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AAQ-16 - Archived 01/2002

Outlook

- No new contracts identified
- AAQ-27 appears to have replaced AAQ-16
- Barring any new contracts, this report will be archived in the near future

10 Year Unit Production Forecast
2001-2010

Orientation

Description. The AAQ-16 is a second-generation FLIR-based night vision system based on long-°wavelength infrared technology. The most significant variant is the AAQ-16D AESOP (Airborne Electro-Optical Special Operations Payload) system used by Special Forces rotor-wing applications.

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Status

AAQ-16: In production and service.
AESOP: Out of production but in service.

Total Produced. Through 2000, an estimated 571 AAQ-16/AESOP systems were produced.

Application. AAQ-16: Turret-mounted night vision system predominantly for helicopters. Typical applications are search and rescue, special operations.

AESOP: AESOP provides Special Operations Forces aircraft with the ability to conduct area reconnaissance, surveillance, and target acquisition/engagement missions.

Price Range. Unit price of the AAQ-16B is estimated at US$800,000, based on a 1997 contract for production systems (1997 dollars).

The AAQ-16D AESOP variant had a contract averaging cost of US$2 million (1994 dollars).

Technical Data

(Basic AAQ-16)

	Metric	**US**
Characteristics		
Turret FLIR Unit (TFU)		
Weight:	24.49 kg	54 lb
Size:	32.77 x 37.08 cm	12.9 x 14.6 in
System Electronic Unit (SEU)		
Weight:	20.87 kg	46 lb
Size:	30.63 x 19.91 x 41.35 cm	12.06 x 7.84 x 16.28 in
Fields of View:	1x (30° x 40°), 6x (5° x 6.7°); 16x (1.9° x 2.5°) optional	
Field of Regard:	+/-210° Azimuth; +85°, to -180° Elevation	
Multifunction Control Unit (MFCU)		
Weight:	0.59 kg	1.3 lb
Size:	7.62 x 7.62 x 15.75 cm	3.0 x 3.0 x 6.2 in
System Control Unit (SCU)		
Weight:	0.45 kg	1.0 lb
Size:	3.81 x 14.61 x 11.52 cm	1.5 x 5.75 x 4.53 in

Design Features. AAQ-16. The AAQ-16 is a high-performance, lightweight, forward-looking infrared (FLIR) system that provides navigation and target recognition capabilities in darkness and low-visibility conditions for helicopters and light aircraft. The AAQ-16 converts thermal energy into a video format to provide flight crews with high-resolution, television-quality infrared imagery in conditions of total darkness, smoke, blowing dust and haze. The Hi-Mag variant is an upgrade of the original AAQ-16, which provides a telescope feature with wide, medium and narrow field-of-view, an enhanced autotracker, and improved stabilization.

The complete FLIR system consists of four line replaceable units: the Turret FLIR Unit; System Electronic Unit; Multifunction Control Unit; and System Control Unit. The Turret FLIR Unit (TFU) contains the FLIR sensor enclosed in a two-axis gimbal housing mounted on the underside of the fuselage. The TFU operates in the long-wave IR range (8-12 microns) and uses parallel scanning technology. An Integrated Detector Electronics Assembly (IDEA) is also incorporated, which provides improved electromagnetic interference (EMI) performance and enhanced TV quality imagery equivalent to second-generation systems, as well as on-demand cryogenic cooling.

The System Electronic Unit (SEU) houses, as a single unit, the internal power supply, dual microprocessors, correlation autotracker (dual-mode optional), and programmable symbol generator. The SEU provides automatic channel balance, multidisplay flexibility, system built-in test, and MIL-STD-1553A/B databus compatibility. Line rates of 525, 875, or 625 are available at 50 or 60 Hz scan rates. The Multifunction Control Unit (MFCU) is a pistol-grip-type controller that provides the pilot/operator with rapid hands-on control of all AAQ-16 system functions. The System Control Unit (SCU) controls the power and the internal test functions.

The FLIR sensor is combined with an automatic tracking and digital video processing capability that produces a black-and-white video image for viewing on a single display, on which flight symbology and

navigational data are also superimposed as an aid in navigation and target recognition. The display can take the form of either a conventional instrument panel-mounted CRT or a helmet-mounted display. When viewed via helmet-mounted display, the FLIR image is projected onto a binocular holographic combiner which is embossed on a see-through visor. The AAQ-16 has a high level of component commonality with the Raytheon Systems Company (formerly Hughes) AAR-50 Thermal Imaging Navigation Set (TINS) that equips US Navy F/A-18C/D fighter aircraft.

