FINAL INVESTIGATION REPORT
on Civil Aviation Safety

CLASSIFICATION

ACCIDENT

Owner
S.C. DUNCA EXPEDIȚII S.A

Operator
S.C. DUNCA EXPEDIȚII S.A

Manufacturer
AIRBUS HELICOPTERS

Aircraft type
AS 350 B3 ÉCUREUIL

Registration country
ROMÂNIA

Registration
YR-DEX

Location
Turistic Complex Muntele Mic – Borlova Slope

Coordinates: Latitudine: 45°21'37.59"N
Longitude: 22°28'27.54"E
Altitude: 1680 m.

Date and time
29.11.2017/15:07 LT (13:07 UTC)
HITTING AN OBSTACLE WITH THE MAIN ROTOR BLADES

<table>
<thead>
<tr>
<th>Aircraft type</th>
<th>AS 350 B3 Écureuil / YR-DEX</th>
</tr>
</thead>
<tbody>
<tr>
<td>Date and time</td>
<td>29.11.2017/15:07 LT (13:07 UTC)</td>
</tr>
<tr>
<td>Operator</td>
<td>S.C. DUNCA EXPEDIȚII S.A.</td>
</tr>
<tr>
<td>Flight type</td>
<td>Private</td>
</tr>
<tr>
<td>Persons on board</td>
<td>The Pilot</td>
</tr>
<tr>
<td>The Pilot</td>
<td>RO.FCL/PPL/....../H - VALID</td>
</tr>
<tr>
<td>Damages</td>
<td>The helicopter was destroyed</td>
</tr>
<tr>
<td>Location</td>
<td>Mount Mic Tourist Complex – Borlova Slope</td>
</tr>
<tr>
<td></td>
<td>Latitude: 45°21'37.59&quot; N</td>
</tr>
<tr>
<td></td>
<td>Longitude: 22°28'27.54&quot; E</td>
</tr>
<tr>
<td></td>
<td>Altitude: 1680 m.</td>
</tr>
</tbody>
</table>

GENERAL DATA

On 29.11.2017, the Civil Aviation Safety Investigation and Analysis Authority (AIAS) was notified by telephone at around 15:50 LT (13:50 UTC) about of an accident involving the AS 350 B3 helicopter, registered YR-DEX, operated by SC Dunca Expediții SA, an event in the Borlova slope area, in the Mount Mic Tourist Complex, Caras-Severin County.

According to the regulations in force, AIAS notified the following organizations: ICAO, European Commission, EASA and Bureau d'Enquetes et d'Analyzes pour la securite de l'aviation civile - BEA France.

As representative of the state of manufacture, BEA - France has designated an accredited representative.

1. HISTORY OF THE FLIGHT

NOTE: The history of the event was reconstituted based on the pilot's statement.

Thus, on 29.11.2017, the helicopter type AS 350 B3 Écureuil, registered YR-DEX, operated by S.C. Dunca Expeditions S.A., was planned to fly a VFR flight, according with the accepted flight plan planned, on the Caransebeș - Muntele Mic - Caransebeș route.

After a flight of approximately 30 minutes, the helicopter landed in an unpopulated area near an inoperative chairlift, located at the top of the Borlova Slope, where various construction materials were needed to arrange it.
After the helicopter was landed and the engine was stopped, the pilot placed some materials in two of the three cargo compartments of the helicopter and got into the cockpit with the intention to take off. After starting the engine, he put the twist grip into the "FLIGHT" position, at which time he noticed on the warning panel that the "DOOR" indication light was activated.

At this point, without securing the collective lever, with friction applied to the cyclic and with the twist grip in „FLIGHT” position, the pilot got off to check the cargo compartment doors, starting from the right side. When he came to check the cargo compartment door on the left, the wind increased in intensity, at which point the helicopter took-off forward and banked to the right with an angle of approximately 20 degrees. This diagonal, height gaining lift-off resulted in the impact of the main rotor blades with the chairlift cable, at a distance of approximately 37 meters and at a height above the ground about 5 meters from the pilot's take-off point in the direction of flight.

The helicopter impacted the ground on its left side, with the tail boom detaching about three quarters of the circumference, the helicopter canopy being destroyed.

Following the occurrence, there were no victims. The chairlift cable was broken following the contact with the helicopter main rotor blades.

