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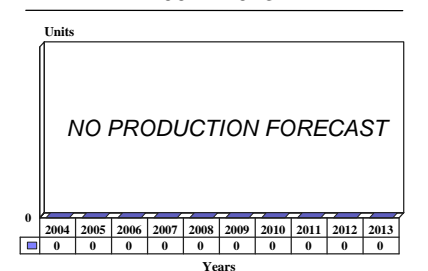
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Type 996/AWS-9 - Archived 7/2005

Outlook

- Last of Brunei's three ships fitted with the AWS-9 launched
- AMS awarded a US\$3.4 million contract for an upgrade study
- Barring any new developments, this report will be archived in the near future

10 Year Unit Production Forecast
2004 - 2013



Orientation

Description. The Type 996 is an E/F-band 3-D surveillance and target identification air/surface search radar used by the U.K. Royal Navy. The designation of the export version is the AWS-9 radar.

Sponsor

United Kingdom Ministry of Defence
Contracts Branch CB/AWL31B
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St. Georges Court
14 New Oxford Street
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Status. In service.

Total Produced. A total of 44 Type 996/AWS-9 radars are estimated to be in service through 2003.

Application. Capable of detecting every form of airborne threat, Type 996/AWS-9 provides surveillance, target identification, and long-range aircraft detection and control, together with point and area defense. Additionally, the unit provides automatic target indication for Seawolf and Sea Dart missile systems for surface ships of frigate and larger sizes.

Price Range. The unit cost of a Type 996 radar is estimated at US\$6.4 million.

Licensee. No known production licenses have been granted.

Contractors

Alenia Marconi Systems (AMS), <http://www.amsjv.com>, Eastwood House, Glebe Rd, Chelmsford, Essex, CM1 1QW United Kingdom, Tel: + 44 1245 703588, Prime

Technical Data

Characteristics

Antenna type	Multibeam stripline feed phased array
Frequency range	E/F-band
Antenna rotation	30 rpm
Antenna stabilization	2-axis (roll and pitch)
Transmitter type	Driven TWT with RF amplifier

Characteristics (continued)

Receiver type	Double superheterodyne/pulse compression
Number channels	2
MTI type	3 and 4 pulse canceller
Plot extractor	Software based
Track extractor	Software based
Confirmed tracks	More than 100
Track initiation	Automatic or manual



Type 996/AWS-9 E/F-band surveillance and targeting radar

Source: BAE SYSTEMS

Design Features. The Type 996 was specifically designed to meet a Royal Navy requirement for general surveillance and target indication to associated weapons systems. The system employs a multi-beam antenna, frequency agility, advanced processing techniques, and extensive electronic counter-countermeasure (ECCM) facilities to permit continued operations in an ECM-heavy environment. The Type 996 radar provides continuous three-dimensional data on all air and surface targets within its operational envelope at a range and accuracy sufficient for successful engagement by the appropriate weapons systems. Track data on air and sea targets can be automatically relayed to the action information system installed on the ship.

Operational Characteristics. Type 996 has the following operational modes:

Normal Mode. This mode provides target indication for medium-range and point defense missile systems, together with long-range surveillance for air picture compilation. In this configuration, a normal fighter/attack aircraft can be detected at ranges of up to 115 kilometers.

Missile Mode. This mode optimizes radar performance for the detection of low-flying and sea-skimming missiles, while retaining the ability to collect air

surveillance data. Inbound sea-skimming anti-ship missiles can be detected as they appear over the radar horizon. Consistently reliable track data are generated and made rapidly available to the ship's point defense systems.

Long-Range Mode. In this configuration, all available power is fed into long-duration pulses in the bottom beam to give extended-range performance for air picture compilation. This permits the detection of maritime reconnaissance aircraft at ranges in excess of 150 kilometers.

