THE EH 101 ADVANCED ASW HELICOPTER

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The Background

During the last decade the need for an ASW Sea King replacement that could counter the faster, quieter submarine was recognized and studies were put in hand to identify the requirements for this new helicopter. This led to National Project Definition of a vehicle and its weapon system completing at the end of 1979 which satisfied the Naval Staff Requirement, but, with a total buy of only 70 aircraft, the unit cost proved too expensive for the R.N. to fund. In an attempt to share the development cost the Service was forced to look elsewhere in Europe for a country with similar requirements.

Discussion with the Marine Militare Italiana progressed well and resulted in the formation of a Memorandum of Understanding between the Governments of the U.K. and Italy. However the total buy was still less than one hundred aircraft and the cost of development remained too high. The resultant gloom at Westland Helicopters and the Italian manufacturer Agusta led to a realization that not only were naval profits being lost but that the vehicle had other commercial possibilities. These possibilities, when quantified by market surveys, indicated a potential market of some 600 EH 101s by the year 2000. This was encouraging enough for both firms to consider investing some of their own money in design and development of the vehicle.

This then was the basis for the International Project Definition completed in March 1982 which concluded that a common vehicle was viable without compromising either naval or civil requirements to too great an extent.

All was not yet over though—the joys of collaboration do not just include an appreciation of Italian wine but also necessitate getting agreement in both countries at the same time, and for a year or so this required detailed management negotiations. In consequence it was not until 7 March 1984 that the EH 101 (FIG. 1) was finally approved for Full Development.

As a result we have a development contract which seeks to achieve the following broad aims:

(*a*) To provide the two navies with a common vehicle and core avionic system into which national specific mission equipments will be integrated.

(*b*) To provide the two firms with a common vehicle which can be adapted into civil and utility variants.

(*c*) To provide both nations with high technology jobs shared equally between the two.

This had to be achieved against a form of incentive and fixed price contract with each country paying for the work that takes place within its boundaries.

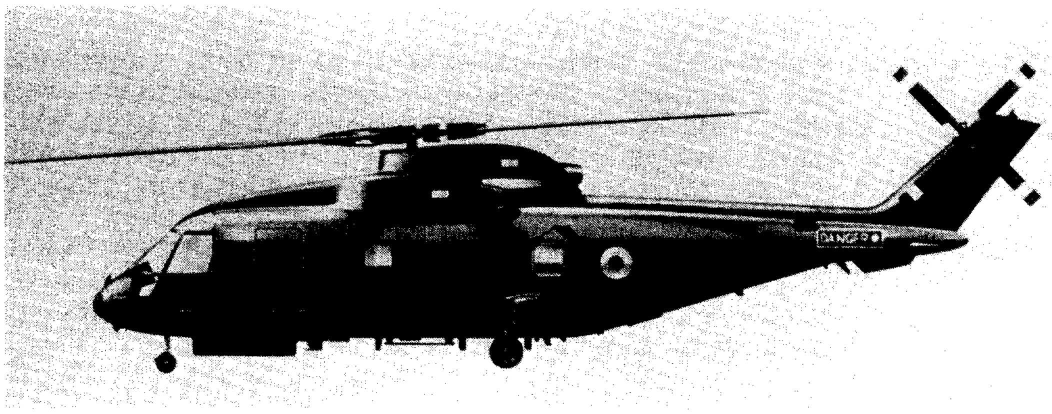

FIG. 1—EH101—AN ARTIST'S IMPRESSION

The ASW Requirements

Although the aircraft is required to replace the Sea King operating in squadron strength from a carrier, it is also needed in the more demanding environment of a Type 23 frigate operating towed array sonar equipment on the edge of a task force. The helicopter's charactertistics are therefore most effectively described in relation to this latter scenario.

Speed

The Type 23's towed array will be able to detect targets at very significant ranges ahead of the task force and the helicopter is the only means of delivering an attack at these ranges. For rapid investigation of the datum a speed of more than 140 knots is required.

