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PREPARING THE PROGRAMS FOR THE FRENCH NEW GENERATION MILITARY HELICOPTERS

ICA D. BERTHAULT

HELICOPTER DEPARTMENT

SERVICE TECHNIQUE DES PROGRAMMES AERONAUTIQUES

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The purpose of this presentation is to describe, in general terms, the actions undertaken in France under sponsorship of the Ministry of Defense for preparing the french new generation helicopter programs.

In a first part, the different french military helicopter fleets are briefly described, together with their missions.

In a second part, the main objectives for improving, keeping up to date and renewing these fleets are identified.

These objectives determine the guidelines for the actions which are undertaken or planned in France for the preparation of the future. These guidelines are identified in the third part.

The corresponding actions are described in a synthetic way and commented in the fourth part.

This review will provide the opportunity, in conclusion, for a global reflexion about the needs arising from the evolution of military requirements, about the way to meet these requirements, about the actions to be undertaken, and about the national or international means of organization to adopt in order to provide the best possible response, within the national french context.

1°/ - CURRENT MILITARY HELICOPTER FLEETS IN FRANCE.

If we except Gendarmerie, which uses, for liaison, rescue and survey missions a relatively small number of light helicopters (currently 30 Alouette II, 11 Alouette III, and, in the future, some Ecureuils), the main users of military helicopters are, in France, the Air Force, the Navy, and, mostly, the Army (Aviation légère de l'Armée de Terre).

The helicopters fleets of these three users, together with their missions, are described in the following tables :

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AIR FORCE		
Mission	Fleet (approximatly)	In service date (approximatly)
Training Liaison Command support	60 Alouette II 50 Alouette III AS 355	Begining of the '60es End of the '60es First delivries in 83
Logistic transport Transportation of Commandos Search and rescue	28 SA 330	1974 through 1982

NAVY		
Mission	Fleet (approximatly)	In service date (approximatly)
Training Liaison	13 Alouette II	End of the '50es
Rescue		Begining of the '60es
Light ASW Rescue	30 Alouette III	60 through 70
ASW ASVW	26 Lynx (14 additional in order)	78 through 80
Operational transport Transportation of Commandos ASW	20 Super Frelon SA 321	End of the '60es

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ARMY AVIATION		
Mission	Fleet (approximatly)	In service date (approximatly)
Light helicopters		
- Training - Observation - Reconnaissance	190 Alouette II 4 Alouette III	'60es
- Liaison - Medevac	168 SA 341	74 through 77
Armed helicopters		
- Antitank - Close Air support	65 Alouette III 52 SA 342 (91 in order)	'60es Starting from '81
Tactical helicopters		
- Tactical transport - Logistic transport	132 SA 330	'70es

These tables show that French Armed Forces use a relatively numerous fleet of helicopters (currently around 850 aircrafts), from which the most significant part is constituted by helicopters produced under the anglo-french cooperation program, (Puma, Gazelle, Lynx) and put in service during the '70es.

3°/ - THE OBJECTIVES.

Taking into account this situation, the main objectives for the action of the Ministry of Defense agencies can be summarized as follows:

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1. - Allow for continous adaptation of existing helicopters to the current state of operational needs and technology.

   In order to make possible technological updating of the in service helicopters, and to face the evolution of operational concepts.

2. - Prepare the response to the new needs dictated by emergence of new operationnal concepts.

3. - Prepare the renewal of the different types of in service helicopters.

   Considering the mean age of the fleets, the need for this renewall is estimated around 1990.

3°/ - GUIDELINES FOR THE ACTION.

On the basis of the above mentionned objectives, it is possible, by carrying out a critical comparison between the operational requirements and their evolution, in one hand, and the performance of current helicopters on the other hand, and through an analysis of the future operationnal requirements (as defined by the different Staffs) to identify the guidelines which have to drive the action of the Ministry of Defense agencies.

