LYNX Mk.8 MID-LIFE UPDATE

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ABSTRACT

This article gives an overview of the progress achieved to update the Lynx helicopter and provides details of the future enhancements intended to bring the aircraft to full Mk.8 standard.

Background

Plans for a mid-life update to the Lynx helicopter have suffered many setbacks over the years. The original Staff Target for a Mk.8 aircraft was rejected within the Central Staffs in 1983. Approvals were later sought to introduce separate modifications to improve operational capability and, although the plans to introduce a 360° radar and over-the-horizon targeting stalled, the other main elements were approved and development commenced in 1985. The programme was further complicated by the late adoption of two more large modifications and the realization that, to exploit fully the capability of the new avionic system, the remaining sensors would need to be integrated.

As development and production of the various new equipments and modifications were out of step, it became necessary to plan the aircraft conversions in phases in order to acquire a degree of enhanced capability in service as quickly as possible.

This article seeks to inform the reader on the progress made to date and to indicate the plans for completion of the project.

Introduction

The first phase of the project was to introduce Wide Band Secure Speech communications using the AD3400 V/UHF radio and to upgrade the Electronic Surveillance Measures (ESM) capability by fitting Orange Crop Mk.3 which includes modulation and pulse analysis enhancements. This has produced the Mk.3 (S) standard of Lynx, of which 30 are now in service, and the remaining 42 are planned for conversion at RNAY Fleetlands by 1994.

The second phase has equipped six aircraft with the Racal Central Tactical System (CTS) which has been designed to reduce the number of individual instruments and displays in the cockpit and to handle communication, navigation and mission management in order to ease crew workload which was unacceptably high. These Mk.3 (CTS) aircraft are currently in service in 700L Squadron (Lynx Operational Flight Trials Unit) and in some ship's flights. More detail on the CTS, which forms the heart of the aircraft's avionic update, is given below.

The remainder of this article concentrates on the final and largest phase of the project, the introduction of the Lynx Mk.8 (FIG. 1).

Baseline Configuration of the Lynx Mk.8

The key features of the basic Mk.8 are:

(*a*) A Central Tactical System which will fully integrate the aircraft's avionics and weapons.

(*b*) The Sea Owl Passive Identification Device (PID).

(*c*) The Advanced Integrated Magnetic Anomaly Detector (AI MAD).

(*d*) Airframe improvements to increase All Up Mass which include a redesigned nose to accommodate the PID turret and repositioning of the Sea Spray radar antenna to a chin-mounted configuration.

(*e*) A reversed direction tail rotor.

(*f*) Composite main rotor blades.

FIG. 1—DEVELOPMENT LYNX MK.8

Central Tactical System

The CTS collates, integrates and processess sensor information and displays it in such a way as to allow the aircrew rapidly to assimilate a tactical situation (FIG. 2). It incorporates a Cockpit Management System which controls the aircraft's avionics and weapon systems, thereby considerably reducing the Observer's previously high workload.

The CTS consists of 13 Line Replaceable Units (LRUs) situated throughout the airframe and interconnected via a dual redundant Mil-Std 1553B data bus. A schematic diagram is shown in FIG. 3 and the functions of the main LRUs are explained in the following paragraphs.

Two non-identical Processor Interface Units (PIU 1 and PIU 2) provide databus control, interfacing with aircraft avionic systems, and the processing and storage of information from navigation sensors and radio systems. Both PIUs interface to primary navigation sensors and V/UHF communications, providing dual redundancy, but other interfaces are dedicated to one PIU only. Bus management during normal operation lies with PIU 2 which, in the event of a detected LRU message failure, will revert to its secondary databus. If PIU 2 fails, PIU 1 will automatically take over control of the bus.