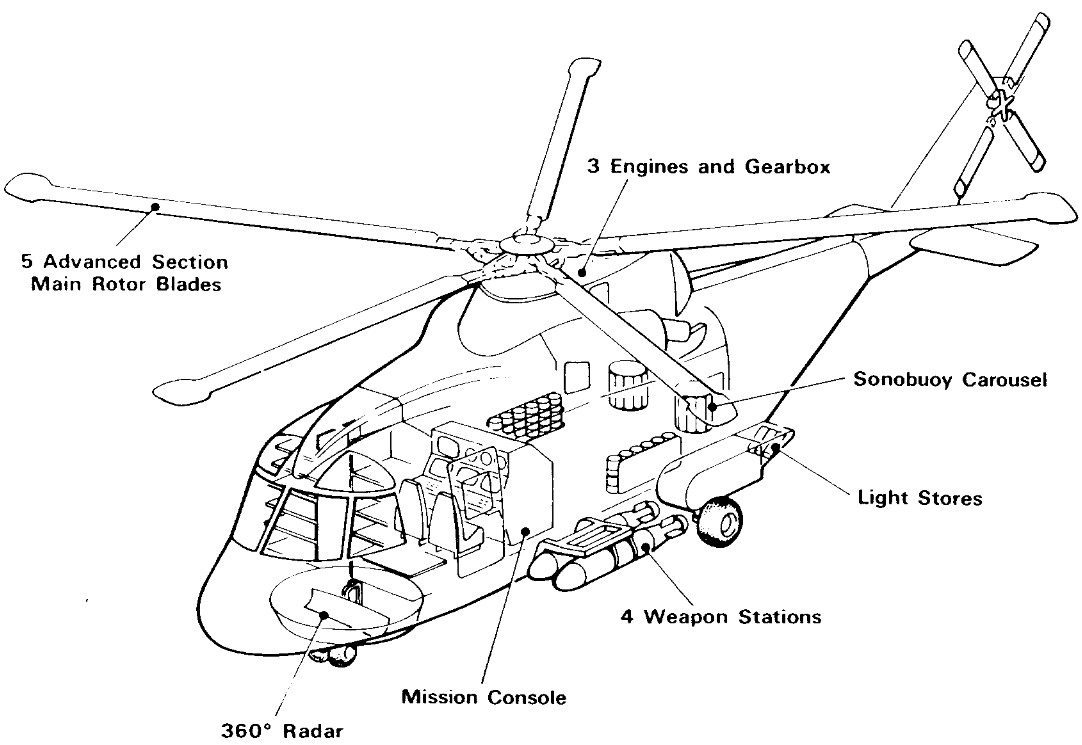

FIG. 2—EH101, THE R.N. VARIANT

Sensing System

The principal sensor is the sonics localization system using sophisticated sonobuoys. It is an autonomous system, with all the processing of sensor information carried out on board, as opposed to the US Lamps III where information is passed back to the parent ship for final processing. As a system it can receive and process information simultaneously from a number of buoys. Advances in processing technology and miniaturization will be fully exploited to achieve a high capability low weight system. The sonics system is complemented by a wideband ESM outfit and a radar which will have full 360° coverage (FIG. 2) and be able to provide a range of facilities, including the ability to track and scan simultaneously.

Endurance

Both studies and experience of localizing targets after initial long-range detection by passive sensors show the need for more than 2 hours on task from arrival in the area of the initial datum, to provide a high probability of success. To this must be added transit and attack times resulting in the requirement for an endurance of more than 4 hours.

Navigational Accuracy

Following localization of a target a navigational system with a high short-term accuracy is essential if weapons are to be effective. This is acheived by a system comprising an inertial reference unit, an Attitude and Heading Reference system, a good doppler, and Navstar Global Positioning System, which all feed into the main mission system.

Weapons

To provide a re-attack capability, several Stingray or Mk. 46 torpedoes can be carried as well as a variety of other stores.

TABLE I—*EH 101 size and weight: a comparison with Sea King*

	EH 101	*Sea King*
Length	22·9 m	22·2 m
Width	5·49 m	4·98 m
Height	5·18 m	4·98 m
Take-off weight	13 000 kg	9600 kg

Agility

To meet the requirements identified above inevitably leads to the design of a medium helicopter with a take-off weight of some 13 000 Kg, 35 per cent. greater than that of the Sea King Mk. 5 (TABLE I). Operations from the deck of a Type 23 in high sea states, however, require the agility normally associated with a small helicopter like the Lynx. The provision of sufficient tail rotor power and main rotor thrust margin enables this agility to be achieved by utilizing the reserves of power available from the three General Electric T700 engines which each deliver 1690 s.h.p. Stability becomes even more important in the agile helicopter and is accomplished by a four-axis duplex automatic flight control system fitted with multiple microprocessors in each lane. The system provides automatic stabilization and a full range of flight control options essential to reduce work-load to an acceptable level for single pilot operation by day and night.

