CIAIAC
Comisión de Investigación
de Accidentes e Incidentes
de Aviación Civil

TECHNICAL REPORT
A-016/2004

Accident of aircraft
Eurocopter SA-365-N1,
registration EC-GJE,
in San Bartolomé de
Tirajana (Las Palmas),
on 30 March 2004

MINISTERIO
DE FOMENTO

Technical report

A-016/2004

Accident of aircraft Eurocopter SA-365-N1, registration EC-GJE, in San Bartolomé de Tirajana (Las Palmas) on 30 March 2004

MINISTERIO DE FOMENTO

SECRETARÍA GENERAL DE TRANSPORTES

COMISIÓN DE INVESTIGACIÓN DE ACCIDENTES E INCIDENTES DE AVIACIÓN CIVIL

Edita: Centro de Publicaciones
Secretaría General Técnica
Ministerio de Fomento ©

NIPO: 161-03-011-0
Depósito legal: M. 23.129-2003
Imprime: Centro de Publicaciones

Diseño cubierta: Carmen G. Ayala

COMISIÓN DE INVESTIGACIÓN DE ACCIDENTES E INCIDENTES DE AVIACIÓN CIVIL

Tel.: +34 91 597 89 60
Fax: +34 91 463 55 35

E-mail: ciaiac@mfom.es
http://www.mfom.es/ciaiac

C/ Fruela, 6
28011 Madrid (España)

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 and its causes and consequences.

In accordance with the provisions of Law 21/2003 and Annex 13 to the Convention on International Civil Aviation, the investigation has exclusively a technical nature, without having been targeted at the declaration or assignment of blame or liability. The investigation has been carried out without having necessarily used legal evidence procedures and with no other basic aim than preventing future accidents.

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

This report has originally been issued in Spanish language. This English translation is provided for information purposes only.

Table of contents

Abbreviations

A/R	As required
ACJ	Advisory Circular Joint
AFM	Aircraft Flight Manual
APP	Approach Control Service or Office
ATC	Air Traffic Control
CECOES	Centro Coordinador de Emergencias y Seguridad
CG	Center of Gravity
CO	«Circular Operativa» (Operations Circular issued by the DGAC)
CVR	Cockpit Voice Recorder
D	Diameter of the main rotor of the helicopter
DGAC	Dirección General de Aviación Civil
E	East
FDR	Flight Data Recorder
FL	Flight Level
ft	Foot (feet)
ft/min	Feet per minute
g	Acceleration of gravity
GCAPP	Canarias APP
GCLP	ICAO designator of Gran Canaria Airport
GIE	Grupo de Intervención de Emergencias
GPS	Global Positioning System
h	Hour(s)
HEMS	Helicopter Emergency Medical Service
Hz	Hertz (cycles per second)
IFR	Instrument Flight Rules
JAR	Joint Aviation Requirements
kg	Kilogram(s)
km	Kilometer(s)
kt	Knot(s)
kv	Kilovolts
lb	Pound(s)
m	Meter(s)
m/s	Meters per second
MBO	Basic Operations Manual
MOV	Flight Operations Manual
MTOW	Maximum takeoff weight
NM	Nautical Mile(s)
N_r	Main rotor speed (in RPM)
RPM	Revolutions per minute
s	Second(s)
SAR	Search and Rescue
SUC	Servicio de Urgencias Canario
UTC	Universal Time Coordinated
VFR	Visual Flight Rules

1. FACTUAL INFORMATION

1.1. History of the flight

After the accident of a tourist bus that turned over in a curve of road Cl-12-4 (GC-505), an alert call was received by the emergency phone of «Centro Coordinador de Emergencias y Seguridad» (CECOES) at 15:03 h local time[1]. This service started coordinating the rescue and evacuation services and several ambulances, fire fighters vehicles and police units went to the accident scene. Three helicopters (two Dauphins and a Bell 412) of two different emergency services, were also called to help in the emergency tasks being carried out. A total of 27 people were injured as a result of the bus accident.

The helicopter EC-GJE SA-365-N1 (radio call sign AH30), with three people on board (the pilot in command, a doctor and a nurse), contacted by radio the ATC of Gran Canaria Airport at 15:13:59 h local time to request clearance for a medical evacuation flight to the area. He was cleared to proceed directly to the bus accident site (located at 12.4 NM form the airport) with West heading.

They took off at 15:16:33 h and in three minutes the helicopter reached 130 kt and 2,800 ft of altitude. When arrived in the accident area, a couple of policemen that were already on scene tried to make signs to the pilot to direct him to an unprepared area besides the road and close to the bus wreckage.

According to some statements, the helicopter carried out several turns flying over the area and recognising the area and finally landed in the road, in an area with a small asphalted shoulder, located uphill around 250 m away from the place where the bus had crashed. At 15:29:58 h the pilot communicated Canarias APP (GCAPP) that they had landed. The landing site had a surface perimeter free of obstacles measuring less than 2D × 2D (D being the diameter of the main rotor of the helicopter in meters).

Almost in the vertical of the landing site there was a high power electricity line composed by three wires located in a north-south direction, supported towards the north by a tower located above the surrounding hill and towards the south by another tower located downhill, below the height where the helicopter had landed. The lowest point of the wires was estimated to be at approximately 40 m above the road in the landing area of EC-GJE. The landing was made passing almost completely below the wires at some point.

The pilot informed on the coordinates of the accident site through the dedicated frequency of CECOES. The radio operator of CECOES asked the pilot whether other helicopters could land in the area. The pilot answered «Land on the road. And with cau-

[1] The time reference used in this report is local time except where noted. It is necessary to subtract one hour to get the UTC time in the accident place.

tion, because there are wires that cross it» («Aterrizar en la carretera. Y con precaución porque hay unos cables que la atraviesan»).

Later on, a search and rescue Bell 412 EC-GSK (radio call sign AH31) arrived in the scene, with five people on board, and landed at 15:39:57 h outside the paved area of the road, between EC-GJE and the crashed bus, in the first area that the policemen tried to signal to the pilot of EC-GJE.

According to some statements, the pilot of EC-GJE commented to the pilot of the Bell 412 helicopter on the existence of the power line and cables, and warned him about them. The cables were closer to EC-GJE, which had its nose pointing somewhat to the right of the road axis.

In the meantime, another private helicopter (a Bell 407, registered D-HOMN), which was called by the «Protección Civil» department of the city of San Bartolomé, arrived with three people on board (the pilot, the manager of the private company and a person from the City Hall of San Bartolomé) and landed at 16:10:46 h in a nearby area that was further to the East, beyond the place of the bus wreckage and outside the road (see Figure 1.1.1).

At 16:15:57 h, EC-GSK departed towards the hospital with four injured people and, in the same place they had used, a Dauphin SA-365-C2 registered EC-GCZ with a total of 4 people landed at 16:24:30 h. The pilot of this helicopter did not talk to the commander of EC-GJE, who was helping with the injured people in the area of the bus wreckage.

Figure 1.1.1. Private helicopter D-HOMN landed close to the bus wreckage

Afterwards, two injured passengers of the bus were boarded with stretchers in the helicopter EC-GJE.

The other Dauphin EC-GCZ, with two pilots on board, was waiting after having taken on board other two injured people. The pilot in command was prepared to start the engines and to depart immediately. They were looking at EC-GJE expecting its imminent takeoff.

The weather was reported as high temperature, 5 kt of Westerly wind and some clouds with good visibility.

At approximately 16:39:21 h local time, the pilot of EC-GJE contacted GCAPP and, after he was asked to repeat the call sign, he reported: «Medical helicopter AH30 with two patients on board, we are in Tunte and proceeding to Negrín hospital through the centre of the island at one thousand feet or lower». GCAPP answered: «AH30 roger en route towards Negrín».

Then the helicopter, whose nose was initially pointing somewhat towards the right, and therefore towards the uphill part of the road, was seen to initiate an almost vertical and apparently normal takeoff. No report of power loss or other kind of mechanical failure was received. Some of the witnesses were used to fly in Dauphin.

