-Royce Pegasus Mk 104 engine, which incorporates additional anti-corrosion features and has the ability to generate more electrical power.

In 1971, the US Marine Corps began taking delivery of the AV-8A Harrier, a close air support and tactical reconnaissance version based on the GR.Mk 3. Subsequently, a CILOP (conversion in lieu of procurement) program was initiated in 1979 to convert a portion of the AV-8A fleet to the AV-8C configuration, which

included outfitting with new avionics and lift improvement devices. The program was completed by FY84. The Marines are currently procuring the enhanced AV-8B Harrier II.

In January 1985, the UK Ministry of Defence awarded a contract to British Aerospace for the project definition phase of a Sea Harrier midlife update program. This effort modernized existing FRS.Mk 1s to the new FRS.Mk 2 standard with improvements such as the Ferranti Blue Vixen pulse-Doppler radar and provisions for the AIM-120 Advanced Medium Range Air-to-Air Missile (AMRAAM). The conversions were completed in late 1995.

## Variants

GR.Mk 1. Initial production version. Produced for Royal Air Force. Powered by Rolls-Royce Pegasus Mk 101 engine rated 84.5 kN (19,000 lbt).

GR.Mk 1A. Re-engined GR.Mk 1 aircraft; powered by Pegasus Mk 102 rated 90.0 kN (20,000 lbt).

GR.Mk 3. Single-seat version produced for RAF. Powered by Pegasus Mk 103 rated 95.6 kN (21,500 lbt). All existing GR.Mk 1/1As have been modified to GR.Mk 3 standard. Total GR.Mk 1/3 production is 118 aircraft plus six prototypes.

T.Mk 2. Dual-seat version. Retains full combat capability of single-seat version as it pertains to equipment fit and weapons carriage. Entered RAF service in July 1970. Powered by Pegasus Mk 101.

T.Mk 2A. Re-engined T.Mk 2; powered by Pegasus Mk 102.

T.Mk 4. Re-engined T.Mk 2/2A; powered by Pegasus Mk 103.

T.Mk 4A. Dual-seat version with pointed nose.

T.Mk 4N. Dual-seat variant for Royal Navy.

T.Mk 8N. Designation for five T.Mk 4Ns approved in 1992 for upgrade with FRS.Mk 2 cockpits.

AV-8A. Single-seat close air support and tactical reconnaissance version produced for US Marine Corps. Total of 102 built. Also known as Harrier Mk 50.

TAV-8A. Dual-seat variant for US Marine Corps. Also known as Harrier Mk 54.

AV-8C. Modified AV-8As fitted with new avionics and lift improvement devices. Total of 47 AV-8As converted to AV-8C configuration.

AV-8S. Spanish designation for AV-8A. Known as Matador. First batch of six were Harrier Mk 50s; second batch of five were Harrier Mk 55s.

TAV-8S. Spanish designation for TAV-8A.

Harrier Mk 52. One aircraft built as a demonstrator using private funding. Similar to T.Mk 4.

T.Mk 60. Dual-seat operational trainer for Indian Navy. T.Mk 4A configuration.

Sea Harrier FRS.Mk 1. Maritime Harrier version. Powered by Pegasus Mk 104 engine. First flew in August 1978.

Sea Harrier FRS.Mk 2/FA.2. FRS.Mk 2 is designation for upgraded FRS.Mk 1. Features Blue Vixen pulse-Doppler radar and AMRAAM capability. In 1994, the Royal Navy stated that the FRS.Mk 2 designation had been changed to FA.2 (Fighter/Attack) following introduction of the Paveway II laser-guided bomb capability.

Sea Harrier FRS.Mk 51. Indian Navy version of Sea Harrier FRS.Mk 1.

## Funding

There is no funding information available for UK, Indian or Spanish Harrier fleets. US funding of AV-8A ended following its 1989 retirement.

