



**COMISIÓN DE
INVESTIGACIÓN
DE ACCIDENTES
E INCIDENTES DE
AVIACIÓN CIVIL**

**Report
A-031/2016**

Accident involving a PZL W-3AS aircraft,
registration SP-SUC, operated by
Hispánica de Aviación at Pico del Cabrito
in the town of Villa de Mazo
(Santa Cruz de Tenerife, Spain)
on 10 august 2016



GOBIERNO
DE ESPAÑA

MINISTERIO
DE FOMENTO

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Foreword

This report is a technical document that reflects the point of view of the Civil Aviation Accident and Incident Investigation Commission (CIAIAC) regarding the circumstances of the accident object of the investigation, and its probable causes and consequences.

In accordance with the provisions in Article 5.4.1 of Annex 13 of the International Civil Aviation Convention; and with articles 5.5 of Regulation (UE) n° 996/2010, of the European Parliament and the Council, of 20 October 2010; Article 15 of Law 21/2003 on Air Safety and articles 1.4 and 21.2 of Regulation 389/1998, this investigation is exclusively of a technical nature, and its objective is the prevention of future civil aviation accidents and incidents by issuing, if necessary, safety recommendations to prevent from their reoccurrence. The investigation is not pointed to establish blame or liability whatsoever, and it's not prejudging the possible decision taken by the judicial authorities. Therefore, and according to above norms and regulations, the investigation was carried out using procedures not necessarily subject to the guarantees and rights usually used for the evidences in a judicial process.

Consequently, any use of this report for purposes other than that of preventing future accidents may lead to erroneous conclusions or interpretations.

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Abbreviations

° ' "	Sexagesimal degrees, minutes and seconds
° C	Degrees centigrade
AEMET	Spain's National Weather Agency
AESA	Spain's National Aviation Safety Agency
AMC	Acceptable Means of Compliance
ATPL (H)	Airline Transport Pilot License (Helicopter)
BRIF	Forest Firefighting Support Squad
cm	Centimeters
CPL(H)	Commercial pilot license (helicopter)
CRM	Crew resource management
CVR	Cockpit voice recorder
DGAC	Spanish Civil Aviation General Directorate
EASA	European Aviation Safety Agency
ECAE	Evaluation for Aeronautical Communications in Spanish
EHEST	European Helicopter Safety Team
EHSIT	European Helicopter Safety Implementation Team
ELT	Emergency locator transmitter
FAA	Federal Aviation Administration (USA)
FCL	Flight Crew Licensing
FCP	Forward Command Post
FDR	Flight data recorder
FF/SAR	Firefighting/Search and Rescue
FI (H)	Flight Instructor (Helicopter)
GM	Guidance material
GPS	Global positioning system
h	Hours
IAS	Indicated airspeed
ICAO	International Civil Aviation Organization
IR	Instrument rating
JAR-FCL	Joint Aviation Regulations – Flight Crew Licenses
Kg	Kilograms

Km/h	Kilometers/hour
Kt	Knots
l	Liters
LAPL (H)	Light Aircraft Pilot License (Helicopter)
LBA	Luftfahrt Bundesamt (German Civil Aviation Authority)
LTE	Loss of tail rotor effectiveness
m	Meters
MAGRAMA	Ministry of Agriculture, Food and the Environment
Min	Minutes
Mm	Milimeters
N/A	Not affected / Not available
OSN	Operation Safety Notice
Psi	Per square inch
PPL (H)	Private Pilot License (Helicopter)
s	Seconds
SENASA	Servicios y Estudios para la Navegación Aérea y la Seguridad Aeronáutica – Services and Studies for the Air Navigation and Aeronautical Safety
SIB	Safety Information Bulletin
SN	Serial number
UTC	Coordinated universal time

Synopsis

Owner:	LPU "Heliseco" Sp. z o.o. ¹
Operator:	Hispánica de Aviación
Aircraft:	PZL W-3AS, registration SP-SUC
Date and time of accident:	10 August 2016 at 16:50 ²
Site of accident:	Pico El Cabrito, Villa de Mazo (Santa Cruz de Tenerife, Spain)
Persons onboard:	2, not injured
Type of flight:	Aerial work – Commercial - Firefighting
Phase of flight:	En route
Date of approval:	29 th March 2017

Summary of the event:

On Wednesday, 10 August 2016, at approximately 16:50 local time, a PZL W-3AS aircraft, registration SP-SUC, was involved in an accident while taking part in firefighting activities.

The aircraft, which was at the Forest Firefighting Support Squad (BRIF) base in the town of Puntagorda, on the island of La Palma, was mobilized at around 15:00 to take part in firefighting efforts in the town of Villa de Mazo.

After making 12 drops in the area, the forward command post instructed its crew to proceed to a different point from the last one but where they had already made a drop. While executing the approach maneuver to make a drop at that point, the helicopter started to yaw left at an increasing rate, eventually becoming uncontrollable.

The aircraft crashed into the mountainside and was significantly damaged. The two occupants were taken to a hospital for observation.

¹ In 2008, Hispánica de Aviación purchased the Polish company Heliseco Ltd.

² All times in this report are local. To obtain UTC, subtract 2 hours from local time.

The investigation has concluded that this accident was likely caused by a loss of tail-rotor effectiveness (LTE), which the pilot was late in identifying, resulting in a loss of control of the helicopter, which ended up impacting the terrain.

Contributing to the accident is the fact that the water was not dropped and the bucket was not released.

1. FACTUAL INFORMATION

1.1. History of the flight

The base at Puntagorda, which is located in the town of Puntagorda (on the island of La Palma), was included in the firefighting forces of the Ministry of Agriculture, Food and the Environment (MAGRAMA) for the year 2016.

Two PZL W-3 AS helicopters operated out of this base, including the accident helicopter, registration SP-SUC.

These helicopters were assigned to take part in firefighting efforts both by transporting firefighting brigades (BRIF) and by dropping water from a bucket suspended from an external cargo hook.

As they had done on other days, after resting at night, the crew of the accident helicopter reported to the Puntagorda base at 09:30 to start their shift. Once at the base, the crew conducted the pre-flight check and left the helicopter ready to fly.

At 15:00, the helicopter was activated as part of a mission to cool off hot spots in a fire that had broken out in Villa de Mazo (on the island of La Palma). At 15:12, the helicopter took off with 1,100 l of fuel. After a 20-minute flight, it reached the area of operations and once there, the crew contacted the Forward Command Post (FCP) to receive their instructions to aid in fighting the fire.

The water was loaded on from an artificial concrete pond located some 1,800 m south of the area of operations.

After making 12 drops at their assigned points, the FCP informed them that their next drop would be at a different point, but one where they had already made a drop. This time the drop would not be over a wide area, but at a specific location, which required them to fly over at low speed.

After loading the water, they proceeded to the location, which was north of the pond. To reach it they flew in an arc to the east so as to make the drop run on an approximate course of 260°.

According to the voice recorder, the crew had problems finding the smoke, which was issuing from a tree trunk that was not in flames.

On this last drop, as per the crew's statement, they approached the drop site with a left tail wind, maintaining their altitude at an approximate speed of 30 kt.

In the last segment, what started as a slight turn to the left developed into a high left-yaw rate situation.

The pilot flying unsuccessfully attempted to control the left turn by applying right pedal.

The left turn rate was increased in part by the moment of inertia produced by the bucket, which had 1,100 l of water and a turn radius of approximately 6 m. During the turn the crew attempted to open the bucket but were unable to do so.

During the descent, the helicopter first struck a pine tree, which lowered its turn rate, and then another pine tree, which stopped the descent.

Once the helicopter came to a stop, the pilot stopped the engines and he and the operator exited the aircraft under their own power.