AAQ-16D (AESOP): The AESOP system combines the AN/AAQ-16 FLIR-based Night Vision System developed by Raytheon (formerly Hughes) with a new three field-of-view telescope and a laser target designator/rangefinder, providing an infrared navigation and targeting system in a turret that weighs less than 40 kilograms. AESOP is based on AAQ-16 Hi-Mag design, which provides both the high-magnification capability required for target identification and the wide field-of-view capability needed for safe night and low-visibility flying.

Note: As the AESOP is a derivative of the AAQ-16, many of the technical specifications are likely to be similar – if not identical – to the AAQ-16. However, as with all Special Operations equipment, confirming the technical specifications of AESOP is difficult.

Operational Characteristics. The FLIR sensor turret is mounted on the underside of the host aircraft and is controlled either by the head movements of an operator wearing a specially designed tracking helmet or by a cockpit joystick. The turret is servo-loop-stabilized in two axes and provides the operator with two alternately selectable fields of view: 30° x 40° (1x) and 5° x 6.7° (6x). An additional field of view – 1.9° x 2.5° (16x) – is also available.

The turret can be steered through 210° in azimuth and from +85° to -180° in elevation, slewing at a rate up to 140° per second. At its maximum 6x magnification, the HNVS (Helicopter Night Vision System) can delineate individual tree limbs and branches. In cases of disorientation, a look-ahead switch can be used to return the FLIR to a full forward, wide-angle view.

The AAQ-16 can be integrated with the aircraft terrain-following radar to allow the pilot to fly at low levels in reduced visibility. Operating in this mode, the system is reported to provide excellent nap-of-the-earth imagery and superior horizon definition. The system is compatible with night vision goggles and has a mean time between failures (MTBF) in excess of 300 hours.

Variants/Upgrades

AAQ-16B. Introduced in 1989, this variant is the current production standard. It incorporates several performance and reliability improvements over the original design.

AAQ-16C. A variant that possesses a dual-mode tracker. Weight of the turret is 65 pounds (29.48 kg).

Hi-Mag. Developed under a company-funded effort and unveiled in November 1991, this improved version of the AAQ-16B incorporates both a high-magnification capability for long-range target identification and a wide field-of-view capability for safe night and low-visibility flying. The Hi-Mag upgrade features three fields of view: wide (1x), medium (6x), and narrow (16x). The upgrade also incorporates an enhanced autotracker and improved stabilization, and provides a growth capability for a laser illuminator. The Hi-Mag Helicopter Night Vision System is totally inter-changeable with existing AAQ-16B units, requiring no modification to helicopters already configured for the AAQ-16.

AAQ-16D (AESOP). The US Army Aviation and Troop Command issued a notice in the June 26, 1991, *Commerce Business Daily* stating a proposed procure-ment effort to develop, fabricate, install, test, and deliver an Airborne Electro-optical Special Operations Payload (AESOP) prototype utilizing off-the-shelf or nearly mature components. Installation kits for the MH-60L and the AH-6J helicopters were also required.

Hughes was selected to develop AESOP in April 1992. The system is based on an improved AAQ-16B Hi-Mag variant and is constructed to stay within the size and weight constraints dictated by the various helicopters currently equipped with the AAQ-16. AESOP is intended to provide strategic offensive forces aircraft with the ability to conduct area reconnaissance, surveil-lance, and target acquisition/engagement missions. The system also incorporates a laser rangefinder/designator for autonomous semi-active laser HELLFIRE anti-tank missile engagements.

AAQ-27. In 1987, the US Marine Corps selected what was designated the Infrared Detection Set (IDS) for the V-22 Osprey tilt-rotor aircraft. Later information released by developer Hughes re-named the system intended for this platform the AAQ-27 (V-22) mid-wavelength infrared (MWIR) staring sensor. Based on the AAQ-16B, it is intended to allow pilots to see through obscurants and in darkness with third-

generation image quality and range performance. For further details on the AAQ-27, please refer to the separate report covering this item.

Program Review

Background. Hughes introduced the Helicopter Night Vision System AAQ-16 in the early 1980s as a high-performance surveillance aid for law enforcement and military applications. The first customer was the US Customs Service, which outfitted an undisclosed number of Piper Cheyenne aircraft for anti-drug-smuggling duty along the borders. In this application, the AAQ-16 was integrated with a Westinghouse (now Northrop Grumman) APG-66(V) radar system. In 1987, the Schweizer Aircraft Corp began marketing a quiet reconnaissance aircraft variant of its SA 2-37A airframe equipped with the AAQ-16 system to federal and state law enforcement organizations.

The present success of the AAQ-16, however, is measured in its military applications, with all US services having funded procurements. Note that Raytheon's acquisition of Hughes transferred control of the AAQ-16 program to Raytheon in late 1997.