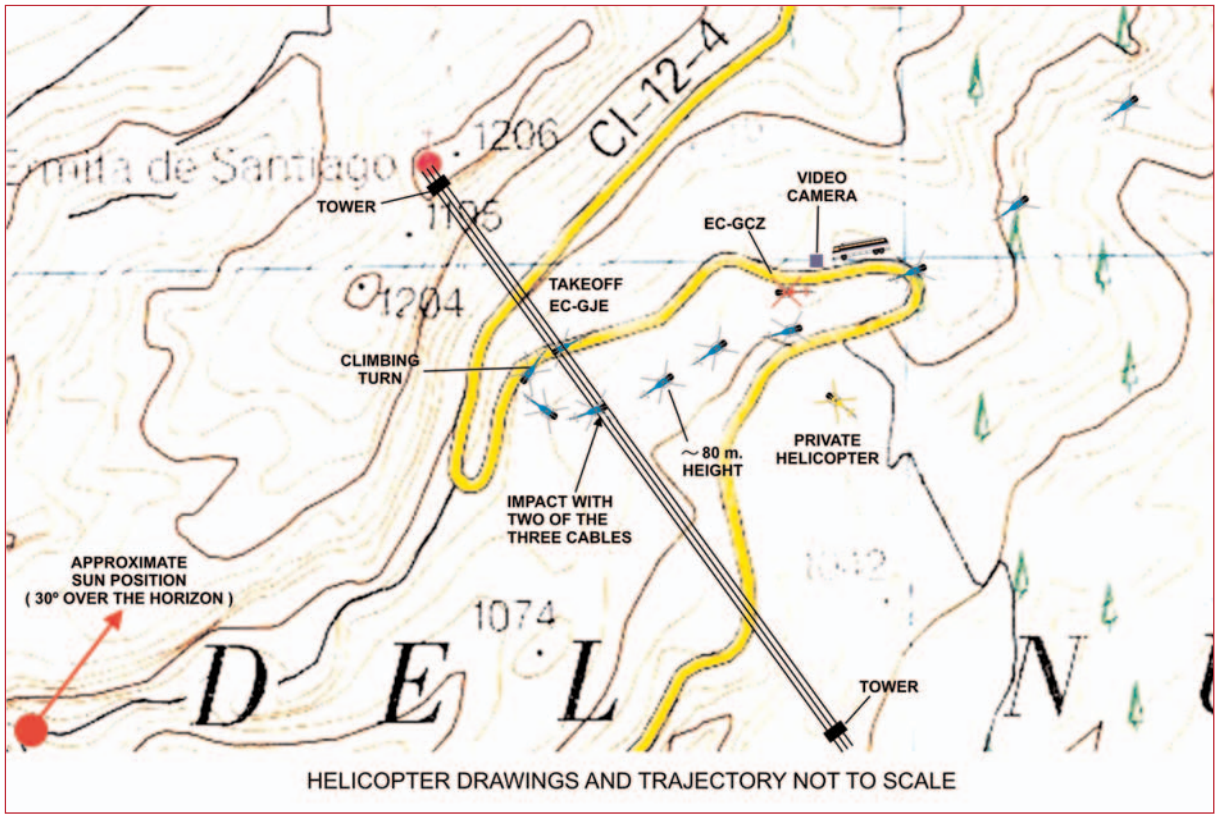


Figure 1.1.2. Initial trajectory of EC-GJE. The Bell 412 EC-GSK had already departed to the hospital. It had previously landed in the same site besides the road that was now being used by EC-GCZ

At some point, it started a tight left climbing turn (see Photo 1 in Appendix A) and a few moments afterwards one of its blades was seen to contact the cables of the power line. This blade was broken in more than half of its span and parts of it fell to the ground in the area, while the leading edge of the blade remained in place. The two upper wires of the power line were cut and also fell to the ground in the road area. The other cable remained undamaged. The cables were composed of a steel central wire rounded by six aluminium wires.

From the statements collected, a reconstruction of the initial manoeuvres of the helicopter was attempted, and it seemed that the helicopter took off from the vertical of the cables and then, while in a left turning climb, a blade cut both upper cables of the power line (see Figure 1.1.2).

After the impact, the helicopter was seen to pitch down and destabilized for a few moments, until it seemed the pilot regained control and started flying towards the place where the bus had crashed.

An video recording taken from that place could be reviewed by the investigators. When the rescue personnel were helping some injured people on the ground, the sound of the rotor was recorded by the video camera. Suddenly, an abnormal sound, although not very loud, was heard and a few moments later the helicopter was recorded flying at relatively low airspeed, at around 80 m of height, and towards the vertical of the rescue people that were besides the bus. They were scared as they thought the helicopter was going to crash into them, and some of them started yelling and running. Then, the helicopter made a shallow right turn, without losing height, and flew above and very close to the top of a surrounding hill until it disappeared from the field of view of the video camera operator (see Figures 1.1.3 and 1.1.4).

Afterwards, the helicopter reportedly flew initially towards the crossing point of roads C-815 and Cl-12-4, and then towards an area of the road called «Cruz Grande» (or «Paso de la Herradura») where there was a tight curve, and where also some cables existed. That area was located approximately 2,500 m away from the take off point (see Figure 1.1.5).

Some witnesses stated that they saw parts of the helicopter falling while it was still in flight, and later on it fell and crashed into the ground, approximately 10 m from the surface of aforesaid road.

According to other statements, white smoke was seen coming out the wreckage area almost immediately after the impact, although the actual fire did not start immediately, but approximately between 5 and 15 minutes afterwards (according to different statements collected).

Figure 1.1.3. The helicopter flying shortly after the impact with the wires. Most of the chord of a blade is missing approximately in half of the span (photo «La provincia»)

Figure 1.1.4. The helicopter flies over a nearby hill (photo «La Provincia»)

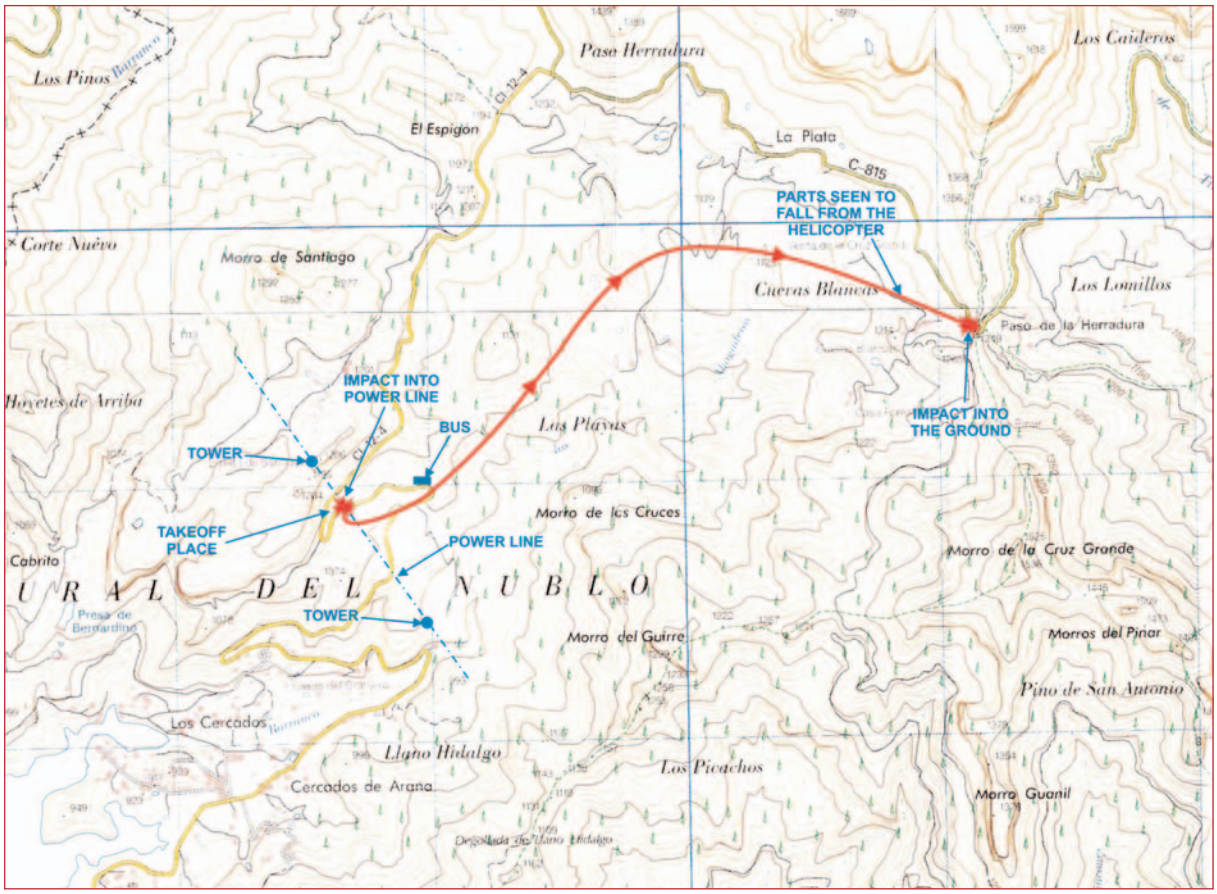


Figure 1.1.5. Possible trajectory of EC-GJE prepared after witnesses statements and wreckage trail

Helicopter EC-GCZ, still waiting near the bus wreckage, disembarked the injured people when they learned about the crash, and flew towards the area, although they could not land in the tight curve of the road in «Paso de la Herradura». The private Bell 407 D-HOMN also flew to the accident area. The crew stated that it was not possible to land in the road above the wreckage site, and therefore landed in other area located 400 m away of that point.

The Bell 412 EC-GSK that had already reached the hospital was also sent back to the place of the accident to try to help.

In the mean time, fire-fighters and police members in the bus accident place saw the crash of the helicopter and tried to go there. They needed to turn the vehicles in the other sense of the road but, because of the lack of space in the narrow asphalted surface, and due to the large crowd of vehicles parked in the area, it was necessary to advance towards the bus wreckage place to have enough space to manoeuvre. Because of the sparks of the broken power wires that were affecting the road, this movement could not be completed until some time later, when the electricity current was cut from the power line.

They could finally reach the place reportedly at around 17:00 h local time, and put out the fire of the helicopter, which was completely destroyed. The five people on board were killed.

1.2. Injuries to persons

Injuries	Fatal	Serious	Minor/None
Crew	3		
Passengers	2		
Others			

1.3. Damage to aircraft

As a result of the impact with the ground and subsequent fire, the aircraft was totally destroyed.

1.4. Other damage

The area had mountainside vegetation and pine trees. Two metallic poles were broken.

