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THE A129 LAH PROJECT

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ABSTRACT

Italy, the United Kingdom, the Netherlands and Spain having decided to launch a 2 years programme for a Light Attack Helicopter (LAH) namely Feasibility and Cost Definition Phase of the A129 LAH, Agusta, CASA, Fokker and Westland formed a Managing Company incorporated in Italy called Joint European Helicopter S.r.l.-

The Ministries of Defense (MOD) of the participating countries have simultaneously established a permanent International Project Team based in Rome for monitoring the programme on behalf of the Governments.

Having briefly described the principles of the 2 years of programme, both the Organization of the Governments and the Industries, the two A129 LAH roles (Antitank and Escort-Scout) and the main requirement for the Governments are mentioned.

The major part of the presentation is devoted to the description of the vehicle and its system as a high performance attack helicopter weapons system capable of operations by day and night and in adverse weather. Great emphasis is placed on overall weapon system performance including battlefield agility and availability, and low acquisition and life cycle costs.

The main types of weapons considered for A129 LAH are third generation anti-tank and air-to-air weapon systems.

However, a wide range of other weapons including guns and rockets will also be deployed.

ACKNOWLEDGEMENT

This paper has been prepared by JEH with the contribution and support of the four Companies (Agusta, Westland, Fokker and CASA).

All statements made in this paper represent the view of the JEH and the Industry Partners.

JEH wishes to thank:

- The four Governments of Italy, the United Kingdom, the Netherlands and Spain, and the International Project Team for their permission to present the paper.

- The four Industry Partners (Agusta, Westland, Fokker and CASA) for their effort in the preparation of the paper.

1. A129 LAH FEASIBILITY AND COST DEFINITION PHASE (F&CDP)

1.1 Origin and Status of the Programme

In September 1986 a first Memorandum of Understanding (MoU n.1) was agreed by the Ministries of Defense of: Italy, the United Kingdom, the Netherlands and Spain concerning:

"the principles and general arrangements governing a Joint Project for the feasibility, development, production and support of the A129 Light Attack Helicopter".

At the same time an INTERCOMPANY AGREEMENT between Agusta, Westland, Fokker and CASA was completed relating to the A129 Light Attack Helicopter".

In October 1986 a second Memorandum of Understanding (MoU no.2) was signed by the above Ministries of Defense concerning:

"a feasibility and cost definition of the A129 LAH Light Attack Helicopter".

In November 1986 the Industries of the four countries, (Agusta 38%, Westland 38%, Fokker 19%, CASA 5%) formed a Joint Venture Company named Joint European Helicopter (JEH) Company based in Italy (Rome).

The JEH Company is the prime contractor to the Italian "Costarmaereo" organization which acts as the contractual agency on behalf of the three other Governments.

The A129 LAH feasibility and cost definition study programme is constituted in two subphases:

* 1A A feasibility phase, during which Industry was asked to assess how the Joint Staff Target may best be met, using the A129 as a datum, followed by an assessment of the results of this study by the four Governments.

* 1B Cost definition

The programme started on the 1st June 1987 and, as required by the Statement of Work, Industries assessed the possibility of deriving from the A129 a small, light and agile helicopter employing a third generation anti-tank missile, to meet the requirements of the four countries.

The first study report was submitted on schedule on the 31st May 88.

The study was conducted so that the items stated in the Governments Statement of Work were covered in sufficient depth to enable the Governments to undertake comprehensive assessments of the study.

Following the assessment of the initial feasibility study, the Governments decided to ask JEH to begin the second part of the study (sub-phase 1B) on 1st March 1989 and for completion on 31st December 1989.

1.2 Objectives of the Feasibility and Cost Definition Phase

The objectives of the Study, as stated in the Governments Statement of Work, are:

a. to determine the feasibility of meeting the requirements of the Joint Staff target for the A129 LAH on the basis of a development of the Agusta A129 helicopter;

b. to identify areas of technical timescale risk, if any;

c. to prepare cost estimates for development and production, and project an initial assessment of life cycle costs;

d. to define a cost effective weapon system in respect of :

* Its overall performance in agreement with the Statement of Work including the man machine interface

* Being an highly survivable, small, agile helicopter

* Be within a mass limit which is compatible with the potential of the A129

* Having low acquisition and life cycle costs

* A timescale compatible with the defined in-service date

* Reliability, maintainability, and testability targets so as to reduce to a minimum logistic support

The objective of the Cost Definition Study is to provide the Governments with Technical planning and cost data on the A129 LAH programme, including risk magnitude associated with action to reduce or overcome it.