US Army. The US Army was the initial military user, procuring a significant number of AAQ-16 sets for use in a complement of special mission helicopters, mostly MH-6, UH-60A and CH-47Ds in the mid- to late 1980s. Procurements continued with the installation of the AAQ-16 in the MH-47E and MH-60K Special Operations Forces helicopters delivered during the 1990s. In this application, the AAQ-16 is used in conjunction with the Raytheon Systems Company (formerly Texas Instruments) APQ-174 terrain-following radar.

Another source of AAQ-16 procurement for the US Army began with the January 1992 contract to develop and evaluate the AESOP AAQ-16D derivative for installation in the MH-60K and AH-6L aircraft. The US Army Aviation and Troop Command issued a proposed procurement effort to develop, fabricate, install, test and deliver an AESOP prototype utilizing off-the-shelf or nearly mature components in June 1991. Installation kits for the MH-60K and the AH-6J helicopters were also required.

Raytheon (formerly Hughes) was selected to develop AESOP in April 1992. The company delivered two prototype AESOP systems to the Army for flight tests, which included live HELLFIRE missile firings, in late 1993.

In March 1994, Hughes was awarded a US$6.3 million Phase I AESOP FLIR system production contract. This contract was followed almost immediately with an April contract award of US$24.1 million for Phase II AESOP FLIR production and installation.

The only known user of AESOP are the US Army's 160th Special Operations Aviation Regiment (Airborne) (SOAR) based out of Ft. Campbell, Kentucky, and Hunter Army Airfield, Georgia. The inclusion of the AESOP laser rangefinder/designator has given the arsenal of the 160th SOAR a much needed punch. As the unit typically flies deep into enemy territory, the inclusion of a stand-off anti-armor capability was considered vital. AESOP provides this capability when either the MH-60Ks or AH-6 "Little Birds" are fitted with HELLFIRE missiles. The system can also be rapidly removed and switched to another aircraft depending on mission requirements.

US Navy. As part of its Persian Gulf escort contingent deployed in the Iran/Iraq conflict, the US Navy outfitted 16 Kaman SH-2F Lamps I helicopters with the AAQ-16 to aid in ship surveillance in the sea lanes during day or night operations. The installations were accomplished in late 1987 and early 1988 as needs arose. The successful use of the AAQ-16 in this sea service led the Navy to include a FLIR system as part of the planned SH-2G upgrade program that began in FY90. Originally, the Navy planned for 115 SH-2Fs to be upgraded at a rate of six to eight aircraft per year. In compliance with the planned downsizing of the Fleet, however, the DoD included the SH-2G program in a group of proposed program terminations announced in 1993. The bulk of the SH-2Fs that would have been upgraded were withdrawn from service concurrent with the decommissioning of the surface ships on which they served. This left the Navy with a total of 24 SH-2Gs (18 refits and eight new productions), with the last completed in 1995.

The Navy also gained considerable experience with FLIR-equipped SH-60Bs during the 1991 Persian Gulf War. For Operation Desert Storm, five SH-60Bs were fitted with AAQ-16 Block 1 FLIR systems. Due to the need to expedite the installation, the FLIR was installed as an independent system with its own cockpit display.

In 1993, the US Navy initiated an SH-60B FLIR program for 40 contingency kits to provide a fast reaction capability for installing FLIRs on a segment of the Seahawk fleet. Announcing its selection in September of that year, IBM chose a FLIR/laser designator/rangefinder design proposed by Texas Instruments (now Raytheon TI Systems) instead of the

AAQ-16. The new system, dubbed the LAMPS FLIR, is a second-generation design that is believed to incorporate the same Litton Laser Systems laser designator used on the US Air Force F-117A stealth fighter.

US Marine Corps. The Marine Corps procured AAQ-16 units as a result of its effort to develop a Helicopter Night Vision System (HNVS) for its fleet of CH-53E Super Stallion Helicopters. Originally, the service had selected an HNVS based on the Lockheed Martin Pilot Night Vision System (PNVS) subsystem used on the AH-64 Apache attack helicopter. This FLIR system was designed to operate in conjunction with a complementary Integrated Helmet & Display Sighting System (IHDASS). Due to budgetary constraints, the PNVS was dropped and the Corps selected the AAQ-16 in its place. A May 7, 1991, *CBD* notice issued by NAVAIR confirmed plans to integrate the AAQ-16 into the CH-53, and Hughes formally announced the Marine Corps selection of the AAQ-16 in an August 1991 press release. In March 1995, Hughes received a US$18.1 million contract for AAQ-16B FLIR controls and displays to outfit this platform; work was completed by July 1997.

US Air Force. US military service procurement of the AAQ-16 has been rounded out with the Air Force procurement to equip its fleet of MH-60G and HH-60G PAVE HAWK SOF helicopters. The 82 HH-60s were re-designated from MH-60G nomenclature and serve in a combat rescue role. Contracts supporting this effort were a US$7.5 million award in December 1994 for life-cycle support of the AAQ-16 on this platform (as well as the Army's MH-47); and a US$9.4 million award in September 1995 for AAQ-16B components, with work completed in August 1997.

