

DATA SUMMARY

LOCATION

Date and time	January, 6th 2002; 13:18 UTC
Site	Fuerteventura Airport (Las Palmas)

AIRCRAFT

Registration	D-AHLJ
Type and model	BOEING 737-400
Operator	Hapag Lloyd

Engines

Type and model	CFMI CFM56-3B/3C1
Number	2

Crew

Pilot in command

Age	52
Licence	Airline Transport Pilot – Aeroplane
Total flight hours	12,790 h
Flight hours on the type	7,970 h

INJURIES

	Fatal	Serious	Minor/None
Crew			6
Passengers			82
Third persons			

DAMAGES

Aircraft	Minor damage in landing gear
Third parties	None

FLIGHT DATA

Operation	Comm. air transport – Non scheduled international – Passengers
Phase of flight	Approach and Landing

REPORT

Date of approval	29th March 2006
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1. FACTUAL INFORMATION

1.1. History of the flight

The airplane registration number D-AHLJ, a Boeing 737-400, was carrying on flight HF-7291 on 6th January, 2002, a charter passenger transport operation from Amsterdam to Fuerteventura. There were 82 passengers on board and a crew of six, two of them were technical crew and four, passenger cabin crew. It took off at 09:16 h UTC¹ in Amsterdam (EHAM), and after four hours flight time, approximately, it was beginning its approach to Fuerteventura airport when it was a little later than 13:00 h UTC. Flight was conducted under instrumental flight rules, (IFR), and instrumental meteorological conditions, (IMC) prevailed, also.

In fact, weather situation was characterized by a dust storm from the African Sahara that decisively affected visibility: horizontal visibility, which was 500 m, and vertical visibility which was regarded as indeterminate. Winds were from south east and its intensity 20 kt, gusting to 28 kt.

Under these conditions the airplane made a first non-precision instrumental approach directly to runway 19, relaying on a VOR-DME aid; this approach was not successful. In a second approach to this runway, also with VOR-DME support, the airplane was able to enter the runway but two wheels burst off and some damage to the landing gear was inflicted to both main landing struts. The aircraft slid on the runway until coming to a halt at mid runway width and at 1,200 m from the over flown threshold.

Passengers de-boarded the airplane throughout the stairways and were transferred to the terminal building in apron bus.

1.2. Injuries to persons

All passenger and crew members became uninjured.

1.3. Damage to the aircraft

Aircraft experienced two main landing gear tires blown off and damage to the struts and other undercarriage components.

1.4. Other damage

Due to airplane retrieval from runway (RWY) and RWY cleaning, airport was out of service from 13:20 h on incident date to 11:15 on the next day. January 7th.

¹ UTC, Universal Time Coordinated. Local time coincide with UTC en Fuerteventura on that date.

1.5. Personnel information

1.5.1. Captain

At the incident date, the captain was 52 years old and had accumulated 12,790 hours total flying experience. Of that amount 7,970 hours were in the airplane type. Flying hours within the latest 90 days were 142 h.

Resting time prior to that flight was 36 h.

He was an Air Line Pilot license holder and his latest proficiency check was passed on 09-08-2001.

1.5.2. First Officer

First Officer age at the incident date was 36 years, had accumulated 3,800 total flying hours, 480 of them in same airplane type.

Resting time prior to that flight was 36 h.

He was an Air Line Pilot license holder and his latest proficiency check was passed on 24-10-2001.



1.6. Aircraft Information

Boeing 737-400 model is a passenger transport twinjet with CFMI CFM56-3B/3C1 of 23,500 pounds of thrust each, mounted in pylons under the wings. Maximum take-off weight is 68,000 kg.

1.7. Meteorological information

1.7.1. Aerodrome Actual Met Report

The aerodrome actual meteorological reports (METAR) that were issued before and after flight HF 7291 landing took place were:

CGFV 061300Z 12021KT 0500 DS VV/// 19/09 Q1015 NOSIG=
CGFV 061330Z 12018KT 0500 DS VV/// 20/10 Q1014 NOSIG=
CGFV 061400Z 12019KT 0500 DS VV/// 20/10 Q1014 NOSIG=

That is to say, winds from SE, 21 kt in strength at 13:00 h, and 18 kt – 19 kt in following reports.

A dust storm (DS) was blowing. Horizontal visibility during these periods stayed in 500 m. and no vertical visibility could be determined which was impaired by the dust suspended in the air obscuring the sky.

Outside and dew point temperatures were 19-20° and 9-10° respectively.