All the information will be provided in sufficient depth to allow the Governments to take a decision to enter Full Development.

2. OPERATIONAL ROLES AND REQUIREMENTS

2.1 Operational Roles

The primary roles of the A129 LAH are:

* Defeating tanks - the priority task.

* Defeating armed helicopters and light armour, including air defense systems.

* Scouting and target acquisition, for both battlefield helicopters and ground forces.

* Escort of airmobile forces.

There are also number of other operational tasks that the A129 LAH may be expected to undertake, including:

* Direction of fire - artillery, multiple launch rocket fire, naval gunfire, and fighter ground attack aircraft.

* Laser designation of targets.

* Air defense for ground troops.

* Dispensing of mines.

Following an industry recommendation at the completion of the Feasibility Study, the programme has adopted a proposal to split the roles between anti-tank and escort-scout roles.

The designs studied to date enable the two roles to be performed by the same aircraft, by adding to it the weapon system required for each role. The mast mounted sight is maintained installed for both the roles.

2.2 Operational Requirements

A Joint Staff Target (JST) has been agreed by the four Governments against which the Industries design studies have been directed.

The JST is very demanding and includes the following key aspects as design drivers:

* **Weapons - Anti Armor Operations**

  The basic weapon fit in the anti-amour role is 8 TRIGAT lock before launch/fire and forget weapons. The carriage of self defense air-to-air weapons in this role remains an option that is receiving further attention. Target acquisition is to be undertaken with a mast mounted sight.

* **Weapons - Scout Escort Operations**

  The ability to operate a variety of weapon combinations is required in this role, The weapons include:

  * gun or cannon for short range air-to-air and air-to-ground operations;

  * free flight rockets for air-to-ground operations;

  * medium/long range air-to-air missiles.

  Surveillance, target acquisition, and fire control is undertaken by a combination of mast mounted sight and crew helmet mounted sight.

* **Comprehensive Mission System**

  An integrated mission management system, including extensive mission equipments (e.g. secure communications, reliable and autonomous navigation, accurate identification, comprehensive defensive aids, etc.). The system is to employ fibre optic data transmission and have a very high level of EMC/EMP tolerance.

* **High Survivability**

  The requirements for survivability emphasises low signatures in combination with ballistic tolerance (7.62, 12.7 and 23 mm calibre projectiles), extensive defensive aids (RWR, LWR, chaff/flare dispensers), crashworthiness, NBC protection, and Nap of Earth (NOE) operations.

* **Day/Night and Bad Weather**

Twenty-four hour all weather operations are required to ensure maximum availability of the A129 LAH to field commanders. This requirement places particular demands on night/bad weather vision systems and displays for the crew.

* **Reliability and maintenance**

Very demanding reliability repairability and maintainability targets are provided to enhance battlefield availability to the field commander, and to reduce life cycle costs.

* **Man-Machine Interface**

Considerable emphasis is placed upon the man machine interface to enable successful prosecution of the mission whilst operating at low level, in a severe threat environment, over 24 hour operations, with a very comprehensive set of mission equipment and weapons.

* **Fly-By-Wire/Light (FBW/L)**

The application of a FBW/L control system implementation capable of upgrading to full Active Control is required for improved handling and control throughout the flight envelope, and to enable the crew to fully exploit low level operations. The application of this technology in combination with multi-axis side arm controls will provide reduced crew workload in the demanding operational environment. Carefree manoeuvring, as a further development is to provide further agility and reduced workload.

* **Cruise and Dash Speeds**

Very high cruise (in excess of 160 knots for the Scout-Escort machine) and dash speeds are required at primary mission all up mass, and with the full weapons fit.

* **Endurance**

A two and a half hour endurance is required for the Anti-Armour aircraft at primary mission all up mass and with the full weapons fit.

* **Post Engine Failure Performance**

The capability currently offered is to fly away following single engine failure in the hower, at high all up mass, 5m above ground level, using an emergency power level from the remaining engine. This extremely severe requirement exceeds substantially that of present twin engined helicopters and has been consistently re-affirmed by the operators.

* **Agility**

High levels of agility and manoeuvrability are required, particularly to exploit Nap of Earth (NOE) at low speed, and for air-to-air engagements at high speed. Powerful yaw control is a further feature of the requirement.

* **Mass**

A low all up mass is emphasised to ensure a highly survivable, small, agile helicopter within a mass limit that is compatible with the potential of the A129.

3. PROGRAMMATIC ASPECTS

3.1 Organisation

Following the two Memoranda of Understanding signed in the autumn 1986, Governments and Industries set up an appropriate organisation on both sides to manage the programme.

