

Our ref. ANSV 1605/17

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Subject: serious incident occurred on the 11th of October 2017, at Montichiari Airport (Italy), to BK117D2 registration marks I-BRXA. ANSV safety recommendations.

1. Foreword.

On the 11th of October 2017 an HEMS operation departed from a Brescia helipad. On board the BK117D2 registration marks I-BRXA (picture 1) there were six people: pilot, co-pilot, HEMS crew member, Task Expert, doctor, nurse. After 4' 35" being airborne at about 6000 ft, the pilots received the warning light "fire eng02". According to the flight manual procedure the crew established OEI (One Engine Inoperative) condition and the fire extinguishing system was activated. The crew aborted the mission and diverted to the nearest airport, Montichiari (BS). While in descent toward the airport, the "low RPM" indication (referred to the main rotor speed, N_R) and the associated audio message was triggered and displayed. The pilots reported not to be able to control the N_R to turn off the "low RPM" indication. However, they managed to land safely.

The Italian civil aviation safety investigation authority (ANSV) launched a safety investigation. The event (serious incident) was notified to the aircraft and engine manufacturer countries (BFU Germany and BEA France). Both appointed an investigator as accredited representatives and nominated, respectively, Airbus Helicopters and Safran as Technical Advisers. EASA also appointed a Safety Investigation Officer as Technical Adviser to the investigator in charge.



Picture 1: BK117D2 I-BRXA.

2. Post Flight Inspection and Data Analysis.

Post flight inspection revealed no signs of fire on engine 2 (picture 2) neither anything unusual on both engines. It was verified that one extinguisher bottle was discharged. Data were downloaded from the CVFDR (Combined Cockpit Voice Recorder and Flight Data Recorder), the two Engine Data Recorders (EDR) and the Aircraft Management Computers (AMC). The analysis of the abovementioned data confirmed the sequence of the events as above reported. Furthermore, it was ascertained that the engine 1 (the remaining engine after the OEI condition was established) was working correctly despite the “low RPM” indication. In more detail, in OEI condition, the red N_R law (figure 1) is used at all airspeeds.



Picture 2: post flight inspection.

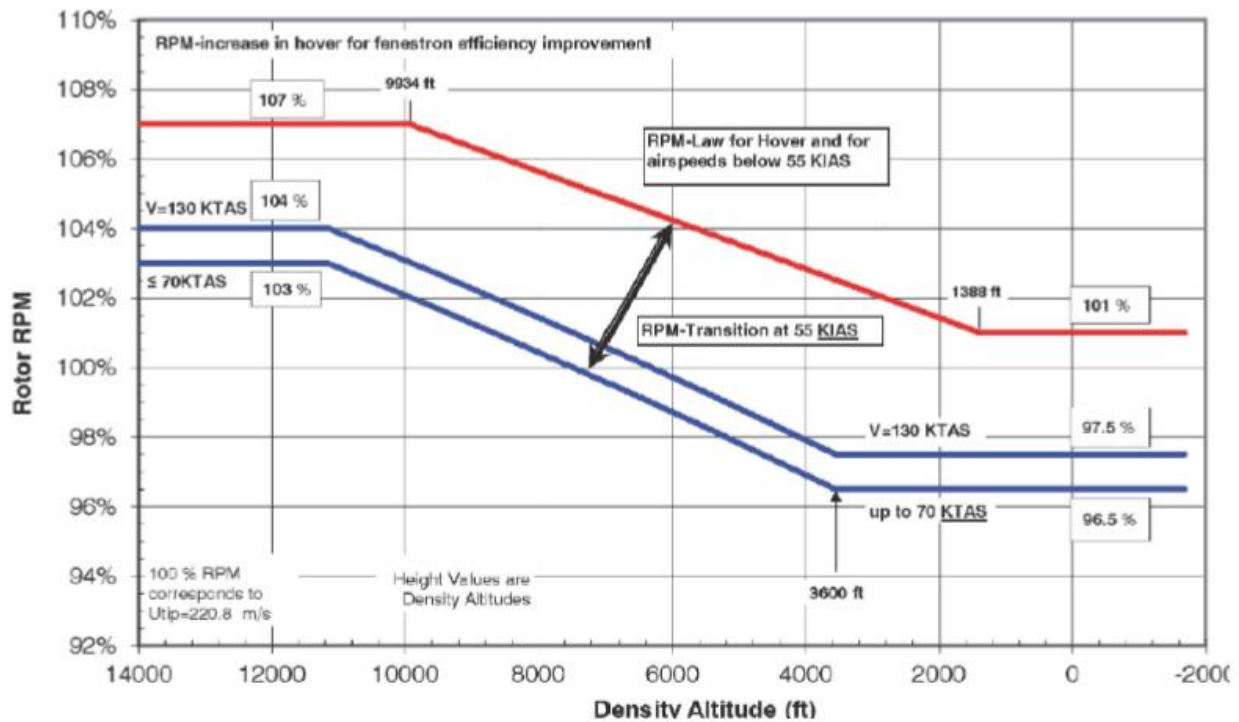


Figure 1: rotor speed governing laws.

