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CONCERNS OVER FLIGHT PARAMETERS INTERPRETATION IN ORDER TO IDENTIFY THE CAUSE – EFFECT CONNECTION IN FLIGHT OCCURRENCES

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Abstract: The study proposes an operations series to be followed by the personnel with duties in analyzing flight parameters acquired at the aircraft board during the flight exercises, in order to identify the cause-effect connection in flight occurrences. The actions flow is exemplified by the effective analyze of flight parameters registered during a specific exercise while a flight occurrence happened.

Analyzing a case study, the paper presents:

- identification of a right flight maneuvers and variation mode for important parameters during maneuvers;
- identification of the maneuver with abnormal variation of some flight parameters;
- identification of the mechanical ensemble of the aircraft affected by the abnormal variation of some flight parameters;
- explanation of the mechanical process at which the affected ensemble was subjected and that leaded to the overloading of an element from the mechanical ensemble.

Keywords: *aircraft flight parameters, flight data recorder system, flight occurrence.*

1. INTRODUCTION

To illustrate how the interpretation of an aircraft flight parameters may help identify the immediate cause of the flight occurrence, we chose Puma helicopter one.

Of high importance in such a situation is the aircraft characteristic to be equipped with acquire and registration system for as many flight parameters (Flight Data Recorder system).

2. CASE STUDY

2.1 Flight description. The helicopter aircrew had to make a flight for training, so that to simulate the occurrence of special situations on board.

At a certain point, the aircrew simulates the helicopter hydraulic system failure, the procedure involving the landing as soon as possible. The situation was timely solved and the landing was made in normal parameters.

At one point, while executing a turn, an engine failure was simulated by reducing the right engine speed. To solve the situation, landing the helicopter with taxiing was required. Immediately after landing, during taxiing, abnormal helicopter vibrations were observed. To limit the vibrations, the increase of the right engine speed (the one reduced for simulation) was commanded to normal operation. This moment coincides with the end abnormal vibrations of the helicopter. An exterior control of the helicopter was made by the flight engineer, with the engines working and everything was normal.

Further, the aircrew performed the flight according to training.

2.2 Consequences of flight occurence.

After the final landing and the engines stop, it was found that the main rotor blades descend too much and the inferior automatic limiters remained in the unlocked position.

Weather conditions during the flight were normal and did not affect the flight occurrence.

The helicopter was moved to the repair shop, the main blades were lifted in normal position and it was found that the inferior automatic limiters return to initial position only by applying a considerable force. Consequently, for further technical investigations the main blades were removed and the articulated axles of the inferior automatic limiter were examined.

Deformations of the articulated axles were found, the maximum bending-deflections values being exceeded (fig. no 1), and the teflon bushings inside the bores limiters were damaged.

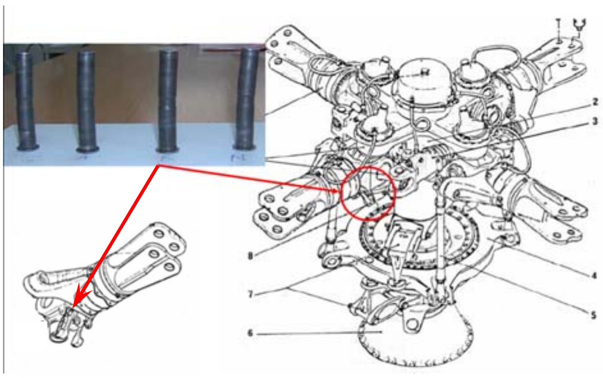

Fig. no 1 – Deformations of the articulated axles of the inferior automatic limiters. Location on the helicopter main rotor.

2.3 Flight parameters analyze. After analyzing the recorded flight parameters, the following were found:

a) Landing procedure with disengaged hydraulic system was executed correctly (fig. no 2). To achieve the landing the adjustable-pitch propeller value (P) was reduced in a period of time ΔT = 9 seconds from P = 12 to P = 5.6, the vertical acceleration coefficient being Nz = 1. The engines rotation speed decreased from 88% to 76 % value.

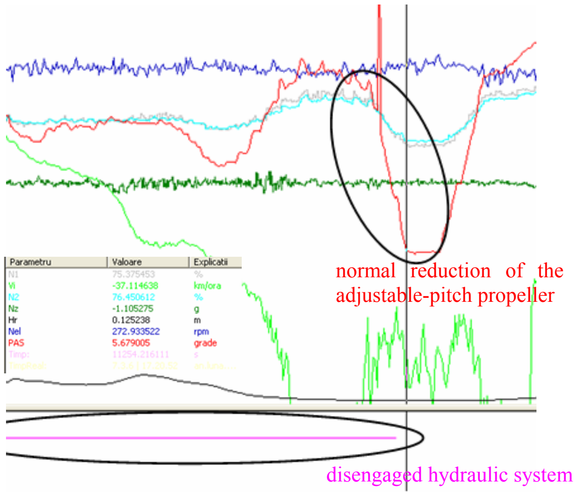

Fig. no 2 – Normal landing with disengaged hydraulic system

b) With right engine decreased, landing with taxiing was made under the following parameters: adjustable-pitch propeller value was reduced in a period of time ΔT = 3s from P = 12 to P = 5.6. The left engine rotation varied during this time between N1 = 95% and N1 = 78% values.