Coordinates of the accident: Latitude: 45°21'37.59"N  
Longitude: 22°28'27.54"E  
Altitude: 1680 m.
Chairlift installation pylon

Helicopter wreckage

Take-off point

Chairlift installation pylon

Fig. 2 – Occurrence Site
2. **SUPPLEMENTARY INFORMATION**

### 2.1 Helicopter Crew Data

<table>
<thead>
<tr>
<th>Role</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pilot</td>
<td>Male, 49 years old</td>
</tr>
<tr>
<td>Licence</td>
<td>RO.FCL/PPL/.../H, Valid</td>
</tr>
<tr>
<td>Medical certificate</td>
<td>Class 2, Valid</td>
</tr>
<tr>
<td>Flight experience</td>
<td>1890 hours, 1273 on type AS 350 B3</td>
</tr>
</tbody>
</table>

### 2.2 Helicopter Information

<table>
<thead>
<tr>
<th>Feature</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manufacturer and Type of the Helicopter</td>
<td>Airbus Helicopters – AS 350 B3 Écureuil</td>
</tr>
<tr>
<td>Serial number and the manufacturing year</td>
<td>4289 – 06.2007</td>
</tr>
<tr>
<td>State and Registration</td>
<td>Romania – YR-DEX</td>
</tr>
<tr>
<td>Owner</td>
<td>S.C. Dunca Expediții S.A.</td>
</tr>
<tr>
<td>Operator</td>
<td>S.C. Dunca Expediții S.A.</td>
</tr>
<tr>
<td>Airworthiness Certificate</td>
<td>Valid</td>
</tr>
<tr>
<td>Total flight hours, Landings</td>
<td>3694 flight hours / 9623 landings</td>
</tr>
<tr>
<td>Engine type, serial number</td>
<td>Arriel 2B1 - 46146</td>
</tr>
</tbody>
</table>

On December 15, 2014, Airbus Helicopters issued the SAFETY INFORMATION NOTICE number 2727-S-00 with the subject "Operational Conditions - Dangers Associated with Operating a Helicopter on the Ground Without a Qualified Pilot at the Controls".

The first edition of this document was issued in 2006 as a result it was decided to write in the helicopter Flight Manual a note stating that the pilot must not leave the aircraft with the rotors spinning.
This information was introduced in the Flight Manuals of the EC120, the EC130, and some Ecureuil versions by adding operational restrictions in Section 2 "Limitations", then in Section 4 "Normal Procedures".

Fig. 4 – LS No. 1788-62-06

Airbus Helicopters has recently released the SIN 3268-S-00 (November 15, 2018) to inform about unintentional lift-off of the helicopter from the ground without control inputs by the pilot and to remind the best practices for helicopters parked on the ground with spinning rotor.

Fig. 5 – SIN No. 3268-S-00
2.2.1 ELT Analysis

The helicopter was equipped with an ELT (Emergency Locator Transmitter) equipment. Following the impact of the helicopter with the ground, it was activated.

The first emergency message was received by the CC-SAR (Search and Rescue Coordination Centre) through the COSPAS-SARSAT system on 406 MHz at 15:10 LT (13:10 UTC) but without coordinates attached. At 15:45 LT (13:45 UTC) the second message was received this time with coordinates but with a distance from the accident site of about 2.4 km.

The fourth emergency message received by the CC-SAR at 18:23 LT (16:23 UTC) with the coordinates - 45 21.5 N 022 28.2 E was the most accurate, the distance from the accident site being 417 meters.
2.2.2 Meteorological Condition

Considering that there are no meteorological stations in the Borlova Slope area in the national meteorological surveillance network, the information provided by the National Meteorological Administration to the investigation commission are those recorded at the meteorological station on the Cuntu Peak, the closest in the area. The distance between the accident site and the meteorological station is about 10 km. The table below shows the hourly measurements between 14:00 - 16:00 LT.

