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# Report A-025/2007

Accident involving a Bell-212 aircraft, registration EC-FBM, operated by Helisureste, on 13 June 2007, in Oñati (Guipúzcoa)

GOBIERNO DE ESPAÑA
MINISTERIO DE FOMENTO

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GOBIERNO DE ESPAÑA
MINISTERIO DE FOMENTO
SECRETARÍA DE ESTADO DE TRANSPORTES
COMISIÓN DE INVESTIGACIÓN DE ACCIDENTES E INCIDENTES DE AVIACIÓN CIVIL

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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.

This report was originally issued in Spanish. This English translation is provided for information purposes only.

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# Abbreviations

| | |
|---|---|
| 00° | Degrees |
| 00 °C | Degrees Celsius (centigrade) |
| ADF | Automatic Direction Finder |
| AENA | Spain's Airport and Air Navigation Operator |
| AFCS | Automatic Flight Control System |
| AMA | Area Minimum Altitude |
| ARO | Air Traffic Services Reporting Office |
| ATC | Air Traffic Control |
| BEA | Bureau d'Enquêtes et d'Analyses pour la Sécurité de l'Aviation Civile |
| CAVOK | Visibility, cloud and present weather better than prescribed values or conditions |
| CFIT | Controlled Flight into Terrain |
| CP | Copilot |
| CPLH | Commercial Pilot License Helicopter |
| CRM | Crew Resource Management |
| CTR | Control area |
| CVR | Cockpit Voice Recorder |
| DH | Decision height/altitude |
| DME | Distance-measuring equipment |
| FL | Flight Level |
| FPL | Flight plan (message type designator) |
| ft | Feet |
| ft/min | Feet per minute |
| GPS | (Global Positioning System) System that uses signals emitted by a network of satellites to calculate the position of a moving object s |
| h | Hours |
| hPa | Hectopascal(s) |
| ICAO | International Civil Aviation Organization |
| IFR | Instrument Flight Rules |
| IMC | Instrument Meteorological Conditions |
| IR(H) | Instrument Rating (Helicopter) |
| kg | Kilogram(s) |
| kHz | Kilohertz |
| KIAS | Indicated Airspeed (knots) |
| km | Kilometer(s) |
| kt | Knot(s) |
| lb | Pound(s) |
| LEBB | Bilbao Airport |
| LEXJ | Santander Airport |
| LEPP | Pamplona Airport |
| LERJ | La Rioja (Logroño) Airport |
| LEVT | Vitoria Airport |
| LEZG | Zaragoza Airport |
| LH | Left Hand |
| m | Meter(s) |
| MEA | Minimum En route Altitude |
| METAR | Aviation Routine Weather Report |
| m/min | Meters per minute |
| N | North |
| NOTAM | Notice containing information concerning the establishment, condition or change in any aeronautical facility, service, procedure or hazard, the timely knowledge of which is essential to personnel concerned with flight operations |
| NDB | Non-Directional Beacon |
| NE | Northeast |
| NM | Nautical Miles |
| OM | Operations Manual |

# Abbreviations

| | |
|---|---|
| PIC | Pilot in Command |
| QNH | Altimeter sub-scale setting to obtain elevation when on the ground |
| RCA | Spain's Air Traffic Regulations |
| RH | Right Hand |
| RPM | Revolutions Per Minute |
| S | South |
| SE | Southeast |
| TAF | Aerodrome forecast |
| TMA | Terminal Control Area |
| UTC | Coordinated Universal Time |
| UTM | Universal Transverse Mercator coordinate system |
| V | Visual |
| VFR | Visual Flight Rules |
| VFRN | Night Visual Flight Rules |
| VMC | Visual Meteorological Conditions |
| VMCN | Nighttime Visual Meteorological Conditions |
| VOR | VHF Omnidirectional Range |
| W | West |

# Synopsis

| | |
|---|---|
| Owner and operator: | Helisureste, S.A. |
| Aircraft: | Bell-212 |
| Date and time of accident: | 13 June 2007; at 11:43 h[1] |
| Site of accident: | Oñati (Guipúzcoa) |
| Persons onboard and injuries: | Two, pilot and copilot, both deceased |
| Type of flight: | General Aviation – Ferry/Positioning flight |
| **Date of approval:** | 23 March 2011 |

## Summary of accident

The helicopter was scheduled to make a positioning flight between Santander Airport and the Mutxamiel Aerodrome (Alicante), with an intermediate stop at the Teruel Helicopter Base. Due to the weather between Santander and Teruel, the crew flew through mountain areas as permitted by the cloud ceiling. In the vicinity of the town of Oñati the helicopter entered an area of fog, and shortly afterwards impacted the terrain.

The investigation has determined that the cause of the accident was the failure to maintain minimum en route altitude, which would have guaranteed obstacle clearance, before knowingly entering IMC conditions.

[1] All times in this report are local. To obtain UTC, subtract two hours from local time.

# 1. FACTUAL INFORMATION

## 1.1. History of the flight

The Bell-212 helicopter, registration EC-FBM, had been based for a month at the Santander Airport involved in civil protection activities under a contract between the operator and the Government of Cantabria. It was replacing the helicopter that normally performed that service, and which was undergoing a scheduled maintenance inspection. On 13 June 2007, having concluded the substitution period, the helicopter was to be returned to the operator's facilities at the Mutxamiel Aerodrome (Alicante).

The flight would be made in two stages, the first between the Santander Airport and the helicopter base[2] in Teruel, where it would refuel before continuing on from there to the Mutxamiel Aerodrome.

The crew during the flight consisted of the Captain and a Copilot, who had gone to Santander four and three days before the flight, respectively.

At 09:00 on 13 June, the crew obtained the weather information they needed to make the flight and at 09:13 they filed their Flight Plan for the first stage between Santander and Teruel under visual flight rules (VFR).

They took off at 10:48, and the crew headed north to fly along the coast to the vicinity of Bilbao Airport. They followed a route where the cloud ceiling allowed them to make the flight under VFR conditions. Once they reached the town of Castro Urdiales (see Fig. 1), near the Bilbao Airport control zone (CTR), they proceeded SE then to the NE until they reached the Ibaizabal River valley, which they followed to the SE, flying over the city of Durango before continuing in the direction of Pamplona.

In the Artixa River valley, past the town of Oñati, the visibility dropped and the helicopter made a turn of about 180°, returning along its original route. Two minutes after the turn, they headed south, entering the Araotz River valley at approximately 11:41. On entering this valley, they penetrated a layer of fog, and shortly thereafter the helicopter impacted against a hillside on said valley while on a heading of 138°. The point of impact was at an elevation of 2,280 ft. Both crewmembers perished after the impact.

## 1.2. Injuries to persons

| Injuries | Crew | Passengers | Total in the aircraft | Others |
|---|---|---|---|---|
| Fatal | 2 | | 2 | |
| Serious | | | | |
| Minor | | | | Not applicable |
| None | | | | Not applicable |
| **TOTAL** | **2** | | **2** | |

[2] Emergency Medical Helicopter Base run by the same Operator.


**Figure 1.** Path taken by helicopter from Point W and location of mountain passes

## 1.3. Damage to aircraft

As a consequence of the impact against several trees and the ground, the aircraft was destroyed.

## 1.4. Other damage

Several trees in the area of the accident were damaged by the helicopter's impact.

## 1.5. Personnel information

The crew consisted of a captain, who worked for Helicsa, and a copilot from Helisureste, S.A., both of which belong to the same business conglomerate, INAER, S.A. It was not the first time the two pilots had flown together as a crew since they had shared the same program within the operator in its regular schedule operations between Ceuta and Málaga.

| | Captain | Copilot |
|---|---|---|
| Age/Gender: | 51 years old/Male | 37 years old/Male |
| Nationality: | Spanish | Spanish |
| License: | CPL(H) | CPL(H) |
| Medical certificate. Validity: | Class 1 | Class 1 |
| Valid ratings held: | • Bell 212/412<br>• Sikorsky 61<br>• IR(H)<br>• Agricultural, firefighting only | • Bell 212/412<br>• AgustaWestland 139<br>• IR(H) |
| Flight experience: | | |
| • Total hours: | 4,889 h | 1,161 h |
| • Total IFR hours: | 649:30 h | 79 h |
| • Hours on the type: | 4,113 h | 597 h |
| • Hours in last 90 days: | 115 h | 57:40 h |
| • Hours in last 30 days: | 03:27 h | 7 h |
| • Hours in last 7 days: | 00:15 (engine startup[3]) | None |

Neither crewmember had any activities assigned in the company's schedule for the next day.

[3] Engine startup for a brief period of time for maintenance purposes only, without any intention to fly.

### 1.5.1. *Captain (PIC)*

Most of his professional career as a helicopter pilot had been in Spain's navy, where he accumulated a great deal of experience on the Bell-212 helicopter. In October 2006 he left the navy and joined Helicsa. His flight experience at Helicsa was mainly at its Maritime Search and Rescue Unit, based in Almeria, where he flew a Bell-212 helicopter.