Once outside they saw that there was smoke issuing from the left engine, and even though the automatic fire extinguisher had discharged into the engine, they finished putting out the fire with a portable extinguisher they had onboard.

1.2. Injuries to persons

Injuries	Crew	Passengers	Total in the aircraft	Other
Fatal				
Serious				
Minor				N/A
None	2		2	N/A
TOTAL	2		2	

1.3. Damage to aircraft

The aircraft sustained significant damage.

1.4. Other damage

Several pine trees were damaged by the helicopter.

1.5. Personnel information

1.5.1. Information on the pilot

The pilot, a 61-year old French national, had a commercial pilot license (CPL(H)) issued by the French civil aviation authority on 28 May 2008 and a W-3 Sokol SP rating, valid until 30 June 2017.

He also had a class-1 medical certificate that was valid until 19 February 2017.

In addition, he had a certificate issued by SENASA on 20 May 2015, indicating that he had taken the ECAE exam, ICAO level 4 (Spanish).

He also had a certificate of proficiency in FF/SAR activities issued by Hispánica de Aviación on 23 June 2016, which attested to the pilot's proficiency in doing the following activities as part of firefighting operations: observation and patrol, coordination, helicopter water drops and transfer of additional specialized personnel.

On the day of the accident he had 5359 total flight hours, 360 of which had been in firefighting operations. The pilot had 388 hours on the helicopter type and had taken part in four firefighting campaigns.

As for his activity prior to the accident, he had flown 16 min on 9 August and 1:33 hours on 10 August.

1.5.2. Information on the firefighting operator

The pilot was accompanied by a firefighting operator who was a 35-year old Spanish national. The operator had a commercial pilot license (CPL(H)), though he was not rated on the accident helicopter type. He had 200 flight hours. This was his second firefighting campaign.

1.6. Aircraft information

The PZL W-3AS aircraft, registration SP-SUC and serial number 30.02.01, was manufactured in 1986 and registered in the Civil Aviation Registry of Poland on 15 May 1991. The aircraft was equipped with two PZL-10W engines. The right engine had serial number 810W734AS and the left engine 119901004AS.

Its landing gear consists of three non-retractable legs, one at the nose with two wheels, and two at the rear, with one wheel each, making up the main gear.

It was outfitted with two rotors in a conventional configuration, a main rotor to provide lift and an anti-torque tail rotor. The main rotor turned clockwise when viewed from above.

It had an empty weight of 4017 kg. At the time of the accident, the amount of fuel onboard was estimated to have been about 500 liters, and the aircraft's total weight, with the bucket full of water, was 5800 kg. The aircraft's maximum takeoff weight for the density altitude conditions was 6300 kg.

The helicopter's weight and balance were inside the parameters specified in the flight manual for the duration of the accident flight.

The aircraft accident had a Certificate of Airworthiness that was issued in December 2014 by Poland's Civil Aviation Authority. The Airworthiness Review Certificate had also been issued by Poland's Civil Aviation Authority on 26 February 2016, and it was valid until 28 April 2017. At the time that the Airworthiness Review Certificate was issued the aircraft had 4251 flight hours.

On the day of the accident, the aircraft had 4321.62 hours.

On the day of the accident, the left engine had:

1. 3589.40 h and 3225 cycles since new
2. 1227.44 h and 1196 cycles since overhaul
3. 272.56 h and 1054 cycles remaining until its next 1500-h inspection.

On the day of the accident, the right engine had:

1. 3486.72 h and 2531 cycles since new
2. 1084.49 h and 1362 cycles since overhaul
3. 415.51 h and 888 cycles remaining until its next 1500-h inspection.

On 6 August, Hispánica de Aviación carried out the final inspections of the aircraft, which had been a 25-h check of the airframe and both engines.

1.7. Meteorological information

AEMET has provided meteorological information for Villa de Mazo. At the time of the accident, the temperature was 28.5° C, the dewpoint 19° C, the relative humidity 56%, there was no precipitation and the wind was from 0° at 22 km/h, gusting to 32 km/h.

In their statement, the crew declared that on a course of 260°, they had a tailwind from the left. In the recordings, the crew calculate that the windspeed was close to 20 kt, which means that the tailwind would have been from the second quarter at approximately 20 kt.

Due to the rough terrain and to the frequent changes in windspeed and direction caused by the high temperatures at the site of the fire, the meteorological information provided by AEMET does not coincide with that reported by the crew.

1.8. Aids to navigation

There is no radar track for the accident helicopter; however, the helicopter had a GPS Garmin GPSmap 296 device installed, serial number 10704012, which was used to obtain the helicopter's flight path in the final instants before the accident.

The image below shows the helicopter's penultimate trajectory in red and its final trajectory in yellow:

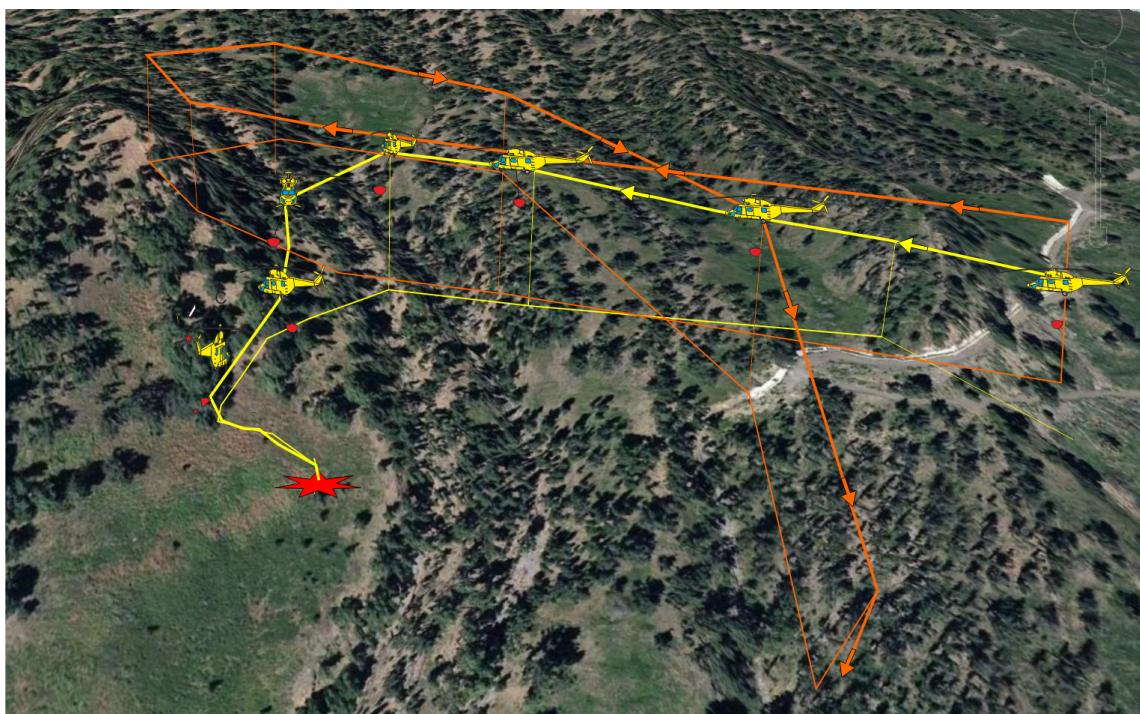


Figure 1. Helicopter flight paths

1.9. Communications

The communications between the pilot and the operator were relevant to the firefighting activity at all times. Similarly, the communications between the operator and air control services in La Palma were also consistent with said activity.

The communications do not reveal any technical problems with the aircraft.

1.10. Aerodrome information

The aircraft took off from the BRIF base in the town of Puntagorda.