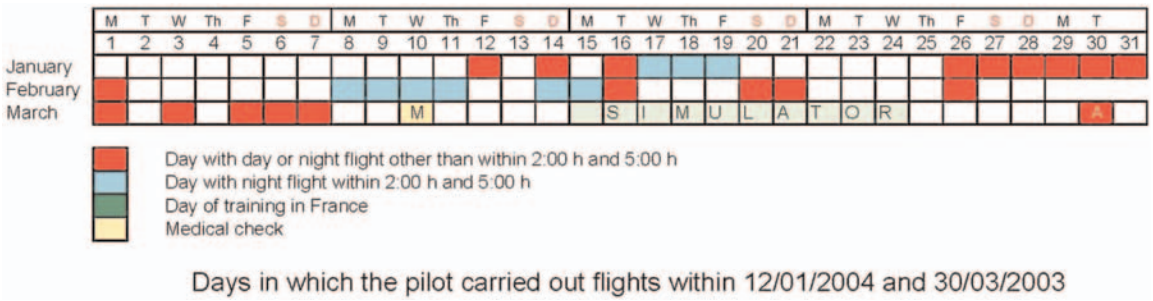
1.5. Personnel information

1.5.1. *Pilot in command*

Age:	47 years
Nationality:	Spanish
Title:	Airline Transport Pilot - Helicopter
Type rating:	IFR, Bell 412, SA 365/365N, Alouette III, Bell 205 and Bell 206
First licensed:	19-12-2001
Licence renewal date:	25-03-2004
Licence expiry date:	14-10-2004
Total flying hours:	6.142:41 hours
Hours on type:	1.409:07 hours

Hours on last 30 days:	7:15 hours
Hours last 72 hours:	30 min (estimated; only the bus rescue flight carried out)

The pilot was working as part of an emergency service active for 24 h during 365 days a year (see 1.17.1). The list of flights carried out by the pilot during the last three months was reviewed during the investigation of the accident.



The pilot had previously flown on the same helicopter on 7-3-2004, when he carried out two flights with 1:05 h of total time. The current activity period started on 30-03-2004 at 10:00. The previous day he worked from 10:00 h to 22:00 h, after having been on leave for three days. The pilot used to live in Las Palmas de Gran Canaria.

The pilot had attended the last 12-month training and check in a flight simulator in France (ending on 24-3-2004, six days before the accident), with a total of 8 h of simulated flight carried out. The training included flight in confined areas, takeoff and landing from platforms, and flight in mountainous areas.

He also had flight experience in several other models of helicopters, including Agusta A109, Bell 206, Bell 412, Bell 47, Hughes 500, and AS350.

He had 728 h of night visual flight, 250 h of day instrument flight and 263 h of night instrument flight.

1.5.2. *Medical personnel*

On board the helicopter there were a doctor and a nurse. They had received some training for medical operations in helicopters, but, according to the statements gathered, they did not act as Helicopter Emergency Medical Services (HEMS) crew members with the duties and training that are specified in JAR-OPS 3 (see 1.17.4 below).

It was not normal to ask the medical personnel to assist the pilots with any operational task on board the helicopter.

1.6. Aircraft information

1.6.1. *Airframe*

Make:	Aerospatiale
Model:	SA-365-N1
Serial number:	6308
Registration:	EC-GJE
MTOW:	4,100 kg
Owner:	Helicsa
Operator:	Helicsa

1.6.2. *Airworthiness certificate*

Number:	3980
Type:	Normal. Public transport of passengers and goods. Aerial work (photography, surveillance, aerial advertising, flying school, emergency operations)
Date of issue:	16-10-1996
Renewal date:	31-10-2003
Expiry date:	30-10-2004

1.6.3. *Airframe maintenance record*

Total flight hours:	5,337:20 h
Last 250 h inspection:	10-03-2004 (5,304:45 h)
Hours since last 250 h inspection:	32:35 h

The helicopter had a tricycle retractable landing gear and hinged, non-sliding doors in both sides of the cabin. The main rotor had four blades and the tail rotor (with composite blades) had a FENESTRON fairing.

There was an option available to operators to install sliding doors on both sides of the helicopter.

The helicopter interior layout was modified with a kit of emergency medical services, approved by the Spanish DGAC. The kit included two stretchers attached to both sides of the cabin, and two seats for the medical personnel located one in front of the other in the centre line of the cabin.

The medical oxygen supply consisted of three bottles located in the cargo compartment (accessible through an external cargo door located on the right side of the helicopter).

The helicopter did not have, nor was required to have, any specific warning against general vibrations that could constitute a structural hazard.

There was an option to install CVR/FDR (see paragraph 1.11) but it has none installed.

1.6.4. *Aircraft flight manual*

The flight manual of the helicopter was reviewed. There was no emergency procedure or other guidance regarding external impact against objects.

In section 4.1 there were procedures as follows: Exterior checklist, Interior checklist, Pre-start checklist, Starting procedures, Post-starting checklist, Pre-taxiing checklist, and Taxiing, takeoff and climbing procedures.

In the Flight Manual checklist only technical aspects of the operation are covered, and there is no item regarding external vigilance regarding obstacles.

1.7. Meteorological information

The weather was reported as high temperature, 5 kt of Westerly wind and good visibility, although there were also some clouds in the area (see Photo 1 in Appendix A).

That day, the sunrise was approximately at 6:53 h UTC and the sunset at 19:18 h UTC. The accident happened approximately at 16:40 h local time (15:40 h UTC time), which means that at that moment the sun was at approximately 225° and elevated approximately 30 degrees over the horizon.

According to some statements of witnesses, the sun did not represent a visibility problem except, at some moments, when looking directly towards it. The video and photos reviewed show a scattered day with no noticeable shadows.

1.8. Aids to navigation

Not applicable.

1.9. Communications

The relevant communications with the ATC were reviewed, and allowed to prepare a graph of the timing of the operations carried out by the different helicopters involved (see Appendix B).

There was no record of relevant communications being held by the accident helicopter with other helicopters, with the ATC or with the emergency coordination services (CECOES and «Servicio de Urgencias Canario», SUC) after the blade impacted against the wires.

The record of the communications held by the different emergency services with the CECOES and SUC was asked for and reviewed. Two relevant facts were noted:

— At around 15:24 h the pilot of EC-GJE said that other helicopters could land on the road but «with caution, because there are wires that cross it [the road]».
— At around 16:06 h a doctor located in the SUC coordination room informed the doctor that went with EC-GJE that the helicopter was blocking the road and obstructing the access of the other aid resources.

1.10. Aerodrome information

Not applicable.

1.11. Flight recorders

The aircraft had no flight recorders. The Certificate of Airworthiness was issued in 1996, the MTOW was less than 7,000 and the helicopter was not being used in commercial air transportation. With those conditions, in Spain it was not mandatory for this type of aircraft to have either CVR or FDR installed.

However, the manufacturer had an option to install CVR/FDR at customer request. The option of a 30 minute CVR had a weight of 5 kg. The FDR with approximately 200 parameters had a weight of approximately 30 kg, and the installation was complex due to the big amount of sensors that had to be installed.

1.12. Wreckage and impact information

The take off and final crash areas were inspected after the accident. In the takeoff zone, several broken parts of the skin of the red blade were collected. Those parts included more than half of the span of the blade.

Two blades had been found in a radius of 100 m before the crash site and another blade, together with the reduction gearbox, was found some 40 m before the area of the main wreckage. A cowling of the engine, the radome, the cockpit instrument panel and other minor pieces of wreckage, were reportedly also found through the final flight path of the helicopter.

The impact place was a very steep hillside with a slope of approximately 45°. The main wreckage was relatively grouped. The impact occurred in an upwards sense, and it could be appreciated that the horizontal speed was low. The impact forces in the vertical sense implied high energy. A 10 m high metallic pole located at the beginning of the impact area was totally bent downwards in half its height, and signs were found that it was hit by the helicopter with a high descent angle. This pole went through the cockpit. A few meters upwards, a similar metallic pole was pulled out from its basement by the impact forces. Those poles supported low voltage electricity cables.

The area between the takeoff and crash sites was mountainous with important slopes and covered by threes and shrubs. There were not many suitable places to attempt a safe landing.

After an initial visual inspection with the help of the operator, the main parts of the wreckage were collected and taken to a hangar. The degree of destruction of most parts of the helicopter was very high.

1.13. Medical and pathological information

The five occupants died as a consequence of multiple traumatisms, and were later affected by the fire. No toxicology analysis was available to the investigation.

The medical records of the pilot, who had renewed his medical certificate on 10 March 2004, were asked for in an attempt to identify any possible symptom of short-term memory lapses. The DGAC informed that the pilot had a valid Class 1 medical certificate and there was «no alteration in his file docket». He was required to use lenses to fly.

1.14. Fire

The statements gathered suggest that the fire started some time after the impact into the ground. Some witnesses stated that the fire broke up around 15 min after the accident. Other said that some flames were already visible 5 min after the impact, and that the fire was very noticeable 10 min after the crash, and some small explosions were heard at that time.

The fire-fighters were close to the accident area, because they were helping with the rescue of the bus passengers. However, the traffic of the road had been interrupted as a result of that bus accident and the effect of the powered electricity wires affecting the road in the area of takeoff retarded their arrival to the helicopter wreckage area. Finally, they went there at around 17:00 h (20 min after the crash) and put out the fire. The main part of the helicopter was completely burnt at that time.

1.15. Survival aspects

The impact had a high descent angle and descent rate, and included high forces. A metallic pole in the area went through the cockpit, causing further damage. Later on a fire started, although there is no evidence that any of the occupants was still alive at that time. The probability of surviving this accident was very low.

1.16. Tests and research

1.16.1. *Analysis of the engine sound*

The sound of the rotor recorded in a video tape during initial climb of the helicopter was analysed.

It was concluded that it appeared very clearly that the main rotor speed never decreased or changed from the beginning of initial impact until the aircraft went off behind the ridge line. The main rotor speed (N_r) value found was 354 RPM, which was a normal value.

1.16.2. *Analysis of the manoeuvrability of the helicopter after the impact with the wires*

The manufacturer was asked to analyse the possible behaviour of the aircraft regarding controllability and performance after the blade was damaged by the power line.

Their answer was: «Just after the crash the aircraft was still flyable but due to the severe unbalance the pilot would have encountered big problem to control it, especially with the sticks which were moving in all directions. The result of the unbalance was the main rotor destruction after some minutes».

1.16.3. *Statement of witnesses*

Several witnesses provided comments during the investigation. The relevant information has been included in other parts of this report. The following two statements are included individually.