Aircraft Systems Management

The single pilot is accompanied by mission system operators but, with the variety and complexity of equipments and tasks, this minimum aircrew would be overloaded without fully integrated and largely automated systems. Dual aircraft managment and mission computers sized at some three and five Z8000 microprocessor respectively operating predominantly on MIL-STD-1553B data buses meet this requirement.

Availability, Reliability, and Maintainability

A high aircraft availability is essential if effective intensive flying operations are to be achieved as well as quick reaction to a threat. To achieve the required MTTR, ground crews are assisted in their diagnosis by an extensive built-in test system and by the recording within the aircraft's management computer of defects occurring during flight. A health and usage monitoring system will aid availability by enabling major components to be replaced 'on condition' rather than after a specified life, as is the case on most current aircraft.

EH 101 Technology

In general terms, EH 101 as a vehicle, as opposed to its weapon system, is not a high technological risk. That said, however, there are some significant areas of new technology used in the aircraft which are as revolutionary as those employed throughout the mission system. Of particular note are materials, and the extensive use of composites containing both glass and carbon for cockpit, cabin, and the entire tail aft of the fold. More interesting, though, are the advantages inherent in composite rotor blades, where ease of construction allows section changes impossible in metals and in turn allows the use of clever aerofoil shaping to maximize critical mach number, reduce vortices, and minimize the effect of retreating blade stall. Other features such as thrust are easy to apply and the overall effect of the blade tips (shown in FIG. 3) and the RAE aerofoils provide lift figures 20 per cent. in excess of existing designs and ensure the achievement of adequate thrust margins. Rotor blade de-icing will also be incorporated. Turning to the dynamics, the main rotor head designed by Agusta is predominantly a composite design using elastomeric bearings and a metal core. The main gearbox and drives are conventional, but the tail rotor uses advanced aerofoil section composite blades with a semi-rigid composite hub, elastomeric feathering hinges, and a blade diameter that ensures adequate yaw control accelerations to give good handling when landing on a small ship.

Finally of note are the cockpit instruments, which will all be of cathode ray tube type using a mixture of colour and monochrome displays and both cursive and raster techniques.