<table>
<thead>
<tr>
<th>Hour</th>
<th>Temperature (°C)</th>
<th>Netralizitate</th>
<th>Vizibilitate verticală (km)</th>
<th>Viteză medie a vântului (ms⁻¹)</th>
<th>Viteză maximă a vântului în rafălu (ms⁻¹)</th>
<th>Direcția vântului</th>
<th>Fenomene meteorologice</th>
<th>Cuantitatea de precipitații (lunp)</th>
</tr>
</thead>
<tbody>
<tr>
<td>14</td>
<td>-1.7</td>
<td>5</td>
<td>=&gt; 50</td>
<td>2.5</td>
<td>5</td>
<td>SSV</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>15</td>
<td>-1.3</td>
<td>5</td>
<td>=&gt; 50</td>
<td>2.2</td>
<td>5</td>
<td>SSV</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>16</td>
<td>-1.4</td>
<td>5</td>
<td>=&gt; 50</td>
<td>2.5</td>
<td>5</td>
<td>SSV</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>17</td>
<td>-1.5</td>
<td>5</td>
<td>=&gt; 50</td>
<td>2.8</td>
<td>5</td>
<td>SSV</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>18</td>
<td>-2</td>
<td>5</td>
<td>=&gt; 50</td>
<td>3.1</td>
<td>8</td>
<td>SSV</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>19</td>
<td>-2</td>
<td>5</td>
<td>=&gt; 50</td>
<td>3.4</td>
<td>6</td>
<td>SSV</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>20</td>
<td>-1.5</td>
<td>5</td>
<td>=&gt; 50</td>
<td>5.4</td>
<td>11</td>
<td>SV</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>21</td>
<td>-1.1</td>
<td>5</td>
<td>=&gt; 50</td>
<td>1.3</td>
<td>6</td>
<td>VS</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>22</td>
<td>-0.5</td>
<td>5</td>
<td>=&gt; 50</td>
<td>4.2</td>
<td>2</td>
<td>SSV</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

Fig. 8 – Data recorded by the metro station on Cuntu Peak

It can be noticed that in the Cuntu Peak area, the maximum wind speed at 14:00 was 5 m/s from the SSV direction, the outside temperature was -1.7° C and the horizontal visibility was more than 50 km.

Fig. 9 – Pictures taken immediately after the accident
2.2.3 Portable AvMap GPS Examination

Considering the technical state in which the portable GPS was found, for activating and downloading the recorded data, it was sent to the manufacturer. These operations were performed successfully, with the investigation commission receiving a raw data file that was analysed.

2.2.4 VEMD Examination

The VEMD (Vehicle and Engine Monitoring Display) is a multifunction screen installed on the instrument panel and designed to display flight data and engine data. The VEMD is a dual module system. In each module, failure information, associated to flight parameters, can be stored on a non-volatile memory component for maintenance purposes. The relevant VEMD data for accident investigations are:

- Flight reports;
- Failure messages with associated dated parameters;
- Overlimits reports (overlimits are not dated).

The VEMD also records the last 8 Engine Power Checks (EPC) that are performed in flight to check the engine health according to the maintenance and flight manuals (EPC are not dated).

VEMD expertise - Vehicle Engine Monitoring Display has taken place at Airbus Helicopters Headquarters in Marignane - Marseilles, in the presence of the Investigation Commission representative, BEA accredited representatives and Airbus Helicopters experts. Expertise began with a session where the steps were set to follow.

![Fig. 12 – VEMD inspection](image)

The first step was to check the test bench to see if the connections between the VEMD and the test bench are compatible. This verification was done with a DEMO VEMD.

![Fig. 13 – The DEMO VEMD](image)
The VEMD was then powered and checked to see if the last flight (the flight of the accident) had closed correctly. The equipment records the last 31 flights.

The data relative to the last recorded flight were associated to the flight numbered 6826. This flight was associated to the flight of the event, and lasted 4 minutes. Flight duration is rounded, so that the flight time could have lasted between 3 minutes 30 seconds and 04 minutes 29 seconds.

Fig. 14 – The accident flight

The VEMD flight duration (computed in minutes) starts when the NG increases over 10% and ends when the NG decreases under 10%. Failures are only recorded during the FLIGHT engine phase.

Four failures and one over-limit were recorded during the flight. The recorded failures were summarized in the following two tables.