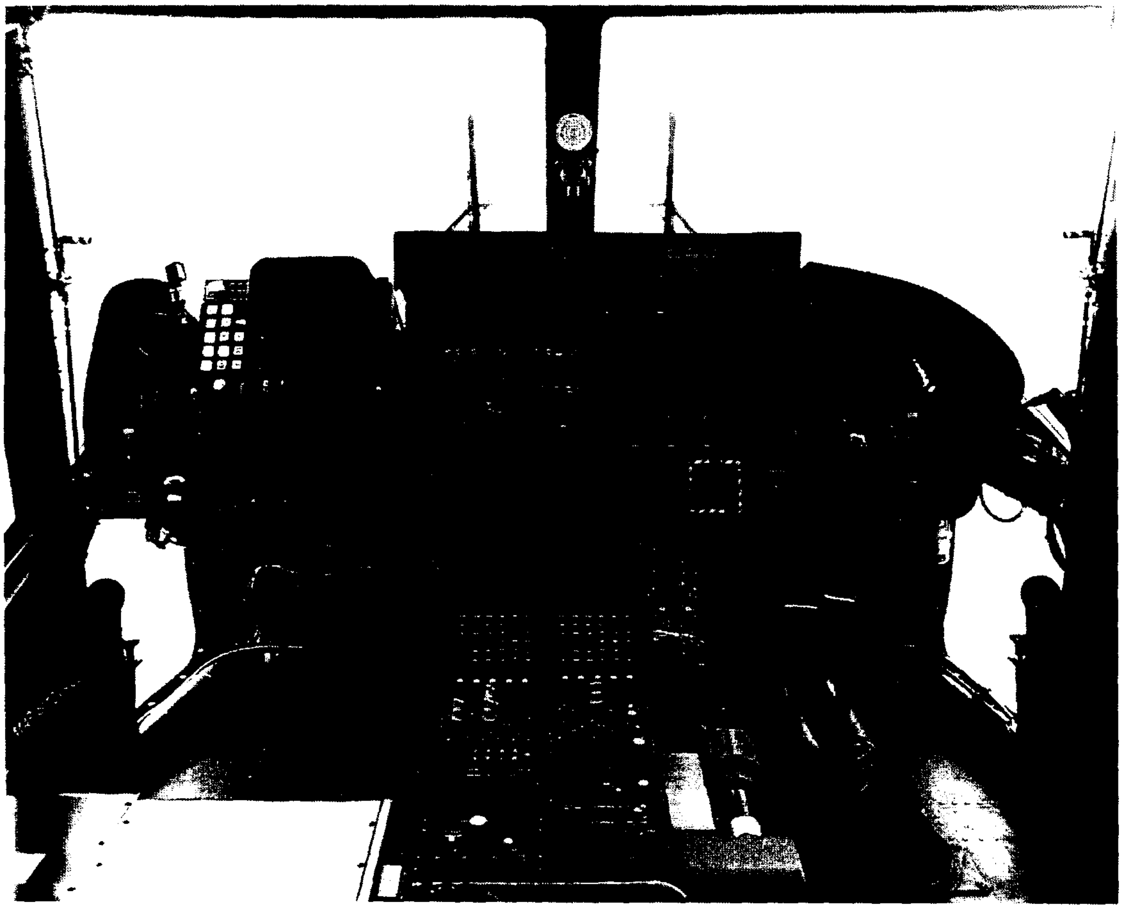

FIG. 2—LYNX MK.3 (CTS) COCKPIT

Two identical and interchangeable Control Display Units (CDUs) are mounted in the cockpit interseat console and provide control of all CTS functions. They allow data entry, retrieval and various other functions from sensor control to weapon selection, radio operation and navigation.

The Stores Management System (SMS) again has identical LRUs (SMU 1 and SMU 2) to achieve dual redundancy. It exercises control and pre-setting of light and heavy stores: 4·5 inch Recce Flares, Stingray Torpedo, Depth Charge and Sea Skua missile.