## Milestones

<u>Month</u>	<u>Year</u>	<u>Major Development</u>
	1957	P.1127 design work begins
Oct	1960	Initial P.1127 prototype first flight
Mar	1964	First Kestrel makes initial flight
Feb	1965	Harrier development aircraft ordered by UK government
Aug	1966	First of Harrier development aircraft makes initial flight
Dec	1967	Initial-production GR.Mk 1 first flight
Jan	1971	AV-8A deliveries to USMC begin
Aug	1978	Sea Harrier first flight
Jun	1979	Initial Sea Harrier delivery to Royal Navy
Apr	1993	First upgraded FRS.Mk 2 aircraft redelivered
Late	1995	FRS.Mk 2 upgrade completed

## Worldwide Distribution

<u>Country</u>	<u>Variant</u>	<u>Total</u>	<u>Avg. Age (Yrs)</u>
India	Harrier Mk 51	15	16
	T.Mk 60	5	14
Thailand	AV/TAV-8S	7/2	24
United Kingdom	FA.2 (Navy)	28	18

## Opportunities

This program review is included strictly for informational purposes and will be archived at its next planned updating.

### PROPULSION

Pegasus 11-61 Upgrade. In mid-1999, the UK Ministry of Defence approved studies of refitting the Sea Harrier FA.2s with the Pegasus 11-61 engines, primarily to permit the aircraft to operate throughout its envelope under hot/high conditions. The 11-61 will also be refitted to 40 RAG Harrier GR.7s, as the two types serve together in the recently created Joint Force.

The FA.2 re-engining was reportedly driven by the perceived requirement to carry four AIM-120 AMRAAMs under hot/high conditions. Due to landing weight restrictions, Mk 104-powered Sea Harriers could not land with all four missiles and, as they cannot be jettisoned, the missiles would have to be fired.

The first re-engined FA.2s are scheduled to re-enter service in early 2003. This project carries an estimated cost of \$231 million.

### ELECTRONICS

SIFF Upgrade. The Sea Harrier FA.2s are being fitted with a Successor Identification Friend of Foe (SIFF) provided by BAE Systems' Sensor Systems Division. The Mk XII SIFF is derived from the APX-113 system.

Missile Approach Warning System (MAWS). In 1994 it was announced that Britain's MoD was considering fitting the Royal Navy's Sea Harriers with a missile approach warning system (MAWS), following the loss of a Sea Harrier to missile fire over Bosnia-Herzegovina. RAF Harrier GR.7s are being fitted with the GEC-Marconi Defence Systems PBS 2000 active MAWS, and this system would appear to be a viable candidate for Sea Harrier refits. If selected, the different configuration of the Sea Harrier's rear fuselage would dictate a modified installation.

Current Sea Harriers are fitted with the GEC-Marconi Sky Guardian 200 radar warning receiver and the Tracor ALE-40 chaff/flare dispenser system. Given the aircraft's increasing shift away from so-called blue water operations to over-land roles, a MAWS upgrade could be deemed appropriate.

However, as the Lockheed Martin F-35 joint strike fighter is expected to replace the FA.2s from about

2012, the outlook for such an upgrade may well hinge on the availability of funds. We are carrying this project as a speculative one in our **Opportunity Outlook**.

Indian Navy Mk 51 Upgrade. The Indian Navy has ultimately decided to drop plans for even a limited upgrade of its Sea Harriers, and will instead use the allocated funds to purchase additional MiG-29s from Russia. This project is no longer included in our **Opportunity Outlook**.

Sea Harrier Recon Upgrade. The Royal Navy is considering refitting its FA.2 Sea Harriers with an electro-optic framing camera and a new 152 mm focal length lens, testing of which began late in 1996.

Also to be evaluated is a pod-mounted IR linescanner, and the service is looking ahead to assess the viability of an internally mounted system.

Neither of these efforts has been formally approved, nor has any installation timetable been announced.

As in the case of the potential MAWS upgrade described above, a recon upgrade may fall by the wayside in favor of higher priorities.

**ARMAMENT**

ASRAAM. Depending on the extent of other FA.2 upgrades under consideration, the aircraft may be fitted with provision for the BAe/Matra Dynamics ASRAAM, which would replace the aircraft's AIM-9L Sidewinder missiles.

## FI's Opportunity Outlook

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Program	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16
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**Propulsion**

**Pegasus 11-61 Upgrade**

In Progress +=====> 10 FA.2 (UK)

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Program	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16
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**ELECTRONICS**

**SIFF Upgrade**

In Progress +=====> 26 FA.2 (UK)

**MAWS**

Anticipated <=====> 26 FA.2 (UK)

**Sea Harrier Recon Upgrade**

Speculative <=====> 26 FA.2

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Program	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16
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**ARMAMENT**

**ASRAAM**

Speculative <=====> 26 FA.2

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Program	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16
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