The rotor speed indications logic is reported in the following table.

NR Limit	PWR ON [%]	PWR OFF [%]	Audio signal
Rotor brake permitted	–	0 to 50	–
Power off min. continuous GM >2200kg GM <2200kg	–	85 80	–
Minimum transient	85	–	–
Low NR transient (max 20 sec) NR _{min} is 3% below the nominal rotor speed or 94%, whichever is higher.	85 to NR _{min}	–	< NR _{min} : slow beep (mutable)
High NR transient (max 12 s)	107.5 to 109	–	–
Power off transient (max 12 s)	–	109 to 113	>109% : fast beep (mutable)
Power off max transient	–	113	>113% : fast beep (not mutable)
ROTOR RPM	on the WU will be triggered, when NR: – <NR _{min} – >109%		
N ₂ Limit	–	–	–
Minimum continuous	94	–	–
Maximum continuous	108.3	–	–

Therefore, based on the density altitude it is possible to calculate the value for the triggering of the “low RPM” signal. Comparing this calculation to the recorded main rotor speed value (blue plot in figure 2, FDR source), it is possible to verify that the behavior engine

remaining in function (N°1) after having established the OEI condition has always been within the prescribed limits despite the “low RPM” indication.

Further analysis highlighted a data handling problem between the Helionix avionic unit and the Engine Electronic Control Units (EECUs) which led to a wrong reference for the variable low rotor RPM warning, which caused the confusing indications (block diagram in figure 3): taking into account many inputs data, the AMCs provide two calculated N2 Datums (N2 is the power turbine rotation speed). These are sent to the EECUs that in turn send back to AMCs two feedback N2 Datums. Then, the N2 Datums undergo a validity check following the logic shown in figure 3. In the event flight of the BK117D2 marks I-BRXA the last valid N2 Datum value of the EECU2 was frozen and considered valid although the OEI condition was established.

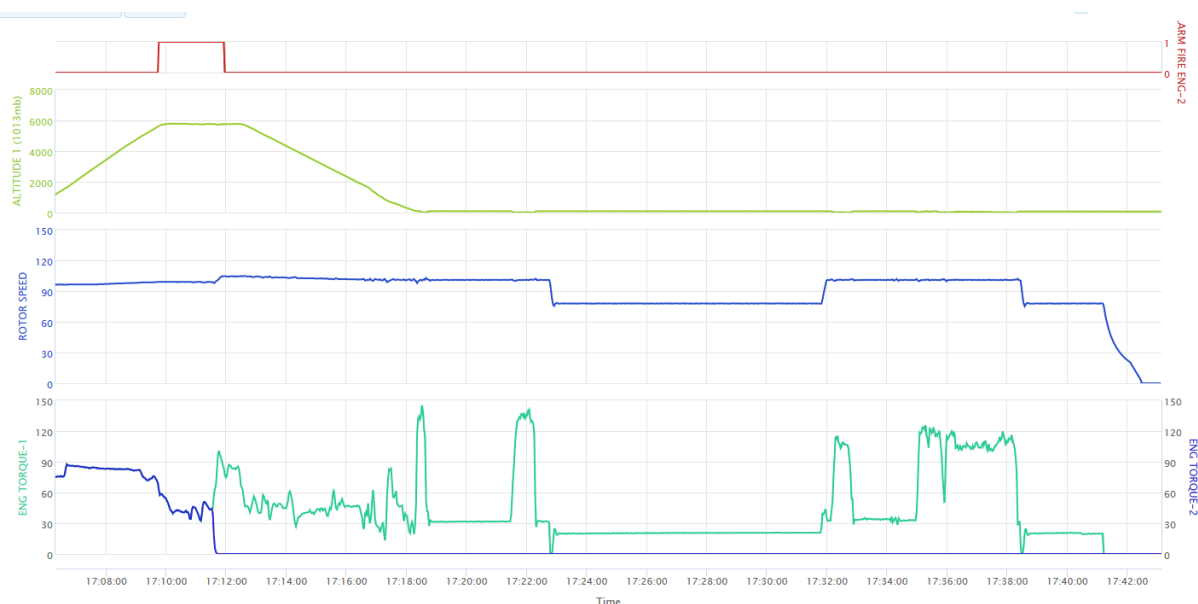


Figure 2: FDR plots. Engine 2 fire alarm (red), Altitude (green), Rotor speed (blue), Engine 1 torque (light blue), Engine 2 torque (blue).