1.16.3.1. Witness that saw the takeoff

A witness with flight experience described the takeoff as being in the direction of the road (approximately west heading) with a high rate of climb. A tight left turn was initiated almost simultaneously, and was continued up to 180° of turn with airspeed of 40 kt or less, until the helicopter impacted with the main rotor blades with the electrical wires. The impact occurred on the left side of the helicopter.

1.16.3.2. Witness with experience in emergency situations

Another witness that was in the area since the first moments after the bus accident stated that, in his opinion, too many vehicles and people were sent to help with the emergency tasks. No specific person was identified as been in command of the whole operation and to provide on-site coordination of the rescue operation. It was difficult for the ground vehicles to manoeuvre in the narrow road and therefore the whole mission would have been quite difficult to coordinate. The doctor on board EC-GJE was the first physician to reach the bus wreckage, and started with the initial evaluation of the injured tourists. The witness was surprised to see that the pilot of the helicopter was directly involved with the help and transportation of the injured people.

In his opinion, the helicopter parked in the road was blocking the movements of other ground vehicles and people, and made necessary to transport the stretchers to the ground ambulances by hand for a long distance.

1.16.4. *Geometry of the impact against the wires*

The electric line «Santa Lucía» of 20 kilovolts (kv) of service and 24 kv of insulation came from the substation «Aldea Blanca», in the municipal area of San Bartolomé de

Tirajana. The weight of the wires was 258.5 kg/km. The height of the lower tower was 17.1 m up to the wires and then a head of 4.88 m. The height of the upper tower (on top of the mountain) was 12.45 m up to the wires and then a head of 4.88 m.

The impact happened while the aircraft was completing a 180° left climbing turn.

During its initial climb, the normal path would have been for the helicopter to encounter the upper and lower wires that were located to the right of the lower tower when viewed from the take off place (see Figures 1.16.1 to 1.16.4). The horizontal distance between wires 1 and 3 was 5.7 m, and between wires 2 and 3 it was 5.4 m. The vertical distance from the highest wire (n° 1) and the lowest wire (n° 2) was 4.0 m.

However, the helicopter cut the two upper wires (one to the right and the other to the left of the tower), while the lowest cable was not damaged. The fourbladed main rotor of the helicopter rotates in a clockwise sense when viewed from above.

If an airspeed of 40 kt (20 m/s) at the moment of impact is assumed, with a rotor speed of 350 rpm (5.8 revolutions per second), some approximate calculations give as a result that the aircraft advances 3.4 m for every complete revolution of the main rotor (four blade passes over a given heading).

Additionally, the red blade suffered major damage in a great portion of its span. The leading edge beam remained in place but the skin broke and detached in a chord wise sense towards the trailing edge after the impact.

In the photos and video tape recordings that were reviewed no damage to other parts of the helicopter could be appreciated. If the landing gear or other part of the aircraft would have contacted the wires, it is highly probable that the aircraft would have become more unstabilised or even crashed at that point.

All those facts led to the conclusion that the impact happened when the complete airframe of the helicopter was above the lowest cable (n° 2) and climbing with an angle lower than 20°, and the first cable that broke was the n° 1 (uppermost) when it was hit by the leading edge of the red blade (see Figures 1.16.1 to 1.16.4).

It is possible that the blade did not break at that point, because the experience in other similar events is that the blades of this kind of helicopter are strong enough to cut the wire without breaking. However, it is considered probable that wire n° 3 was also hit by the same red blade and at that moment the skin broke and detached.

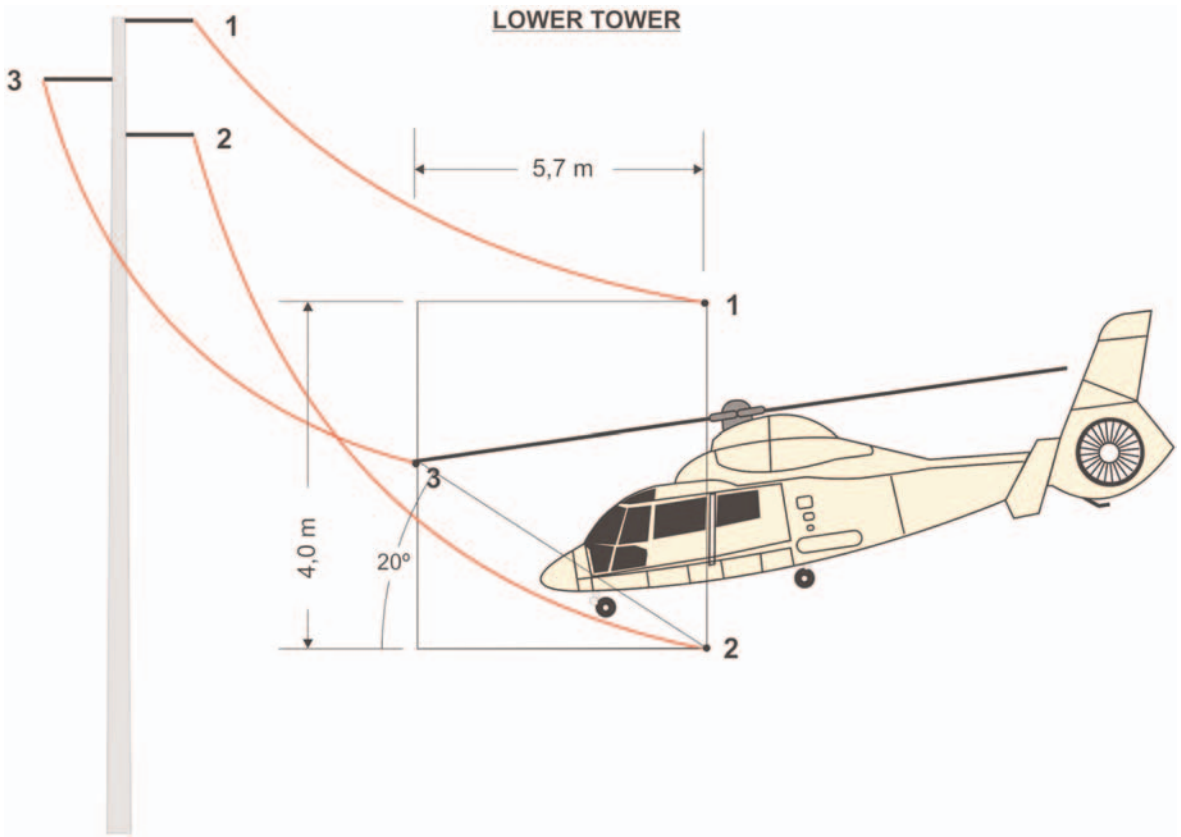


Figure 1.16.1.

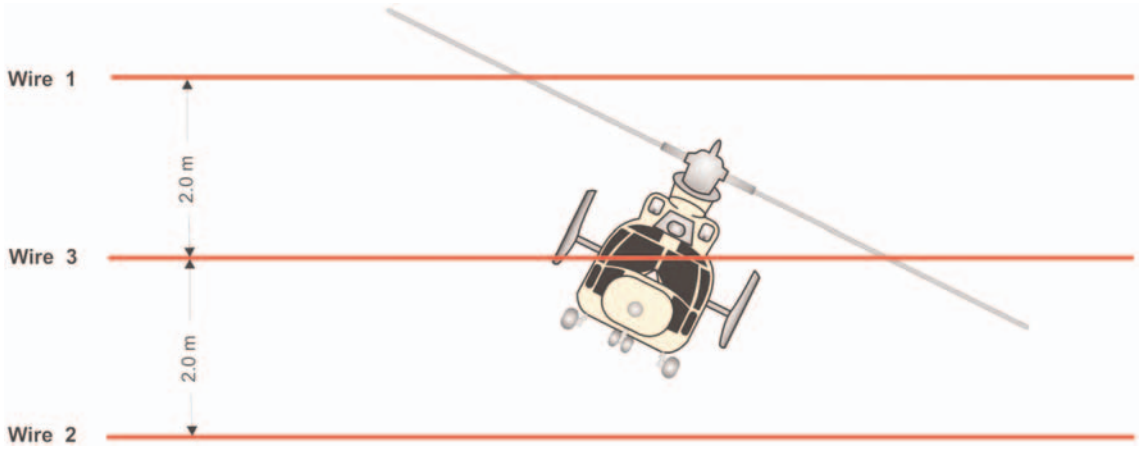


Figure 1.16.2.