This facility, which is owned by the Government of the Canary Islands, is run by the La Palma Council. The base at Puntagorda has two large 40x80 meter pads, and thus a capacity for two helicopters.

An aerial view of the Puntagorda base is shown below:



Figure 2. BRIF base at Puntagorda

1.11. Flight recorders

The accident helicopter had a CVR, with SN 00874, and an FDR, with SN 80427.

As concerns the CVR, the essential parts from the recordings have already been incorporated into the text of the report and are not repeated in this section.

The FDR showed that the pilot flying attempted to control the turn to the left.

The graph below shows the values of the following variables during the last minute before the impact:

- Psi shows the heading in degrees, from 0° to 360° .
- Xrp shows the position of the right pedal, ranging from 83 mm with the right pedal forward and 77 mm with the right pedal back.
- Xcoll shows the position of the collective pitch control, whose value ranges from 0 to 300 mm.
- Xlong shows the longitudinal displacement of the cyclic pitch control, whose value ranges from ± 138 mm. When the cyclic pitch is moved forward, this value is negative.
- Xlat shows the lateral displacement of the cyclic pitch control, whose value ranges from ± 111 mm. When the cyclic pitch is moved to the right, this value is negative.

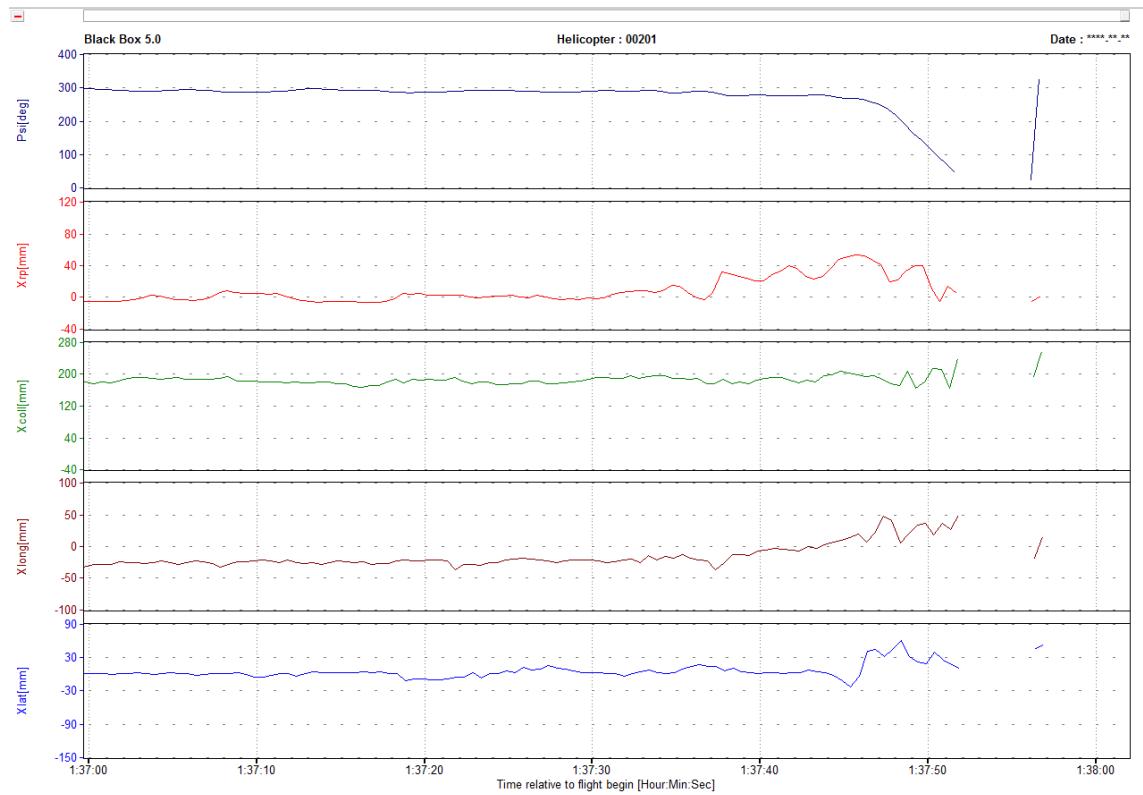


Figure 3. Inputs to the controls

At 1:37:43 into the flight, the helicopter started to turn left. The turn continued until the impact, which must have occurred 9 seconds later, 1:37:52 into the flight.

The pilot reacted initially by applying right pedal³ to compensate for the left turn. Then, 1:37:46 into the flight, the inputs to the right pedal exhibit oscillations, probably resulting from the pilot's loss of control of the helicopter.

At the same time, the pilot moved the cyclic control back⁴, which lowered the speed, and to the right⁵ to compensate for the turn. The motion of the cyclic control then oscillated erratically.

Simultaneously, the pilot raised the collective pitch control⁶ to increase power. Subsequently, the collective pitch also exhibited large oscillations.

³ A sharp increase in Xrp in the graph.

⁴ In the graph, the variable Xlong increases and takes on a positive value.

⁵ In the graph, the variable Xlat decreases and takes on a negative value.

⁶ In the graph, the variable Xcoll increases.

The following variables are shown below:

- Psi, which is the heading in degrees, from 0° to 360°
- TQ1 and TQ2, which indicate the power provided by the engines. These variables range from 0 to 140%.
- IAS, or indicated airspeed, which ranges from 60 to 400 km/h.

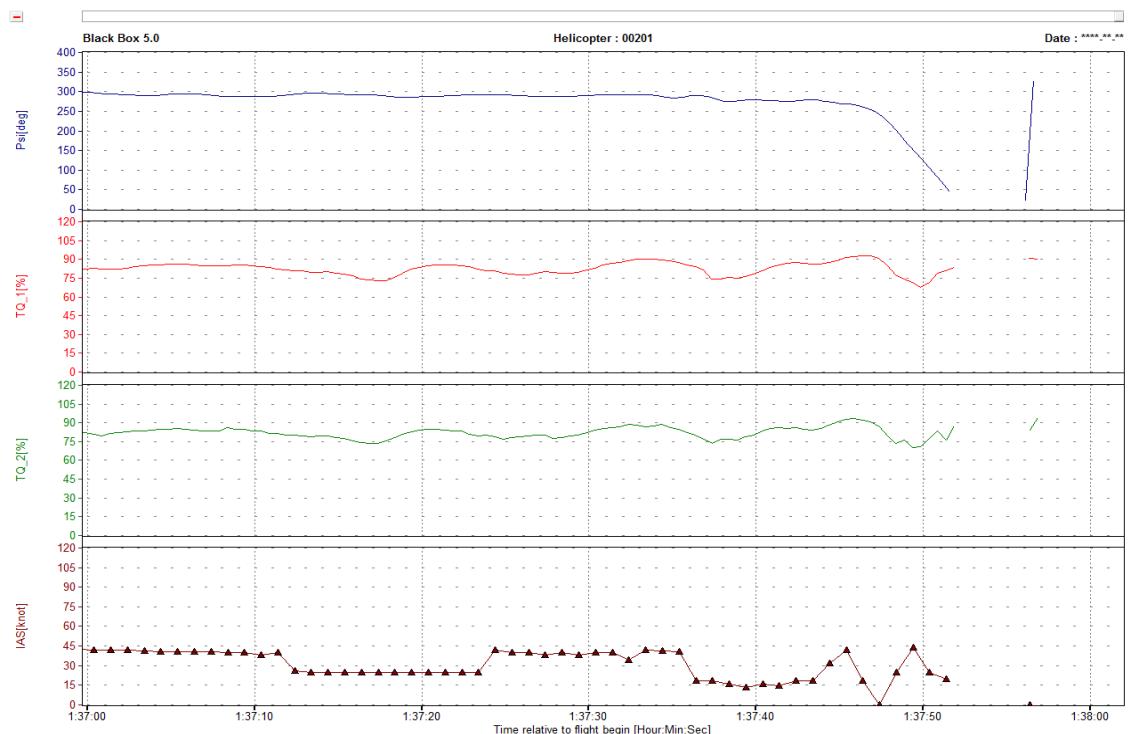


Figure 4. Graphs of the power and speed

The graph shows that after raising the collective pitch, the power in both engines went up. Then, 1:37:46 into the flight, the power in both engines started to oscillate.