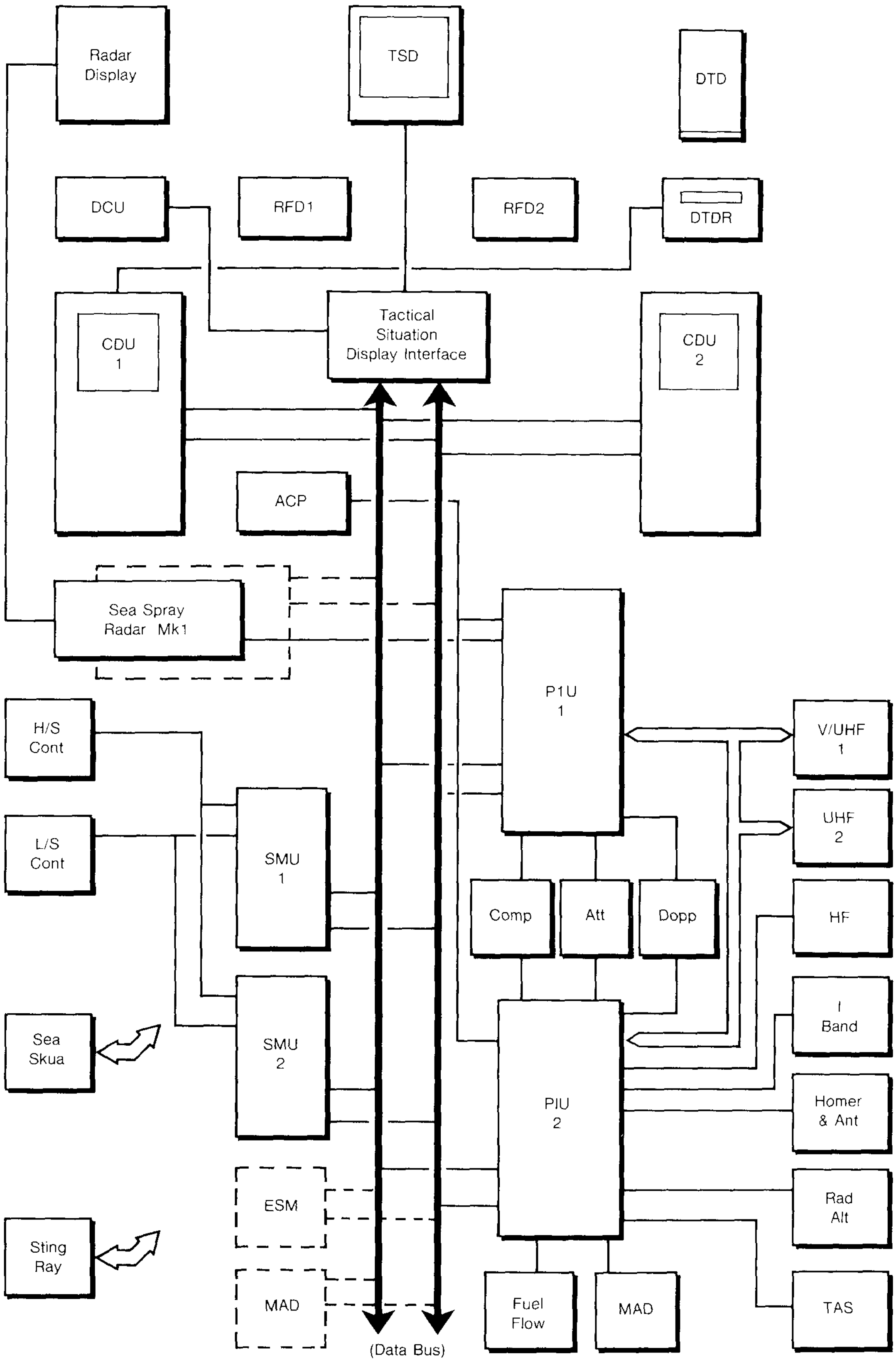

FIG. 3—CENTRAL TACTICAL SYSTEM (CTS)

ACP:	Auxiliary Control Panel	DTD:	Data Transfer Device	PIU:	Processor Interface Unit
Att:	Attitude	DTDR:	Data Transfer Device Receptacle	Rad Alt:	Radio Altimeter
CDU:	Control Display Unit	ESM:	Electronic Surveillance Measures	RFD:	Remote Frequency Display
Comp:	Compass	H/S Cont:	Heavy Stores Control	SMU:	Stores Management Unit
DCU:	Display Control Unit	L/S Cont:	Light Stores Control	TAS:	True Air Speed
Dopp:	Doppler	MAD:	Magnetic Anomaly Detector	TSD:	Tactical Situation Display

A Tactical Situation Display (TSD) is mounted in the cockpit instrument panel (FIG. 4) and provides a colour display of sensor and tactical information. The TSD is a 12 inch diagonal colour display, capable of showing a stroke or raster picture. It incorporates a keyboard which has function keys used to select the primary display mode, as well as brightness and contrast controls.

The TSD is fed from the Tactical Situation Display Interface Unit (TSDIU), which is responsible for generating the tactical plot picture from the database maintained by the PIUs. The output is in stroke-written video to the TSD and generates tactical information as 'cursive' information. The TSDIU also provides the scale change, mode and local picture control facilities.