Taking into account the evolution of the operationnal requirements, and due to the increasing complexity of materials and techniques to be used, it is clear that the aspects pertaining to the vehicule and the aspects pertaining to the system (equipment, armement) are to be considered together and globaly, at the weapon system level.

vehicule + equipments + armement = WEAPON SYSTEM

integration

In this global weapon system approach, the guidelines can be listed and commented as follows :

- Increase system performance
- Increase system readiness
- Increase system military characteristics
- Decrease system life cycle cost.

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- Increase performance.

The word "performance" is to be taken in a general sense : it includes on one hand vehicule performance,

- extension of the flight enveloppe
- increase of the payload/A.U.W ratio
- improvement of handling qualities

and on the other hand performance of aircraft mounted equipments and systems, the combination of both beeing optimized, through integration, for an optimal global performance (or efficiency) of the weapon system.

- Increase readiness.

Readiness corresponds,first,to the external conditions of use :

- night time
- adverse weather conditions
- icing conditions

and,second,to the utilization characteristics of the materiels :

- servicing
- reliability
- maintenability

- Increase military characteristics.

That is first to organize and optimize the weapon systems in view of their military purpose (in particular, in the case of the attack helicopter, to optimize the answer to the new terms of the helicopter versus tank and helicopter versus helicopter combat).

Second,to increase the weapon system survivability :

- detectability
- vulnerability
- crashworthiness

Third,to improve the man/machine interface, in order to leave to the crew members the only duties for which they are irreplaceable, on to allow them to perform these duties in optimal conditions.

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- Decrease life cycle costs.

Through an action on :

- maintenance and repair costs
- consumptions
- development and acquisition costs.

4°/ - THE ACTIONS.

Within the framwork of the above mentionned guidelines, the main actions undertaken or planned in France are presented below.

For the sake of clarity, these actions are presented in relation to the above identified guidelines. It is clear, nevertheless, that this classification might be in some cases arbitrary, and that a given action can contribute to more than one task.

The presentation will be limited to those of the actions which have a global character. Thus, the actions specifically concerning engines, equipments or armements will not be presented. In addition, the actions which are specifically program - oriented, and run in the framework of the development of a program will not be addressed.

This being said, the actions can take different forms :

- Studies or pluriannual research programs
- Exploratory developments or demonstrators
- Development or creation of tools.

PERFORMANCE.

Aerodynamics.

Studies :.Development of aerodynamics computer models and computer codes
.Study, definition and testing of new blades airfoils (OA Airfoils)
.Definition, windtunnel testing and flight testing of new blade tips planforms
.Aerodynamic study of different types of tai. rotors (or fan - in - fin)

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Multiannual research programs :.Development of pressure instrumented rotor blades for flight test on the SA 349 research helicopter (1983).

Dynamics.

Studies :.Study of rotor dynamic stability. Stall-flutter
.Dynamic study of rotors : modes computation
.Development of unsteady aerodynamics models
.Study, definition, ground and flight testing of new types of suspensions.

Handling Qualities.

Multiannual research programs :.Research on higher harmonic control (Flight testing in 1983 on SA 349)

Studies :.Study of an automatic moving horizontal stabilator (Flight testing in 1984 on SA 349)

Technology.

Studies :.Fundamental studies on composite materials behavior
.Technological studies on composite materials applications
.Study of a grease or non cooled oil lubricated gear box
.Study of new concepts of mechanical assemblies (gear box)

Multiannual research programs :.Study, definition and test of new rotor head concepts.Hingeless "TRIFLEX" rotor head
.Flight testing in a main rotor head configuration on the SA 349 in 1982.
.Flight testing in a tail rotor configuration on a SA 332 in 1983.

Demonstrator :.Composite rotor head for a 6 to 8 tons helicopter. Flight testing planned in 1985.

Demonstrator programs planned, but not yet launched :

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.Fly by wire control system for helicopters
.All composite helicopter airframe (contemplated within european cooperation programs).

READINESS.

Flight in icing conditions.

Studies :.Study of ice formation on blades. Study of deicing devices.Qualification of scaling laws through wind tunnel testing (S 1 Modane)

Night flight.