AAQ-27. In an effort that began in 1987 to equip US Marine Corps V-22 Osprey tilt-rotor aircraft with the Infrared Detection Set (IDS), a variant of the AAQ-16, the AAQ-27, a mid-wavelength infrared (MWIR) staring sensor was developed. Since the development of the AAQ-16's successor, the AAQ-27, no further progress has been noted on this system.

Funding

No specific funding for the AAQ-16 has been allocated.

Recent Contracts

Contractor	Award ($ millions)	Date/Description
Hughes	8.2	Dec 1996 – Mod to previously awarded contract for AAQ-16B components for CH-53 helicopters. Completed Jun 1999. (N00019-94-C-0054)
Hughes	11.3	Aug 1997 – Follow-on production contract for 14 AAQ-16B systems and associated controls and displays to be used aboard US Air Force HH-60G helicopters. Includes the following components: 14 Turret FLIR Unit and System Electronics Unit sets; 14 Multifunction Control Units; 14 System Control Units; nine Display Electronic Units; and 19 Panel Display Units. Delivered between March and Nov 1999. (F09603-97-C-0472)

Timetable

Month	Year	Major Development
Early	1980s	HNVS/AAQ-16 in development
	1985	US Army selects AAQ-16 for SOF helicopters
	1985	AAQ-16 selected by US Customs Service
	1987	US Navy installs AAQ-16 on SH-2F on duty in Persian Gulf
	1987	US Marines plan to install AAQ-16 derivative in V-22
	1989	AAQ-16 selected for Army SOF helicopters
	1989	Improved AAQ-16B enters production
	1991	AAQ-16 deployed on US Navy SH-60Bs in Persian Gulf War
	1991	AAQ-16 selected for US Marine Corps CH-53E
Jun	1991	Army issues AESOP proposal
Apr	1992	Hughes selected as prime developer
Jan	1992	Award of AESOP development contract
	1993	Prototypes tested
Mar	1994	Phase I contract for low-rate initial production
Mar	1994	Award of AESOP production contract
Apr	1994	Phase II contract for production and installation
	1995	Last US Navy SH-2Gs receive AAQ-16
Dec	1997	Raytheon's acquisition of Hughes finalized
Late	2000	Projected end of AESOP deliveries for US Army MH-60K/L refits

Worldwide Distribution

AAQ-16: The AAQ-16 has been sold to **US** military and civilian services, including the Customs Service (Piper Cheyennes), Army (CH-47D, OH-6, UH-60s, MH-60, MH-47), Navy (SH-2G, SH-60B), Marine Corps (CH-53E), and Air Force (MH-60G, HH-60G); **Australia** specified a variant for its navy's S-70Bs and SH-2Gs.

AESOP: AESOP has been installed on the US Army's SOF Sikorsky MH-60K/L and McDonnell Douglas AH-6J Little Bird helicopters. This is a **US Army** effort. There have been no known international sales.

Forecast Rationale

The Raytheon AAQ-16, a second-generation, long-wavelength, infrared night-vision device developed for airborne navigation, surveillance and targeting. Its three fields of view allow pilots to fly and navigate on low-level missions, and to detect and identify long-range targets when flying at higher altitudes.

Developed in the early 1980s, the AAQ-16 was first implemented on Piper Cheyenne aircraft by the US Customs Service in anti-drug-smuggling operations along the US Border. In the mid-1980s the US Army outfitted its special mission helicopters with the AAQ-16. Later, in 1992, the US Army awarded a contract to Raytheon to develop the AESOP (Airborne Electro-Optical Special Operations Payload) variant for its special-operations-designated MH-60K and AH-6 helicopters. After proving useful in the US Navy's Persian Gulf escort mission during the Iran/Iraq conflict, the US Navy installed the AAQ-16 in some of its Kaman SH-2F and SH-2G helicopters between the late 1980s and the early 1990s. The US Air Force followed suit when it ordered the AAQ-16 for its fleet of 82 HH-60 helicopters. Work for these units was completed in 1997.

The AAQ-16 has been successful to some extent, but with the development of its successor, the AAQ-27, demand for the AAQ-16 seems to have diminished. Since 1997, no new orders for the AAQ-16 have been detected. With three years of contract inactivity and the development of the AAQ-27, the AAQ-16 program appears to have ended. Barring any new contracts for the AAQ-16, this report will be archived in the near future.

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**
AAQ-16	Prior Prod'n:	444	0	0	0	0	0	0	0	0	0	0	0
AESOP	Prior Prod'n:	127	0	0	0	0	0	0	0	0	0	0	0
Total Production		571	0	0	0	0	0	0	0	0	0	0	0