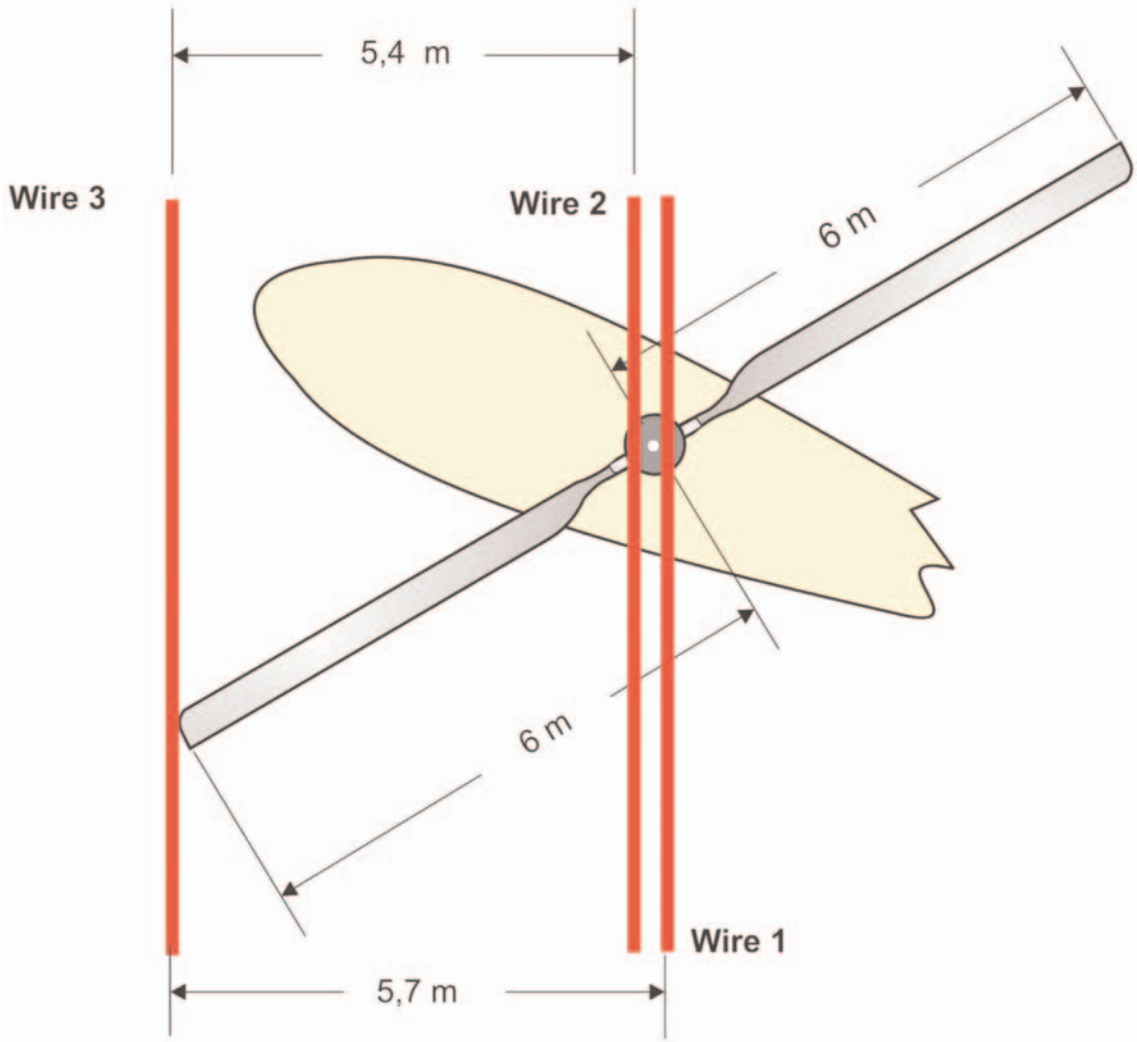


Figure 1.16.3.

Figure 1.16.4. Lower tower. Wire 2, highlighted with yellow dots, remained undamaged. Lateral wires are also highlighted with yellow dots.

1.17. Organizational and management information

1.17.1. *Organization of the operator*

The operator had long experience in aerial works with helicopters, including search and rescue and emergency medical services.

The accident helicopter was located at the «Las Palmas» base of the «Servicio de Urgencias Canario» (SUC), where it was being used in medical evacuation services, being active for 24 h during the complete year.

According to the statements gathered there were two pilots to cover the 24 h period of every day.

The first pilot started at 10:00 h local time and was replaced at 22:00 h by the other pilot. This schedule was being normally maintained for a week and then the shifts were changed, which would necessarily require a third pilot, because in the event that the same two pilots continued on duty, one of them would have had to work for 24 h that day, which was not allowed by any regulation.

The pilots used to be at the airport premises during the day. According to the information retrieved, no specific rest facilities were provided for the crews at the airport. During the night shift, the pilots used to wait in an apartment close to the airport, where individual bedrooms were provided. The flight crews were supposed to be able to answer an emergency call in 10 min.

According to the Basic Operations Manual of the operator, the minimum crew was composed of two fully type rated pilots for night VFR flights and for IFR flights even in helicopters certified for a single pilot. On those helicopters, the operator required a single pilot for day VFR flights.

However, the operator had also prepared an «HEMS Flight Operations Manual» (MOV HEMS) in Spanish that described the procedures and methods used in HEMS operations (Helicopter Emergency Medical Services). This manual already included some aspects of the HEMS operations of JAR-OPS 3 (see paragraph 1.18.2), including the definition of «crew member with medical dedication» as «a person assigned to a HEMS flight with the purpose of attending any on board person in need of medical assistance and of helping the pilot during the mission. He will be subject to the specific training detailed in [other chapter of the manual]». This training would include, according to the manual, aspects like navigation, radio communications, reading of instruments, use of normal and emergency checklists, selection of HEMS sites, etc.

In accordance with this manual, the minimum crew in diurnal HEMS flights could be composed of a pilot and a HEMS crew member with medical dedication. This crew could be reduced to a pilot alone only in circumstances previously approved by the Operations Department.

In Section 03 «Intervention at the place of the accident», the manual stated that the pilot in command, in the event that the engines were shut down, «will watch the security of the aircraft, and if there is coverage, will maintain communication with the Emergency Call Center».

1.17.1.1. Periodical training/checks of flight crews

The periodical training consisted of visits of the instructors to the different bases of the company, where the following activities were carried out:

— Proficiency check.
— Line check.
— Emergency and safety equipment.
— Cockpit resource management.
— Ground and refreshment training.

According to the information gathered, no specific training for prevention of impacts against wires was provided.

1.17.1.2. Operational procedures for takeoff

The Basic Operations Manual of the operator states that, after the takeoff, no turn may be initiated until the helicopter reaches 200 ft above the ground. The limitations section of the helicopter flight manual states that the climb path during the takeoff must not exceed 10° and at least 30 kt of speed is required at 30 m of height.

An operator-prepared checklist that was applicable to EC-GJE was reviewed. In that checklist, the following steps were required during the pre-takeoff checks:

Take-off clearance ..... *Received*
Transponder ..... *On*
Emergency floats ..... *A/R*
Runway heading ..... *Checked*
Caution panel ..... *Checked*
Auto-Pilot,CPL,F/D ..... *On*
Check-List ..... *Completed*

1.17.2. *Organization of the emergency coordination services of the Canary Islands*

1.17.2.1. General

The following services were active in the Canary Islands for management of emergency situations:

«Centro Coordinador de Emergencias y Seguridad» (CECOES 1-1-2), in charge of coordination of the different emergency resources after having notice of any incidence, normally through the phone number 112.

«Grupo de Intervención de Emergencias» (GIE), with the functions, among others, of search of missing persons, rescue of persons or goods, assistance to emergencies over the sea, location and extinguishing of forest fires, and also assisting the medical services with the evacuation of injured people or in case of accidents with multiple victims. Their helicopters were based in Gran Canaria and Fuerteventura islands.

«Servicio de Urgencias Canario» (SUC), in charge of both ground (ambulances) and aerial (medicalized helicopters) emergency medical services. Their medicalized helicopter EC-GJE was based at Gran Canaria Airport.

The day of the bus accident, given the fact that it seemed to be a serious event with multiple victims, the SUC immediately activated the helicopter EC-GJE with the purposes of making a medical evaluation of the situation as soon as possible, selecting the most serious injured persons for early evacuation, providing on-site medical assistance as needed. The SUC also activated 14 ground ambulances and coordination vehicles because of the accident.

The CECOES activated police and fire fighters services and 2 helicopters of the GIE.

1.17.2.2. Operational procedures for medical evacuation

The medical personnel of the SUC that go on board the helicopters were provided with an «operations manual» of medical emergencies with helicopters. This manual included general information about the helicopter and guidelines of safety when moving around it.

There was no requirement or mention for the medical personnel to be involved in the external vigilance of the flight.

According to the information gathered, this manual was also used for a short training course taught to medical personnel involved in aerial emergency services.

1.18. Additional information

1.18.1. *Wire strike avoidance systems*

In addition to the wire strike cutter that can be installed on this kind of helicopter as a customer option, some operators use a laser radar system that is effective in a cone of approximately 30° of angle in front of the helicopter. This system can detect the presence of wires approximately 1 km in advance in good visibility conditions.

Other operators use a GPS based map system that can detect the presence of wires in relation to the helicopter position provided that the obstacle data base is updated.

The laser radar system added a weight of around 30 kg to the helicopter.

1.18.2. *Provisions of JAR-OPS 3 regarding HEMS operations*

The Joint Aviation Requirements JAR-OPS 3 «Commercial Air Transportation (Helicopters)» specifically covers the Helicopter Emergency Medical Services (HEMS) operations in Appendix 1 to JAR-OPS 3005 (d) and the corresponding Advisory Circular Joint (ACJ). It is stated that HEMS operations must not be confused with aerial ambulance (where immediate and rapid transportation is not essential) or search and rescue (SAR) operations.

The concept of HEMS crew member is described as «A person who is assigned to a HEMS flight for the purpose of attending to any person in need of medical assistance carried in the helicopter and *assisting the pilot during the mission*. This person is subject to specific training as detailed in subparagraph (e)(2) below».

The HEMS crew member is distinguished from a «medical passenger» because the latter does not assist the pilot during the mission.

The crew composition for HEMS operations is required to be as follows:

> *«(A) Day flight. The minimum crew by day shall be one pilot and one HEMS crew member. This can be reduced to one pilot only in exceptional circumstances.*
> *(B) Night flight. The minimum crew by night shall be two pilots. However, one pilot and one HEMS crew member may be employed in specific geographical areas defined by the operator in the Operations Manual to the satisfaction of the Authority taking into account the following:...»*

In the ACJ to Appendix 1 to JAR-OPS 3.005 (d), the following tasks are assigned to the HEMS crew member:

> *«When the crew is composed of one pilot and one HEMS crew member, the latter should be seated in the front seat (copilot seat) during the flight, so as to be able to accomplish the tasks that the commander may delegate, as necessary:*
>
> *a) Assistance in navigation;*
> *b) Assistance in radio communication/ radio navigation means selection;*
> *c) Reading of check-lists;*
> *d) Monitoring of parameters;*
> *e) Collision avoidance;*
> *f) Assistance in the selection of the landing site;*
> *g) Assistance in the detection of obstacles during approach and take-off phases...»*

Items e) and g) are especially relevant to the present accident. It is also stated that when a HEMS crew member is carried on board, his primary task is to assist the commander, although there are occasions when this may not be possible. One of those occasions is when the medical passenger requires the assistance of the HEMS crew member in flight.

