29th Congress of the International Council of the Aeronautical Sciences
St. Petersburg, Russia; September 7-12, 2014

IMPROVEMENT OF THE AIRCRAFT GENERAL OVERHAUL PROCEDURE

Bosko Rasuo*, Gradimir Djuknic*
***University of Belgrade, Faculty of Mechanical Engineering, Aeronautical Department**

Keywords: *General Overhaul, Maintenance of Aircraft, Logistics Support*

Abstract

This paper contains the development results of the overhaul melioration plan for the following aircraft types: MiG-21Bis (Figure1), G-4 Galeb (Figure 2) and SA-341 helicopter (Figure 3).

This research has been conducted based on available knowledge and extensive experience gained by performing general maintenance of the Air Force of Serbia aircraft.

1 Introduction

A general analysis has been performed by processing data collected while performing maintenance and repair procedures. The magnitude of data is based on detecting the delays and errors that occurred while going through the operational and inter-operational stages of aircraft overhaul. On the basis of the obtained research results, a proposal for the aircraft overhaul optimization has been offered.

The proposed overhaul improvement plan points out the priority steps to be taken in order to optimize the most critical features that jeopardize the quality of the aircraft overhaul process relating to organization, technology and design. Moreover, existing technical logistics have been used for providing actions to achieve the objective in focus: the all-encompassing optimization of the above selected aircraft overhaul.

The method of the overhaul optimization has so far been applicable to the aircraft of the Army of Serbia. However, the particular methodology can be proved potentially useful and highly germane when applying to other aircraft types.

A plan to optimize the overhaul is based on a one-year monitoring process of the aforementioned aircraft. It enables significant savings in performing overhauls within the financial realm as well as time-wise.

Figure 1 MiG-21Bis Aircraft

Concerning the high material value, complexity, operating conditions and the necessary safety in using the aircraft, all issues related to the aircraft maintenance are subject to very strict legislation of each country, and in the international air transport to international regulations [1]. This applies both to the civil and military aviation. The concept of the civil aviation maintenance mainly depends on the use of aircraft, status of logistics support etc., and must be fully harmonized with the applicable aviation operation and maintenance regulations [2]. In case of the military aviation, the situation is significantly different. Dominant role in the maintenance concept, which defines activities, has the maintenance policy and organization (number of levels), aircraft design (classical,

modular, etc.), environment (war conditions), the state of logistics support etc.

Considering the longer service life of modern combat aircraft, the funds initially provided for the purchase (even over 25 million Dollars per aircraft) almost equal to the Air Force technical logistics costs in the course of their service life. The more advanced aviation technology, the greater procurement and Air Force Logistics costs. Particularly high level of resources should be allocated for general overhaul of modern aircraft; therefore any saving in such work brings significant resources to the community. This has been the motive to initiate this research with the main goal to optimize the overhaul of aircraft in the arsenal of the Army of Serbia. The purpose of the optimization is to reduce the costs (number of working hours spent on removing disturbances in the course of the general overhaul process) and to shorten the overhaul cycle [3].

Figure 2 G-4 Galeb Aircraft

2 Analysis of Research Results

General overhaul of aircraft may be carried out in different ways, as in relation to the concept, so in relation to the implemented organization and technology (see Figures 4-6). In other words, the aircraft general overhaul can be carried out in several variants (overhaul of components-assemblies, accessories, series and industrial overhaul) with larger or smaller differences in individual solutions. When there are several variants, the question is to be raised which one to choose? The answer is not simple for at least two reasons: (1) - each variant causes certain effects, that is, it affects the quality of the overhauled aircraft, the costs and the overhaul aircraft ground time; (2) - comparison of different variants is performed by various criteria, and it comes down to the multicriteria issue, which can be solved only if limits and requirements are pre-determined in advance. Selection of "optimum" for defined criteria and limits represent the immediate optimization task. "Optimum" in this case does not have to be (but may be) the mathematical extreme of an appropriate criterion function, but may be a compromise solution, which is an "optimal" for the established criteria [4].