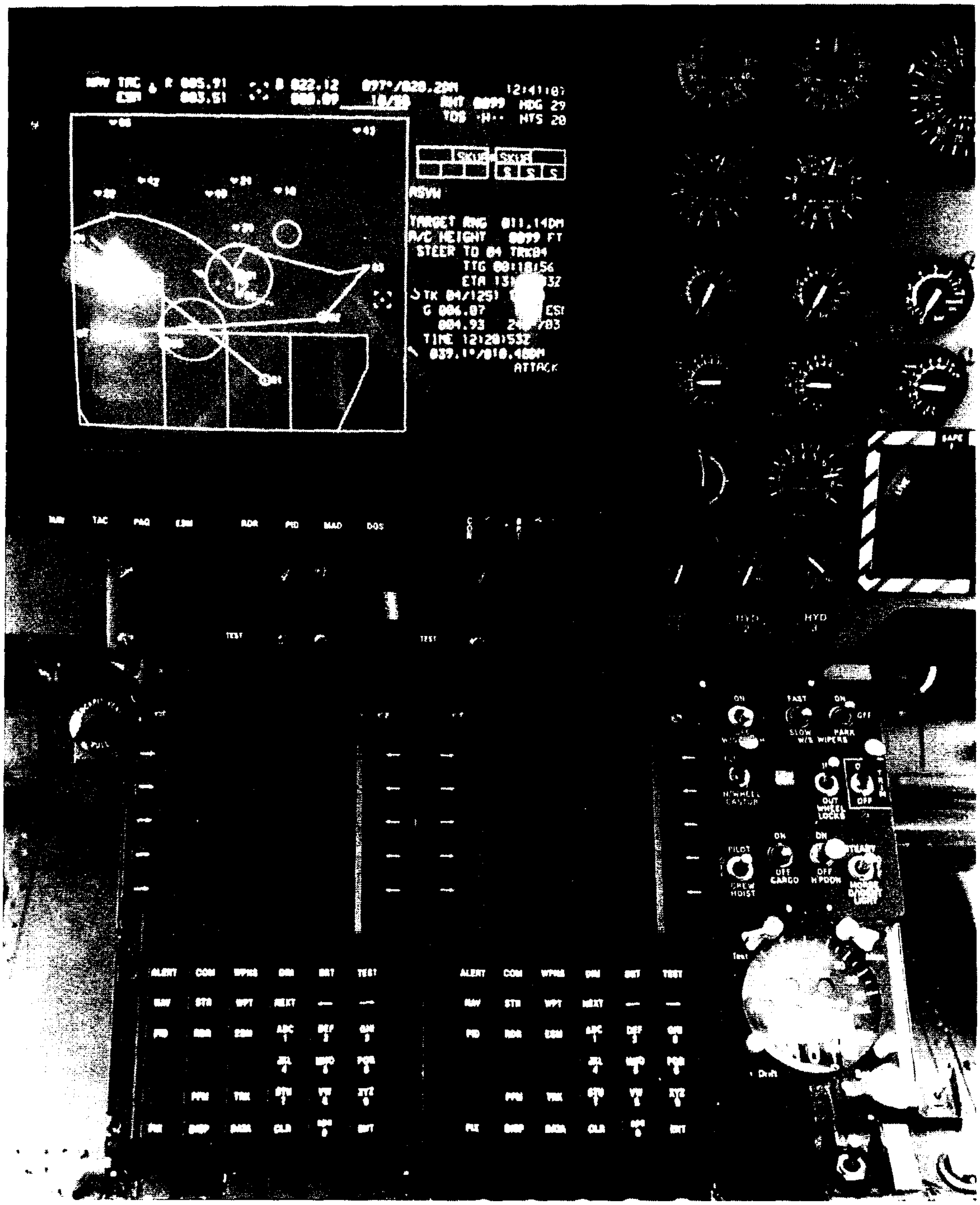

FIG. 4—CLOSE-UP VIEW OF THE LYNX MK.3 (CTS) COCKPIT INSTRUMENT PANEL SHOWING THE TACTICAL SITUATION DISPLAY (TOP LEFT) AND THE TWO CONTROL DISPLAY UNITS (BOTTOM)

A Display Control Unit (DCU) is mounted alongside the TSD on the instrument panel, providing control and editing functions via keying switches to select local display functions on the TSD via the TSDIU.

Additional control of the CTS system is provided by the Auxiliary Control Panel (ACP) fitted in the interseat console. A stiff stick allows the operator to position a marker at any point on the TSD, and when the Sea Owl passive identification device is fitted it can be used to steer its turret in azimuth and elevation. A data erase switch allows the removal of all sensitive data held in the CTS.