Fig. 15 – Recorded failure codes and overlimit

<table>
<thead>
<tr>
<th>Time</th>
<th>Label</th>
<th>NG (%)</th>
<th>NG FADEC (%)</th>
<th>TRQ FADEC</th>
<th>T4 (⁰C)</th>
<th>T4 FADEC (⁰C)</th>
<th>NF (rpm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>00 min 21 s</td>
<td>RUDDER PEDAL POTENTIOMETER (L)</td>
<td>60.2</td>
<td>61.4</td>
<td>4.7</td>
<td>657</td>
<td>648</td>
<td>91</td>
</tr>
<tr>
<td>03 min 53 s</td>
<td>COLL PITCH POT (L)</td>
<td>91.1</td>
<td>92.6</td>
<td>80.9</td>
<td>654</td>
<td>684</td>
<td>357</td>
</tr>
</tbody>
</table>

Table 1 – Failure codes recorded

<table>
<thead>
<tr>
<th>Time</th>
<th>Label</th>
<th>EOP (bar)</th>
<th>EOT (⁰C)</th>
<th>FQ (kg)</th>
<th>FT (⁰C)</th>
<th>FF (kg/h)</th>
<th>SLING (kg)</th>
<th>OAT (⁰C)</th>
</tr>
</thead>
<tbody>
<tr>
<td>03 min 54 s</td>
<td>OUT OF RANGE EOT (L)</td>
<td>3.13</td>
<td>156</td>
<td>249.1</td>
<td>-45</td>
<td>53.3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>03 min 54 s</td>
<td>OUT OF RANGE (R)</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
</tr>
</tbody>
</table>

Table 2 – Failure codes recorded

- NF is the free turbine rotation speed (N2), converted as a rotor rotation speed.
- TRQ is the torque value.
- NG is the gas generator rotation speed.
- T4 is the temperature measured at the exit of the gas generator chamber.
- EOP is the Engine Oil Pressure
- EOT is the Engine Oil Temperature
- FQ is the Fuel Quantity
- FT is the Fuel Temperature
- FF is the estimated Fuel Flow
- SLING is the mass of the sling
- OAT is the Outside Air Temperature

The recorded parameters are either measured by VEMD dedicated sensors or sent by the DECU/FADEC. In the second case, the parameter name is tagged with the “FADEC” mention.
"MAINTENANCE" Mode, “FAILURE” sub-mode

Failure code 1/4 – 120 RUDDER PEDAL POT L

This failure code appeared on the DECU left channel (L), It occurred at the flight duration of 0h 00min 21s for a total flight duration of 0h 04min.

This failure corresponds to a rudder pedal anticipator failure. It triggers when:

- There is a problem with the rudder pedal anticipator potentiometer.
- The measurement of the relative position of the rudder pedal anticipator potentiometer reaches its minimum (5 %) or maximum (95 %) thresholds or when its variation is above 950 % per second.

Failure code 2/4 – 122 COLL PITCH POT L

This failure concerns the collective pitch potentiometer. It appeared on the DECU left channel (L). It was at the flight duration of 0h 03min 53s for a total flight duration of 0h 04min.
This failure corresponds to a collective pitch potentiometer anticipator failure. It triggers when:

- There is a problem with the potentiometer.
- In this case, it is always possible to fly safely but the engine will take time to react the pilot request.
- The measurement of the relative position of the collective pitch potentiometer reaches its minimum (5%) or maximum (95%) thresholds or when its variation is above 350% per second.

These thresholds can’t be mechanically reached because of the collective pitch system design.

During crash sequence due to the ground contact, resulting structure deformation or/and main rotor blade contact with ground, Airbus Helicopters experience, that failure was usually one of the first failures recorded. At that time the engine is in “FLIGHT” mode.

**Failure code 3/4 – 68 OUT OF RNG EOT L**

![Fig. 18 – Failure code 3/4 – OUT OF RNG EOT L](image)

This failure concerns the engine oil temperature. It appeared on the DECU left channel (L). It was at the flight duration of 0h03min54s for a total flight duration of 0h04min.

This failure is triggered when the engine oil temperature value is lower than -50°C or higher than 150°C.

The associated parameters showed: engine oil pressure (EOP) 3,13bars and engine oil temperature (EOT) 156°C.
Failure code 4/4 – OUT OF RNG EOT R

This failure concerns the engine oil temperature. It appeared on the right channel (R). It was at the flight duration of 0h03min54s for a total flight duration of 0h04min. This failure is the same as failure 3/4 but on the other channel.

"MAINTENANCE" Mode, "OVERLIMIT" sub-mode

One free turbine speed overlimit (NF) has been recorded during this flight (the overlimits are not dated) which has reached 487rpm with a duration recorded of 1s. This free turbine speed overlimit is probably the consequence of the engine drive shaft rupture during the sequence of the accident (main rotor blades ground impact).
2.2.5 General Wreckage Examination

The helicopter wreck was located at the upper end of the chair lift installation on the Borlova Slope, halfway between the last two pylons of the installation, under its cables. The distance between pylons is about 60 meters. The wreckage was found overturned on the left side, on a hard ground covered by a thin layer of snow. The installation cable was found broken and fell over the wreck of the helicopter.