Ample reduction of the adjustable-pitch propeller, in a short time, led to a hard landing and this was the cause of the vibrations that were felt in the helicopter main rotor hub and also in the whole structure. The vibrations are visible on the flight parameters recorded, in the ample, unnatural variation of the vertical acceleration coefficient Nz (fig. no 3), which had values between Nz = 0.6 and Nz = 1.5, for a period of time ΔT = 9s. A further proof for the vibrations cause is that they stop when the adjustable-pitch propeller value increases (during the aircrew command) to P = 8.5. The end vibrations moment coincides with the moment when the engine rotation speed is commanded to normal value.

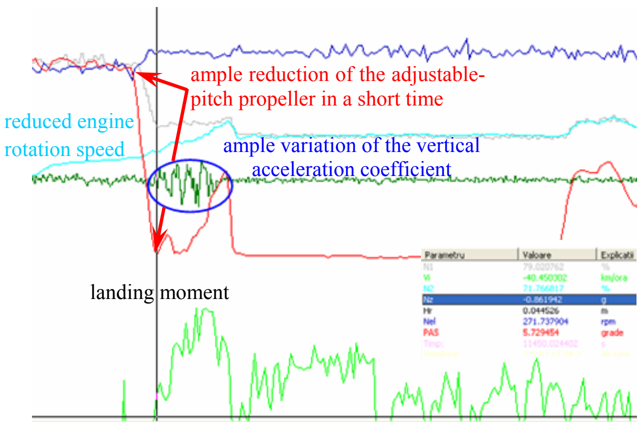

Fig. no 3 – The hard landing

2.4 Explanation of the mechanical process. The immediate cause of the flight occurrence was the ample reduction of the adjustable-pitch propeller value, in a short period of time. (P = 12.17 ÷ 5.7, ΔT = 3 sec.)

Due to the ample reduction of adjustable-pitch propeller value, the main rotor blades had a forceful beat movement, the main rotor sleeves hitting the inferior automatic limiter feeders (fig. no 4) and forcing (under the Fs force action) the articulated axles to be deformed. The pitch articulation sleeve is equipped with a limiter which stops the blades to descend under a constant value, when the engines stop (in order to protect the tail beam ensemble).

The articulated axles being deformed, the limiters springs can not longer bring the feeders in the locked positions, thus, when the engines stop, in the absence of centrifugal force, the sleeves descend to the fixed limiters level, and therefore the blades descend over the normal position.

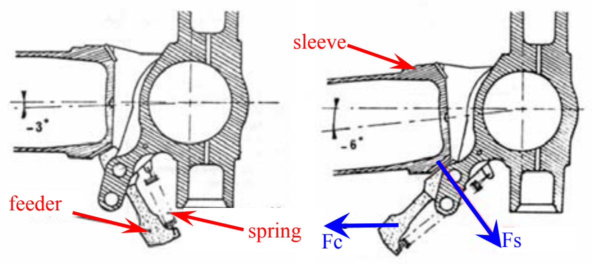

Fig. no 4 – Inferior automatic limiters positions

In fig. 4a the main rotor hub is stopped. The sleeve rests on the contact surface of the two feeders which are pulled by springs. The value of the angle (3^0) between blades and rotor disk is normal.

In fig. 4b the engines are working at normal rotation speed. The centrifugal force (Fc) acts on the feeders which, unlocked, allow the blade to have a beat movement down to the fixed limiters. The value of the angle (6^0) between blades and rotor disk is normal only in a few situations during the flight.

Thus can be explained why nothing abnormal was noticed when the flight engineer executed the visual examination over the helicopter with the engines working. In this case, the engines were working, the feeders were unlocked, but the blades weight was canceled by the lift force.

3. CONCLUSIONS & ACKNOWLEDGMENT

Flight parameters interpretation has a specific character from one type of aircraft to another, a particular role having the knowledge of the aerodynamics and constructive limits of the aircraft, the analyst's experience in exploring the aircraft as a macrosystem, as well as correlating the results with information obtained from the flight aircrew.

By the above mentioned, this study itself takes part in the reactive activity for preventing flight occurrences, by identifying, in a particular case, a cause – effect connection which, once known, leads to propose recommendations for avoiding, in the future, occurrences with similar causes.

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