1.18.3. *Requirements of the DGAC regarding HEMS operations*

JAR-OPS 3 was not in force in Spain at the date of the accident. No specific requirements were found in Spain regarding HEMS operations, more than those included in the approved Operations Manual of every operator.

1.18.4. *Regulations regarding activity and rest periods*

The Annex 1 to Circular Operativa 16-B issued by the DGAC (on 28 May 2001) was included in the Basic Operations Manual (MBO) of the operator, and contained rules regarding the maximum activity periods and the minimum rest periods to be applied to emergency operations with helicopters. The rest period must have at least 10.5 h, with a minimum of 8 h in the lodging.

It was stated that if a crew member had to stay for more than 3 h in a designated place waiting for a task to be assigned, a suitable rest facility had to be provided, including an individual place to rest with adequate conditions regarding temperature, light, noise and ventilation.

The maximum period of physical presence in a duty place was 12 h. The maximum number of flight hours in a period of 28 days was 80 h, and the duty periods must be scheduled in a way that at least 8 free days in a month were provided to the crew member.

«Real Decreto 294/2004, de 20 de Febrero, por el que se modifica el Real Decreto 1561/1995, de 21 de septiembre, sobre jornadas especiales de trabajo, en lo relativo al tiempo de trabajo en la aviación civil», (Decree that covers the special schedules relating to working time in civil aviation) was a higher rank rule that specifically mentioned that CO 16-B was still in force except were opposed to it.

1.19. Useful or effective investigation techniques

None.

2. ANALYSIS

2.1. General

The factual information presented in this report lead to the conclusion that the accident probably happened because the aircraft was inadvertently manoeuvred into the power line wires in absence of mechanical failure of the helicopter that would have impaired its performance or manoeuvrability.

The following facts support this conclusion:

— Qualified witnesses did not notice any mechanical abnormality during the takeoff and initial climb of the helicopter. Those manoeuvres involved a low speed tight left climbing turn that required plenty of power and control authority of the aircraft.
— The aircraft flew for approximately 2,500 m after the impact against the wires, in which some corrections of the flight attitude could be applied.
— The sound analysis of a video tape showed that the main rotor was functioning at a normal speed even after the impact against the wire.

Another very important fact regarding this accident was that, as noted in the communications records and through witnesses statements, after he landed in the road, the pilot was aware of the presence of the wires in the vertical of his helicopter position.

It was determined that both poles of the power line were in a conspicuous position, and were noticeable along the road from the bus wreckage to the helicopter landing place.

Therefore, it is considered that a factor that could cause the impact against the power line during the subsequent takeoff was a forgetfulness or memory lapse, whether momentary or not, which affected the pilot while he was carrying out the pre-takeoff procedures.

Then, after the takeoff, he could not see the power line on time to carry out an evasive manoeuvre. This fact could have been influenced by the workload conditions at those moments or any distraction that happened inside the cockpit at those moments, but those circumstances are unknown.

The following paragraphs try to analyse the different aspects involved in the operation of the mission that helicopter EC-GJE was carrying out, with the aim to derive possible preventive safety measures.

2.2. Emergency services coordination

The sequence of the events started with the accident bus that caused a number of injuries. The local police of the city of San Bartolomé reached the area and called the emergency coordination services (CECOES or 112 phone) to inform about the situation.

The normal procedure is that the CECOES determines what services are needed and starts activating the different emergency departments (fire fighters, medical, etc.).

The CECOES decided that several helicopters were needed to evacuate the injured people and called the SUC, which sent the medical helicopter EC-GJE to the area. Other two helicopters of the rescue service GIE that were located in the islands of Gran Canaria and Fuerteventura were also called on duty.

On the other hand, officials of civil protection of the city of San Bartolomé also started activating their local resources and called a private helicopter to transport one of their officials to the wreckage area.

According to the statements gathered, a lot of ground vehicles (fire-fighters, police, and ambulances) were also sent to the bus accident area. Some witnesses stated that the resources activated were too numerous taking into account the characteristics of the accident and especially the physical capability of the narrow single-lane road and the space available to park vehicles in the area.

2.3. Preflight planning

The pilot in command of EC-GJE had come on duty that day at 10:00 h local time. On 29 March, he ended his activity period at 22:00 h without any flight. That day had been his first day of work after 3 days off. Since he had his residence in Las Palmas de Gran Canaria, it is reasonable to think that he could have had at least 8 h at his lodge for effective rest before starting the new activity period on 30 March.

That day, after the accident of the bus, the pilot in command filed a local flight plan at Gran Canaria Airport (GCLP) to fly to the area (15:15:24 h local). The accident area was familiar to the pilot and he had experience with this kind of flights.

After the takeoff, in 2:46 min the helicopter reached 2,800 ft (a mean climb speed of 1,000 ft/min) and approximately 130 kt of groundspeed.

2.4. Selection of the landing area

According to some witnesses, the helicopter came from the east and carried out several passes over the bus accident area to select a suitable place to land. At that time, it was the first and only helicopter in the zone.

The helicopter finally landed in a small racquet in the narrow road, around 250 m further west of the bus wreckage. It is unknown whether the pilot had some constraints with his helicopter to prefer that asphalted area instead of other unprepared, wider are-

as that were closer to the bus wreckage. It is obvious that a prepared and flat area is always preferred over other unprepared terrains, but in this case that preference involved leaving the helicopter far away from the bus wreckage and, additionally, to land close to the power line wires.

It was considered the possibility that this fact was influenced by the lack of sliding doors on the helicopter. Since the hinged doors could not be opened in flight in order to carry out a visual survey of the tail rotor area during the landing, maybe the pilot preferred to land on the road to be sure that the tail rotor was not going to impact against any obstacle. However, it was established that the medical personnel on board do not usually perform any activity related to the operation of the aircraft, like for example watching the tail rotor area during landings, and therefore that possibility was discarded. The flight manual did not have any procedure for the opening of the doors in flight, although this action is not specifically prohibited either.

The manufacturer informed that no characteristic of the SA-365-N1 model (for example the FENESTRON or composite tail rotor blades) made it necessary to select an asphalted area to land. However, in the opinion of experts of the operator, the area selected was the best given the fact that the helicopter had a retractable landing gear with wheels and a vertical stabilizer with little clearance with the ground, and therefore the selection of a levelled landing site without vegetation was a good choice to avoid possible damages to the aircraft.

The landing area had less than 2D × 2D of surface free of obstacles, and therefore the provisions of the operations manual were not complied with at that point.

The helicopter came to rest just below a high power electricity line that ran almost perpendicular to the longitudinal axis of the aircraft. The horizontal projection of the line passed slightly behind the line of the pilot and copilot seats. The upper tower of the line remained to the right and to the front of the pilot position, and the lower tower was located to the left and behind the cockpit of the helicopter.

2.5. Activities of the pilot on the ground

After the aircraft landed, the pilot was seen in the bus wreckage area helping with the injured passengers. The doctor and the nurse that were on board EC-GJE were the first medical personnel in the area, and they were very busy in determining the seriousness of the injured people and making a first classification of people ready for evacuation.

In the mean time, the Bell 412 and the private Bell 407 helicopters arrived in the area.

The pilot of EC-GJE was well aware of the presence of the wires and in fact tried to warn the CECOES coordinator and the pilot of the 412 about the corresponding hazard.

He carried out auxiliary activities on the ground, and helped with one of the stretchers of the people that were being boarded on his helicopter. These activities did not strictly comply with the provisions of Chapter 4 on operational procedures of the HEMS Operations Manual of the operator, which in Section 03 «Intervention at the place of the accident» stated that the pilot in command, in the event that the engines were shut down, «will watch the security of the aircraft, and if there is coverage, will maintain communication with the Emergency Call Center».

It has to be concluded that the pilot, as it commonly happens, was driven by his willingness to help the injured people, especially at the first moments when few medical and rescue people were in the area. The total time that the helicopter remained in the area was one hour and ten minutes (15:29:50 h to 16:39:21 h).

Some witnesses mentioned that helicopter EC-GJE was interrupting the way of ground aid people from their vehicles to the bus wreckage. The fire-fighters and ground medical personnel had to walk for approximately 400 m to reach the accident place, and therefore there were comments that the helicopter should be moved from the road to any other place.

Those comments were transmitted to the doctor of EC-GJE, and also to the pilot, which probably increased his stress or the pressure to takeoff as soon as possible.

2.6. Takeoff manoeuvre

Some of the photos reviewed showed that while the two stretchers with injured people were being boarded, the pilot was probably already inside the cockpit, preparing the takeoff. The nurse was seen manipulating something, probably opening the oxygen valve, in the cargo compartment located in the right side of the helicopter.

According to witness statements and to some photos reviewed (see Appendix A) the takeoff involved an almost immediate left hand climbing turn after liftoff. No specific explanation for this maneuver was found during the analysis of the accident. The operations manual did not allow this maneuver (200 ft of height required before initiating a turn), and the characteristics of the area and even the wind favoured a takeoff with a west heading while climbing in a normal angle. Even in absence of the wires, this manoeuvre would have imposed certain hazard to the helicopter because a tight turn was initiated towards an area that was outside the normal field of view of the pilot.

The hospital was located to the east and the maneuver carried out may be linked to certain pressure to reach the hospital as soon as possible. However, from the information gathered, it seems the two injured tourists on board were in a stable state at that point.