Demonstrator : APHRODITE program. Research on night piloting using a FLIR and a helmet mounted display.
This program consists in evaluating a Puma fitted with :
- a FLIR on an orientable turret
- a helmet mounted sight slaving the turret position
- a helmet mounted display
- an inertial/doppler navigation and a pilot symbology generator.

Flight testing, in various configurations aimed at exploring the problem of night flying with FLIR and helmet mounted display with begin in 1982.

Operationnal avaibility.

Studies :.Studies of global reliability
.Studies on self contained test systems and o. automatic maintenance systems
.System studies about concept of self contained systems and about the self deployability concept.

MILITARY CHARACTERISTICS.

System definition and optimization.

Multiannual research program :

- Definition study of the future helicopter-borne Navy weapon system.
This study consists on a long term definition study of the helicopter borne weapon-

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system meeting the operationnal requirement of the Navy for the '90es on wards.

On the basis of a detailed analysis of the envisaged missions, a functionnal definition of these systems will be established. Then, by use of a basic simulation equipment, the integration of actual or simulated components will be carried out. This will allow for definition and realisation of a airborne digital system . This "soft" mock-up will be ground and flight tested and developped, with the result of an optimized definition of the system, ready for a prototype phase.

This long term oriented and ambitions program is currently in its phase 1.

- System study for an helicopter borne battle field survey and acquisition system.
- Study of the Air - to - Air helicopter firing.

This program is aimed at developping and experimenting in piloted simulation, on the ground and in flight on an helicopter an airborne digital system for optimization of the piloting firing parameters for the air to air firing from helicopter. The informatic tool will be in function in 1984.

Demonstrators :

- "Cassiopée" : .Study of the air to ground gun firing helicopter mission

  Experimentation will take place on a Puma helicopter fitted with :
  - a 20 mm gun mounted on a wide angular movement turret
  - different sights
    - a gyrostabilized roof mounted sight (copilot)
    - a fixed pilot sight (forward firing)
    - a helmet-mounted sight (for target designation)
    - a computer.

  The system is currently in a in-flight evaluation phase.

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- Mast mounted observation sight :

This demonstrator program is aimed at exploring the technical and operational problems linked with a mast mounted observation sight.

It consists of fitting a Dauphin helicopter with a gyrostabilized sight (with a FLIR and a TV camera). Flight testing is planned for 1985.

Survivalility.

Detectability :

- Radar detectability :

.Study of a low detectability rotor (Fligh testing anticipated in 1984)
.Study of improvements of the airframe trea ment (partial experimentation in 1983)

- Infra-red detectability :

.Theorical studies
.Engine exhaust jet studies
.Study and realization of dilution devices planned for 1983.

Vulnerability :

- Development of models for quantification of vulnerability to middle calibre rounds.
- Study of a low vulnerability rotor (middle calibre rounds). Study launched in 1982.
- Technological study of airframe concepts minimizing vulnerability to middle calibre rounds.
- Study of crew protection systems :

.Optimization of armors and "semi-armors"
.Study of an anticrash armored seat

- Study of low vulnerability equipments :

. In 1982, beginning of a low vulnerability servo-controls program.

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Crashworthiness :

- Extension of the "Krash" model
- Study of the crash behavior of composite materials (launched in 1981)
- Crash tests : In 1983, full size crash test of a Gazelle landing gear, and of an actual Gazelle helicopter.

Cable detection :

Exploratory development :

- Laser cable detection : testing planned in 1982
- millimetric wavelenght cable detection : Development and testing of an helicopter borne demonstrator equipment using a 94 GHZ radar.
  Flight test planned in 1983.

Crew-system interface.

Studies :.Ergonomic studies
.Studies on the "mini-stick" concept
.Studies of a flight management computer

Demonstrator program :.Advanced helicopter cockpit.
This demonstrator program has not yet been launched and is contemplated within european cooperation.

LIFE CYCLE COST.

This very important item involves many previously mentionned actions. As a matter of fact, performance improvement, reliability improvement, technology evolution contribute to life cycle cost reduction.