The indicated airspeed 1:37:43 into the flight was approximately 15 knots. Initially an increase in the IAS is exhibited, before it, too, starts to oscillate.

1.12. Wreckage and impact information

As the aircraft descended at high speed while spiraling to the left, the main rotor blades impacted a 20-m tall pine tree, which was also struck by the tail rotor blades. The bucket, which was full of water, also struck a medium-height tree as it swung left. The impact was so strong that it broke a 20-cm diameter branch.

In this area, labeled A in the diagram below, there was a large amount of debris, as described later.

Then, as the helicopter continued its turning descent, the tail boom struck another 20-cm thick pine tree, uprooting it. This tree was found underneath the helicopter. The bucket, which was still hooked to the external load hook, remained attached by the suspension cable to this other tree, in which the last third of the tail boom was also caught. It was the helicopter striking and being caught by the tree that must have stopped it from continuing to slide downhill.

Labeled B in the diagram is an area between the two trees hit by the helicopter that was dug up, probably by the landing gear wheel that had broken off where it attached to the fuselage. Since the ground was not hard, the hole's depth was about 40 cm. This impact with the ground probably absorbed some energy, thus helping bring the helicopter to a stop.

The helicopter was found resting on its left side.

The main wreckage was distributed in two areas separated by some 45 m, with a ground inclination of 90%.

The tail rotor blades, broken at various points, were found in a wide area around the first pine tree. This top area in the diagram is labeled A.

At the bottom area, labeled C, the helicopter was found resting on its left side. There was impact damage to the main rotor head and part of the three blades were detached at the root. Most of the fourth blade was found halfway between the two pine trees. The tail cone, which was severed near where it connects to the fuselage, was only attached by the control cables that move the tail rotor. The tail rotor head was attached to its shaft, though two of the three blades were severed at the root. The screws on the tail rotor head contained bits of wood, indicating that it struck the tree while it was rotating.

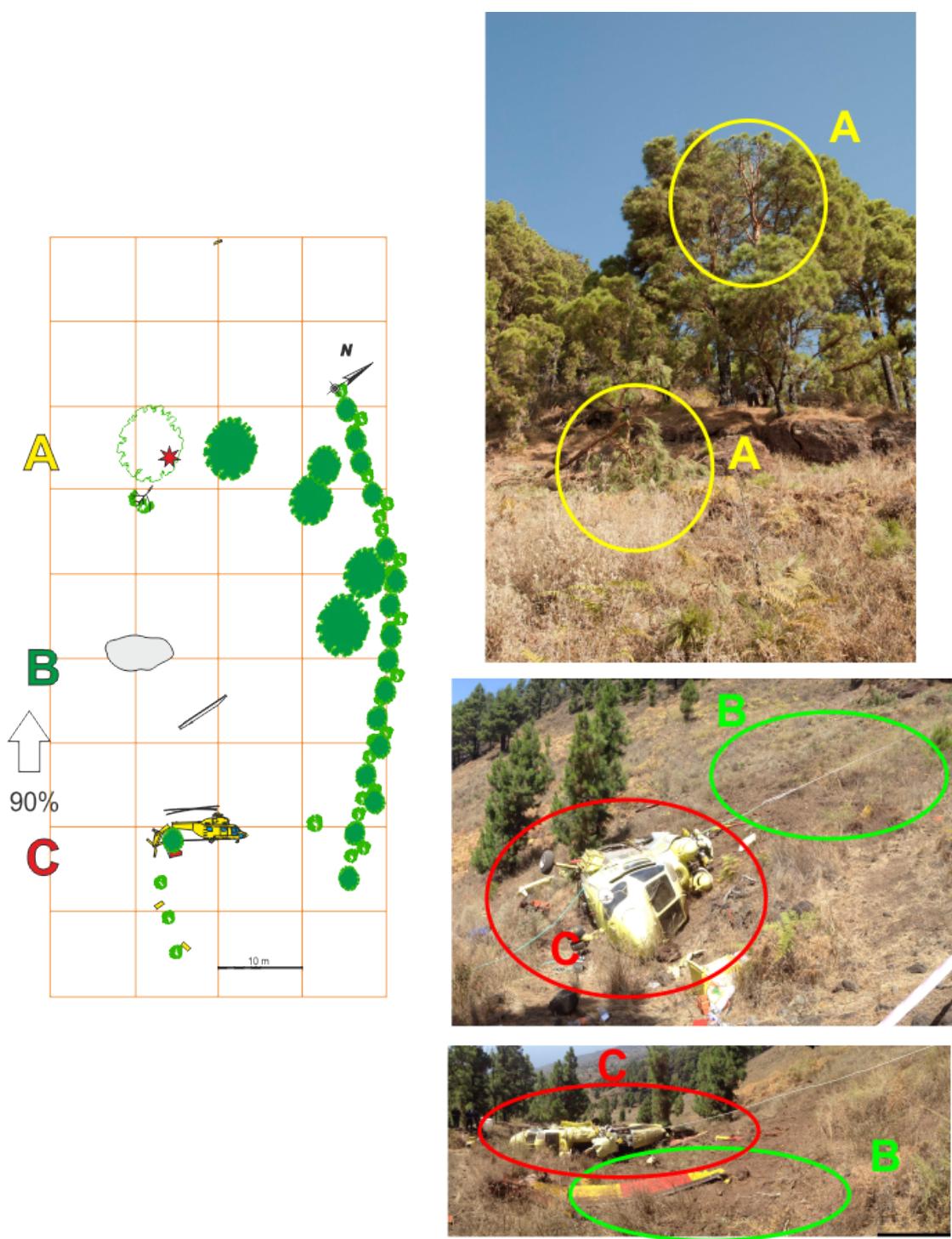


Figure 5. Diagram of the aircraft wreckage

1.13. Medical and pathological information

There are no signs that the pilot was incapacitated or that his actions were hampered by any physiological factors.

1.14. Fire

A fire broke out in the no.2 (left) engine that was extinguished by the crew and by the automatic engine fire suppression system.

1.15. Survival aspects

The aircraft had an ELT beacon, but its antenna broke when the helicopter impacted the ground, and as a result the beacon did not broadcast a signal.

The cockpit retained its shape during the impact; even the windows were intact.

1.16. Tests and research

1.16.1. Pilot's statement

The pilot stated that on Wednesday, 10 August, he was at the BRIF base in the town of Puntagorda at 09:30 in the morning to report for duty. At about 15:00 he was told that they had to sortie to take part in firefighting activities in the town of Villa de Mazo. Twelve minutes later they took off from the base at Puntagorda on a southerly heading to the area indicated.

Twenty minutes into the flight they contacted the Forward Command Post for the fire, which informed them of four points where they needed to make water drops. They proceeded to reconnoiter the area and assess the points where the water drops were required. They then took on water from a pond located in the town of Mazo.

After flying for approximately 1:35 hours, they had made a total of 12 drops. The forward command post then instructed them to proceed to a point where they had made a drop earlier. They picked up water from the same pond as for previous drops.

The area where they were instructed to drop water was a hot spot caused by pine, the base of which was smoldering. To make the drop, he commenced the run with a tailwind from the left at an approximate speed of 35-40 kt at a constant altitude. The bucket was loaded with approximately 1100 l of water.