On 9 June 2007, he went to Santander to join the crew of helicopter EC-FBM in Civil Protection duties. He did not take part in any flights until the day of the accident.

### 1.5.2. *Copilot (CP)*

The copilot had 597 flight hours on the Bell-212 helicopter. His instrument flying (IFR) experience had been on scheduled passenger flights between Ceuta and Malaga on AW-139 helicopters. On 10 May 2006, he joined the Civil Protection Service of the Canary Islands and on 10 June 2007, he joined the Civil Protection Service of Cantabria as a crewmember of helicopter EC-FBM, which was taking part in civil protection duties. He did not make any flights until the day of the accident.

## 1.6. Aircraft information

### 1.6.1. *General information*

| | |
|---|---|
| Manufacturer: | Bell Helicopter |
| Model: | 212 |
| Serial number: | 30574 |
| Year of manufacture: | 1973 |
| Number and type of engine: | Two, Pratt & Whitney PT6T-3 |
| Total hours on airframe: | 19,584:40 |
| Airworthiness certificate: | Valid until 16 February 2008 |
| Aircraft Station License: | Valid until 16 February 2008 |

The aircraft had been maintained in accordance with the authorized maintenance program and was certified for both day and night IFR operations.

The last check of the aircraft was the 5 year/3,000 h overhaul, which was done on 21/03/2007. At that time the aircraft had 19,584:40 h, the no. 1 engine 8,240:55 h, and the no. 2 engine 11,299:15 h.

The next inspection due was for 19,599:00 h, meaning that it had 5:20 h remaining at the start of the flight.

The operator reported that there were no maintenance or flight activities scheduled for the day of the accident or the next.

### 1.6.2. *Minimum Crew*

The minimum crew required on VFR flights for this aircraft model is only one pilot, seated in the RH seat. A second pilot can fly in the LH seat if the helicopter is equipped with dual controls and approved instruments. The accident helicopter had said controls and instruments installed.

The minimum crew required for IFR flights is two pilots, both of whom must have valid IFR licenses.

### 1.6.3. *Flight control and stabilization system*

The helicopter had a stabilization system (Automatic Flight Control System, AFCS), designed to assist the pilot in controlling the helicopter, and a flight director that was capable of maintaining the selected heading, speed and climb rate. It also had two radioaltimeters, which indicate the distance between the aircraft and the ground or another type of vertical obstacle. These instruments feature a system called "Decision Height" (DH), which issues an acoustic and luminous warning if the aircraft falls below the altitude selected by the crew on said instrument.

### 1.6.4. *Navigation equipment*

The aircraft had two very high frequency omni-directional range (VOR) receivers, two DME (distance measuring equipment) receivers, two automatic direction finders (ADF) and one global positioning system (GPS) receiver.

The data obtained from the CVR transcript revealed that in the last 30 minutes of the flight, they had one of the ADF receivers tuned in on a frequency of 405 kHz, which corresponded to the obsolete "BIL" NDB. They later tuned the ADF to the 422 kHz of the "PAM" NDB, and the number two VOR receiver to a frequency of 112.3 Khz, which corresponded to the "PPN" VOR[4].

[4] VOR PPN.- VOR located in the vicinity of Pamplona Airport.

The GPS equipment installed on the aircraft, a Trimble 2102 I/O, did not display graphical information of the area's topography. The information on the CVR revealed that the reference point selected on the GPS was in the vicinity of Pamplona, though it could not be identified. When this point was entered into the GPS is also unknown.

### 1.6.5. *Fleet tracking equipment*

There was a second GPS unit installed on the helicopter that was used exclusively to send information to the Operator's operations center regarding the helicopter's geographical position, altitude, heading, speed and UTC time in hours, minutes and seconds.

### 1.6.6. *Performance*

The estimated weight of the helicopter at the time of the accident was 7,860 lb (3,565 kg).

According to the Climb Rate table in the Performance section of its Flight Manual, at the time of the accident the helicopter was capable of reaching and maintaining a climb rate of 2,400 ft/min (731 m/min) for weights equal to or less than 8,000 lb (3,628 kg) with two working engines, maximum continuous power and a speed of 58 KIAS.

## 1.7. Meteorological information

### 1.7.1. *Observed and forecast*

At 09:00 on Saturday the 13th, the crew requested the METARs, TAFs and low-level significant weather chart shown in Appendix 1 from the LEXJ Weather Office. Personnel from said office discussed with the crew the level of the isozero (0°, FL110) and the significant cloudiness forecast between the coast and the mountains along their planned route.

The 07:00 UTC METARs for the airports of Santander, Bilbao, Vitoria and Pamplona indicated the following:

- Santander: wind variable at 2 kt, visibility equal to or greater than 10 km, scattered clouds at 1,700 ft, broken clouds at 3,000 ft, temperature 18 °C, dewpoint 15 °C, QNH 1,010 hPa.

- Bilbao: wind from 320° at 5 kt, visibility 6,000 m, mist, few clouds at 2,000 ft, broken clouds at 3,500 ft, temperature 18 °C, dewpoint 15 °C, QNH 1,010 hPa. It also included a forecast for the two hours following the issue time of the report that called for temporary reductions in visibility to 4,500 ft.
- Vitoria: wind from 60° at 5 kt. In the 10 minutes prior to the observation, the wind direction had varied between 030° and 100°. Visibility 6,000 m, mist, scattered clouds at 400 ft, overcast at 800 ft, temperature 16 °C, dewpoint 15 °C, QNH 1,011 hPa.
- Pamplona: wind from 30° at 3 kt. In the 10 minutes prior to the observation, the wind direction had varied between 350° and 080°. CAVOK, temperature 19 °C, dewpoint 15 °C, QNH 1,010 hPa.

The forecasts for the airports of Bilbao, Vitoria, Pamplona, Logroño and Zaragoza, valid from 06:00 to 15:00 UTC on the day of the accident, were as follows:

- Bilbao: wind from 290° at 8 kt, visibility 8,000 m, mist, scattered clouds at 1,200 ft, broken clouds at 3,000 ft. A 30% chance of showers and that the visibility would drop temporarily between 06:00 and 10:00 UTC to 4,500 m, a 40% chance that visibility would drop temporarily between 06:00 and 09:00 UTC to 4,500 m and of mist and broken clouds at 1,200 ft, and a 30% chance for mist and broken clouds at 400 ft between 06:00 and 08:00 UTC.
- Vitoria: wind variable at 4 kt, visibility equal to or greater than 10 km, scattered clouds at 2,000 ft. Temporary reduction in visibility to 4,500 m, mist and broken clouds at 800 ft between 06:00 and 09:00 UTC. Temporary reduction in visibility to 1,500 ft, fog and broken clouds at 400 ft between 06:00 and 08:00 UTC. A 30% chance that visibility would drop to 4,500 m with light rain and broken clouds at 1,400 ft between 06:00 and 10:00 UTC.
- Pamplona: wind variable at 2 kt, visibility equal to or greater than 10 km, few clouds at 3,000 ft. A 30% chance of temporary showers and broken clouds at 3,000 ft and cumulonimbus between 10:00 and 15:00 UTC.
- Logroño: wind variable at 3 kt, CAVOK. A 30% chance of temporary showers and broken clouds at 3,000 ft and cumulonimbus between 10:00 and 15:00 UTC.
- Zaragoza: wind from 120° at 3 kt, visibility equal to or greater than 10 km, few clouds at 3,500 ft. Showers temporarily from 13:00 to 15:00 UTC.

The significant weather chart forecast abundant cumulus and stratocumulus clouds with bases between 2,000 and 4,000 ft and ceilings between 7,000 and 9,000 ft for the area that included Cantabria and a large part of the Basque Country.

### 1.7.2. *Real weather en route*

The Bilbao control tower informed the crew that clouds covered the mountains to the south of the airport. Also, from the conversations held between the captain and the copilot at Point S, and in the vicinity of the town of Oñati, one may deduce that the

sky was overcast but that the cloud layer was not thick, since they could make out the sun above the clouds.

In the opinion of the crew of Civil Guard helicopter CUCO 34X, which was in contact with the accident helicopter when they were near Llodio, the horizontal and vertical visibility at Puerto de Altube, which is located between Point S and Vitoria, minutes before helicopter EC-FBM reached Point S was not suitable for a VFR flight.

### 1.7.3. *Visibility at airports and at destination base*

The forecast and actual conditions at the takeoff and alternative airports noted in the FPL, and at those near the path taken by the helicopter, allowed them to remain open to visual and instrument traffic.

Weather conditions at the destination base in Teruel allowed for visual traffic.

### 1.7.4. *Meteorology at crash site*

A local shepherd who was in the area of the accident at the entrance to the valley, halfway up the slope at an approximate elevation of 1,475 ft (450 m), reported that there were fog banks covering the upper parts of the valley. From his position he could see the town of Araotz, located at an elevation of 1,530 ft (466 m), toward the interior of the valley and on the hillside opposite his. He also stated that the helicopter was flying in the interior of the valley and close to it. He saw it climb rapidly and enter a fog bank that covered the valley. Seconds later he heard a loud noise, and alerted emergency services by calling 112.