3.1.1 Government Organisation

For the Feasibility & Cost Definition Phase the Governments have formed the following bodies in which each of them is represented equally and in which decisions have to be made unanimously:

* **The Steering Committee**

  Consisting one representative of each country's MOD staff, meeting in rotation in the participating countries, chaired by the host-country. Decisions are made on major programme policy matters at important programme-milestones.

* **The Management Committee**

  The Management Committee consists of up to four representatives from each participating government and is responsible for the execution of the joint programme.

* **The International Project Team (IPT)**

  Located in Rome, having one representative per Government and responsible for monitoring the programme and supporting the Management Committee on technical & financial matters.

  For the first programme phase the Governments agreed to use the Italian MOD procurement agency Costarmaereo as the contracting agency.

  For the subsequent phases a more project oriented organisation may be implemented similar to (or in fact being) a NATO agency coordinating all governmental aspects towards the Industry.

3.1.2 Industry Organisation

Upon receipt of the contract for the first programme phase from Costarmaereo, the JEH subcontracted the work to the Shareholder Companies acting as subcontractors to the JEH.

The work for the first programme phase (Feasibility & Cost Definition) is divided in the following proportions:

- **AGUSTA** **38%**
- **WESTLAND** **38%**
- **FOKKER** **19%**
- **CASA** **5%**

The JEH has a General Manager who chairs the Industrial Managing Committee (IMC) which is responsible for the day to day management. Each partner industry is represented in the IMC by its national Project Manager managing the industry activities of its Country.

For the Feasibility & Cost Definition phase Industry has organised the work by applying Expert teams for all major areas to be addressed in the study. The Expert teams use the best available resources from the participating industries.

Fokker's participation represents the Dutch Industry in a wider sense: the N.L.R., DAF Special Products, V.G.T., Katan and Philips USFA form an integral part of Fokker's contribution to the first programme phase.

3.2 Programme (Fig. 1)

The programme has been divided in a number of phases as follows:

- **Feasibility & Cost Definition**

  (1 June 87 to 31 Dec. 89)

  In this phase the feasibility of the governmental requirements/targets were evaluated by studing 4 concepts with decreasing commonality with the Agusta A129. A Baseline Configuration was selected by the Governments early in 1989 and is now subject of a Cost Definition Study resulting in a worksharing & price proposal in December 1989.

- **Bridging Period**

  (1 Jan. 90 to 31 Dec. 90)

  Industry has proposed to the introduction of a Bridging Period in which final negotiations with Governments on the Full Development contract should be completed and the organisations, at governments and industry side, should be established to ensure a proper management and control over the Programme.

- **Full Design & Development**

  (1991-1998)

  The full development phase is assumed to start in January 1991 one year after the completion of the feasibility and cost definition study.
  There will be two aircraft final assembly lines established for the Development Phase at Agusta and Westland. The flight testing of the prototype aircraft will be performed at the flight test centres presently existing at these Companies.
  The flight trials programme will utilize five development aircraft and an A129 Esercito Italiano as "hack aircraft" to support the fly by wire control system development.
  The five prototype aircraft are broadly dedicated to the following tasks:

  PT 1 - Initial configuration set up and basic development.

  PT 2 - Engine Installation qualification, and performance and handling evaluation with fly-by-wire.

  PT 3 - Basic avionics development AFCS and final handling quality evaluation.

  PT 4 - Mission system development, and mission trials.

  PT 5 - Flight type test, vulnerability and survivability assessments and firing trials.

  The first flight of the first prototype is scheduled in April 1994.

- **Productionisation & Production**

  (From 1995 onwards)

  Activities are scheduled to start from the beginning of 1995 to launch the first batch of long lead items. The first production aircraft is expected to be delivered at the end of 1998.

  To support the introduction of the aircraft into service, six initial production standard aircraft will be delivered to a Government operational test centre, to provide a 18 months period of operational evaluation by the Governments prior to the first production aircraft release.

4. WEAPON SYSTEM DESCRIPTION AND MAIN CHARACTERISTICS

4.1 Vehicle System

4.1.1 General Architecture

The general arrangement of the baseline A129 LAH is given in figure 2. The principle features and changes to the A129 Esercito Italiano (A129 E.I.) layout are:

- Mast mounted sight installation.
- Main rotor with four Westland BERP blades or five A129 E.I. blades and a hub fairing.
- Slightly increased main and tail rotor diameters.
- Side ways facing engine air intakes.
- Retractable landing gear and sponson fairings.
- Air to Air missile carriage under fuselage.
- A nose mounted gun installation.
- A new weapon wing.