Nevertheless, some specific actions are to be mentionned :

- Study of simple constructive solutions.
- Conception studies for infinite life or TBO assemblies.
- Studies of optimized maintenance methods.

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THE TOOLS.

In the above description, most of the actions are studies or demonstrator actions. But there is an other very important form of action, which consists in development or creation of tools.

This form of action, including creating or improving the tools or facilities available in the official establishments or test centers (ONERA, CEV, CEAT, CEPR) (these tools utility often not being limited to helicopter applications) or providing incentive or contribution to industry to improve existing tools, or to develop new tools, is not alway easy to link to a single finality, so it will be adressed separatly.

I will limit myself to the simulation facilities.

These tools are developped for helicopter and helicopter borne weapon systems definition and development. The current program includes adaptation to the helicopter specificity of the two national simulation centers :

in CEV Istres with :
- moving cockpit
- visualization sphere
- imagery : camera and mock up in a first phase, followed by computer generated imagery.

in CELAR :
- simulation facility oriented towards firing simulation :
  .non moving single seat cockpit with computer generated imagery.

These two facilities will be used simultaneously with the same flight mechanics software, some specific visualizatic means, and some equipments (like helmet mounted sights) separatly developed.

Both simulators will be operational for helicopter oriented use at the beginning of 1984.

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5°/ - CONCLUSION.

This global presentation is certainely too broad, and many of the described actions would have deserved a more detailed presentation. I hope nevertheless that it gave a global idea of what is done, and according to which guidelines.That was anyway the objective.

In conclusion, I just would like to propose you some personal comments.

- First, we are not fully satisfied of this set of actions : you have certainely noted that some of the planned actions are not yet launched,and we are aware that our action in the field of life cycle cost is not sufficient. We will have to correct that in the future.

- Secund, it is clear, for many reasons (operationnal requirements, increasing sophistication of techniques and materials) that new programs are becoming more and more demanding and costly.

  On the other hand,the longevity of materials (or at least of vehicules) and the evolution of operational needs and technology lead to that fact that it becomes reasonable to think that a given type of helicopter will be at least once in its life, retrofitted with a new set of equipments.

  These two facts bring as a consequence that preparation of the future has, today more than ever, to be carrefully and permanently dealt with. This means that the corresponding effort has to be continuous and increasing. That is what we try to acheive, in collaboration with the staffs.

- Third, the action has to be dominated by the weapon system concept. So it has to be global, and to be pluridisciplinary.

  Global : we put in a high priority on the weapon system oriented aproach of the problems.

  Pluridisciplinary : The spectrum of the actions run is broad, and we try not to neglect any scientific or technical branch. Nevertheless, it is fact that we put the emphasis on the more specifically military characteristics, taking into account that the non specifically military characteristics might benefit, to a certain

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extent, from the effort made by our industry in the field of civil helicopters.

Last, it is clear that the effort to be done is a costly one, and that the volume of the necessary actions might raise a budgetary problem, in France,like, possibly,in many other countries. In this context, one can consider that international cooperation development might improve feasability of major actions, suppress redundancies,and reduce costs.

Dealing with research and preparation of the future in the military field, this idea of cooperation obviously raises some problems, which have to be adressed cautiously and with realism.

Nevertheless, we believe that such a cooperation is desirable and necessary on many points.

In the field of research activities, we are already involved in some very fruitfull cooperations with the United States (M.O.U. with the US Army on helicopter dynamics, MWDDEA on crashworthiness) and with the United Kingdom (AFARP 6).

In addition to that, we benefit from the background of the anglo-french cooperation programs (Puma - Gazelle - Lynx).

In the european context, a number of favorable conditions are met :

In many cases, our national military requirements are based on a concertation of our staffs, elabored in groups such as FINABEL K; our national industries are at a comparable level of importance and technicity, and,within the framework of european cooperation, some cooperation structure are in the process of beeing set up.

We have to take advantage of this situation. It is a necessity, and that is the meaning of our efforts to promote cooperation in the field of research and technology activities, and to start the technology program currently contemplated within the framework of the european cooperation.