During the run to make the drop, the helicopter started to yaw left and an increasing rate.

He attempted to control the turn rate. He applied right pedal, lowered the collective to decrease power and at the same time moved the cyclic forward to increase speed in an effort to use the vertical stabilizer to help control the aircraft. This maneuver lowered its altitude and brought the helicopter closer to the ground. Due to the proximity of the terrain, the power and speed corrections were no longer effective and the helicopter became uncontrollable. They continued to lose altitude and the left side of the helicopter ended up impacting the hillside.

He instructed the operator to release the water, but he was unable to actuate the release system.

The helicopter fell from an altitude of 50 or 60 meters. When it started to yaw their speed was low and there was a slight tailwind. He added that despite the tailwind, the only way to make the drops was to approach on a descending trajectory, as he had done without any problems on the previous drops.

After the impact he stopped the turbines and the fuel pumps and valves. They then evacuated the helicopter via the copilot's door.

The pilot was asked if he had detected any malfunctions or had received any fault warnings since the first flight that day, and he replied that during the power test he felt the aircraft rolling on the ground. This motion was not noticeable while in flight. He added that there were no fault warnings during the flight, and specifically no malfunctions of the hydraulic system, the pressure of which was normal.

He was also asked if he had any problems with the flight controls, in particular with the pedals. He stated that when he took on water, the helicopter yawed to the left, but while flying with a load of water in the line of flight, the left yaw was not present. He had not noticed this effect in the days prior to the day of the accident. The pilot was easily able to compensate for the left yaw by applying right pedal.

The pilot added that the engines were working correctly.

Two days before the accident, he conducted a test flight after replacing the main rotor head. The test flight lasted 15 minutes. The flight required him to accelerate at sea level. During the flight the pilot did not detect anything out of the ordinary.

Lastly, the pilot was asked what could have caused the accident, and he answered that the tail rotor could have lost effectiveness.

1.16.2. Statement from the firefighting operator

The firefighting operator, who was with the pilot, corroborated the pilot's statement. He added that for the last drop, they flew in at about 30 kt and at the same altitude so they could exit with a left turn. On this run, what started out as a slow turn to the left turned into a spiral in that direction.

He did not see any warning lights or abnormal instrument readings before or after the yaw.

He further stated that he had taken a CRM course at Hispánica de Aviación on the same dates he had taken the Firefighting Operator course. The CRM course consisted of a theory phase with lectures and a test, after which they did a familiarization flight, sitting in the copilot's seat on the same type of helicopter as the accident aircraft.

1.16.3. Check of the flight control system

During the investigation, the flight control system was checked, and in particular the tail rotor. No malfunctions were detected. The details of this check are provided below:

1 – Inspection of the pitch change system on the tail rotor.

- The cables for the pitch change system on the tail rotor were cleanly and vertically cut with a tool so as to free the tail from the rest of the fuselage in order to facilitate the transport of the wreckage.
- The system for moving the cables over the pitch change pinions in the tail rotor was working correctly. Both the motion and the actuation of the pitch change for the three tail rotor blades were correct.
- There were no impediments to turning the tail rotor, which rotated freely.
- The tail rotor transmission, and specifically its attachment and the continuity of the transmission shaft through the tail rotor gearbox, worked properly.
- The pitch change link rods for the tail rotor blades were properly attached.

2 – Check of the actuating rods for the flight controls.

- All of the inspection panels for the flight control actuating rods were removed.
- All of the flight control rods were inspected from the rear of the first pilot's seat to the part of the passenger cabin where they enter the main rotor gearbox (in the overhead of the cabin). No abnormalities or loose screws were identified and the rods were inside their sliding/travel housing.

- The flight control rods behind the 1st pilot's seat were checked. No abnormalities or loose screws were found. The bars were properly attached and they moved correctly inside their housing.
- The pedals were actuated to check the continuity of the entire control system from the pedals to the main component of the tail rotor pitch change assembly. The continuity was verified to be correct for both pedals.
- The effect of moving the pedals on the main actuating unit to change the tail rotor pitch was checked, and said unit was verified to travel satisfactorily when both pedals were applied. The hydraulic actuator was also verified to move correctly in both directions without loss of hydraulic fluid. The motion was smooth, without any obstructions.

1.17. Organizational and management information

The Ministry of Agriculture, Water and the Environment (MAGRAMA) contracted the operator, Hispánica de Aviación, to cover the request to provide forest firefighting support, in this case, to the Canary Islands region.

To provide this service, the Ministry has heliborne reinforcement brigades (BRIF) and other resources. The accident helicopter was supporting the BRIF that is based in Puntagorda (La Palma).

The pilot and firefighting operator had been hired by Hispánica de Aviación in June 2016.

1.18. Additional information

1.18.1. Rate of loss of tail rotor effectiveness (LTE) in helicopter accidents

A search of CIAIAC records from 1999 until 2013, both inclusive, revealed that 85 accidents and 27 serious incidents occurred in Spain involving helicopters. Of these 85 accidents, 9 were caused by LTE, which thus accounts for 10% of all such accidents.

The table below lists the accidents and serious incidents caused by LTE in Spain:

Report number	Date	Type of operation	Phase of flight	Aircraft type and model	Recommendations
A-028/99	22/06/1999	General Aviation – Commercial – Firefighting	Takeoff – Initial climb	Bell 206 L4	No ⁷
A-030/2000 bis	4/08/2000	General Aviation – Commercial – Firefighting	Maneuvering – Low-altitude flight	Bell 205 (UH-1H)	No
IN-066/2002	7/09/2002	General Aviation	Takeoff – Initial climb	Robinson R-22	No ⁸
A-068/2002	15/09/2002	General Aviation – Commercial – Firefighting	Landing	Garlick UH-1H	Yes, but not pertaining to the LTE phenomenon
A-043/2003	6/08/2003	General Aviation – Commercial – Firefighting	Maneuvering – Low-altitude flight	Bell 206 L3	No ⁹
A-074/2004	20/12/2004	General Aviation - Private	-	Robinson R44 II	No ¹⁰
A-068/2005	1/12/2005	Aerial work – Commercial – Public patrol and observation service	Takeoff	Bell 206 LAT	REC 20/07 REC 21/07

continues >

⁷ Although no recommendations are issued with the report, it states that it would be advisable to disseminate the manufacturer's operating procedures, specifically "Operation Safety Notice. OSN 206-83-10" and "Information Letter 206-84-41", to make pilots aware of this phenomenon.

⁸ The report describes the phenomenon of loss of tail rotor effectiveness using material from the Federal Aviation Administration, specifically, manual FAA-H-8083-21 "Rotorcraft Flying Handbook", to share this information.

⁹ As concerns an inadvertent yaw or loss of tail rotor effectiveness, the report highlights the importance of knowing the circumstances that give rise to this situation, how to prevent it and how the pilot should react.

¹⁰ Although the report notes that the applicable regulation has no specific LTE training requirements, no recommendations are made in this regard.