![Fig. 21 – Wreck position and the broken chairlift cable](image1)

All the aircraft's parts and component were accounted for and located in the immediate vicinity of the main wreckage.

The tail boom was found attached to the wreckage just a quarter of the circumference. The left side horizontal stabilizer exhibited damage/deformation due to contact with a hard surface and was intact on its right side. The tail rotor blades didn’t exhibit any visible damage or deformation.

![Fig. 22 – The detached tail boom](image2)
The main gearbox was disconnected from the engine transmission, displaced from the helicopter's mounting position, the suspension bars being broken.

The nose lower left side of the cabin was damaged. The right front door has been damaged and broken.
2.2.6 Engine Examination

The Arriel 2B1 engine is a turboshaft engine with a single-stage axial compressor, a single-stage centrifugal compressor, an annular combustion chamber, a single stage high pressure turbine, a single stage power turbine, and a reduction gearbox with a nominal output at 6000 rpm.
The engine is composed of 5 modules:

- Module M01: Transmission shaft and accessory gearbox;
- Module M02: Axial compressor;
- Module M03: Gas generator (high pressure section);
- Module M04: Power turbine;
- Module M05: Reduction gearbox.
2.2.7 Check of the Engine M05 Drive Nut Markers

Dismantling and inspection took place at Safran Turbomeca Engines headquarters in Tarnos, France, in the presence of the representative of the investigation commission and the Safran expert.

Removing the M05 engine module was aimed at inspecting the markings on the splined drive nut mounted on the drive gear’s shaft transmission under "muff coupling".

The activity started with a short briefing where the steps to be taken were established. The engine was mounted on a special stand and all accessories were removed. The next step was to dismantle the M05 module and inspect the two markers.
Fig. 30 – The two aligned markers

The two markers were aligned. This indicates that the engine has not been overloaded.

2.2.8 Engine to Main Gear Box (MGB) Coupling Assembly Examination

The engine was not connected to the main gear box - MGB. The coupling tube exhibited interference traces with the drive shaft flange (MGB input). The flexible coupling in the MGB input connection was completely destroyed by overtorque.
Engine output  MGB input  Coupling tube

Flange to Engine output  Flange to MGB input

Drive shaft

Fig. 32 – Engine – MGB transmission assy.
2.2.9 The Engine’s Controls

The twist grip was in the “FLIGHT” position. This is the normal position during flight. The collective lever was not secured.

Fig. 33 – the collective unsecured, the twist grip position in “FLIGHT”

The starting selector was in the “ON” position with the guard in the folded down position. This is the normal position during flight.

Fig. 34 – Starting selector switch
The fuel shut-off valve handle was not activated (red handle).

2.2.10 Tail Rotor Drive Shaft Assemblies Examination

Power is transmitted from the engine rear power takeoff to the tail rotor via:
- a forward drive shaft (1)
- a rear drive shaft (2)
- a tail gearbox (3)

Fig 36 – Schematic diagram of the tail rotor drive shafts
The engine output flange, the flexible coupling and the forward steel shaft flange exhibited a high deformation.

![Image of engine output flange]

Fig. 37 – The engine transmission output to the tail rotor

The rear shaft cowling after dismantling exhibited damages visible inside (not visible outside due to the thermal protection) due to interference with the forward steel shaft of the rear drive shaft which has been disconnected to the splined shaft and free to move.
The disconnection of the splined junction is possible with:

- Failure of the engine output flexible coupling (not our case)
- High deformation of the tail boom.

The forward steel shaft exhibited traces of circular rubbing compatible with a splined junction disconnection and a shaft rotation during the crash.

After the splined disconnection, the forward steel shaft is only connected to the engine output and is not guided in its rotation generating interference with the structure, the coupling, the splined shaft (for the splined flange area) and with the rear firewall (for the tube).