Navigation, communications, radar and ESM threat data, prepared on a ground station computer is loaded into the CTS using a Data Transfer Device (DTD) before flight. Post-mission tactical data and a maintenance fault log can be down-loaded after each sortie.

Advanced Integrated MAD System AN/ASQ-54(V)

The AI MAD is an airborne anti-submarine warfare (ASW) device which detects submerged submarines by sensing anomalies in the earth's magnetic field. The system complements other active and passive ASW sensors by enabling the distinction between marine life and metal contacts.

The system consists of three main components (FIG. 5). The Detecting Head uses caesium gas nuclear resonance techniques to sense magnetic disturbances. It gives greatly enhanced sensitivity over previous systems, and considerably improves detection ranges. The Detecting Head, unlike previous systems, is not towed behind the aircraft but will be permanently mounted internally. This approach removes the hazards associated with towed MAD and has the significant advantages of reduced weight, improved reliability and reduced maintenance due to the absence of a winch, cable and towed body exposed to the elements.

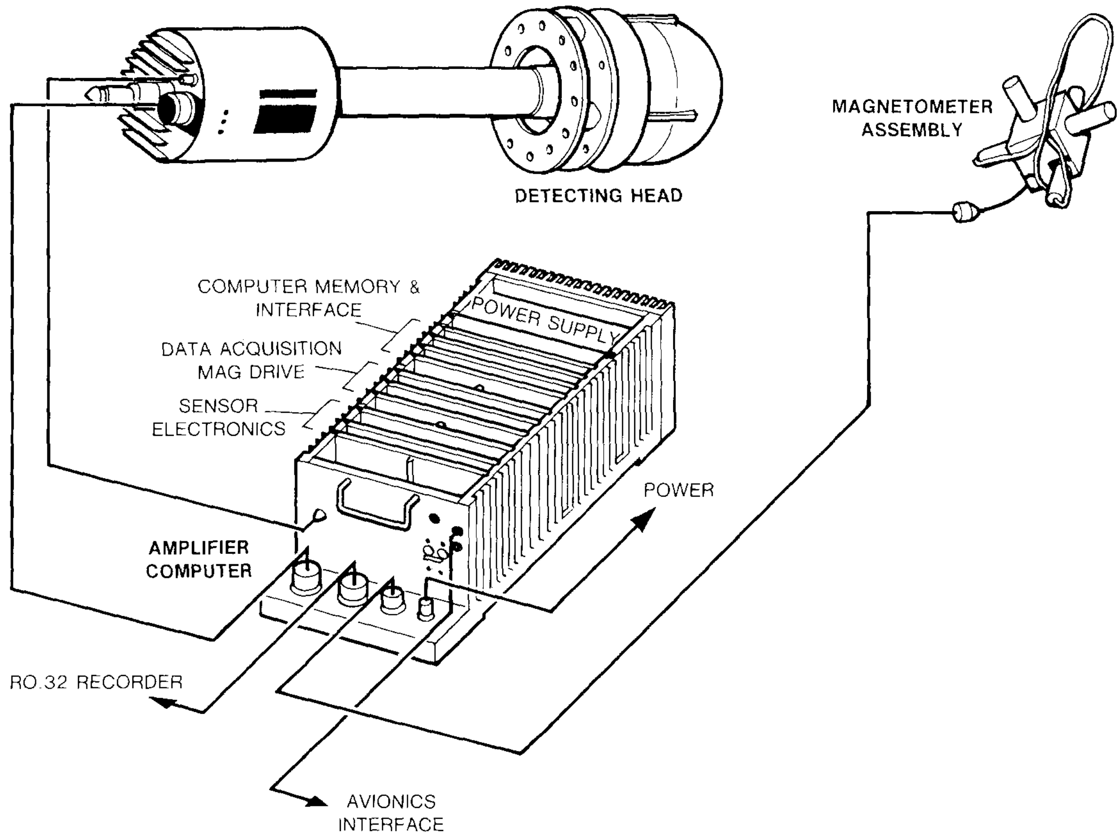

FIG. 5—ADVANCED INTEGRATED MAD

The purpose of the Amplifier Computer is to process the analogue signals generated by the Detecting head and the magnetometer assembly, and perform magnetic compensation for aircraft induced and environmental magnetic noises. It will output an audio alarm to the aircraft intercom system to alert the crew and provide data for display on the CTS via the avionics data bus. The integration of AI MAD with the CTS system will remove the need for a separate control indicator and chart recorder as employed in the Sea King Mk.6 fit.