Report number	Date	Type of operation	Phase of flight	Aircraft type and model	Recommendations
A-032/2011	18/09/2011	Aerial work – Commercial - Filming	En route	Bell 206B	REC 61/12 REC 62/12
A-045/2011	12/11/2011	General Aviation - Private	Maneuvering – Low-altitude flight	Hughes 369E	No

1.18.2. LTE recommendations published by the CIAIAC

The table below lists the recommendations on LTE published by the CIAIAC:

Recommendation	Text of recommendation	Status
REC 20/07	It is recommended that the DGAC include the LTE phenomenon in helicopter pilot training programs in Spain by publishing the syllabi accepted under the JAR-FCL 2.	Closed. Canceled. Redirected to EASA as number REC 88/12.
REC 88/12	It is recommended that the EASA include the LTE phenomenon in helicopter pilot training programs in Spain by publishing the syllabi accepted under the JAR-FCL 2.	Open. Reply satisfactory.
REC21/07	It is recommended that the DGAC distribute information on the LTE phenomenon to all helicopter operators, flight schools, sport flying clubs and private helicopter owners.	Closed. Reply satisfactory.
REC61/12	It is recommended that Rotorflug GmbH specify the measures required to raise its pilots' awareness of the LTE phenomenon, and in particular of the danger of flying in conditions that increase the likelihood of the phenomenon's appearance.	Closed. Reply satisfactory.
REC 62/12	It is recommended that AESA and Luftfahrt Bundesamt (LBA) take measures along the EASA's recommendations in SIB 2010-12R1.	Closed. Reply satisfactory.

Regulatory situation in Europe

In REC 88/12, the CIAIAC recommended that the training specified in JAR FCL 2 be required in Europe. The JAR FCL 2 was analyzed, and LTE training is only required to obtain the PPL(H) and FI(H) licenses. No training on this subject is required in the JAR FCL 2 to obtain the CPL(H) or ATPL(H) license, meaning that the Recommendation should be restated in different terms.

Separately, the EASA published Commission Regulation (EU) No 1178/2011 of 3 November 2011, which lays out the technical requirements and administrative procedures related to civil aviation aircrew. The Acceptable Means of Compliance and Guidance Material (AMC & GM) accompanying this Regulation were published in December 2011. The AMC & GM only specify LTE training requirements for obtaining the LAPL(H), PPL(H) and FI(H) licenses. As with the JAR FCL 2, no LTE training was required to obtain the CPL(H) or ATPL(H) licenses.

In May 2016, the EASA published an update to the Acceptable Means of Compliance and Guidance Material (AMC & GM) for the FCL (Decision 2016/008/R). This new version of the AMC & GM includes the following pertaining to LTE training.

License	Requirement	AMC&GM
LAPL(H)	FCL.110.H LAPL(H) Experience requirements and crediting	AMC1 FCL.110.H Flight Instruction: (xxiii) Exercise 15: Hover OGE and vortex ring: (A) establishing hover OGE; (B) drift, height or power control; (C) demonstration of incipient stage of vortex ring, recognition and recovery (from a safe altitude); (D) loss of tail rotor effectiveness.
PPL(H)	FCL.210.H PPL(H) Experience requirements and crediting	AMC1 FCL.210.H PPL(H) Flight Instruction: (xxiii) Exercise 18: Hover OGE and vortex ring: (A) establishing hover OGE; (B) drift, height or power control; (C) demonstration of incipient stage of vortex ring, recognition and recovery (from a safe altitude); (D) loss of tail rotor effectiveness.

continues >

CPL(H)	FCL310 CPL – Theoretical knowledge examinations	<p>AMC1 FCL310; FCL.515(b); FCL.615(b). Theoretical knowledge syllabus and Learning Objectives for ATPL, CPL and IR</p> <p>“Explain the loss of tail-rotor effectiveness, vortex-ring state, causes, crosswind and yaw speed.”</p>
ATPL(H)	FCL.515 ATPL – Training course and theoretical knowledge examinations	<p>AMC1 FCL310; FCL.515(b); FCL.615(b). Theoretical knowledge syllabus and Learning Objectives for ATPL, CPL and IR</p> <p>“Explain the loss of tail-rotor effectiveness, vortex-ring state, causes, crosswind and yaw speed.”</p>
IR(H)	FCL.615(b) IR – Theoretical knowledge and flight instruction	<p>AMC1 FCL310; FCL.515(b); FCL.615(b). Theoretical knowledge syllabus and Learning Objectives for ATPL, CPL and IR</p> <p>“Explain the loss of tail-rotor effectiveness, vortex-ring state, causes, crosswind and yaw speed.”</p>
FI(H)	FCL.930.Fi – Training course	<p>AMC1 FCL.930.Fi – Training course. Helicopters. Air Exercises</p> <p><i>“EXERCISE 15: HOVER OUT OF GROUND EFFECT AND VORTEX RING</i></p> <p><i>(a) Long briefing objectives:</i></p> <p class="list-item-l1">(1) revision of ground effect and power required diagram;</p> <p class="list-item-l1">(2) drift, height and power control, look-out or scan;</p> <p class="list-item-l1">(3) vortex ring, (including dangers, recognition and recovery actions);</p> <p class="list-item-l1">(4) loss of tail rotor effectiveness.</p> <p><i>(b) Air exercise:</i></p> <p class="list-item-l1">(1) to demonstrate hover OGE;</p> <p class="list-item-l1">(2) drift, height, power control and look-out, and instrument scan technique;</p> <p class="list-item-l1">(3) recognition of incipient stage of vortex ring and settling with power;</p> <p class="list-item-l1">(4) recovery action from incipient stage of vortex ring;</p> <p class="list-item-l1">(5) recognition of loss of tail rotor effectiveness and recovery actions.”</p>

The CIAIAC is of the opinion that the European regulation is very inconsistent in this area, since practical knowledge of the LTE phenomenon is required to obtain the LAPL(H), PPL(H) and FI(H) licenses, without mention of any theoretical knowledge, and theoretical knowledge is required to obtain the CPL(H), ATPL(H) and IR(H) licenses, but not practical knowledge. As a result, the following recommendation is issued:

It is recommended that the EASA standardize the theoretical and practical training on the LTE phenomenon among the various helicopter training programs for obtaining the LAPL(H), PPL(H), CPL(H), ATPL(H) and FI(H) licenses. This training should befit the level of complexity and responsibility associated with each license.

Regulatory situation in Spain

The European regulation is complemented by Royal Decree 750/2014 of 5 September, which regulates aerial firefighting and search and rescue activities and lays out the requirements pertaining to airworthiness and licenses for other aeronautic activities. Along with this Royal Decree, the AESA has published several resolutions to provide guidance material for applying the aforementioned Royal Decree. Neither the Royal Decree nor the AESA Resolutions make any reference to the need for helicopter pilots to receive theoretical or practical training on the LTE phenomenon.

As a result, the following recommendations are issued to the DGAC and AESA:

It is recommended that Spain's Civil Aviation General Directorate (DGAC) regulate the theoretical and practical training on the LTE phenomenon for helicopter pilots involved in firefighting and search and rescue operations.

It is recommended that Spain's National Aviation Safety Agency (AES) take the regulatory initiative to regulate the theoretical and practical training on the LTE phenomenon for helicopter pilots involved in firefighting and search and rescue operations.

Enhanced LTE training

In light of the rate at which this phenomenon appears in accidents investigated by the CIAIAC, this Commission deems it necessary to enhance LTE training, and as a result:

It is recommended that Spain's National Aviation Safety Agency (AES) stipulate that operators' Operations Manual include refresher knowledge on the loss of tail-rotor effectiveness, and incorporate this topic as deemed convenient into the forms outlining the proficiency checks and the refresher training of the operator.