Other key features of the baseline A129 LAH are:

- a more powerful propulsion and transmission system,
- a stand alone fly-by-wire flight control system,
- a multibus avionics system with fibre optic data transmission.

4.1.2 Drive System and Power Plant

The power plant consists of two LHTEC T800 or MTM 390T engines and a main gearbox using either a A129 development based on the A129 E.I. transmission or a new approach incorporating conformal gear technology. Each of the alternative drive systems will provide sufficient capability to meet the demanding performance requirements of A129 LAH for both normal and one engine inoperative flight.

4.1.3 Flight Control System (Fig. 3)

The Flight Control system will consist of a stand alone quadruplex system providing primary flight control and a duplex system providing stability augmentation and autopilot modes.

4.1.4 Avionic Architecture

The multibus Avionics system will integrate all communication, navigation, sensors, man-machine and weapons control functions.

A high degree of system redundancy is provided resulting in reduced vulnerability and mission failure rate.

4.1.5 Anti-Tank and Escort/Scout Configurations

The general arrangement of the Anti-tank helicopter is shown in figure 2. The role conversion to Escort/Scout configuration can be achieved in the field.

Carriage of alternative stores is achieved by provision for nose mounting a gun and wing carriage of rocket pods and alternate Anti-tank missiles. External fuel may be carried on the wing store station.

4.2 Mission System

4.2.1 System architecture

The configuration of the avionics bus architecture data transmission network is derived from considerations of likely bus loading, sensor fusion, and vulnerability.

A multi-bus architecture is proposed as a means of separating the many functions and thereby decrease the bus loading to an acceptable level and provide an inherent level of battle damage tolerance.

The following buses have been defined (see Fig. 4)

(i) Navigation bus
(ii) Pilot bus
(iii) Co-pilot/Gunner bus
(iv) Engine/Utilities bus
(v) Weapon bus

All the mission system buses are interconnected via two General Purpose Processors (GPP) which act as primary and secondary bus controller for each bus, and also provide a control and data path between all the buses.

Furthermore it is proposed the five data buses and a number of private data links be implemented by means of fiber-optic networks.

4.2.2 System installation

The rationale for the distribution of the avionics equipments takes into account the equipments function, redundancy, functional association, vulnerability, and specific installation requirements. To assign priority for the distribution of equipments they have been subdivided into four categories:

* Core system
* Weapon system
* Duplicated avionics equipment
* Simple avionics equipment

The general rules governing equipment distribution are :

* Duplex systems, to be split
* Primary and secondary units to be separated
* Interdependent, simplex units to be closely located
* Minimize cable length
* Minimize risk of EMC problems

4.3 Weapons

Consideration has been given to providing for role changing in the field and for the accommodation of a range of weapons covering anti-armour and air-to-air as well as a gun, rockets, and the ability to carry external fuel.

Trade off studies have been performed in such a manner as to maximize operational capability and the necessity to minimize aerodynamic drag to provide a high level of flight performance.

While the A129 LAH baseline configuration, as a reference, is primarily matched to the TRIGAT and MISTRAL weapon fit the aircraft has the inherent flexibility to carry a range of other weapons.

The anti-tank weapon alternatives to TRIGAT considered were TOW, Laser Hellfire, and Brimstone.

The air-to-air weapon alternatives to MISTRAL considered were Stinger and Starstreak.

The primary weapons for area suppression and attacks on soft, or lightly protected targets are guns and rockets.

4.4 Reliability, Maintainability, Testability/Integrated Logistic Support (RAMT/ILS)

This topic covers the RAMT/ILS features to be introduced in the early Feasibility and Cost Definition Phase performing a trade-off study in conjunction with the Government. A detailed study covering the following subjects has been carried out:

- Harmonisation of RAMT/ILS requirements between Government and Industry with the aim to provide the engineering with the relevant RAMT/ILS design features to be incorporated in the early phase of the project.

- Interface between Government and Industry with the aim to study and develop a Logistic Common Scenario to reduce, where feasible, costs due to customarisation.

- issue of Testability features guideline driving the relevant designers under the Governments requirements.

- Develop and assess a Life Cycle Cost by which the cost drivers are highlighted with the aim to provide Government and Industry with an overview of the A129 LAH programme cost.

4.5 Growth

The defined baseline configuration has a built-in overall growth of the 20% increase in aircraft all-up mass for both anti-tank and escort/scout role for all major sub-systems.