Another witness in the area reported that at the time of the accident, the fog covered the valley and that 25 minutes after the event, the fog had given way to fog banks, which gradually diminished in intensity before disappearing.

## 1.8. Aids to navigation

Along the route taken by the helicopter there were a number of radioelectric navigation aids that helped or could have helped the crew to chart their course. These are listed below. Another aid was the satellite navigation available through the GPS unit installed onboard.

The crew also made reference at one point to the "BIL" NDB, which had been out of service since it was dismantled in 1998.

### 1.8.1. *Radio-electrical aids and satellite navigation*

The Vitoria VOR, "VRA", the VORs near the Pamplona Airport, "PPN" and "PAP", and the Pamplona NDB, "PAM", were identified by the crew as intermediate points along the route. The Bilbao VOR, "BLV", was also on the route taken by the helicopter.

The satellite navigation system covered the route and enabled the crew, by means of the GPS unit installed onboard, to ascertain their position and navigate at all times. Said system also provided positioning and other information as detailed in 1.6.5 to the GPS Fleet Tracking System installed onboard the helicopter.

### 1.8.2. *"BIL" NDB, 405 Khz*

The BIL NDB, on a frequency of 405 kHz, used to be located in the approach area to runway 30 at Bilbao Airport, and had been out of service since 22/01/1998 and its ground facilities dismantled shortly thereafter. Said removal was properly reported in a NOTAM.

Despite this, the instrument chart for low-level airspace in Spain, published by the Air Force's Cartographic and Photographic Center in November 2005 and valid until May 2006, still showed said NDB.

The Pilot's Manual present onboard the aircraft showed this NDB among the list of radio aids.

The information on this NDB was no longer listed in the chart published in the first half of 2007 by the Air Force's Cartographic and Photographic Center.

The radio and television facilities of the autonomous Basque Country region are now located near the site where the BIL NDB used to be.

## 1.9. Communications

The helicopter crew established radio contact with the LEXJ and LEBB control towers and with helicopter CUCO 34X.

They contacted LEXJ for the relevant startup and takeoff clearances and to acknowledge the transfer of control to the LEBB tower.

They contacted the LEBB tower to report their entry into the Bilbao CTR via Point W and to inform of their intention to proceed toward Victoria and Pamplona initially,

though they then reported they were going to the Vitoria[5] or Pamplona VOR, depending on the visibility. The tower informed them of the current weather in LEVT and LEPP.

In the vicinity of Point S they made contact with CUCO 34X to report their status and intentions. The exchanges between the pilots of both helicopters is shown in Figure 2, along with the time and place where they took place.

During the conversation with the CUCO 34X, the Bilbao Tower asked helicopter EC-FBM if they had passed Point S. This call was not received by EC-FBM, though the tower did receive the following message: "Echo (intermittent communication) in dir...tion Pamplona". The Tower replied "acknowledged", after which it received a "Likewise" from an unknown source, though this word corresponded to the answer given by the CUCO 34X when the Captain of EC-FBM signed off wishing them a good flight.

At Point S the crew changed course to the NE, and once in the vicinity of Amorebieta, while flying to the SE, acknowledged via CUCO 34X the message to contact Vitoria Tower on 118.5 MHz. There was no further contact with Bilbao Tower.

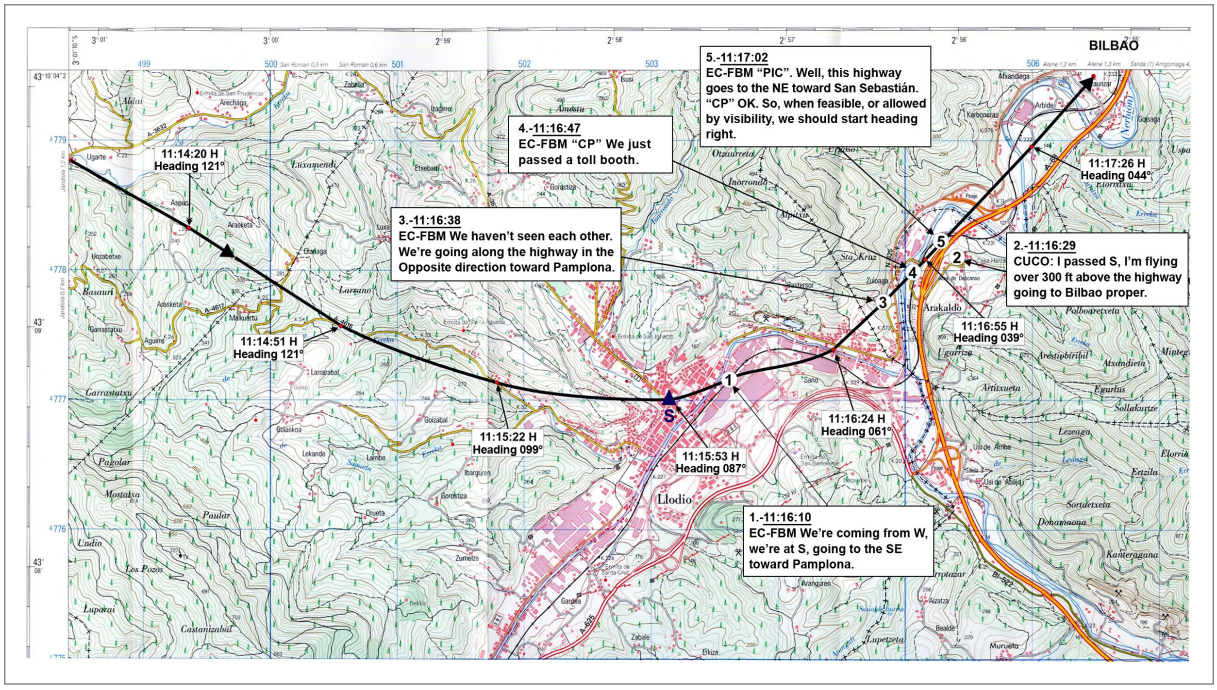



**Figure 2.** Route via Point S of the Bilbao CTR and communications between Helicopters EC-FBM and CUCO 34X

[5] The Vitoria VOR is SW of the LEVT Airport.

## 1.10. Aerodrome information

The takeoff airport, the alternative airports of Logroño and Zaragoza listed on the FPL, and the airports of Bilbao, Vitoria and Pamplona were open to visual and instrument traffic.

## 1.11. Flight recorders

The aircraft had equipment to record the voices and sounds present in the cockpit (CVR). The data sent by the fleet tracking equipment (Section 1.6.5) to the operator's Operations Center were also recorded and were used to plot the path taken by the helicopter (Fig. 1).

### 1.11.1. *Cockpit Voice Recorder (CVR)*

The CVR, a Fairchild A100, serial number 4486, featured four channels that recorded simultaneously and which stored the recordings corresponding to the last 30 minutes of the flight.

The timeline of the CVR recordings was obtained by synchronizing them with the time stamps on the communications held with the Bilbao Tower.

In the final seconds of the CVR recording there were no identifiable sounds associated with the acoustic warning for low or high main rotor RPMs or with the acoustic safe altitude (DH) warning selected on the radio altimeters.

Those instances during which a communication between the pilots or lack thereof is considered pertinent to the circumstances of the accident are noted below:

#### 1.11.1.1. Segment between Point W, Point S and the town of Amorebieta

Fig. 2 shows, along with the communications between the Captain and helicopter CUCO 34X, the conversation held by the crew while passing over Point S and changing course from the SE to the NE.

#### 1.11.1.2. Approach segment to runway 30 at Bilbao Airport

At 11:24:22, the copilot said "the NDB that is halfway along the route leaving the Bilbao TMA and which is now ahead of us is on 405". Seconds later the copilot stated,

"the NDB is around here because "it is giving the pass"[6]. The captain confirmed this by saying "I don't see it... when it signaled, oh, it's this one".

At 11:30 the crew did a check of the navaids. They selected the PAM[7] NDB on 402 kHz on one of the NDB receivers, commented that there were two VOR stations in Pamplona, and the captain said, "in any case we have the GPS".

### 1.11.1.3. Segment from the Artixa River to the vicinity of Oñati

At 11:32:48, having crossed the Kampazar Pass, the captain and copilot held the following conversation:

Captain: "Pamplona if I see 129, a course to the South is ok too, but which way"
Copilot: "It's more or less clear through there"
Copilot: "*Eh!*"
Copilot: "It's more or less clear that way too"
Captain: "Let's go that way for now, that'll get us closer to Pamplona"

At 11:35 the captain noted that the visibility was worsening and that considering how the sun was, he would climb, but they were 30 NM away from Pamplona and they would lose the visual conditions.