The witnesses did not see any trace of manoeuvre of the helicopter to avoid the cables. This fact supports the conclusion that the pilot did not note the wires before the impact or, in the event he saw the cables at some point, he did not have time to react or preferred not to aggravate the situation with abrupt late stage manoeuvres.

Since the helicopter did not have any recorder installed, it is not possible to determine whether something happened or was said inside the helicopter to distract the pilot's attention during the takeoff. However, the geometry of the intended maneuver suggests that the pilot had already forgotten the presence of the wires during or before the pre-takeoff tasks.

2.7. Visibility of the power line

When the pilot was seated on the right hand seat of the cockpit, prepared for the takeoff, his vision of the upper tower of the power line was probably impaired by a couple of high shrubs located in the area that were above the height of the main rotor. It was not possible to determine whether the pilot was wearing lenses at that moment.

The lower tower was to the left and to the back of the pilot, behind the line of view through the window of the copilot.

The medical personnel were seating face to face in the two seats prepared in the cabin. It is possible that the person seated in the front of the cabin (looking rearwards) was able to see the lower power line tower through the left cabin door. However, it is also probable that both the doctor and the nurse were watching the injured people inside the cabin. They are not required by the operations manual to carry out any operational task during the flight of the helicopter.

2.8. Manoeuvring after the blade impact

The recorded sound of a video tape showed that the engines were already started when the recording was initiated.

There were 10 s since the moment the engines were heard to change the frequency (indicating takeoff) until the impact with the wires happened.

Afterwards, the helicopter flew for around 18 s until it disappeared above a nearby hill (see Figure 1.1.4). The distance from the wires impact point to the hill is approximately 500 m.

It is probable that the impact against the wires was heard inside the cockpit. It must certainly have been noticed, because the helicopter changed the pitch and roll as a result of the impact.

Since the pilot had seen the wires during his previous landing, even if he forgot about the presence of that obstacle during the takeoff, the sound and effects of the impact must have almost immediately reminded him about those wires.

Therefore, even without any warning or indication of malfunction in the cockpit, it is reasonable to think that he was able to quickly identify the source of the sound, the high vibration and the controllability problems he noticed.

After being aware that an impact against wires had occurred, the first task of the pilot was to regain full control of the helicopter, which was destabilized for a few moments according to some statements, while he was probably trying to assess the extent of damage to the helicopter. However, this process took some seconds during which the helicopter continued flying forward at a height of approximately 80 m above the ground.

That must have been a critical period regarding selection of possible emergency landing areas, and a view of the bus wreckage surroundings shows that the more the helicopter advanced towards the hill, the least possible landing areas remained in place to be reached without important heading or roll angle changes (see Photo 2 in Appendix A).

Then, another factor seems to have affected the pilot making decision process, because initially the helicopter seemed to be going to the area where most people was concentrated on the ground, to the point where some of those people were scared. The pilot carried out a shallow turn to the right in what seemed to be an attempt to avoid further hazards to the people on the ground. This manoeuvre probably consumed more seconds that could have been devoted to locate a landing area.

Photo 2 of Appendix A shows several places where an emergency landing could have been attempted. However, due to the factors exposed above, it is obvious that it was not an easy decision to be taken on board. In addition to the stress and workload inside the cockpit, those landing areas required important yaw and roll changes and probably the pilot was unsure of the flight capability of the helicopter at those moments and did not want to take the risk. One of the suitable areas was occupied by helicopter EC-GCZ and other by helicopter D-HOMN.

The helicopter continued flying and over flew the mentioned hill. From that moment on, a different scenario was probably faced inside the cockpit. The helicopter was stabilized and seemed to be flying with at least some kind of normality but, however, the suitable places to carry out an emergency landing had disappeared, because from that hill to the place where the helicopter finally crashed there was mountainous terrain covered with trees and shrubs for most of its surface. The helicopter seemed to head towards a crossroad for some extend, but then it changed the heading and flew almost in parallel with the road (see Figure 1.1.5).

The pilot had previously landed in the narrow road. Therefore, it could be argued that the complete span of the road could have been a suitable emergency landing place. However, consideration must be given again to the fact that the aircraft was damaged and maybe the pilot considered that it was not in the best position to attempt such a precision manoeuvre. Additionally, there were also a lot of power line wires along the road, which was also somewhat crowded with cars and people.

It is possible that the pilot, noticing that the helicopter remained in flight for more and more seconds, tried to reach another wider or more suitable area in the surroundings of «Cruz Grande». A study of the area map showed several places where that landing could have taken place. However, the helicopter started disintegrating in flight because of the vibration and the aircraft crashed close to the road in that area of «Cruz Grande».

The private helicopter D-HOMN that flew to the zone after the accident, landed in an area located approximately 400 m from the accident place. Other statements gathered indicated that from the air it could be appreciated that there were not many places to carry out an emergency landing, and that it was very difficult and risky to try to land in the road close to that place.

2.9. Structural behaviour of the aircraft

The specialist's opinions received stated that it was amazing that the aircraft could fly for such a long distance after the impact. The normal pattern of accidents where a severe wire impact has occurred is the almost immediate crash of the aircraft. On the other hand, the leading edge of the blades of this helicopter is stiff enough to survive an impact against wires of this kind.

In this case, the impact affected the trailing edge of the blade, where there is no structural spar to absorb the corresponding load.

The unbalance due to the parts missing was so important that the vibration destroyed later on the attachments of the reduction gear box, because the ultimate loads of those attachments were largely exceeded.

However, it is noticeable that an experienced pilot like the one involved in the accident was not trained to quickly recognize the deep hazard of disintegration imposed to the helicopter and to try to quickly land or approach the ground even in an unsuitable place. As it has been discussed above, the decision making process on board is very difficult after an event as the one faced by EC-GJE and every situation can be unique in its nature and effects. It is difficult to provide general written procedures to crews to cope with such situations.

It would anyway be convenient to provide pilots with more information and training related to structural capability of the helicopter after impacts that produce imbalance to help crews to make a decision in such conditions. Although it would not be practical to include this information in the Flight Manual, because the great diversity of situations that may be faced in every flight, it could be provided by the manufacturer in the form of general information publications addressed to the operators.

2.10. Possible causes of the memory lapse

As previously discussed, the circumstances of this accident seem to point to a forgetfulness of a previously detected obstacle, rather than to a low visibility of the wires. Even with a highly visible wire, the pilot would have had little time to react at the end of the left turn. The cause that made the pilot to forget about the wires could have been a noticeable workload on board with the contributory factor of either medical issues or fatigue issues.

2.10.1. *Medical factors*

The medical records of the pilot were asked for, in an attempt to identify any specific source of the short term memory lapse he apparently suffered before or during the take-off. No relevant data in this respect could be identified in the medical file of the pilot.

No toxicological analysis of the bodies of the occupants was available.

2.10.2. *Fatigue factors*

It seems that the day of the accident the pilot had rested at least during 8 h.

The day before, he did not carry out any flight. The last «flight» was done on 24 March in a flight simulator in France. After that course, he had 3 days off (considering that 25 March was devoted to travelling) until he started working again on 29 March.

It is therefore considered that short-term fatigue was not a factor in this accident.

It is always difficult to carry out a detailed analysis of the so called long-term fatigue, normally associated to 12-hour shifts in 24-hour services along 20 continuous days, with short expected response times when called for an assignment. This process may affect the performance of pilots that spend long periods of inactivity in the same base waiting for a flight to be carried out on demand, followed by short periods of intense activity after an emergency call. This situation may be aggravated if not optimum resting facilities are provided during such long periods.

Even if such condition existed, it would be very difficult to establish its direct influence in the accident. However, in any case, it is considered convenient to issue a safety recommendation to the DGAC to review the organization and procedures of the emergency medical services of the operator in the Canary Islands regarding activity periods and resting conditions to be sure that the possibility of long term fatigue for the involved pilots is minimized.

2.11. Discussion of possible accident prevention measures

2.11.1. *General*

Two safety aspects can be covered in this accident regarding prevention of similar events:

1. Avoidance of impact against wires.
2. If the impact could not be avoided, measures to minimize the effects on the occupants.

2.11.2. *Prevention of impact against wires*

Regarding item 1 above, the same general means of prevention have been mentioned and discussed for years in a lot of helicopter accidents reports. Those general or «classical» wire strike avoidance means are:

— Wire cutters.
— Beaconing of wires.
— Wire detection and warning systems, including, in a general sense, both automatic devices (see paragraph 1.18) and a second pilot on board to look for wires and obstacles in the path of the helicopter.
— Training.

A new item could be introduced for wire impact prevention, as it could be exclusive dedication to the flight of all the occupants of the aircraft during the takeoff, initial climb, final descent and landing phases, with a specific training to the crew members that are not pilots.

It is considered that neither the wire cutters nor the laser wire detection devices could have prevented the present accident, because the wire strike happened with the blade (and the cutter is installed in the front fuselage) and while the helicopter was in a left climbing turn (and the laser detection devices work in a cone in front of the helicopter).

Maybe a GPS-based detection system could have warned the pilot of the presence of the wires, provided its database was updated to include the subject power line. However, since the helicopter had landed first place just below the wires, it is probable that a nuisance alert had been generated during the landing, and in this kind of situations there could be a tendency to disconnect the obstacle warning function of the system, once the obstacle has been recognized by the pilot. Additionally, it has to be considered that the system searches a certain area ahead the aircraft. Therefore, the warning would probably have been generated a certain point during the turn, again leaving the pilot with a short time to react and manoeuvre to avoid the power line.

The beaconing with orange plastic spheres to make the wires more visible could obviously have helped to pilot to detect them in advance. However, given the abrupt takeoff manoeuvre that was being performed, in which the wires only came into the vision field of the pilot after the left turn was almost completed, doubts remain about the possibility of avoidance with an appropriate manoeuvre. In any case, since the power line was not close to an area subjected to aeronautical use, and given the huge cost of this kind of devices, it is difficult that in practice this kind of lines are marked with diurnal beacons.