4.6 Commonality

A qualitative approach has been attempted in order to define a degree of commonality between the proposed baseline configuration and the existing A129 Esercito Italiano (A129 E.I.).

Several subsystems have been retained from the current A129 E.I. or slightly modified (i.e. main rotor head, airframe basic system and primary structure).

Where significant changes have been introduced in a number of areas, every effort has been made to ensure that the new items can be retrofitted to A129 E.I. In some cases the effort required to undertake the retrofit will be significant, in others straightforward.

In addition to the component commonality discussed above it is also extremely profitable to retain the common design criteria of the A129 A129 E.I. because this means full benefit can be taken from proven know how, learning and available skills.

All of these advantages will provide low risks both for technological and programmatic aspects with the benefit of reduced development and productionisation costs.

5. CONCLUSIONS

The Cost Definition sub-phase is proceeding with the agreement of the four governments and completion is expected by the end of this year (1989).

The feasibility studies demonstrated that the A129 helicopter offers a basis for developing an advanced light attack helicopter capable of meeting the threat in the next century.

Furthermore the most recent study results demonstrate that the A129 LAH represents a comprehensive high performance attack helicopter weapon system capable of day and night operations and in adverse weather. With emphasis placed on overall weapon system performance, including battlefield agility and availability, the A129 LAH is an effective 3rd generation attack helicopter capable of operating and surviving in the developing threat environment.

The A129 LAH configuration proposed for the Cost Definition is a highly capable cost effective weapon system that satisfies the Governments statement of work, and has the following key features:

. **Role change in field**

. **Mission performance**:

- High cruise speed in Anti-tank role
- Very high cruise and dash speed in Escort/ Scout role
- Large hover thrust margins at primary mission all up mass (both roles)
- High agility and manoeuvrability;
- Exceptional engine failed performance

. **Survivability:**

- Low thermal and radar signature
- Ballistically tolerant
- NBC and EM tolerance
- Crashworthy
- Extensive defensive aid equipment

- **High reliability**

- Extensive range of mission avionics, integrated electronic cockpit and man/machine interface, and optically signalled avionics architecture.

- Commonality with A129 Esercito Italiano (A129 E.I.) in a manner that is compatible with a mid term update of the helicopter, its weapons and mission system. The updating of A129 E.I. may be undertaken by retrofitting A129 LAH systems and components.

- In-service mass growth potential.