The Magnetometer Assembly consists of three identical flux-gate vector magnetometers mounted orthogonally in a solid block to sense the three vectoring components of the earth's magnetic field.

Sea Owl Passive Identification Device

The Passive Identification Device is a thermal imaging indirect view sensor. The system provides an infra-red surveillance capability by detecting inherent thermal radiation of the viewed scene under day and night conditions and in poor visibility. The system converts the detected radiation into a composite video signal for display on the CTS.

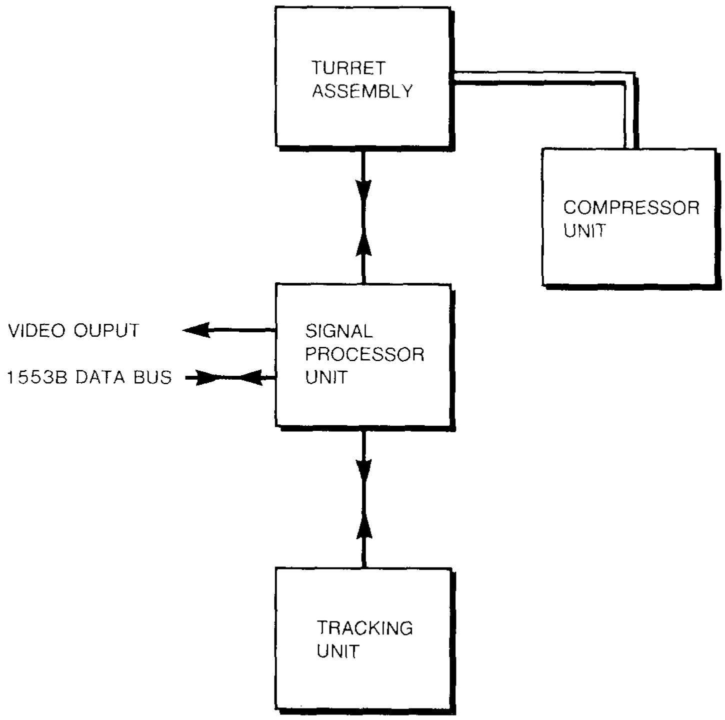

FIG. 6—SEA OWL PASSIVE IDENTIFICATION DEVICE

The system (FIG. 6) consists of a Turret, containing the thermal imaging sensor mounted on the nose of the aircraft; a Signal Processor Unit; a Tracking Unit; and a Compressor Unit.

The Turret is a four-gimbal, two-axis platform, stabilized against aircraft perturbations. This platform provides the mounting for the thermal imaging sensor scanner. The scanner is fitted with a two-position zoom telescope. Incorporated in the turret external cover is a germanium window which allows the free passage of IR radiation for scanning by thermal sensor.

The Signal Processor processes the infra-red video signals from the thermal imaging sensor scanner in the Turret and converts them into a composite television video signal. The Signal Processor also provides the external and internal interface functions necessary to operate and control the system, and a built in test facility.

The Tracking Unit uses auto-correlation algorithms on specific targets and passes error co-ordinates to the signal processor to provide an automatic tracking facility.

The Compressor Unit provides the cryogenic cooling for the detector in the thermal imaging scanner, at a temperature of about 80°K and a pressure of approximately 4000 lb/in^2.

Maximum All-Up Mass

The original Lynx helicopter entered service with a maximum all-up mass (MAUM) of 9735 lb; since then the equipment weight has grown by 1000 lb and it will increase by at least a further 600 lb with the Mk.8 avionic improvements. This weight increase would adversely affect aircraft endurance and handling performance. Thus, from experience gained with the Army Lynx Mk.7, it was decided to overcome these effects by introducing a series of airframe modifications.

To increase the MAUM to 11 300 lb and extend the life of the aircraft requires considerable structural changes to the airframe. Primarily ribs, frames, doubler plates, areas of skin and panels will be strengthened throughout the aircraft, but especially in the tail pylon, tail cone, tail fuselage and lower cabin structure areas indicated in FIG. 7. The nose is completely redesigned to accommodate the PID Turret.