Figure 3 SA-341 Helicopter

Figure 4 General overhaul of MiG-21Bis aircraft

Based on available knowledge and experience gained in the aircraft general overhaul, this paper develops a genuine approach to the optimization process of the aircraft overhaul, which is based on the assumption that these processes are optimally

designed, but that the overhaul process suffers the external and internal factors influences. The effects of these factors are, among other things, operational and interoperation delays of the process, and as a result, unforeseen costs emerge (more than 700 working hours per observed aircraft in average), extension of the overhaul cycle (on average more than 200 working days per observed aircraft in average), and complaints of overhauled aircraft users (about 3 complaints per aircraft in average).

Figure 5 General overhaul of G-4 Galeb aircraft

Monitoring and analyzing these delays by means of brainstorming, brainwriting, and using Ishikava diagram has led to the most dominant causes of disturbances of the general overhaul process. Discovering the causes of disturbance has led to the necessary remedial and preventive actions required to optimize the process, and by their implementation reaching the possibility of shortening the overhaul cycle (more than 200 working days in average), cost reductions (by more than 700 working hours) and overhauled aircraft complaints reduction (for three complaints in average).

The paper is based on the continuous monitoring of the registered 122 general overhaul disturbances of the observed aircraft. Analysis of the causes of these disturbances led to particular corrective and preventive actions which are to be undertaken, and these are appropriate modifications of the overhaul documentation and information systems, improvement of supply systems, additional education and training of the staff participating in the overhaul process, increased surveillance of some processes, increased improvement of some tools, devices and equipment, undertaking appropriate organizational changes, as well as adjustment of some facilities, workshops and warehouses to overhaul requirements, and adequate storage of spare parts.

A method for optimizing the overhaul presented in this paper is the result of the experts' experience, and can be applied to all overhaul processes, and is based on monitoring the indicators of the general overhaul process disturbances.

Figure 6 General overhaul of SA-341 helicopter

This methodology directly indicates the extent of optimization, their priorities according to the importance and size of effects. It is applied continuously and is continuously monitored. The effects are as follows: (1) - increment of the aircraft readiness, (2) - increment of reliability, (3) - better provision of spare parts and materials required for general overhaul, (3) - reduction of costs of labor, energy, waste and spare parts, (4) - better use of overhaul capacities, (5) - more organized and easier work of employees used in general overhaul, and (6) - increment of customer's satisfaction, or users of overhauled aircraft with effects achieved etc [4,5].

3 Conclusion

Principles of research can be applied to any factory in which the aircraft general overhaul is performed, but the measures to increase the quality of general overhaul reached in this paper

are not universal, and can be applied only to the respective factories, because each factory that deals with the aircraft general overhaul is specific in terms of process disturbances, and thus in terms of optimization actions.

References

[1] Rasuo, Bosko, *Aeronautical Safeguarding*, Belgrade, Military Academy, (in Serbian) 2004.

[2] Rasuo, Bosko, *Aircraft Production Technology*, Faculty of Mechanical Engineering, University of Belgrade, Belgrade. (in Serbian) 1995.

[3] Djuknic, Gradimir, *Optimization of the Aircraft Overhaul Process*, Ph.D. Thesis, University of Belgrade, Faculty of Mechanical Engineering, Belgrade. 2010.

[4] Rasuo, Bosko, Djuknic, Gradimir, Optimization of the Aircraft General Overhaul Process, A*ircraft Engineering and Aerospace Technology: An International Journal*, Volume: 85, Issue 5, 2013, (pp. 343-354),

[5] Siladic, Mato, Rasuo, Bosko, On-Condition Maintenance for No modular Jet Engines: An Experience, *The ASME Journal of Journal of Engineering for Gas Turbines and Pow*er, 131, Issue 3, New York, 2009.

Contact Author Email Address

Professor Dr Bosko Rasuo, University of Belgrade, Faculty of Mechanical Engineering, Aeronautical Department, Belgrade, Serbia, E-mail: brasuo@mas.bg.ac.rs and and Dr Gradimir Djuknic, E-mail: gdjuknic@gmail.com

Copyright Statement