Informative material on this phenomenon:

The table below lists, in chronological order, the informative material published to date:

	Operational Safety Notice OSN 206-83-10 published in 1983
Bell Helicopters	Information Letters on the subject of Low Speed Flight Characteristics Which Can Result in Unanticipated Right Yaw (206L-84-27 y 206-84-41), published in 1984
FAA	FAA-H-8083-21 Rotorcraft Flying Handbook AC 90-95 Unanticipated right yaw in helicopters, published in 1995
Eurocopter	Service Letter 1518-67, published in 2001 Service Letters 1673-67-04 y 1692-67-04, published in 2005
EASA	Safety Information Bulletin (SIB) n° 2010-12R1, dated 21 October 2010
EHEST (Equipo Europeo de Seguridad de Helicópteros)	Safety considerations. Methods to Improve Helicopter Pilots' Capabilities

1.18.3. LTE safety information published by EHSIT

The European team for the implementation of safety measures in helicopters (EHSIT), which is part of the European Helicopter Safety Team (EHEST), has published a document titled "Safety considerations. Methods to Improve Helicopter Pilots' Capabilities", which analyzes the loss of tail rotor effectiveness. Specifically, it explains when it occurs, how to avoid it and how the pilot can regain control following a LTE.

When the thrust from the tail rotor is insufficient, a yaw movement results that if not rapidly corrected, makes the helicopter uncontrollable. This phenomenon is called LTE.

Whenever possible, pilots must avoid combinations of the following:

- Adverse wind conditions at low airspeed.
- Uncommanded yaw.

- Large and rapid collective and yaw inputs at low airspeed.
- Low airspeed flight in turbulent wind conditions.

To exit LTE:

1. Apply full opposing pedal to the direction of turn.
2. Adopt an accelerative attitude to gain forward speed.
3. If altitude permits, reduce power.

1.18.4. Bucket

To drop the water, the crew press a button on the cyclic control, which electrically releases a cable hooked to the discharge system, allowing the water to exit the bucket under the force of gravity.

The bucket is suspended from the external load hook so that the external load can be released quickly. This hook can be opened electrically and manually.

1.19. Useful or effective investigation techniques

Not applicable.

2. ANALYSIS

On Wednesday, 10 August 2016, a PZL W-3AS aircraft, registration SP-SUC, was at the BRIF base located in the town of Puntagorda on the island of La Palma. At about 15:00, it took off to take part in firefighting activities in the town of Villa de Mazo.

After approximately 1:35 hours of flight time, it had made 12 water drops, after which the forward command post instructed its crew to proceed to a point different from the last one but where they had already made a drop.

Due to the rugged terrain and in order to make an effective drop over the hot spot, the crew decided to make the approach with a slight left tailwind.

Given the small area of the drop point, the crew approached low and slow to keep the water from dispersing. Since they had about a 20-kt tailwind, the flight was being conducted outside the realm of translational lift¹¹; in other words, inside the hover envelope without ground effect.

The combination of low speed, low altitude, high power and a tailwind resulted in a loss of tail rotor effectiveness, following which the helicopter became uncontrollable, rotating about itself as it lost altitude. It then impacted several trees before coming to a full stop.

The graphs below simulate the final seconds of the flight.

¹¹ Translational lift is achieved at a relative speed in excess of 35 knots.