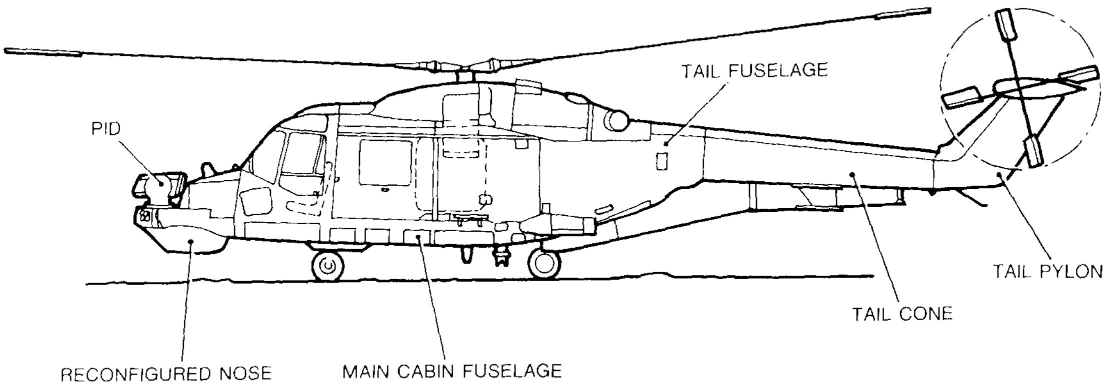

FIG. 7—LYNX MK.8 AIRCRAFT
PID: Passive Identification Device

Reversal of the tail rotor direction of rotation will improve handling performance and contribute considerably to restoring the aerodynamic properties of the aircraft. A spring bias unit is also provided to fine off the tail rotor if control is lost. The tailplane will also be modified by removing the outboard section and adding a gurney flap along the remaining rear edge to restore the lift lost by 'cropping'. This modification was introduced after development trials found that it would reduce vibration levels.

The Lynx Mk.8 will also be fitted with glass and carbon fibre composite main rotor blades (CMRBs) which are a direct replacement for the existing metal blades. CMRBs will allow significant growth in all-up mass, while also improving the aircraft's forward speed, manoeuvrability and vibration characteristics. Maintenance will also be reduced because the leading edge shield of titanium and electroform nickel has much greater erosion and corrosion resistance than the stainless steel of the current blades.

If a Lynx Mk.3 suffers an automatic flight control system pitch autostab runaway, the aircraft will tend to nose down. The danger of this to the Lynx with metal blades is deemed acceptable because of the relatively low authorized maximum speed which allows the pilot sufficient time to recover the situation, even at low level. However, in the Mk.8 this would present a much greater problem because the aircraft will be capable of greater speeds, will have a reconfigured nose shape which downgrades the aerodynamic pitch stability, and an increased all up mass. A pitch axis runaway protection system (PARPS) which introduces dual redundancy to the Automatic Flight Control System (AFCS) computer channels will therefore be incorporated.