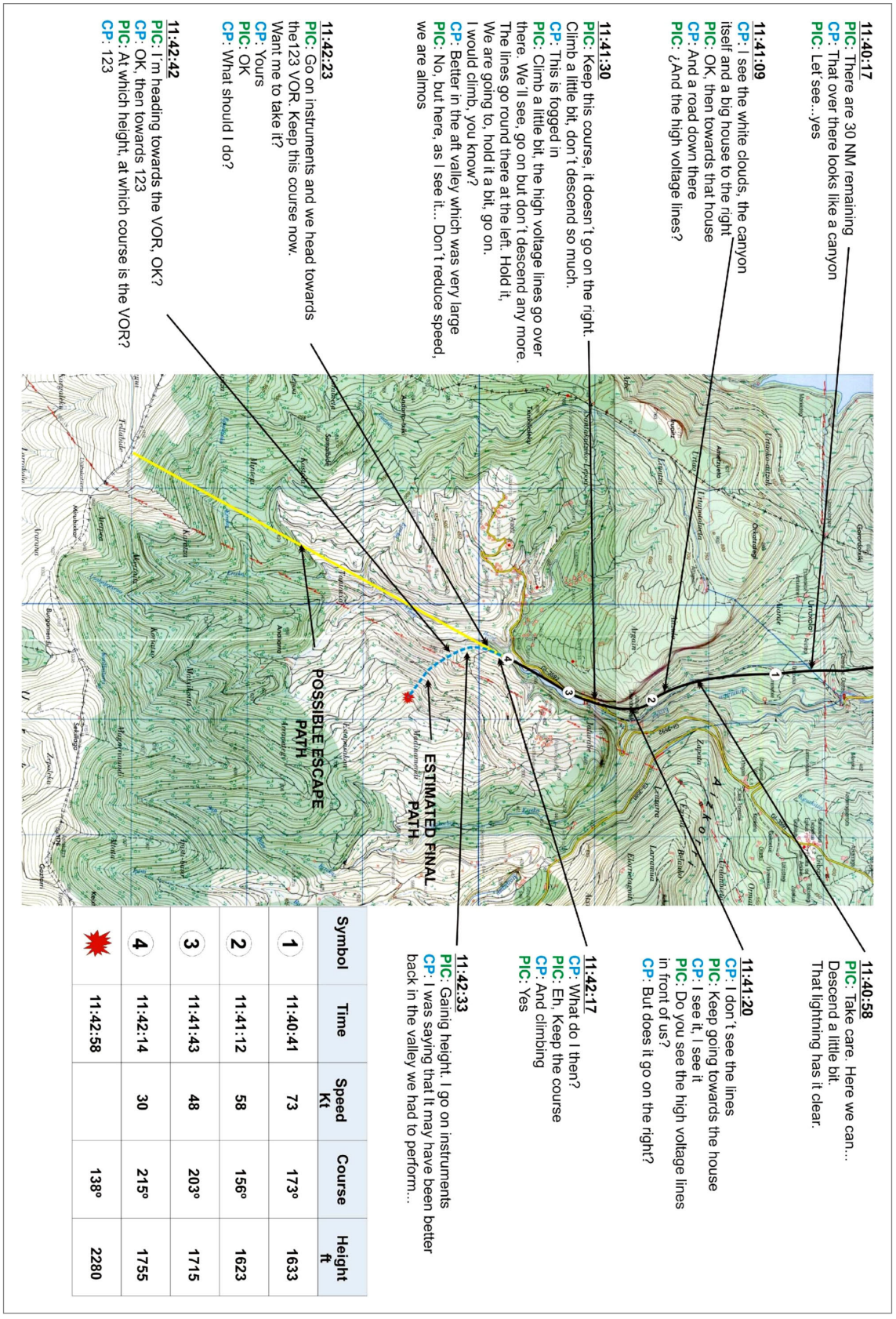
Seconds later they noted that the visibility had worsened because the clouds were staying close to the mountains, so they decided to turn around and go back along the same path. Two minutes later the Captain said: "This valley ends here, we have to find another way, we can't get through here, maybe this way", after which they headed for the Araotz River valley.

The copilot asked what the maximum elevation in the area was, to which the captain replied 6,100 (without specifying the unit of measurement).

### 1.11.1.4. Final segment, Araotz River valley

Figure 3 shows the conversation held between the pilots shortly before entering the Araotz River valley until the end of the flight.

[6] It means that the needle is coming down.
[7] PAM NDB - NDB located in the vicinity of the Pamplona-Noain Airport.




| Symbol | Time | Speed Kt | Course | Height ft |
|---|---|---|---|---|
| 1 | 11:40:41 | 73 | 173° | 1633 |
| 2 | 11:41:12 | 58 | 156° | 1623 |
| 3 | 11:41:43 | 48 | 203° | 1715 |
| 4 | 11:42:14 | 30 | 215° | 1755 |
| ✸ | 11:42:58 | | 138° | 2280 |

**Figure 3.** Estimated final leg of the helicopter's path, with indication of the possible escape path

### 1.11.2. *Data recorded by the fleet tracking equipment*

About every 30 seconds, the fleet tracking equipment installed on the helicopter transmitted via cellular signals the following data, which were recorded at the Helisureste Operations Office:

Helicopter position in UTM coordinates, UTC time expressed in hours, minutes and seconds, and the following helicopter data at that time: speed in km/h, heading in degrees and altitude in meters.

## 1.12. Wreckage and impact information

The main aircraft wreckage was found near the summit of Mount Madinamendi, which is located some 4 km southwest of the town of Oñati (Guipuzcoa). It was at an altitude of 690 m and coordinates:

- 42° 58′ 55.5″N
- 02° 26′ 26.8″W.

The aircraft was resting on its right side.

The final impact, with the aircraft already tilting 90° to the right, was head on against a pine tree, which pierced the cockpit almost to the transmission.

Most of the material on both main rotor blades detached, leaving only the leading edge, which was severely bent. The tail rotor was alongside the main wreckage and had detached during the final impact. The tail cone was broken in two and also situated next to the aircraft. Due to the severity of the damage, it was not possible to check the continuity of the controls or to check the positions of the engine controls or the indications.

A visual inspection of the area revealed that the first impact had been by one of the main rotor blades against a pine tree that was located downhill, some 100 m from the site where the main wreckage was found and 30 m lower in elevation. The gradient between the two points was 30%.

A few meters beyond this first impact point was the second, where the helicopter struck three more trees.

From that point on there was debris from the blades and specks of fuselage paint. The helicopter's path then progressed full into the forest, such that the impacts against the trees were increasingly frequent.

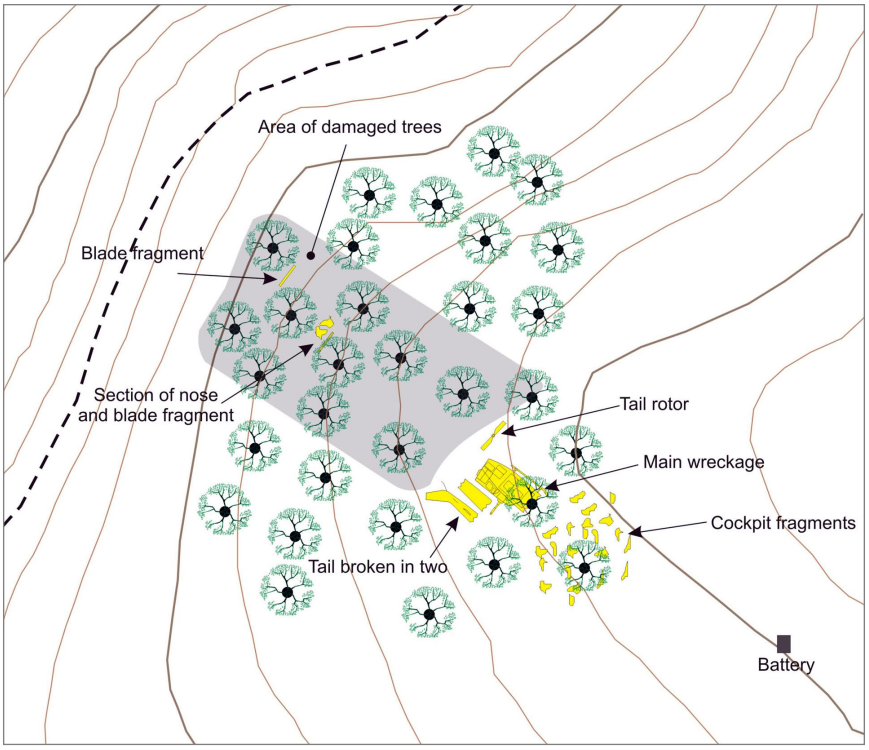



**Figure 4.** Diagram of debris field

Part of the aircraft's nose, fragments from the cockpit glass and more pieces from the main rotor were found 35 m away from the first impact. From that point on until the site of the main wreckage, there was a constant stream of debris from the aircraft that included fragments from the blades, doors, fairings, glass and one of the cyclic controls.

The trajectory taken by the aircraft into the pine forest indicates that it approached Mount Madinamendi on an approximate course of 138°, which is practically perpendicular to the hillside.