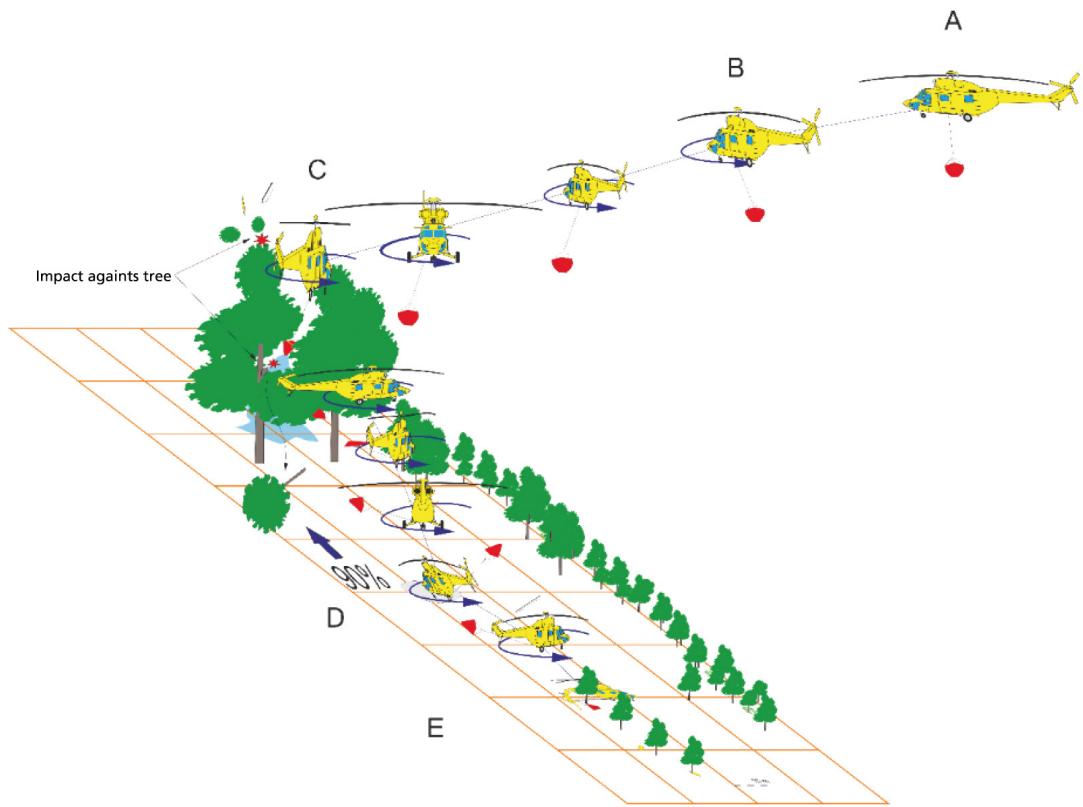


Figure 6. Simulation of the final seconds of the flight

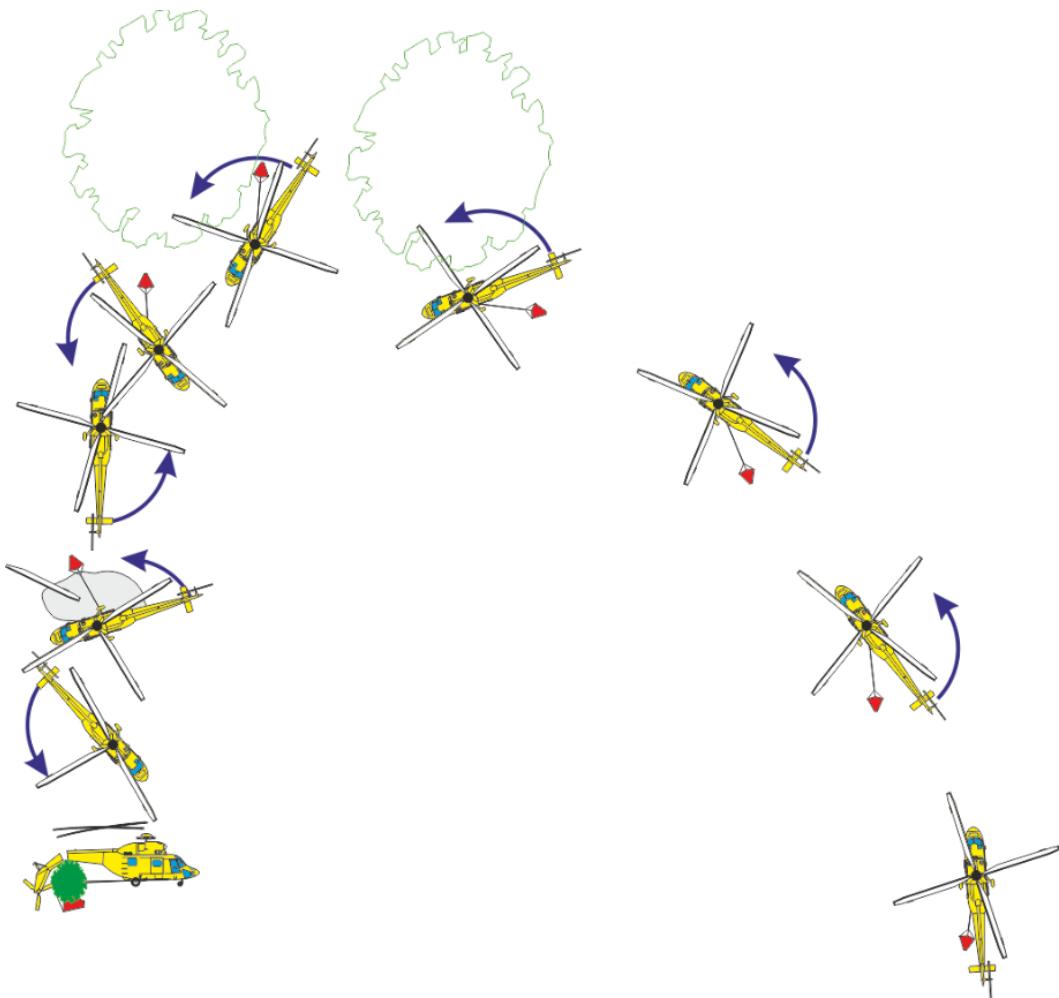


Figure 7. Simulation of the final seconds of the flight seen from above

2.1. Analysis of the pilot's actions

Initially, when the loss of tail rotor effectiveness occurred, the water was not dropped. This action would have meant reducing power, which would have affected the amount of tail rotor thrust and helped control the turn to the left.

A subsequent attempt to release the water was not effective, probably because the bucket was not directly below the helicopter, but was swinging due to the helicopter's turn. The fact that the suspension and release cables were entangled could also have hampered the opening of the bucket, since the release cable would have been unable to slide to open the bucket.

Similarly, the system to release the external load was not activated, which would also have helped to control the helicopter.

As is recommended in the document prepared by the EHSIT group, the procedure to recover from a loss of tail rotor effectiveness would have required the pilot to:

1. Apply full opposing pedal to the direction of turn. The pilot applied the right pedal to control the turn to the left, but despite this, he could not control the turn and the helicopter continued turning ever faster to the left.
2. Adopt an accelerative attitude to gain forward speed. Although the pilot stated that he moved the cyclic control forward to increase speed, the information in the data recorder indicates that he, in fact, moved it backward.
3. If altitude permits, reduce power. Once again, although the pilot stated that he lowered the collective control to reduce power, the flight recorder data show that he raised it.

Therefore, the pilot's inputs to the collective and cyclic controls, as recorded by the flight recorder, did not conform to his recollections.

The helicopter's low altitude when it began to yaw must also be considered. The pilot recalled that the altitude was 50 or 60 meters. Due to that low altitude, it is reasonable to assume that the pilot intended to increase his forward speed and reduce power, but that he did not carry out his intention due to the proximity of the ground.

Furthermore, as the data contained on the flight recorder indicate, the helicopter became uncontrollable in barely 3 seconds, which was not enough time for the pilot to react.

2.2. Analysis of training on LTE

The CIAIAC has analyzed the training on the LTE phenomenon required by European regulations and is of the opinion that said regulations are inconsistent in this area, since practical knowledge of the LTE phenomenon is required to obtain the LAPL(H), PPL(H) and FI(H) licenses, but no mention is made of theoretical knowledge, whereas theoretical, but not practical, knowledge is required to obtain the CPL(H), ATPL(H) and IR(H) licenses.

As a result, the CIAIAC will recommend that the EASA standardize the theoretical and practical training on the LTE phenomenon among the different helicopter pilot training programs for obtaining the LAPL(H), PPL(H), CPL(H), ATPL(H) and FI(H) licenses. This training should befit the level of complexity and responsibility associated with each license.

Likewise, the CIAIAC has analyzed the training on the LTE phenomenon required in Spain and, given the lack of relevant regulation, will recommend to Spain's Civil Aviation General Directorate (DGAC) and the National Aviation Safety Agency (AES) that national regulations require training on the LTE phenomenon for helicopter pilots taking part in firefighting and search and rescue operations.

It would also be advisable that helicopter pilots involved in fighting forest fires refresh this knowledge during specialized training.

In the wake of this accident, Hispánica de Aviación has included, in its pilot training and requalification programs, refresher training on evaluating and recovering from these situations. Because of this, no safety recommendation is issued to the operator in this regard.

However, so as to make this refresher training the norm among all other operators, a recommendation is issued to the AESA to have it stipulate that operators' Operations Manual include refresher knowledge on the loss of tail-rotor effectiveness, and incorporate this topic as deemed convenient into the forms outlining the proficiency checks and the refresher training of the operators.

The operator's checks and training do not consider conducting flights in abnormal or emergency situations with an external suspended load, including a bucket full of water. Adding this external load factor would force pilots to internalize the need to release the load in order to recover from the aforementioned situations. As a result, a safety recommendation is issued to the operator in this regard.

3. CONCLUSIONS

3.1. Findings

- The pilot had a valid license and medical certificate.
- The aircraft's documentation was valid and the aircraft was airworthy.
- The pilot did not detect any technical faults in the aircraft during the flight.
- The pilot did not activate the water drop system in the bucket or the external load release system either electrically or manually.
- The pilot was not instructed on the LTE phenomenon either during his proficiency checks or during refresher training.
- The pilot did not perform abnormal or emergency maneuvers with an external suspended load either during his proficiency checks or during refresher training.
- Between the years 2000 and 2013, both inclusive, a loss of tail rotor effectiveness was present in 7.3% of accidents.

3.2. Causes/Contributing factors

The investigation has concluded that this accident was likely caused by a loss of tail-rotor effectiveness (LTE), which the pilot was late in identifying, resulting in a loss of control of the helicopter, which ended up impacting the terrain.

Contributing to the accident is the fact that the water was not dropped and the bucket was not released.

4. SAFETY RECOMMENDATIONS

The CIAIAC is of the opinion that the European regulation is very inconsistent in this area, since practical knowledge of the LTE phenomenon is required to obtain the LAPL(H), PPL(H) and FI(H) licenses, without mention of any theoretical knowledge, and theoretical knowledge is required to obtain the CPL(H), ATPL(H) and IR(H) licenses, but not practical knowledge. Thus:

REC 27/17. It is recommended that the EASA standardize the theoretical and practical training on the LTE phenomenon among the various helicopter training programs for obtaining the LAPL(H), PPL(H), CPL(H), ATPL(H) and FI(H) licenses. This training should befit the level of complexity and responsibility associated with each license.

Moreover, the national regulation should be amended to include training on the LTE phenomenon for helicopter pilots involved in firefighting and search and rescue operations. As a result:

REC 28/17. It is recommended that Spain's Civil Aviation General Directorate (DGAC) regulate the theoretical and practical training on the LTE phenomenon for helicopter pilots involved in firefighting and search and rescue operations.

REC 29/17. It is recommended that Spain's National Aviation Safety Agency (AES) take the regulatory initiative to regulate the theoretical and practical training on the LTE phenomenon for helicopter pilots involved in firefighting and search and rescue operations.

This initial training should be complemented with:

REC 30/17. It is recommended that Spain's National Aviation Safety Agency (AES) stipulate that operators' Operations Manual include refresher knowledge on the loss of tail-rotor effectiveness, and incorporate this topic as deemed convenient into the forms outlining the proficiency checks and the refresher training of the operators.

The following recommendation is also deemed necessary:

REC 31/17. It is recommended that Hispánica de Aviación S.A. (HASA) include the conduct of flight maneuvers in abnormal or emergency situations with an external load in its Operations Manual, and specifically in its proficiency checklists and in its refresher training.