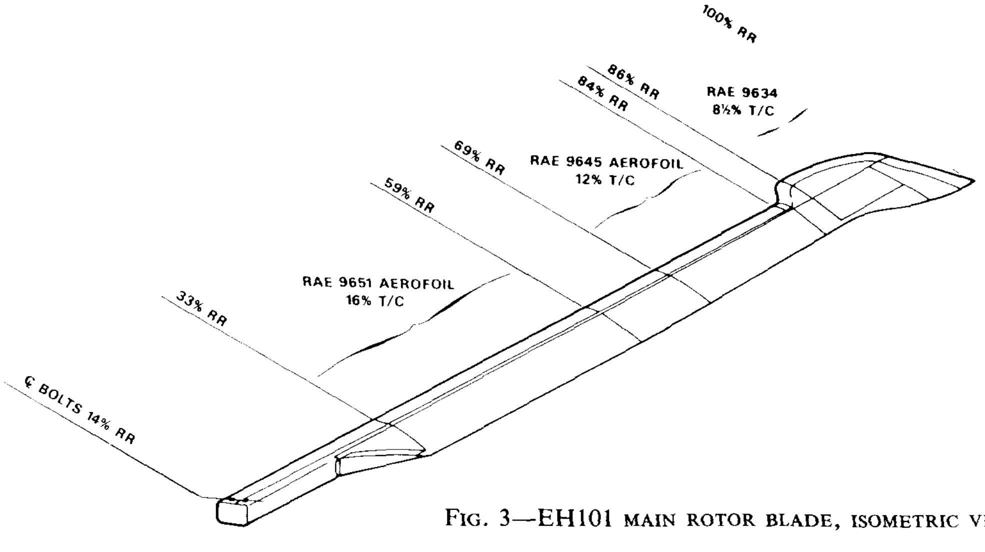

FIG. 3—EH101 MAIN ROTOR BLADE, ISOMETRIC VIEW

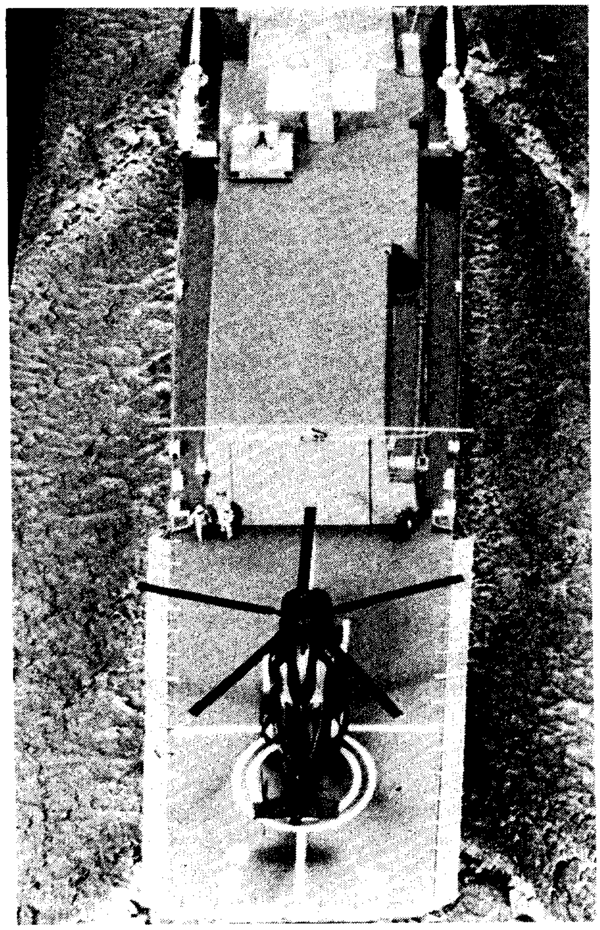

FIG. 4—MODEL OF EH101 ON A FRIGATE

The Frigate Operating Concept

The limitations of space in a frigate (FIG. 4) do not make it practical to provide a full range of spares, test equipment and second line workshop facilities that would enable the helicopter to be fully supported by the ship, nor indeed would it be cost-effective to do so on a permanent basis. As a result the Forward Operating Base (FOB) concept has been developed for EH 101 operations on frigates. First line (at the aircraft) and a limited range of second line repairs will be conducted on board, with all remaining support facilities being readily available at short notice from a mother ship which will be able to support a number of FOBs. By this method high availability can be achieved even at significant flying rates. The precise range of spares and support equipment held on board the frigate will, of course, be a matter for regular review and will depend mainly on the component reliabilities achieved in service.

Timescale

A long development programme is scheduled for the EH 101. It comprises the building of major rigs, the use of so called 'hack' aircraft for early flights of equipment, and the manufacture and extensive flying of a number of preproduction helicopters of which the navies will pay for half. For the vehicle, it is necessary to complete the detail design, go out to tender for components and equipments, order materials and build the prerequisite rigs and air frames for the first flight of an EH 101 in some two years time.

Fig. 5—EH101 in flight—an artist's impression

Further basic aircraft form the flight test programme in subsequent years and these will be used to explore the full flight and environmental envelope. For the mission system, it remains necessary for the governments to decide on the mission sensor manufacturers and then for the various firms to define interfaces, tender for common equipments, take delivery of early models, and commence the fundamental task of system integration using rigs, simulators, hack aircraft, and eventually mission sensor equipped preproduction aircraft.

During the same period, the civil aircraft must be certificated so as to ensure the timely delivery of the first aircraft. If the firms fail to achieve this date, market penetration estimates begin to reduce quite significantly for each year late.

The development timescale may seem protracted but in relation to the achievement of a quantum leap in Naval ASW helicopter operability, performance, and cost-effectiveness, it is the price that has to be paid. Whilst this article has concentrated on the EH 101's primary role of ASW, it will also be capable of a variety of secondary roles and, with its adaptability and stretch potential, there is little doubt it will be seen in other primary roles before the turn of the century.