## 1.13. Medical and pathological information

The autopsies and other biological and toxicological checks conducted on the pilots indicate that both perished as a result of multiple impact injuries. No toxic substances were detected in their bodies.

## 1.14. Fire

There was no fire.

## 1.15. Survival aspects

Given the characteristics of the helicopter's impact first against the trees and then against the ground, the occupants had practically no chance of survival.

## 1.16. Tests and research

The aircraft's position, time, heading and speed data recorded on the fleet tracking equipment were used to plot the helicopter's path (Fig. 1) on an aviation chart[8] between Point W on the Bilbao CTR and the site of the accident. After passing through Point W, the aircraft remained below the elevation of the nearby mountains the entire time.

The path was subdivided into the following segments:

1. Segment between Point W, Point S and the town of Amorebieta.
2. Approach segment to runway 30 at LEBB.


**Figure 5.** Photo of main helicopter wreckage and the southern end of the Araotz River valley

[8] AENA ICAO Aviation Chart 1:500,000 of BILBAO / 2319-A published on 21 MAR / 02.

3. Segment near the Artixa River and the town of Oñati.
4. Araotz River valley segment.
5. Final segment before impact.

### 1.16.1. *Segment between Point W, Point S and the town of Amorebieta*

The helicopter was cleared by the Bilbao tower to proceed from Point W to Point S. On passing Point W, it departed the CTR to the SE, entering a mountainous area where it flew through the Mayor and Galdames river valleys, crossed the Alto de Umaran until it reached and crossed the wide Cadagua River valley. It then flew over the vicinity of Güeñes and followed the Zaldu River valley. The average speed on this segment was 105 kt.

At 11:14, while passing the Alto de Malkuartu between the Zaldu and Nervion river valleys, the first conversations between the crew were recorded on the CVR as they flew close to two transmission lines, at which time the speed dropped to 76 kt.

Two minutes later, when the helicopter was almost over Point S, the Civil Guard helicopter, callsign "CUCO 34X", was reporting its position in reference to Point S to Bilbao tower, along with its altitude (1,100 ft), QNH (1,010 hPa) and its intention to proceed to S1 in the city of Bilbao (see Fig. 2).

In the meantime, helicopter EC-FBM, which was flying to the SE, initiated a course change to the left until it reached a heading of 039°, to the NE (see Fig. 2). The copilot, who was the pilot flying, did not report the course change to the Captain. During this process the Captain was talking to CUCO 34X on the radio, informing its crew that they were going from Point W to Point S in a southeasterly direction toward Pamplona.

CUCO 34X stated that they had passed Point S and were 300 ft above the highway flying toward Bilbao. The Captain of EC-FBM reported that they had not seen each other and that they were following the highway in the opposite direction, toward Pamplona.

At 11:17 the Captain told the copilot that "this highway goes to the NE, toward San Sebastian", to which the latter replied, "OK". The Captain then added, "When possible or allowed by the visibility, we should start heading right" (see dialogues on Fig. 2).

At 11:18 the helicopter once more entered the Bilbao CTR heading to the NE.

At 11:20 the helicopter changed course to the E, until the lack of visibility ahead and the possibility of flying north forced them in this direction to the town of Amorebieta, in the Ibaizabal River valley. While in this segment, CUCO 34X relayed a message from the Bilbao control tower that they contact the Vitoria control tower on 118.45 MHz.

### 1.16.2. *Approach segment to runway 30 at LEBB*

This segment went through the approach area to runway 30 at Bilbao Airport and was almost parallel to the A-8 highway between Bilbao and San Sebastian.

At 11:26 the copilot informed the captain that the NDB "is around here, it is giving the pass".

Once past the city of Durango, the headed on an approximate course of 150° toward the town of Elorrio, leaving the Bilbao CTR and flying away from the AP-8 highway. The speed during this segment oscillated between 75 and 111 kt.

### 1.16.3. *Segment near the Aritxa River and the town of Oñati*

At 11:31, after crossing the Kampazar mountain pass and reaching the Deba River valley at an altitude that varied between 472 and 577 m, the captain considered the possibility of going to the south or SE. The copilot informed him that they had visibility to the SE, so he decided to proceed in that direction. The road that went south crossed the mountains via the Arlaban Pass.

Once past Oñati, the helicopter made a turn of approximately 180°. This is the point in time when the pilots decided that they could not continue flying straight because the clouds were too close to the mountains, so they decided to turn back, see 1.11.1.3. They flew west for two minutes until the Captain said, "this valley ends, we'll have to find a way through, there's no way through here, maybe there", after which they set course for the Araotz River valley.

The speed recorded during this segment dropped from 102 kt to 71 kt.

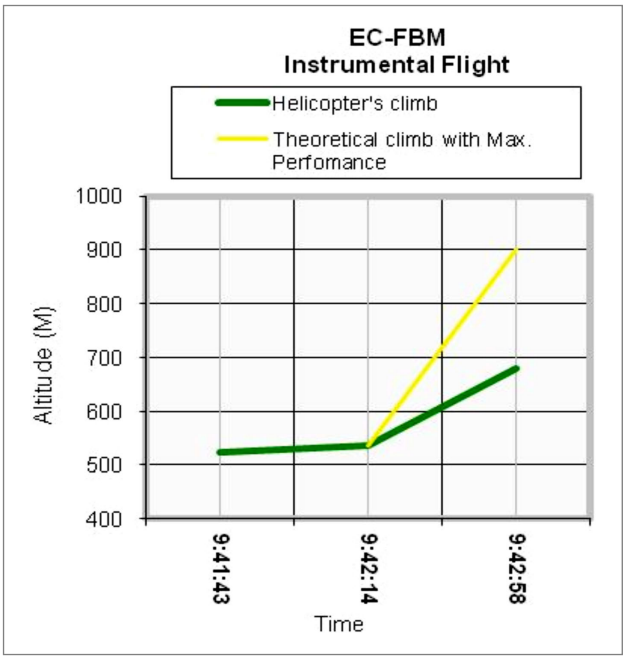



**Figure 6.** Graph of helicopter's climb during final moments o flight and theoretical climb applying the aircraft's maximum performance

### 1.16.4. *Araotz River valley segment*

At 11:41, flying south at a speed of 58 kt, they entered the Araotz River valley, where they gradually reduced their speed to 30 kt while making constant altitude and speed adjustments. At one point the copilot said, "this is fogged in". The captain asked him if he saw a high-voltage transmission line, which

they copilot could not see. They were still making speed and power adjustments when the copilot asked, "What do I do then?"

At 14:42:23, they switched to instrument flight (see Fig. 3). The captain told the copilot to "go on instruments[9] and let's go to the 123 VOR. For now let's stay on this course. Want me to take it?" to which the copilot replied "yours", passing the controls to the captain. The copilot then asked, "What should I do?"

The captain stated that he was increasing their altitude and was on instruments. The copilot noted, "I was saying that it may have been better back in the valley to make a...".

"I'm going to the VOR now, ok", said the Captain. "OK, to one two three then" replied the copilot.

Seconds later, while on a course of 138°, the helicopter impacted the valley's east wall at an elevation of 2,280 ft.

### 1.16.5. *Final segment before impact*

The estimated route (see Fig. 3) taken by the aircraft between the last point recorded by the fleet tracking system and the impact site was plotted using the last speed and course data from the GPS unit, the courses indicated by the crew on the CVR and the trajectory of the debris left by the aircraft as it impacted the trees and by its final resting place.

The course varied from 215° to 138° and the average climb rate was estimated to be 670 ft/min (204 m/min) (see Fig. 6).

## 1.17. Organizational and management information

### 1.17.1. *VFR flights at the operator*

In its Operations Manual, the operator describes the policies and operational requirements for conducting a flight under visual flight rules.

The policies that reference VFR flight are:

- When a flight cannot be made under VFR conditions due to visibility restrictions, an IFR flight shall be made when weather conditions require this type of flight, though under no circumstances when meteorological freezing conditions are present.
- During VFR flights, at no time may IMC conditions be entered.
- No VFR flight shall be initiated under any case unless the most recent weather reports, or a combination of said reports and forecasts, indicate that the weather

[9] To "go on instruments" is a colloquialism for piloting the aircraft based on the references supplied by the helicopter's instruments.

conditions along the route will allow compliance with visual flight rules at the time of the flight.

The requirements involving VFR flights are:

- Visibility – in Class G[10] airspace it may not be less than 1,500 m during daylight hours, though it may drop to 800 m for short periods of time if the ground is kept in sight and the helicopter maneuvers at a suitable speed that allows the pilots to see other traffic and obstacles in time to avoid a collision.
- Meteorological – for a Captain to choose to conduct a VFR flight beyond the immediate area around an airport, the weather forecast for the route and the destination aerodrome must indicate that visual flight conditions will prevail for the duration of the flight.

In terms of the measures to take in case of inadvertent entry into IMC conditions, the operator provided the procedure to be used when conducting nighttime visual flights (VMCN):

- Route reversal (when conditions safely allow for the route to be reversed).
- Climb to IFR level (when conditions safely allow to continue the flight under IFR).