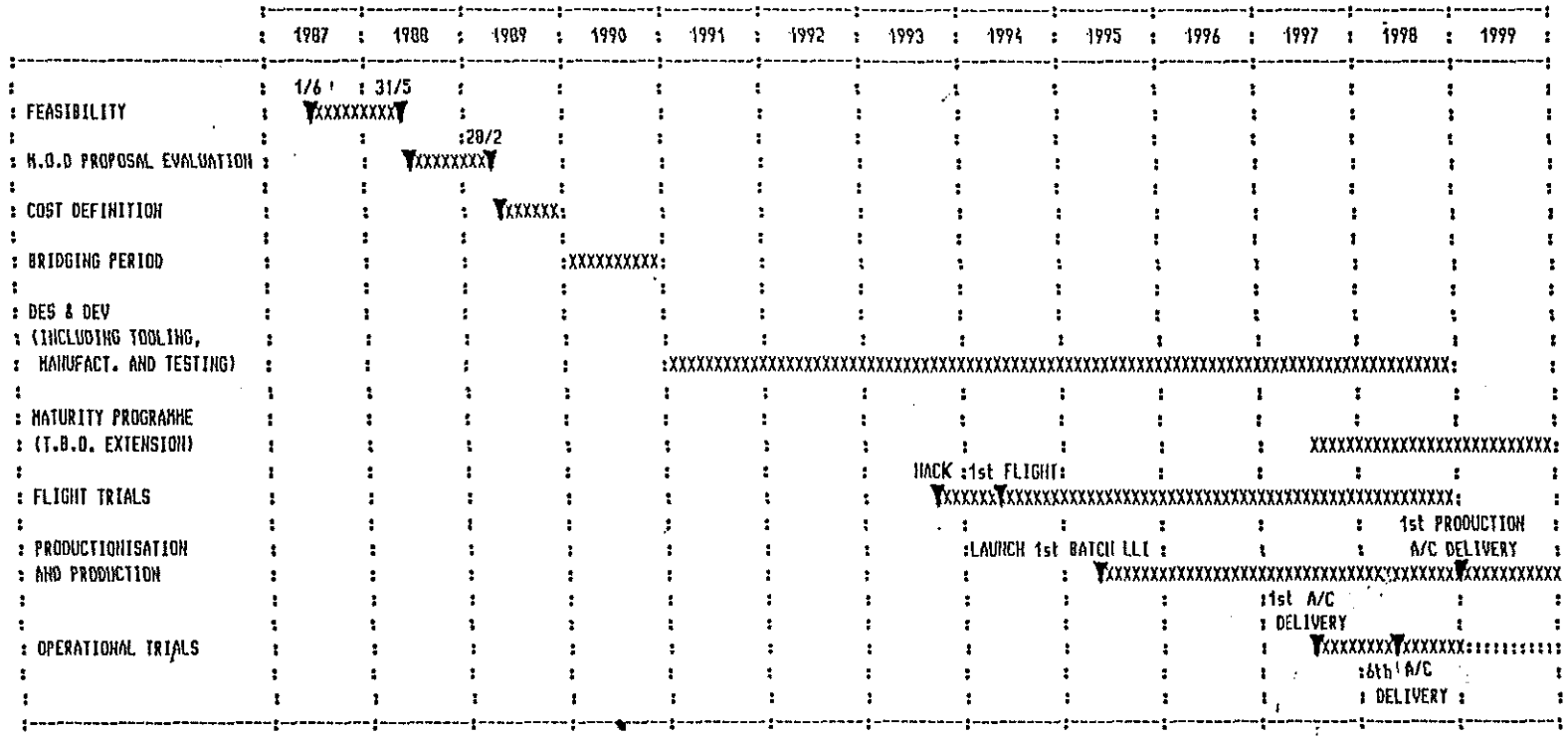

FIG. 1 - A129 L.A.H. MASTER PLAN

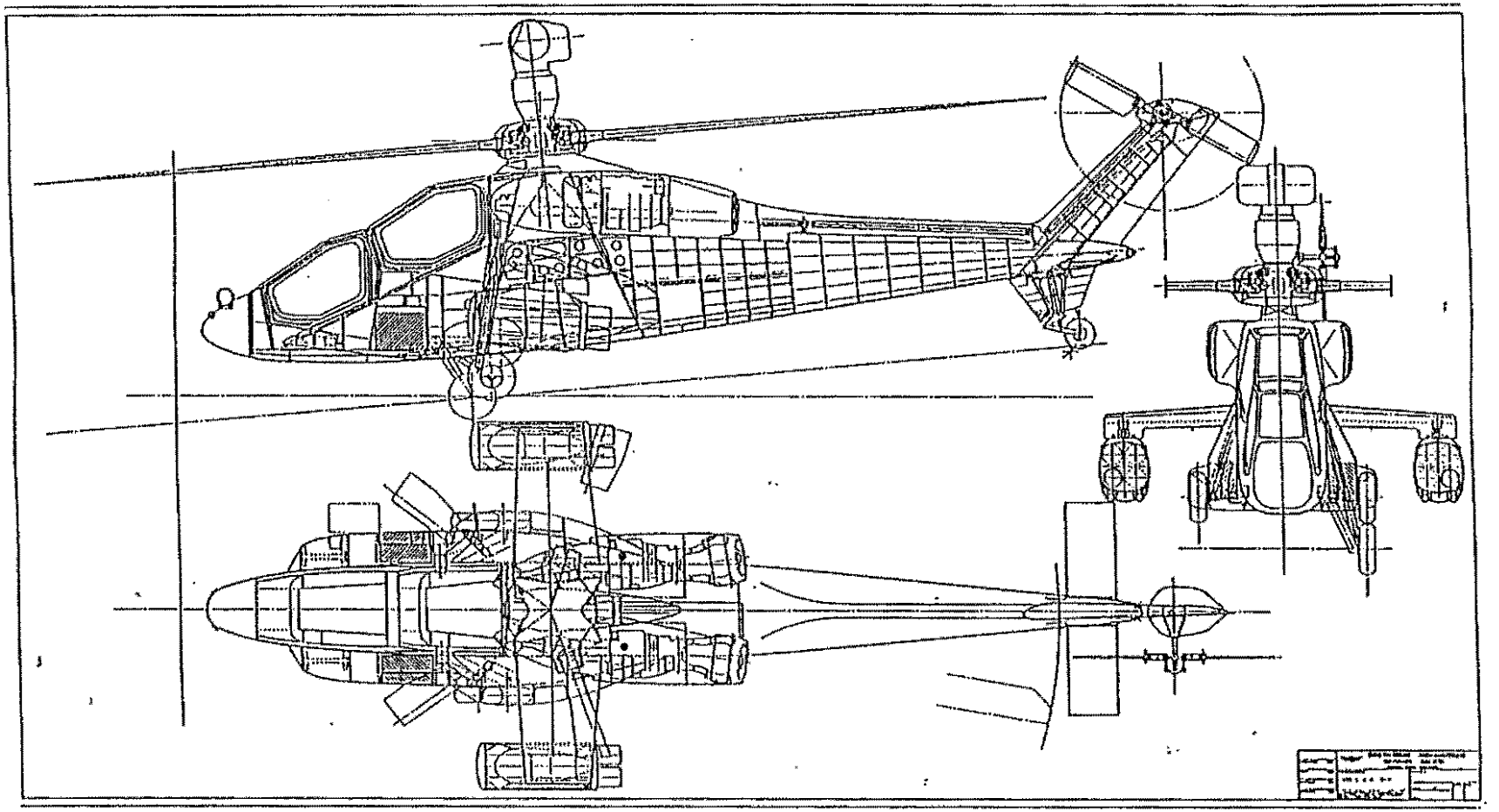

FIGURE 2. A129 LAH