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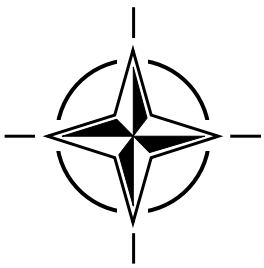
RTO LECTURE SERIES 218

Aging Engines, Avionics, Subsystems and Helicopters

(Moteurs, avionique, sous-systèmes et hélicoptères de générations précédentes)

The material in this publication was assembled to support a Lecture Series under the sponsorship of the Applied Vehicle Technology Panel (AVT) and the Consultant and Exchange Programme of RTO presented on 23-24 October 2000 in Atlantic City, USA and 26-27 October 2000 in Madrid, Spain.



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Aging Engines, Avionics, Subsystems and Helicopters

(RTO EN-14)

Executive Summary

Aging aircraft concerns have dramatically escalated during recent years. Due to NATO's changing role, which includes peace keeping missions remote from home bases, the requirement of unimpaired high operational capacity, higher utilization of its air fleets and budgetary constraints, prospects are for aging aircraft problems to continue to become more acute. Airworthiness concerns have preoccupied authorities wrestling with the aging aircraft issue. However, the NATO nations are having to contend with another dimension which could not at all have been anticipated even some years ago, viz., severe budgetary constraints have necessitated retention of aircraft designed decades ago for much longer, meaning that the performance of such aircraft have to satisfy fast-changing mission needs, which might be considerably beyond their original design basis. On account of the currency and interest in the subject a Lecture Series on Aging Aircraft is proposed.

A Lecture Series (LS-206) titled "Aging Combat Aircraft Fleets – Long Term Implications," under the sponsorship of AGARD was offered in 1996. Due to the immediacy of structural airworthiness concerns, LS-206 largely dealt with issues pertaining to forms of structural degradation in aging aircraft. Also, due to the vast scope of concerns relating to the airframe in an aging aircraft, the coverage of the previously offered LS virtually excluded other structures and subsystems. For instance, it did not address any aspect of aging helicopters – a major component of the defense force of the NATO alliance. The LS was even devoid of guidance as to how to deal with other critical subsystems in aging airplanes such as avionics and electrical related subsystems and aircraft engines. Yet a recent study indicates, for instance, that the power plant and ancillary components account for some 30% of the life-cycle-cost of an aircraft. One of the principal aims of the proposed LS is to highlight schemes for retrofitting major subsystems, other than the airframe, in aging aircraft. Performance enhancement of subsystems to counter their technological obsolescence will be the major theme of the proposed LS.

The material in this publication was assembled to support a Lecture Series under the sponsorship of the Applied Vehicle Technology Panel (AVT) and the Consultant and Exchange Programme of RTO presented on 23-24 October 2000 in Atlantic City, USA and on 26-27 October 2000 in Madrid, Spain.

Moteurs, avionique, sous-systèmes et hélicoptères de générations précédentes

(RTO EN-14)

Synthèse

Le problème des aéronefs vieillissants s'est considérablement amplifié ces dernières années. Etant donné l'évolution du rôle de l'OTAN, qui comprend désormais des missions de maintien de la paix à distance des bases d'attache, la nécessité d'une grande disponibilité opérationnelle, et l'utilisation croissante des flottes aériennes dans une période de contraintes budgétaires, il est fort probable que ce problème s'accentue à l'avenir. La question de l'aptitude au vol préoccupe les autorités qui cherchent une solution au problème des aéronefs vieillissants. Toutefois, les pays membres de l'OTAN doivent aujourd'hui faire face à un autre aspect du problème, qui ne pouvait être anticipé il y a quelques années: d'importantes restrictions budgétaires nécessitant le maintien pour encore quelques temps d'appareils conçus il y a des dizaines d'années, les performances de ces derniers doivent répondre à l'évolution rapide de la nature de la mission, laquelle pourrait largement dépasser le cadre de sa conception initiale. L'actualité du sujet et l'intérêt qui lui est porté conduisent à proposer un cycle de conférences sur les aéronefs vieillissants.