  — Go on instruments.
  — Stabilize helicopter attitude.
  — Establish and maintain safe climb course.
  — Apply climb power.
  — Decide on and maintain best climb rate and climb speed.
  — Climb to the minimum safe altitude for the area.
  — Contact ATC for IFR instructions.
  — Contact ground services.

### 1.17.2. *IFR flights at the operator*

The operator's requirements for conducting a flight under instrument flight rules (IFR) in IMC conditions and in B-212/B-412 helicopters require a multi-pilot crew, with both pilots being in possession of a valid and in force license and the relevant type rating. Moreover, the captain must have a minimum of 700 total flight hours on helicopters, of which 300 must be as the pilot in command and 100 in IFR flights.

### 1.17.3. *Crew resource management (CRM)*

Regarding the crew's training in crew resource management (CRM), the operator, on the date of the accident, had a Training Manual dated 03/03/2003 in which the CRM course was still being developed.

[10] Class G Airspace – Space in which IFR, VFR and VFRN are allowed. All flights receive flight information services if they so request.

The operator has since instituted a CRM training course for its crews that as of 13/09/2010 had been given to 87% of its pilots. CRM training is currently held as recurrent annual training for each pilot. The instructors are the operator's pilots to whom a CRM providers' course developed by the operator itself has been given since June 2010.

### 1.17.4. *Charts*

The investigation was unable to accurately determine which charts were used by the crew for the flight. The information gleaned from the CVR indicates that the charts used to navigate were:

- The ICAO Aviation Chart 1:500,000 by AENA which lists an area minimum altitude (AMA) for visual flight of 6,100 ft for the grid that includes the town of Oñati.
- The Instrument Chart for Low-Level Airspace in Spain, November 2005 edition published by the Air Force's Cartographic and Photographic Center, which features the symbol for the "BIL" NDB, its frequency of 405 kHz and its Morse code identifier.

The Pilot's Manual that was recovered had been published by the Air Force's Cartography and Photography Center, whose last revision was dated April 2005. The visual approach chart for Bilbao shown in Figure 7 was taken from said manual.

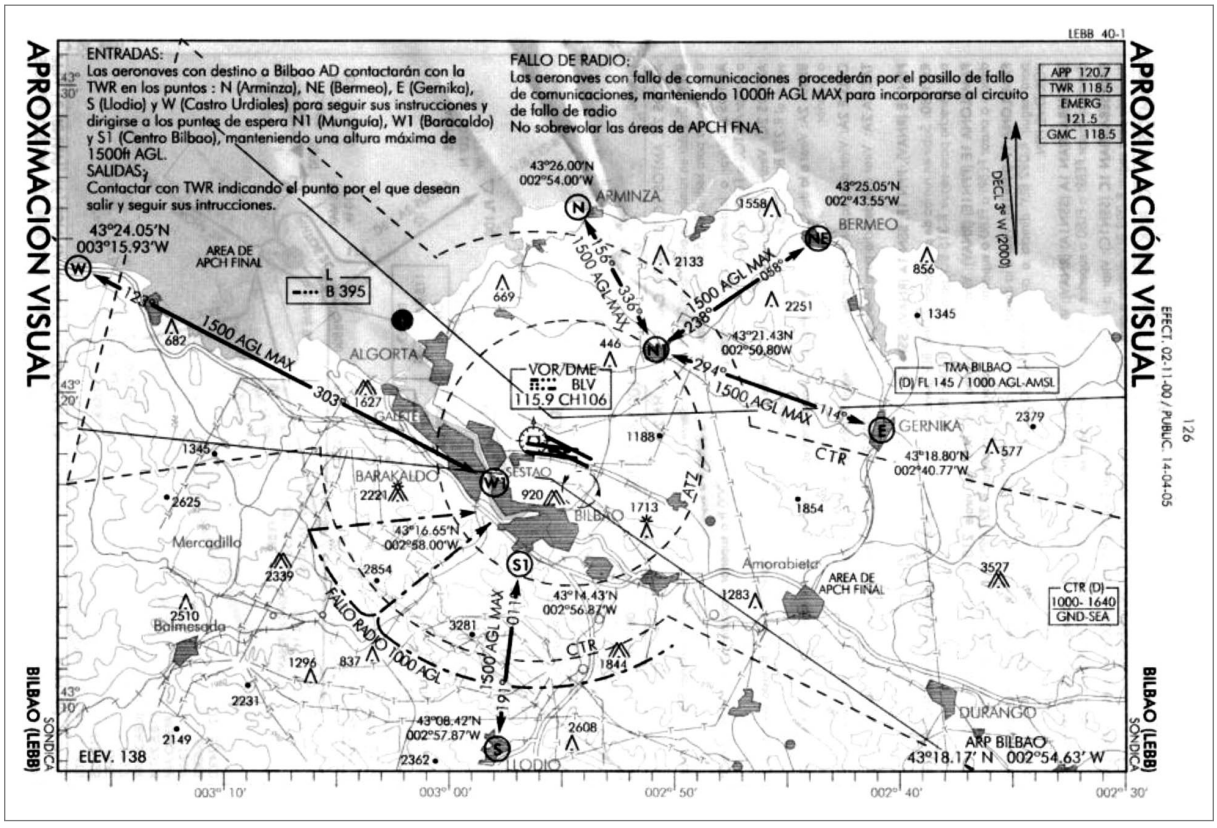



Figure 7. Visual approach chart for Bilbao

On the topic of charts, the operator reported that they are renewed every two years, and as required by revisions.

## 1.18. Additional information

### 1.18.1. *Flight Plan*

The Flight Plan was filed at 09:13 at the Santander Airport ARO. The type of flight was V (flight made in accordance with visual flight rules) and its destination was Teruel. The alternative airports listed were LERJ and LEZG. The scheduled departure time was 11:00 local.

The Flight Plan format also allows for the possibility of making a Y flight (one that is made in accordance with instrument flight rules and once in contact with the ground, is continued according with visual flight rules). Requesting a Y-type flight requires approval from Eurocontrol, a process that implies some delay and which in airspaces with little traffic has barely any effect on the flight schedule, according to sources at the Santander Airport traffic office.

### 1.18.2. *Possible VFR routes between Santander and Teruel*

The direct VFR route between Santander and Teruel crosses the highest mountains of the Cantabria range, which features narrow valleys and mountain passes whose elevations are very close to those of the summits.

The route taken through the Bilbao CTR leads to the Altube, Barazar, Dima, Urquiola and Arlaban mountain passes, which are at a lower elevation than those in the direct route and are preceded by wider valleys.

### 1.18.3. *IFR flight*

To make an IFR flight, Spain's Air Traffic Regulations (RCA) (Royal Decree 57/2002 of 18 January) requires that an aircraft be equipped with instruments and navigation equipment that are suitable for the route to be followed. The minimum flight levels, except as required for takeoff or landing or when expressly authorized by the competent authority, cannot be below the minimum flight altitude specified by the State whose territory is being overflown or, if no such minimum altitude has been established:

a) Over elevated or mountainous terrain, it shall be at least 600 m (2,000 ft) above the highest obstacle that is located within an 8-km radius with respect to the aircraft's estimated flight position (*);

b) In any other part different from that specified in a), it shall be at least 300 m (1000 ft) above the highest obstacle that is located within an 8-km radius with respect to the aircraft's estimated flight position (*).

### 1.18.4. *IFR routes and flight zones*

There are two low-level airways that leave LEXJ to the east, both of which finish in LEPP. One goes through the BLV VOR and the other through the VTA VOR. The MEA[11] for both is FL80 for the first segment and FL70 for the second.

Two airways cross perpendicularly above the crash site, at Reporting Point CEGAM. The minimum flight level for both is FL70, and the area minimum altitude is 6,100 ft[12].

### 1.18.5. *Study of GPS events*[13]

The BEA (Bureau d'Enquêtes et d'Analyses pour la securité de l'aviation civile (France)) published a study based on 35 general aviation accidents and incidents recorded at the BEA between 1995 and 2004 in which the improper use of GPS was detrimental to the safety of the flight.

In general, GPS does not systematically lead to accidents or incidents. Its improper use, however, either when preparing or executing the flight, can contribute to them.

On this topic, it should be noted that prior to the flight, the pilot pays particular attention to the weather forecast and to the consequences that the weather could have on the flight. For example, if a low-altitude flight is planned, the pilot must consider the optical range of the radionavigation or communications equipment, or the visibility of ground references, among other things. Despite this, some pilots ignore these checks when they have a GPS receiver because they regard the analysis of the weather forecast as secondary, or even useless. Since they no longer think they have to navigate, they assume they will have more time to plan a flight in marginal meteorological conditions. Pilots feel more capable of dealing with adverse atmospheric conditions when they have a GPS unit. This decision can lead to opportunistic flight planning and can result in the pilot being caught in changing conditions in terms of the weather, the terrain or obstacles.

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(*) The aircraft's estimated position shall take into account the navigation accuracy that can be attained in the flight segment in question, considering the navigation facilities available on the ground and onboard.