Anti-Jam Mode. The key to the radar's added functions is the three receptor horns mounted on the radar antenna, one directly above the radar's axis of rotation, the other two well out toward the vertical edges of the antenna. These are receivers for hostile jamming emissions, which exploit Doppler characteristics to get a very fine fix on the source of the emissions. The central horn acts as a reference antenna. The Doppler component is derived from its relation to the jamming emissions, taken as reference zero. As the Type 996 antenna rotates through the jamming beam, the horn on one side will read a positive Doppler as it approaches the jamming source, then – on the other – a negative Doppler as it retreats from that source. When the sum

of these positive and negative Doppler readings is equal to the reference zero, the face of the Type 996 antenna is at exactly 90 degrees to the bearing of the source of the jamming beam. In addition, when the face of the antenna is exactly parallel to the jamming beam, all three horns will have Doppler readings of reference zero, the side horns being at the one position where they are neither advancing nor retreating with reference to the jamming source.

The fact that two individually accurate readings are taken on each source means that the final reading derived from the data is very precise. It is then

transferred to the operations room, where it is displayed as a strobe on a large circular double parallel index plot (DPIP) forming part of the anti-jam terminal. Information on the electronic characteristics of the jamming beam is displayed on a small rectangular screen underneath. This mode enables many different sources of jamming to be displayed on the DPIP. Similar information from up to three other Type 996 radars can be transferred over to the terminal by datalink and displayed on the DPIP. Cross-bearings are provided so the actual range and bearing of the source of jamming radiation can be determined and targeted.

Variants/Upgrades

Type 996/1. U.K. Royal Navy designation for retrofit variant.

Type 996/2. U.K. Royal Navy designation for Type 23 frigate variant.

AWS-9. Export derivative. This is available in both 2-D and 3-D versions.

Program Review

Background. Technical proposals for the Type 996 were submitted in 1983, in response to a Staff Target/Cardinal Points Specification. At that time, it was claimed that Plessey's entry for the Type 996 was developed from and incorporated many characteristics of the Plessey AWS-5 radar system. The Type 996 actually represented a radically different level of technology from older Plessey naval radars, in that it has 3-D capability.

Development contracts were awarded during 1983, and Plessey was declared the winner in 1984. Development and evaluation of preproduction models of Type 996 radar were conducted in 1985. During that year the export derivative of Type 996, AWS-9, was announced.

An initial full-production contract for Type 996/1 was awarded in 1986, with a subsequent contract for Type 996/2 following two years later. HMS *Invisible* received its Type 996 in 1987, and installation on the Type 42 destroyers followed at the ships' regular refits. In late 1989, the first Type 23 frigate, HMS *Norfolk*, was commissioned with Type 996/2.

The AWS-9 radar was specified for installation on the second batch of Turkish MEKO frigates. These were ordered in two groups of two ships, with the second order confirmed in December 1992.

The Turkish order was followed by one from Norway for five simplified AWS-9 radars with 2-D-only operation. Subsequent to this order, one of the five intended platforms, the KNM *Oslo*, sank, thus reducing the number of radars required to four.

The AWS-9 radar (in 3-D form) was specified as required equipment for the eight frigates operated by the UAE, but this requirement lapsed when the UAE decided to purchase off-the-shelf Dutch designs.

In late 1996, Siemens-Plessey announced that it had commissioned a competitive tender on behalf of the U.K. Ministry of Defense, for a new enhanced-performance track extractor for the Type 996 used by the U.K. Royal Navy. According to a company statement, the new equipment (designed to analyze radar data and track aircraft and missiles) would significantly increase the performance of the unit. The upgrade was also said to complement further technical studies by the U.K. MoD aimed at optimizing the operational effectiveness of the radar well into the next century. The socket-compatible equipment was given the U.K. Royal Navy designation Outfit LFE.

British Aerospace (BAE Systems) and DASA purchased the Defense Electronics Group of Siemens AG in November 1997. BAE Systems bought the Siemens-Plessey Systems business in the U.K. and the Siemens Plessey Electronics Systems Australia subsidiary. DASA took over the remaining activities located in Munich-Unterschleissheim. BAE Systems entered a joint venture with Finmeccanica of Italy to form AMS. The Type 996/AWS-9 radar systems are now being handled under this joint venture.