Without guide and with rotation of the forward steel shaft, an unbalancing load is generated and the engine output flexible coupling ends to break.
2.2.11 Seats Examination

All the seats were correctly fitted on the mechanical floor. No seats were deformed or had failures. The shock absorption system installed on the seats was inspected. It was not activated.
This sliding device is used to guide the seat pan/back in case of vertical crash when the acceleration is high. In case of vertical crash, a lower fixed structure fitted on the seat pan deforms and the seat pan/back moves downward in order to limit the acceleration of the occupant and so the compression load applied on its spine.

The sliding is generally unsymmetrical because the acceleration is never purely vertical and/or the occupant weight is never strictly positioned on the middle of the seat.

The damages of the aircraft in this event were not compatible with a vertical acceleration able to activate this device.

The activation of this device can occur when a load is applied laterally on the seat back. This can occur if an occupant is on the seat with the belts or if a rear seat occupant impacts the seat in the case of a forward/lateral impact of the aircraft.

2.2.12 Main rotor blades examination

Fig. 42 - Blue blade

Fig. 43 - Red blade
Evidences shows the blue blade has impacted the first part of the cable which is consistent with the blade extremity completely destroyed. The cable cut led to the drop of the second part cable on the red and yellow blades leading to the destruction of theirs trailing edges.

The first blade (blue) impact with the cable led to damage the associated main rotor head arm (starflex, sleeves, etc.) and the engine / main gear box coupling.

This is consistent with the no-damage of the yellow and red main rotor head arms. The blades exhibited failure of the trailing edges by compression and low deformation of the leading edges.

3. ANALYSIS
The helicopter’s ability to move in any direction or rotate 360 degrees makes piloting a helicopter to require good coordination in movement. It takes both hands and both feet in a permanent and coordinated motion to fly a helicopter.

To control a helicopter, the pilot grips the cyclic in one hand, the collective in the other. At the same time, his feet must operate the foot pedals that control the tail rotor, which allows the helicopter to rotate in either direction on its horizontal axis.

During take-off, the pilot works the collective and the foot pedals simultaneously. The twist grip controls the power output of the engine, increasing or decreasing the speed of the main rotor. To make a helicopter take-off, the following commands are executed:

1. The pilot moves the twist grip from "IDLE" to "FLIGHT" position;
2. Then slowly lift the collective lever to increase the pitch of the main rotor blades;
3. As the pilot increases collective pitch, he depresses the right foot pedal to counteract the torque produced by the main rotor.
4. The pilot keeps pulling up slowly on the collective while depressing the left foot pedal to keep the helicopter in the take-off direction by controlling the cyclic.
5. When the amount of lift being produced by the rotor exceeds the weight of the helicopter, the aircraft will get light on its skids and slowly leave the ground.

For hoovering flight or very low speed flight, to prevent a quick turn to the left of the helicopter the pilot should immediately actuating the right pedal with the required amplitude.
To perform a directional flight, the pilot must tilt the cyclic forward. When the helicopter reaches about 15 to 20 knots of forward speed, the helicopter starts to move from a hovering flight to a full forward flight. At this point, as the speed increases, the pilot progressively adjusts the position of the pedals in order to maintain the flight direction.

The Investigation Commission tried to determine the helicopter dynamics taking into account the pilot's statement, namely:

- The pilot outside the helicopter, on the left-hand side;
- The twist grip on the collective in the "FLIGHT" position;
- The collective not secured;
- Friction applied to the cyclic.

When friction is not applied to the collective and this is not secured, due to engine helicopter vibrations, the collective can change its position. The result is the change of the main rotor blades pitch and the increase of the load, thus the helicopter is lifting off.

If the position of the cyclic is not altered from the one that it has on the ground, during the lifting from the ground, the helicopter will tend to move in the direction of its position.

Also, if the right pedal is not actuated to counteract the reactive torque of the main rotor, the helicopter will rotate about its vertical axis to the left.

In conclusion, in the case of an uncommand lift off, the helicopter dynamics would be the following: the collective rises slightly, the main rotor blades pitch changes, the rotor produces a load, the helicopter partially lifts off, inclined to the position of the cyclic and rotates about its vertical axis to the left due to the increase in the reactive torque of the main rotor, the result will be the aircraft turn/roll over.

The Investigation Commission has studied similar accidents that happened in the last twenty years, similar with the details provided by the pilot:

- AS350B2 SN2684 F-OGUZ Guyana 17/07/2000;
- AS350B3 SN3209 HB-ZBN Switzerland 09/10/2001;
- AS350B2 SN2345 OE-XRR Austria 01/09/2009;
- AS350B2 SN4419 ZK-IMS New Zealand 06/05/2010;
- AS350BA SN2473 ZK-HBD New Zealand 23/09/2010;
- AS350BA SN1132 ZK-HKU New Zealand 09/08/2012;
- AS350B3e SN7718 N840PA SUA 18/05/2014.