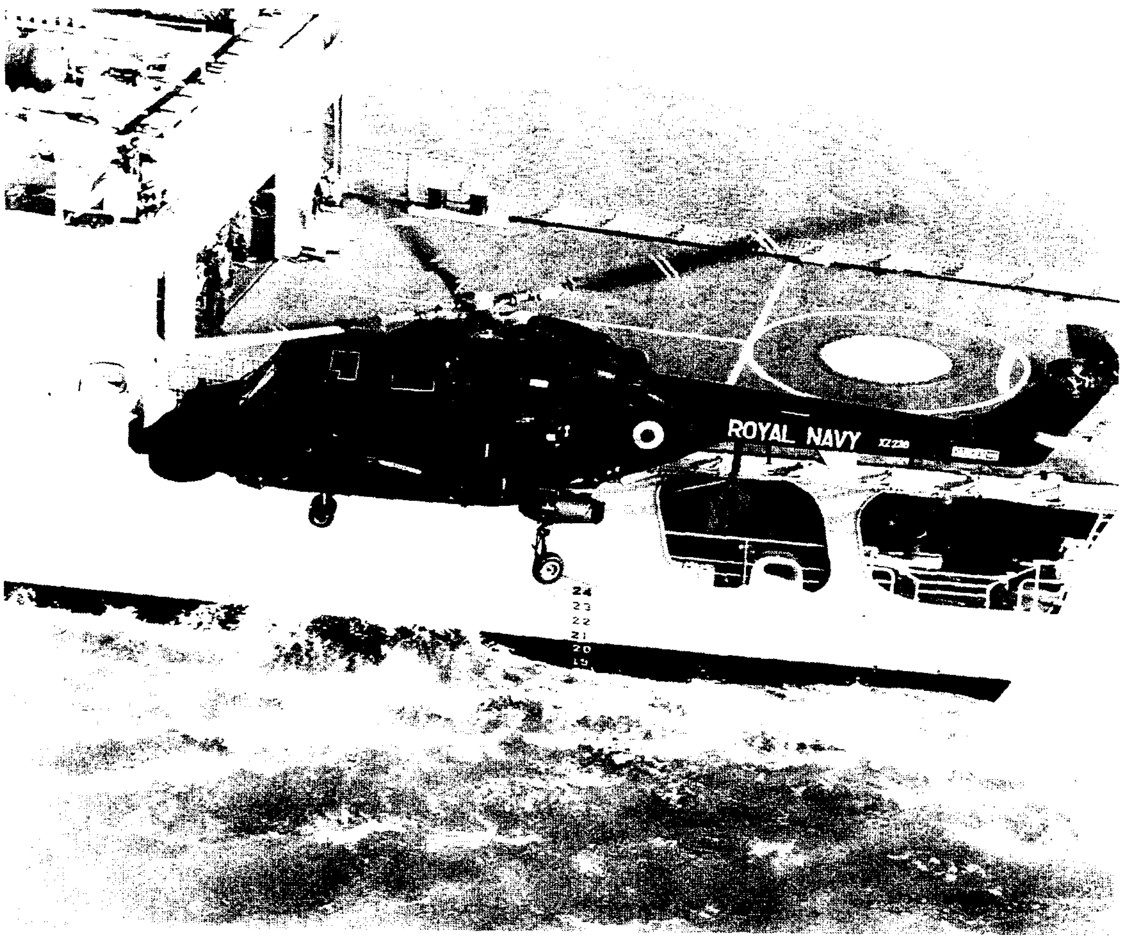

FIG. 8—DEVELOPMENT LYNX MK.8

Development State

Basic CTS development is complete and there are now six aircraft in service operating with this system. Development of the next change to the CTS software, to integrate the Passive Identification Device, has progressed well and initial trials have been encouraging. Comprehensive flight trials are planned to commence early in 1992 after which it is intended to further enhance the CTS software with the integration of MAD, AI, ESM and ECM (Electronic Countermeasures) to provide a totally integrated avionic sensor and weapon system.

The structural changes, brought about by the increase in all up mass and the need to extend the airframe life, have been identified and schemed. At the time of writing, Westland Helicopters Limited is embodying the changes into the first development aircraft in time for flight testing planned for autumn 1991.

Maintenance and Support

Due to the confines of a frigate or destroyer, maintenance at sea is limited to LRU replacement aided by the comprehensive Built In Test facility of each aircraft system for fault diagnosis and confirmation of rectification. Lynx flights at sea are thus provided with an extensive support package to allow one-for-one exchanges. The removed LRU is then returned to second-line avionic workshops at RNAS Portland for deeper testing and replacement of defective modules. Repair to component level is carried out at third line Service repair centres or in industry.

Software support will be provided by industry, but to ensure that aircraft software meets the operational and engineering support requirements in the most cost-effective way, it is planned to form an in-service Software Support Cell (SSC) at RNAS Portland. The SSC will provide a focus of customer software engineering expertise, investigate Service software fault reports, vet software change proposals and generate change requirement statements. To assist in these tasks, it is intended to provide facilities for initial prototyping of man-machine interface changes.

Conversion Programme

Proof installations of the modifications and conversion of the first seven aircraft to full Mk.8 standard are due to commence in 1993 at Westland Helicopters Ltd. Airframe modification kits will be produced concurrently and supplied to RNAY Fleetlands together with the necessary jigs, tooling and work instructions to enable them to undertake the bulk of this major conversion programme which should complete towards the end of the decade.

Conclusion

Despite a somewhat chequered history, the Lynx Mk.8 project has come a long way since its inception some eight years ago. Initial operating experience with the Central Tactical System has shown it to be an extremely reliable and effective system. The final Mk.8 standard with the Sea Owl passive identification device, the Advanced Integrated Magnetic Anomaly Detector and a fully integrated avionics system promises to be a most versatile and potent helicopter which will provide a significant enhancement to the Fleet's capability.