[11] Minimum en route altitude. The lowest altitude that may be used in instrument meteorological conditions (IMC) while preserving a minimum vertical buffer of 300 m (1,000 ft) or, in certain mountainous areas, 600 m (2,000 ft) above all of the obstacles situated in the specified area. This figure is rounded up to the nearest 30 m (100 ft).

[12] ICAO Aviation Chart 1:500,000, Bilbao/2319-A dated 23 Nov 2006, by AENA.

[13] http://www.bea.aero/etudes/etudegpse/etudegpse.pdf.

Most of the accidents analyzed resulted from improper flight preparations. The pilot decides to fly without the necessary documentation even when the weather conditions are adverse. It is difficult to determine after the fact when exactly the pilot decided to ignore the flight conditions, whether it was during the planning or during the flight itself.

The thirty-five events analyzed in this study included airplanes, helicopters, ultralights and gliders, and resulted in thirty-four fatalities and thirteen injuries. Of all the aircraft involved, only three emerged intact.

The events were divided into five categories based on the initial information available and on the eventual consequences:

1. Controlled flight into terrain.
2. Loss of control due to adverse weather conditions.
3. Fuel shortages.
4. Voluntary flight interruptions.
5. "Miscellaneous".

A controlled flight into terrain (CFIT) is an event in which the pilot is in control of the aircraft's position but has not real view of the terrain or of any obstacles present. The impact takes place in conditions of adverse visibility. The energy involved in the crash is high and the damage significant. This type of event was involved in sixteen of the cases and resulted in twenty-five fatalities and seven seriously wounded.

The findings of this study show that some pilots who resort to GPS rely too much on:

- The multiple features offered by GPS
- Their databases
- And their own ability to conduct the flight.

Likewise, pilots' insistence on continuing a flight in the face of adverse meteorological conditions is a very frequent cause of CFIT or loss of control type accidents. This type of event occurred twenty times, resulting in thirty-three fatalities (97% of all the deaths recorded in this study).

Moreover, when a pilot decides to use GPS to avoid the hardships of navigation at the expense of exhaustive flight preparations, he is creating conditions that will encourage a greater reliance on said system and less on proper preparation.

Among pilots, the study notes in particular those with extensive experience in flights with no visibility and who rely on GPS even in poor visibility conditions. These pilots have one goal, namely, to reach their destination, which leads them to cut corners in the decision-making process required in each stage of the flight.

### 1.18.6. *Human factors*

The ICAO, in its 217-AN132 Circular *Human Factors Digest No. 2*, defines crew resource management (CRM) as training in personal and group skills aimed at recognizing risk situations on the flight deck so that proper measures can be taken to solve the problems that originate them.

Said digest describes the skills that pilots must become proficient in through training in order to improve interpersonal communications in the cockpit while overcoming the potential barriers posed by rank, age, piloting position or the lack of personal knowledge of the other person.

It also highlights the need to improve the decision-making process. Solving a problem during a flight should not be based solely on recognizing the problem and taking steps to solve it. The problem must be assessed as broadly as possible and all relevant inputs analyzed before the pilot in command reaches a final decision. On this point, CRM addresses how to evaluate the different points of view present among the various crewmembers.

# 2. ANALYSIS

## 2.1. General

There was no sign over the course of the investigation that either of the pilots was unable or unfit to conduct the flight. The information regarding the aircraft wreckage, the marks at the impact site and the absence of any reference by the crew or of any abnormal noises on the CVR indicative of a malfunction all point to the fact that the aircraft was involved in a controlled flight into terrain at full power.

The presentation of the facts reveals several areas that could have influenced the event and which merit further study. These areas specifically involve the composition of the crew, the pre-flight preparations and the choice of flight type, the use of GPS, the radio communications, the location of the transmission lines, the entry into IMC conditions during the visual flight and human factors.

## 2.2. Flight preparation and selection of flight to be made

The investigation was unable to determine the amount of time used by the crew to prepare for the flight. The data revealed that they may have reviewed the navigation aids available in the areas of Bilbao, Vitoria and Pamplona, but investigators could not confirm the existence of an exhaustive study of the topography of the area to be overflown.

The weather information obtained by the crew at 09:00 is deemed sufficient for studying and determining whether the flight could have been performed under VFR or IFR rules. The pilots were aware of the cloud cover that affected the first part of the route and of the presence of the isozero at FL 110.

The selection of the alternative aerodromes of LERJ and LEZG in the Visual Flight Plan filed in Santander, given the actual and forecast weather conditions, is regarded as ill-conceived since the airports closest to the most likely route were LEBB and LEVT. It is possible, however, that the crew could have chosen the first two airports for reasons unknown to investigators.

The visibility conditions at the time of takeoff and the visibility conditions forecast for the rest of the route provided no assurance that the entirety of the flight could be executed under VMC conditions as required by the Operations Manual (see 1.17.1). Therefore, it may be regarded that the crew did not strictly adhere to the instructions in the Operations Manual. As the flight progressed, it became obvious that the cloud cover present along the route matched the information in the weather forecast, making it impossible to execute a VFR flight and requiring an IFR flight.

A Y-type flight, which is envisioned by the flight plan, would probably have been the more prudent choice for crossing the Cantabrian Range to the south considering the existing weather forecast, and would have allowed them to finish the flight under VFR. The company's OM suggests that when weather conditions call into question the performance of a VFR flight and allow for an IFR flight, that the latter type be flown.

And yet from the start the crew selected and performed a flight under VMC conditions. The delay that may have resulted from waiting for Eurocontrol to approve a Y-type flight is not considered sufficient reason to discard said possibility in the Flight Plan, since a crew can always cancel it and file a new Visual Flight Plan if visibility conditions improve.

## 2.3. GPS navigation system

The GPS Navigation System is an important navigational aid for the crew of an aircraft in that it provides constant information on the magnetic course the aircraft must follow from its current position to a selected geographical point. The almost exclusive use of this system, however, as a basic navigational tool could result in routes being taken that have not been studied and evaluated previously and which are therefore unknown. The topography of these routes, which are possibly more direct, could make a flight difficult or even impossible under adverse weather conditions.

Between Points W and S the helicopter took the shortest, but also the most difficult, path (see 1.16.1), since it required crossing several valleys and mountain passes, in addition to being out of radio contact with the Bilbao Tower. The normal route is inside the CTR and follows only the Nervion River valley (see Fig. 1). Once past the Kampazar Pass (see 1.16.3), given the alternative between flying toward a mountain pass or taking the course marked on the GPS toward Pamplona, they chose the latter, which led them to the valley from which they were forced to back out by the lack of visibility.

Some of the data indicate that the GPS was the basic navigational tool for the crew. The CVR revealed that when they were going NE instead of SE (see 1.11.1.1), the Captain stated, "When possible or allowed by the visibility, we should start heading right". This substantiates the fact that he was looking at the indications on the GPS display. After a check of the VOR and NDB units, the captain also said "in any case we have the GPS" (see 1.11.1.2).

Finally, when they were inside the Araoz Valley on a course of 123 to reach the Pamplona VOR, said course was most likely obtained from the GPS because at the altitude the helicopter was flying the onboard VOR receivers could not have received a signal from any of the Pamplona VORs since the helicopter was flying in a radio shadow. It would also have been impossible for the copilot to calculate it using the navigational

charts due to the little time available to him, judging by the information on the CVR, since he had just turned over control of the aircraft to the captain.

Some of the circumstances identified by the BEA in its study (see 1.18.5) could have been a factor over the course of this flight, like inadequate flight planning and the determination to continue the flight despite the weather conditions.

## 2.4. Flight in IMC conditions

At 11:42:23, while flying inside the Araotz valley and near a fog bank, the captain told the pilot to fly using instruments. Shortly thereafter the helicopter penetrated the fog, and the crew entered IMC conditions. Immediately afterwards they exchanged roles, with the Captain taking over as the pilot flying. They increased the climb rate to 500 ft/min and turned left for the purpose of establishing a course of 123° toward the Pamplona VOR. Moments later the helicopter impacted the terrain.

Until 11:42:23 the crew could have maintained visual contact with the ground despite the deteriorating visual conditions present. From that moment on, they lost visual contact with the ground, which is consistent with an eyewitness's statement that the helicopter had penetrated the fog.

Flying with the helicopter between mountains and in adverse visibility conditions, losing outside references and transitioning to instrument flight, the crew should have performed a controlled maneuver to reach the area minimum altitude for that grid or an altitude that would have allowed them to fly in VFR conditions. This required initiating a climb as quickly as possible using the optimum climb rate based on the helicopter's performance while maintaining course. The crew, however, did not react properly and continued flying as if they were in an obstacle-free area.

In this case, had the crew acted as described in 1.18.6, the aircraft's performance would have enabled the helicopter to take a path out of the valley, described in 1.18.7, which would have allowed them to reach and fly at the minimum en route altitude (MEA), thereby clearing the mountains.