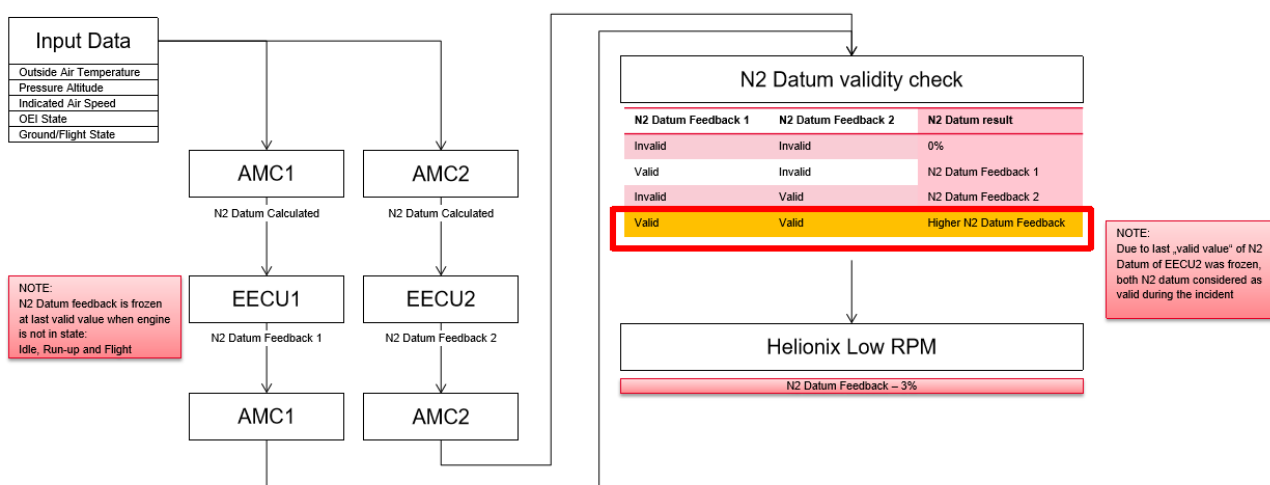


Figure 3: global overview of Helionix low RPM triggering.

3. Safety Recommendations.

The ANSV acknowledges that the manufacturer is already putting in place actions in order to solve the above-described issue. However, based on the information gathered up to now, the ANSV considers as necessary to issue the following safety recommendations.

Motivation: in the serious incident flight, during descent for an emergency landing in OEI condition, the crew of the BK117D2 marks I-BRXA received the main rotor “low RPM” indication (audio and visual). Subsequent technical activities demonstrated the remaining in function engine (N°1) behavior was correct as well as the the main rotor speed in relation to flight conditions in OEI. It was ascertained that the “low RPM” indication was not meant to be triggered. This was recognized as a design issue related to the data handling between the avionic units responsible for the N2 Datum processing (N2 Datum calculated, N2 Datum feedback, N2 Datum validity check).

Recipient: EASA.

Safety Recommendation ANSV-9/1605-17/1/I/17.

To verify the above explained data handling issue will be solved by means of a built-in design solution, applied to all the affected helicopters, allowing in every flight condition, including in OEI, the correct processing of the N2 Datum by all the involved avionic units.

Safety Recommendation ANSV-10/1605-17/2/I/17.

To verify that, in the meantime a design fix of the above explained data handling issue will be applied to all the affected helicopters, the crew operating the BK117D2 will be quickly informed that in OEI condition a misleading and false “low RPM” indication (audio and visual) can be received.

Safety Recommendation ANSV-11/1605-17/3/I/17.

To verify that, in the meantime a design fix of the above explained data handling issue will be applied to all the affected helicopters, a detailed procedure will be quickly provided to the crew in order to clarify how to deal with a “low RPM” indication (audio and visual) during OEI condition. This procedure has to allow a rapid and reliable evaluation of the “low RPM” indication trustworthiness.