The presence of a second pilot on board would also obviously have been of benefit in order to prevent the impact against the wires, especially taking into account that he would have been seated on the left side of the cockpit with better visibility to the lower tower to the side where the impact happened in this case.

The mandatory inclusion of a second pilot (whether fully type rated or not) in this kind of single-pilot certified helicopters when used in special missions, has been in discussion for long time. Certain benefits can be mentioned with such a measure, apart from the increase in safety, like gaining flight experience at lower cost. However, two shortfalls or disadvantages remain: an appreciable increase of the operational costs, and added weight that, in some missions, may be critical.

The operator required (see 1.17.1) two type rated pilots for night or IFR operations, but no similar requirement existed for day VFR missions. In the case of HEMS flights, the HEMS Manual of the operator stated that the minimum crew might be composed of a pilot and a HEMS crew member with medical dedication. This minimum crew could be reduced to a single pilot only in circumstances previously approved by the Operations Department.

JAR-OPS 3, which was not in force in Spain at the time of the accident, required a minimum crew of a pilot and a HEMS crew member for every day VFR flight in this kind of operation and this philosophy was somewhat included in the HEMS manual of the operator, although during the accident flight this crew composition was not complied with.

The interpretation of the functions of a HEMS crew member is that the support to the operation of the aircraft, when required by the pilot in command, happens when the-

re are no injured people on board that require his assistance during the flight. In this accident, there are doubts about the kind of assistance required by the two injured people on board, although it is possible that if one of the two medical passengers would have been a qualified HEMS crew member, he or she could have been seated in the left cockpit seat to help the pilot during the takeoff and subsequent flight, while the other medical passenger could have remained in attendance of the injured people.

In any case, in other situations in which the HEMS crew member could not be seated in the copilot seat during the takeoff and landing because of the need to attend the injured people on board, he could still carry out some tasks in support of the operation, when required by the pilot in command, like for example collision avoidance, assistance in the detection of obstacles, and assistance in the selection of the landing site

As with any other possible safety measure, cost must be balanced against potential safety benefits. It is considered that the inclusion of a properly trained HEMS crew member in every day VFR HEMS operation, which would be required under JAR-OPS 3 except in exceptional circumstances, could represent a noticeable increase of safety while keeping the associate cost at an acceptable level. This consideration would lead to the conclusion that it is recommendable that the regulation JAR-OPS 3 comes into force in Spain as soon as possible, because it is not considered practical to publish partial regulations that reflect only some concrete aspects of the regulation.

2.11.3. *Measures after an impact with wires*

As discussed above, the measures to be taken would broadly be «land immediately» (in the «flight manual sense» of this phrase) after the impact, and «beware of the hazardous vibrations that can destroy the helicopter quickly». However, it has also been concluded that every event is almost unique in its own circumstances, and «land immediately» may not always be feasible, as it probably happened in the accident of EC-GJE. Therefore, more training to quickly make the safest decisions remains as the most practical means of helping crews to maximize the survival probability after a wire strike.

3. CONCLUSIONS

3.1. Findings

1. The pilot had a valid licence and was qualified for the flight.
2. The aircraft had a valid and current airworthiness certificate.
3. Records indicate that the aircraft was being maintained in accordance with an approved maintenance program.
4. The weather conditions were adequate for the type of flight being conducted.
5. One of the blades of the main rotor was seen to impact against two wires of a power line shortly after takeoff. Parts of approximately half of the span of the blade fell to the ground at that point.
6. There was no evidence of malfunction of the aircraft before impact against the wires.
7. After the impact, the helicopter continued flying for approximately 2,500 m.
8. The reduction gearbox and three blades of the main rotor detached from the helicopter before the final impact into the ground.

3.2. Causes

It is considered that the most probable cause of the accident was the impact of a blade of the main rotor against two power cables, whose presence was previously known to the pilot, during a takeoff manoeuvre that included a tight left climb turn.

4. SAFETY RECOMMENDATIONS

REC 01/05. It is recommended to the operator that more training is provided to flight crews involved in emergency medical services regarding the selection of landing areas and the actions to be taken on the ground by the pilot in command, including the need to conveniently prepare the subsequent take off.

REC 02/05. It is recommended to the manufacturer that general guidance in the form of information letters or other means is provided to the operators of SA-365 helicopters regarding the immediate actions to be carried out after an impact against external objects, including the need to carry out an emergency landing as soon as feasible.

REC 03/05. It is recommended to the DGAC of Spain that, after discussion with the representatives of the sector, the helicopter operations requirements JAR-OPS 3 are published in Spain.

REC 04/05. It is recommended to the DGAC of Spain that they review the organization and procedures of the emergency medical service of the operator in the Canary Islands, in particular regarding activity periods scheduling, change of shifts between pilots, and provision of suitable resting places for the flight crews for both day and night shifts, with the intend of minimising the possibility of long term fatigue.

APPENDICES

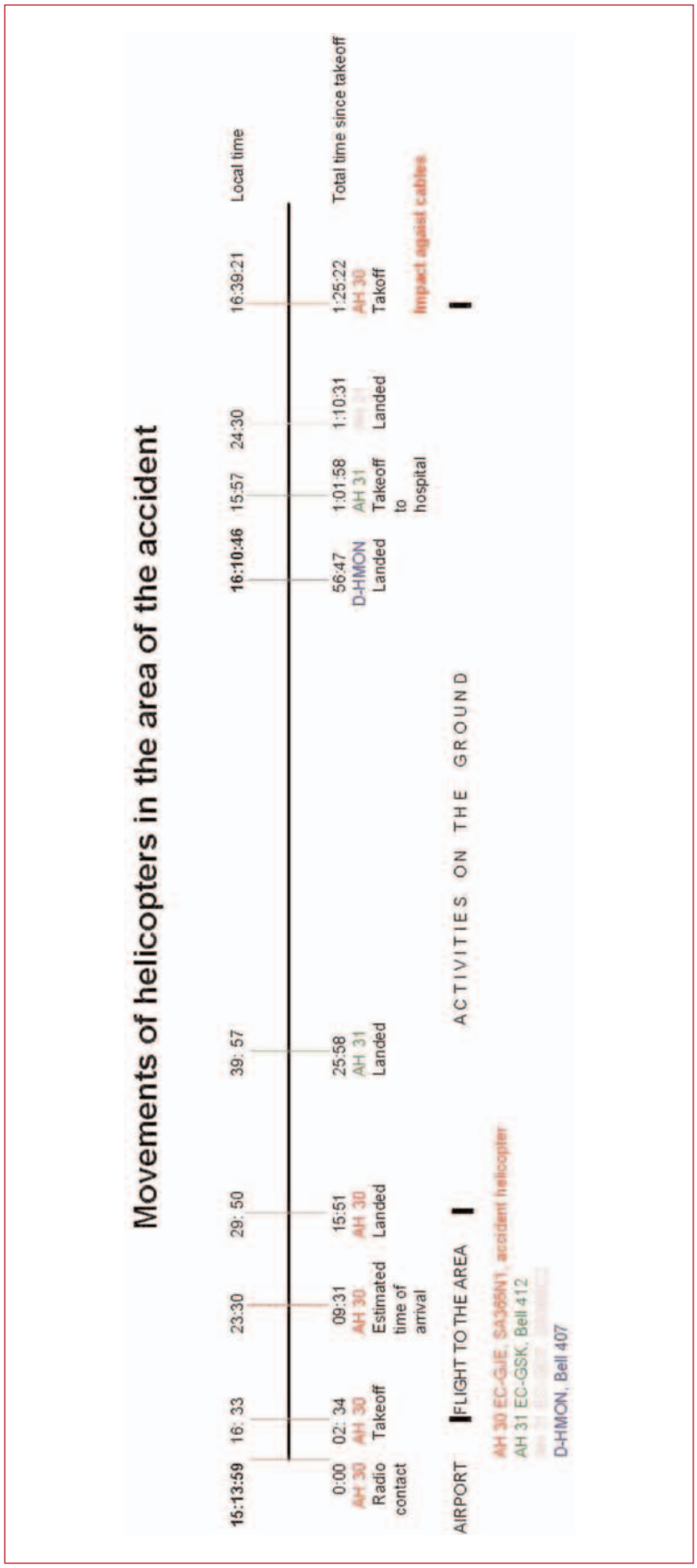
APPENDIX A
Photographs

Photo 1. *Helicopter EC-GJE is turning left shortly after takeoff, before impacting against the cables (photo: City Hall of San Bartolomé). The other Dauphin, EC-GCZ, is waiting and prepared to start the engines. The power cables have been highlighted in red for clarity*

Photo 2. *General view of the bus wreckage area and possible landing areas. Trajectory of EC-GJE after the impact represented in accordance with video tape recording ing (photo: City Hall of San Bartolomé)*

APPENDIX B

Time table of the activity of helicopters in the area of the bus accident


Movements of helicopters in the area of the accident
15:13:59
16: 33
23:30
29: 50
39: 57
16:10:46
15:57
24:30
16:39:21
Local time
Total time since takeoff
0:00
AH 30
Radio contact
02: 34
AH 30
Takeoff
09:31
AH 30
Estimated time of arrival
15:51
AH 30
Landed
25:58
AH 31
Landed
56:47
D-HMON
Landed
1:01:58
AH 31
Takeoff to hospital
1:10:31
Landed
1:25:22
AH 30
Takoff
Impact against cables
AIRPORT
FLIGHT TO THE AREA
ACTIVITIES ON THE GROUND
AH 30 EC-GJE, SA365N1, accident helicopter
AH 31 EC-GSK, Bell 412
D-HMON, Bell 407