## 2.5. Human factors

No medical signs or evidence of fatigue were found in either crewmember that could have influenced their performance or diminished their skills. There were other factors, however, that are believed to have affected the conduct of the flight and which resulted in increased risks.

A review of their professional background reveals that the pilots had little or no experience flying in the area of the Cantabrian Range.

Based on the CVR recording, the relationship between them seemed courteous during the flight. A certain lack of communications and coordination in the cockpit was apparent at certain crucial moments, such as during important course changes which were made but not reported by the copilot. Also notable were the deficiencies in the captain's leadership, such as when he failed to request the copilot's back-up on important decisions, like the route to take when entering IMC conditions. The copilot, as well, evidenced a lack of determination and force by not pointing out the risk presented by climbing in IMC conditions in the Araotz valley, when earlier he had stated that the best opportunity for climbing had been in the valley they had left behind, which was wider.

# 3. CONCLUSION

## 3.1. Findings

It may be deduced that the preparation for the Flight Plan did not include an adequate study of the terrain when selecting the geographic routes best suited to the forecast weather conditions. The alternative aerodromes that were closest to the planned route were also not chosen.

The flight was initiated under VFR even though the weather forecast, known by the crew, did not assure the presence of visual meteorological conditions for the entirety of the flight.

The pilots are believed to have had little or no knowledge of the flight area.

The navigation relied mainly on the information supplied by the GPS, which was used to navigate directly to Point S in the Bilbao Airport CTR. From there on, the pilots looked for the most direct route allowed by the visibility to reach one of the two Pamplona VORs selected on the GPS unit, ignoring the natural mountain passes that could have allowed them to cross from the north to the south of the Cantabrian Range at a lower altitude.

No objections were heard on the CVR from either crewmember regarding the risks involved in navigating with reduced visibility, as was the case during this flight.

The captain knowingly entered IMC conditions inside a Class G airspace and with ground obstacles close to the flight path.

Once in IMC conditions, the crew reacted inappropriately by not attempting to return to VMC conditions or trying to reach the minimum safe altitude as quickly as possible.

## 3.2. Causes

This accident resulted from a failure to maintain the minimum en route altitude, which would have assured obstacle clearance, prior to knowingly flying into IMC conditions.

The following are considered to have contributed to the accident: improper flight preparation on the ground, navigating primarily using the GPS, the failure to adhere to the procedures in place at the operator for entering into IMC conditions, and the failure of the crew to use teamwork techniques (CRM).

# APPENDICES

# APPENDIX 1
## Meteorology

Weather information given to the crew by the Weather Office at LEXJ for the segment from LEXJ to Teruel.

- Santander, LEXJ

  — Metar 130700Z VRB02KT 9999 SCT017 BKN030 18/15 Q1010
  — TAF 130500Z 130615 VRB04KT 8000 SCT15 BKN020 PROB30 TEMPO 0610 4500 –RA BKN014 TEMPO 0609 4500 BR BKN012 PROB40 TEMPO 0608 1500 BR BKN004 PROB40 TEMPO 1015 03010KT

- Bilbao, LEBB

  — Metar 130700Z 32005KT 6000 BR FEW020 SCT030 BKN035 18/15 Q1010 TEMPO 4500 BR
  — TAF 130500Z 130615 29008KT 8000 SCT012 BKN030 PROB30 TEMPO 0610 4500 SHRA PROB40 TEMPO 0609 4500 BR BKN012 PROB30 TEMPO 0608 BR BKN004

- Vitoria, LEVT

  — Metar 130700Z 06005KT 030V100 6000 BR SCT004 OVC008 16/15 Q1011
  — TAF 130500Z 130615 VRB04KT 9999 SCT020 TEMPO 0609 4500 BR BKN008 PROB40 TEMPO 0608 1500 BCFG BKN004 PROB30 TEMPO 0610 4500 –RA BKN014

- Pamplona, LEPP

  — Metar 130700Z 03003KT 350V100 CAVOK 19/15 Q1010
  — TAF 130500Z 130615 VRB02KT 9999 FEW030 PROB30 TEMPO 1015 SHRA BKN030CB

- Logroño, LELO

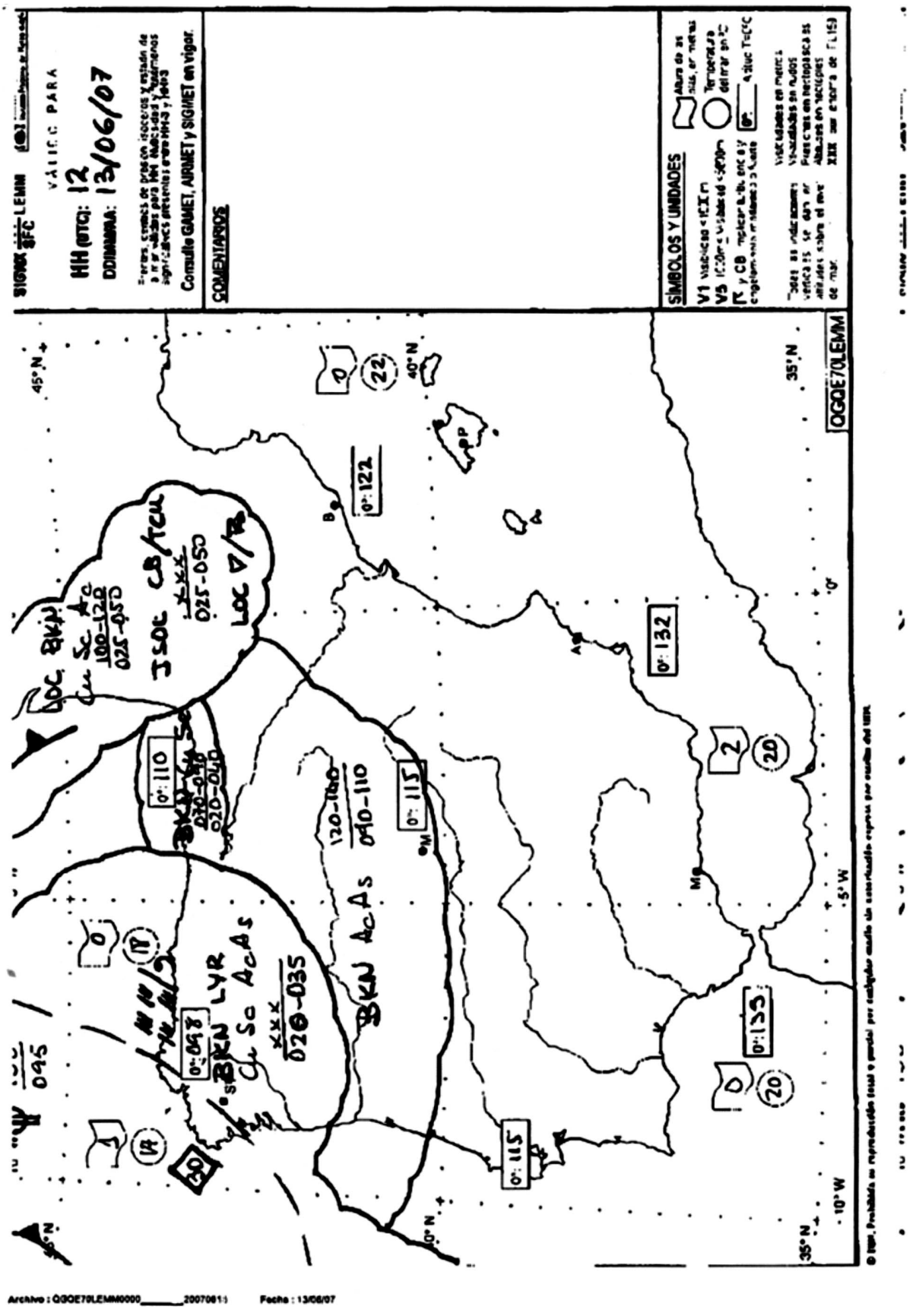
  — Metar 130700Z VRB01KT 8000 NSC 20/16 Q1009
  — TAF 130500Z 130615 VRB03KT CAVOK PROB30 TEMPO 1015 SHRA BKN030CE

- Zaragoza, LEZG

  — Metar 130700z 11007KT 9999 FEW060 SCT180 22/16 Q1009
  — TAF 130500Z 130615 12003KT 9999 FEW035 TEMPO 1315 SHRA

- Burgos, LEBG

  — Metar 130700Z 23011KT 9999 FEW040 14/11 Q1013


SIGWX
LEMM
VÁLIDO PARA
HH (UTC): 12
DD/MM/AA: 13/06/07
Consulte GAMET, AIRMET y SIGMET en vigor.
COMENTARIOS
SÍMBOLOS Y UNIDADES
QGOE70LEMM
ISOL CB/TCU
BKN AcAs
BKN LYR
Loc Cu Sc Ac
Loc CB/TCU
0°:110
0°:122
0°:115
0°:132
0°:135
0°:115
025-050
020-040
120-180
040-110
020-035
045
45° N
40° N
35° N
0° N
10° W
5° W
0°
5° E