Un cycle de conférences (LS-206), intitulé « Le vieillissement des flottes d'avions de combat – Implications à long terme » et organisé sous l'égide d'AGARD, a été proposé en 1996. Du fait de l'urgence des préoccupations d'aptitude au vol du point de vue structural, le cycle de conférences a essentiellement traité de points relatifs aux types de dégradation structurelle d'aéronefs vieillissants. De même, étant donné le grand nombre de questions que soulève la cellule d'un appareil vieillissant, les autres structures et sous-systèmes n'ont pratiquement pas été abordés par le cycle de conférences précédent. Ainsi, le cycle n'a évoqué aucun aspect relatif aux hélicoptères vieillissants, composante majeure de la force de défense de l'Alliance. Il n'a pas non plus fourni de ligne directrice permettant de gérer d'autres sous-systèmes essentiels sur les aéronefs vieillissants comme l'avionique, les sous-systèmes électriques et les moteurs. Pourtant, une étude récente a montré à titre d'exemple que le groupe propulseur et les éléments annexes représentent environ 30% du coût global de possession d'un aéronef. L'un des principaux objectifs du cycle de conférences proposé est de mettre en évidence les programmes de rattrapage des sous-systèmes majeurs (autres que la cellule) sur les appareils vieillissants. L'accroissement des performances des sous-systèmes visant à pallier leur obsolescence technologique constituera le thème majeur du cycle de conférences proposé.

Cette publication a été rédigée pour servir de support de cours pour le Cycle de conférences 218, organisé par la Commission des technologies appliquées aux véhicules (AVT) dans le cadre du programme des consultants et des échanges de la RTO du 23-24 octobre 2000, à Atlantic City, Etats-Unis, et du 26-27 octobre 2000 à Madrid, Espagne.

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† Paper not available at time of printing.

Theme

Aging Aircraft concerns have dramatically escalated in the military community and commercial aviation during the past decade. The percentage of aircraft, operated beyond their original design life is steadily increasing. Some models, which have already been in service for more than 40 years, will need to be retained for another two decades or longer, often serving in roles and in theaters very different from what was envisioned when they were originally designed.

Aging Aircraft has several connotations. To name a few: technological obsolescence, the specter of runaway maintenance costs, and safety. However, the adverse impact on sustainment of the fleet is the common thread.

There are other considerations when dealing with the Aging Aircraft issue; for example, spare parts, processes and tooling may no longer be available, logistic procedures may have changed and suppliers may be out of the business. Budgetary limitations and higher fleet utilization will increase the demand to cope with aging structures and major subsystems like engines and avionics. Heightening the awareness in the user community about typical challenges and technical solutions to ameliorate some of the concerns is the purpose of this Lecture Series.

Thème

Le problème du vieillissement des aéronefs s'est considérablement amplifié pour les exploitants militaires et commerciaux au cours de la dernière décennie. Le pourcentage d'aéronefs en exploitation au-delà de leur durée de vie théorique augmente régulièrement. Certains modèles, déjà en service depuis plus de 40 ans, devront être maintenus pendant encore deux décennies au moins, souvent pour des missions et des théâtres très différents de ceux qui étaient envisagés à l'origine.

Le terme "aéronefs vieillissants" a plusieurs connotations différentes, parmi lesquelles l'on peut distinguer l'obsolescence technologique, le spectre des coûts de maintenance incontrôlés et les considérations de sécurité. Mais, tous ces aspects ont un facteur commun: l'impact négatif sur le maintien de la flotte.

Il y a aussi d'autres considérations à prendre en compte; par exemple la disponibilité de pièces de rechange, de processus et d'outillage, les procédures logistiques qui peuvent avoir changé, et les fournisseurs qui peuvent avoir fait faillite. Les limitations budgétaires et l'utilisation accrue des flottes aériennes nécessiteront de porter plus d'attention aux aspects de vieillissement de la structure et des sous-systèmes principaux des aéronefs, tels que les moteurs et l'avionique. Ce cycle de conférences a pour objectif de promouvoir une meilleure sensibilisation des utilisateurs aux défis et aux solutions techniques typiques susceptibles de pallier à certains de ces problèmes.

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Aircraft engines	Airworthiness	Noise (sound)
Aircraft equipment	Service life	Aging aircraft
Electric equipment	Fatigue (materials)	Impulse noise
Airborne equipment		

14. Abstract

Aging Aircraft concerns have dramatically escalated in the military community and commercial aviation during the past decade. Some models, which have already been in service for more than 40 years, will need to be retained for another two decades or longer, often serving in roles and in theatres very different from what was envisioned when they were originally designed. Aging Aircraft has several connotations. To name a few: technological obsolescence, the spectre of runaway maintenance costs, and safety. Moreover, spare parts, processes and tooling may no longer be available, logistic procedures may have changed and suppliers may be out of the business. Budgetary limitations and higher fleet utilisation will increase the demand to cope with aging structures and major subsystems like engines and avionics.

Specific topics covered by this Lecture Series are:

- An operator's perspective on aging engines
- Modern engine modernisation programmes
- Aging electrical systems and wiring
- Aging avionics
- Aging helicopter-related issues
- Other subsystems
- Safety and service difficulty reporting

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