ANTI-TANK CONFIGURATION

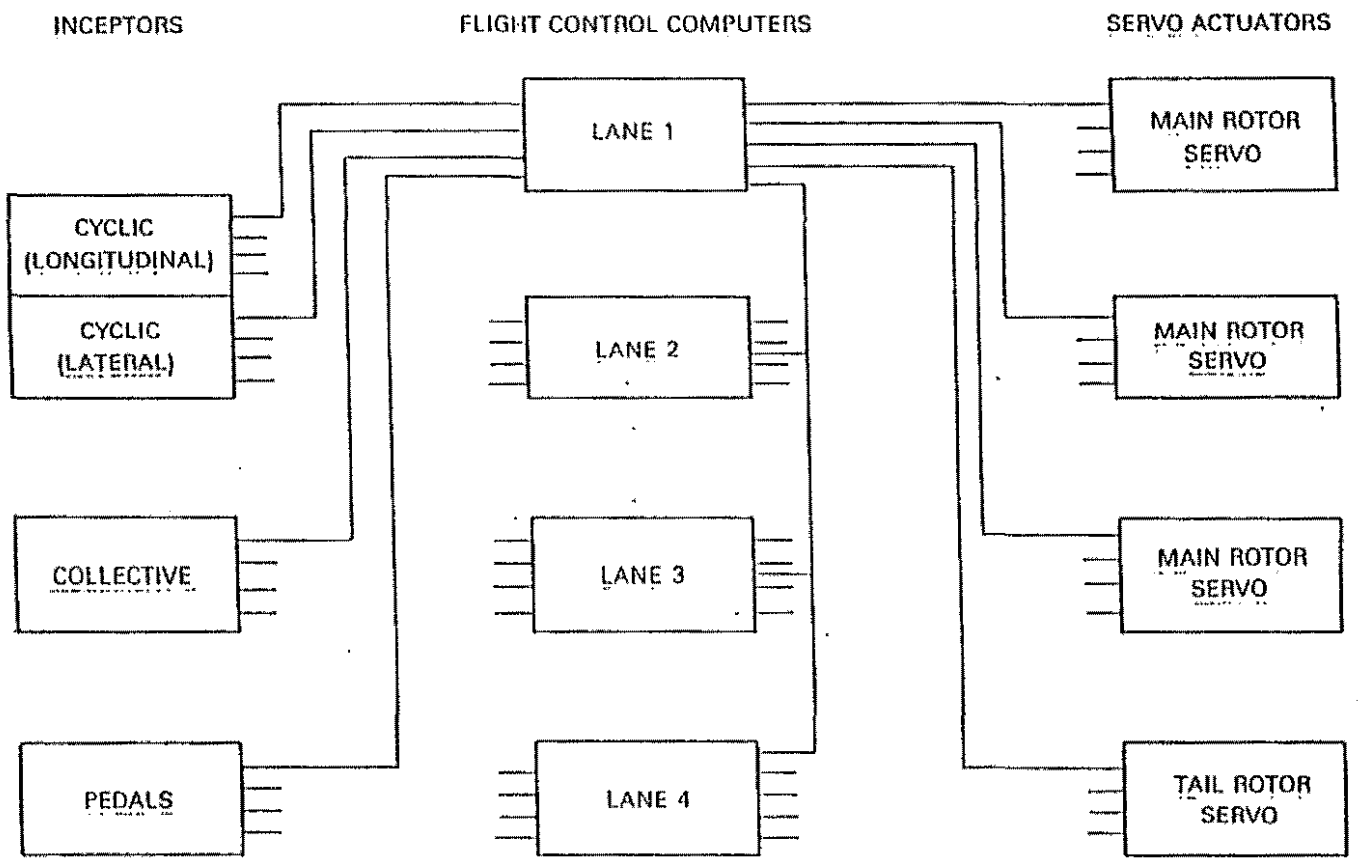

FIGURE 3 - QUADRUPLEX PFCS SCHEMATIC

(Only Lane 1 interconnections shown)