In May 1999, the U.K. Royal Navy awarded British Aerospace a US\$74 million contract to upgrade the performance and operational availability of the Type 996 radar. Under the terms of the contract, British Aerospace supplied a new Track Extractor that includes

commercial off-the-shelf (COTS) processors. The Track Extractor is designed to improve the Type 996's tracking capability and, at the same time, reduce the number of false track alerts. British Aerospace also enhanced the radar's operational availability to allow on-site replacement of key subsystems in above-deck equipment.

In January 1998, Brunei ordered three new offshore patrol vessels. All three were fitted with the AWS-9(3-D) radar system. The first of these vessels, the *Nakhoda Ragam*, started sea trials in the winter of 2001/02. The second of this class, the *Bendahara Sakam*, has been launched and sea trials have begun. The final ship, the *Jerambak*, was launched in 2002.

Funding

The Type 996 radar was developed under U.K. MoD contract, with total funding amounting to US\$169 million during the period 1984-89.

Recent Contracts

<u>Contractor</u>	<u>Award (US\$ millions)</u>	<u>Date/Description</u>
AMS	3.4	Mar 2003 – U.K. Royal Navy issued contract for an upgrade study, under the Automated Software Adaptive program (ASAR), of 29 Type 996 radars systems. ASAR is to improve performance in hot climates and against supersonic sea-skimming and high-altitude diving anti-ship missiles.

Timetable

<u>Month</u>	<u>Year</u>	<u>Major Development</u>
Sep	1983	Development contract awarded
4th Q	1984	Plessey won U.K. Royal Navy radar competition
Jan	1985	Ferranti awarded track extraction system contract
Apr	1986	Production contract awarded
	1988	First Type 996 declared operational
	1987	AWS-9 export variant announced
		Type 996 installed on HMS <i>Invincible</i>
	1996	Performance Track Extractor enhanced
Mar	2003	U.K. issues contract for ASAR upgrade study program

Worldwide Distribution

Brunei	3 on Nakhoda Ragam frigates
Norway	4 on Oslo class FF
Turkey	4 on MEKO 200TN Tack II-A class FF
U.K.	1 on Ocean LPH, 3 on Invincible class CVH, 16 on Duke FF, 7 on Sheffield (Type 42A/B) DDG, 4 on Manchester (Type 42C) DDG, 2 on Albion class (LPD)

Forecast Rationale

The Type 996/AWS-9 radar system is an E/F-band surveillance and targeting radar used aboard surface vessels ranging from frigates to aircraft carriers. Most of the sales for the Type 996 radar have come from domestic sales in the U.K. Out of the 44 systems

produced, 33 were fitted on to U.K. vessels. On the international market, the AWS-9 variant has not had much success. In all, 11 systems have been sold to only three customers: Brunei, Norway, and Turkey. The most recent order came in 1998 from Brunei. The last

of Brunei's three ships to be fitted with the AWS-9 was launched in 2002.

In 2003 AMS was awarded a US\$3.4 million contract for an upgrade study, under the Automated Software Adaptive Radar (ASAR) program. The ASAR program is aimed at improving AWS-9 performance in hot climates and against supersonic sea-skimming and high-altitude diving anti-ship missiles. If the study concludes

the ASAR upgrade is viable and effective, approximately 29 U.K. AWS-9 systems will be modified.

Apart from the ASAR upgrade study there has not been any publicized information on Type 996/AWS-9 radar sales. With no systems slated for any vessel, it can only be assumed that the production line for this particular radar system has been halted. If there are no major changes in the Type 996/AWS-9 radar program, this report will be archived in the near future.

Ten-Year Outlook

ESTIMATED CALENDAR YEAR PRODUCTION

Designation	Application	<u>High Confidence</u> <u>Level</u>					<u>Good Confidence</u> <u>Level</u>			<u>Speculative</u>			Total 04-13
		Thru 03	04	05	06	07	08	09	10	11	12	13	
AWS-9	Prior Prod'n:	11	0	0	0	0	0	0	0	0	0	0	0
TYPE 996	Prior Prod'n:	33	0	0	0	0	0	0	0	0	0	0	0
Total Production		44	0	0	0	0	0	0	0	0	0	0	0