In the accident on 18 May 2014 in Grand Canyon, Peach Springs, Arizona involving the registered N840PA, type AS350B3E helicopter, it was equipped with an Appareo Vision 1000 equipment that allows video and audio recording of the cockpit and with an Engine Data Recorder (EDR) that allows recording the engine operating
parameters. These devices allowed the accident investigation commission to analyse in detail the helicopter dynamics.

Fig. 47 – The wreckage of N840NPA

Thus, after the pilot has left the helicopter by leaving the collective lever and the engine started in the "FLIGHT" position, the blade step has changed, the helicopter has partially become airborne, with nose down attitude bank to the right side and turning the nose to the left until the main rotor blades touched the ground.

Fig 48 – Ground scars in front of the fuselage from the main rotor blade strikes

On 06.05.2010 the pilot of the AS 350 B2 helicopter, registered with ZK-IMS, landed the helicopter in order to attach a cable to carry out a lifting operation. While the pilot was out of the helicopter, with the twist grip in “FLIGHT" and the collective lever unsecured, a gust of wind rotated the helicopter, pushing a skid toward lower ground, causing it to roll over.
In similar accidents studied by the investigative commission, the helicopters involved did not lift-off the ground and did not fly directionally with height gaining.

In the accident involving the YR-DEX helicopter, the helicopter deformations are compatible with the main rotor blades contact with the chairlift cable. After contacting the blades with the installation cables, the helicopter impacted the ground with the nose lower left side, then resting on its left side.

The Investigation Commission could not determine accurately the flight phase in which the main rotor blades touched with the cables of the chairlift installation.

Following the analysis of the helicopter wreckage and electronic equipment fitted, no anomalies were observed in the helicopter structure, electronic equipment or its control systems before the accident occurred.

4. CONCLUSIONS

4.1 Findings

1. The pilot held the Flight Crew License, Medical Certificate and General Radio Operator Certificate, all within validity;

2. The helicopter registered YR-DEX was in possession of a valid Airworthiness Certificate;

3. The maintenance records revealed that the helicopter was equipped and maintained according to the regulations and procedures applicable for this type of aircraft;
4. The helicopter was not equipped with flight recorders (FDR and CVR). The equipping with these recorder types is optional according to the regulations in force;

5. The helicopter was equipped with an ELT (Emergency Locator Transmitter) equipment. Following the impact of the helicopter with the ground, it was activated;

6. The data relative to the last recorded flight were associated to the flight numbered 6826. This flight was associated to the flight of the event, and lasted 4 minutes. Flight duration is rounded, so that the flight time could have lasted between 3 minutes 30 seconds and 04 minutes 29 seconds;

7. It was no fire on board of the helicopter after the impact;

8. The engine was not connected to the main gear box – MGB, the flexible coupling in the MGB input connection was completely destroyed by overtorque;

9. The forward steel shaft of the tail rotor drive exhibited traces of circular rubbing compatible with a splined junction disconnection and a shaft rotation during the crash.

10. The twist grip was in the “FLIGHT” position. This is the normal position during flight;

11. The collective lever was not secured;

12. The starting selector was in the “ON” position with the guard in the folded down position. This is the normal position during flight;

13. The fuel shut-off valve handle was not activated;

14. No elements have been identified indicating an abnormal operation of the engine before impact;

15. Following the analysis of the helicopter wreckage and electronic equipment fitted, no anomalies were observed in the helicopter structure, electronic equipment or its control systems before the accident occurred.

4.2 The cause of the accident

The probable cause of the accident is erroneous assessment of the distance between the main rotor blades and the chairlift cable during flight, which has caused the contact between the blades and the cable.

The Investigation Commission could not determine accurately the flight phase in which the main rotor blades touched with the cables of the chairlift installation.

4. SAFETY RECOMANDATION

Following this accident, the investigative commission does not issue safety recommendations.
Note: The analysis documents and objects used to prepare the safety investigation report are confidential and are archived to the Civil Aviation Safety Investigation and Analysis Authority (AIAS), in accordance with the legal provisions.