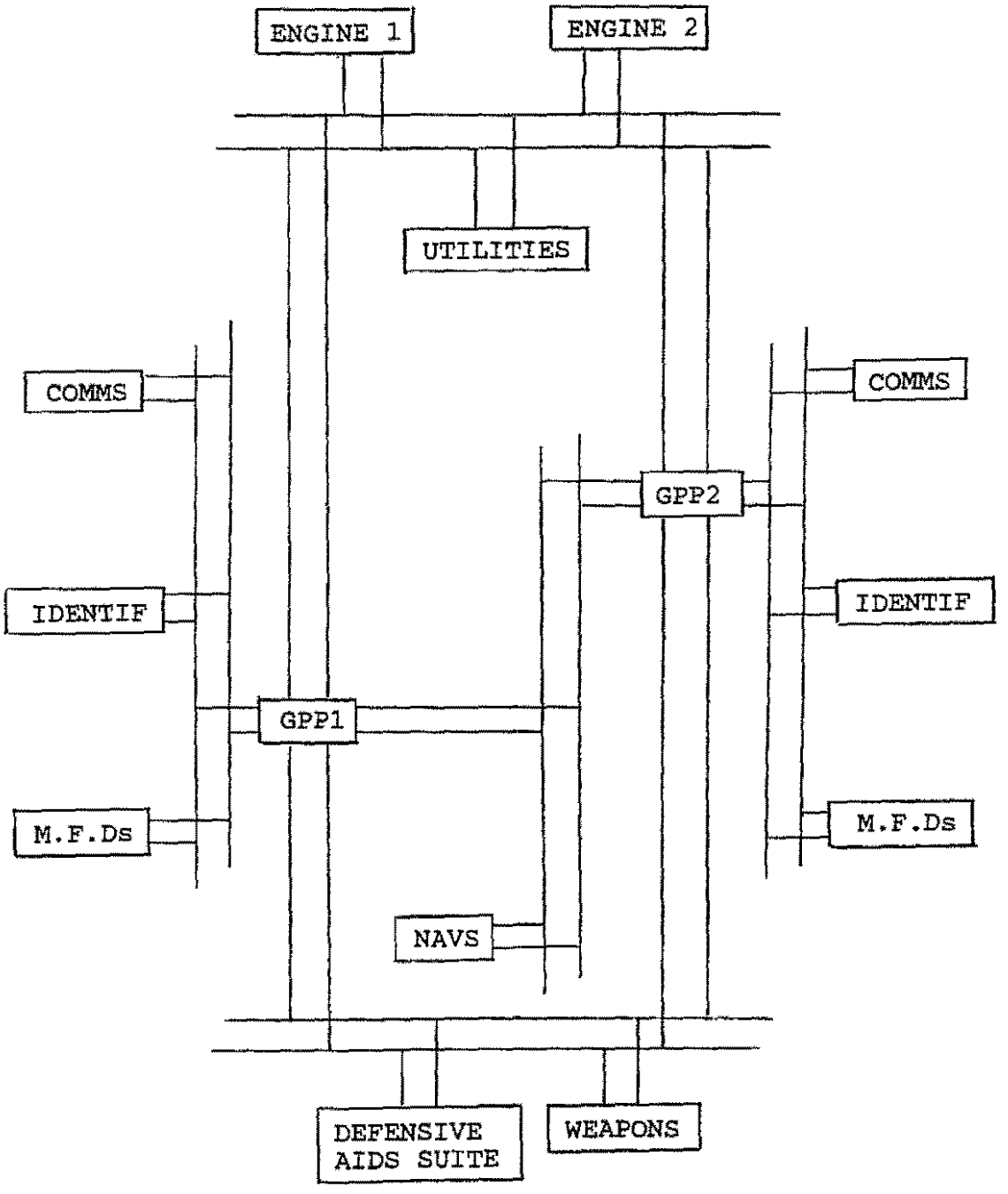

FIG. 4 - MISSION SYSTEM ARCHITECTURE