1.7.2. Satellite Image

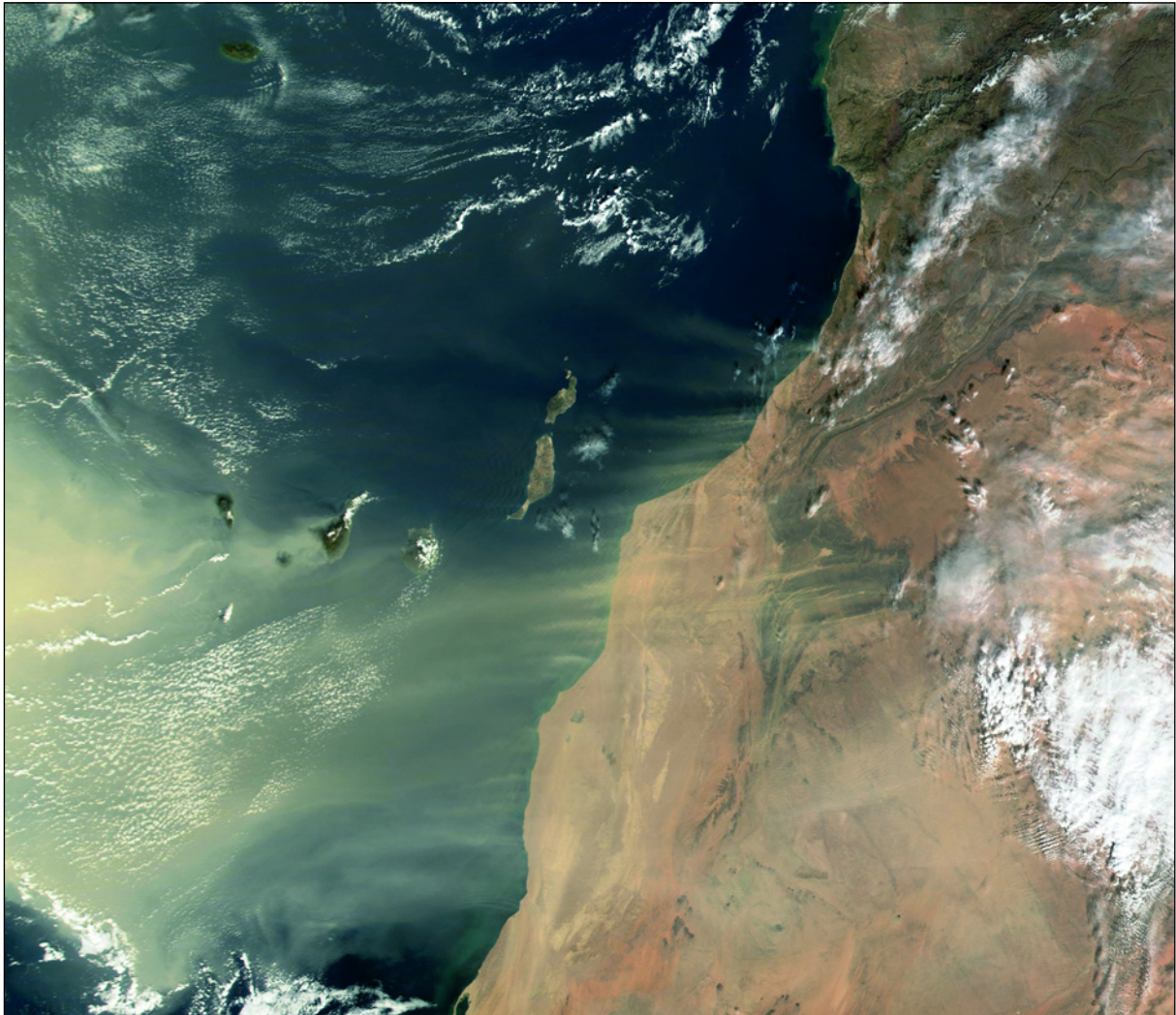
This true-color image was captured by the Moderate-resolution Imaging Spectroradiometer (MODIS), flying aboard NASA's Terra satellite, on January 7, 2002.

Picture comment at NASA file said:

«A thick pall of sand and dust blew out from the Sahara Desert over the Atlantic Ocean yesterday (January 6, 2002), engulfing the Canary Islands in what has become one of the worst sand storms ever recorded there».

1.7.3. Other met information

ATC in TWR communications with the airplane gave the same wind general information as stated in the METARs but it added gust information of 28 kt in the first approach and go-around and 27 kt in last approach.



<http://visibleearth.nasa.gov/>

The INM have let know that significant weather was the dust storm and that wind and temperature at higher levels were:

Flight level	Wind dir.	Wind strength	Temperature
050	SE	35 kt	9 °C
100	SE	35 kt	-2 °C
180	SE	20 kt	-21 °C
240	SE	20 kt	-39 °C

1.8. Aerodrome information

Fuerteventura airport, in the island of the name, is placed on the island east coast and possesses a runway of 01-19 orientation.

General data for the runway is:

- RWY name: 19
- Magnetic heading: 188° (on the incident date)
- Dimensions of the RWY: 2,400 × 45
- Dimensions of the strip: 2,520 × 150
- LDA: 2,400 m (landing distance available)
- Threshold elevation: 75 ft
- Surface: Asphalt
- Visual aid PAPI: 3.2°
- No ILS available.

VOR-DME available.

All navigational aids were duly serviceable except ILS on RWY 01, which was out of service due to LLZ and GP equipment substitution.

The runway sense 19 is active only about ten days around the year, being wind or northerly direction predominant.

The alternate airport, Lanzarote, having a runway 03-21, is located at some 30 NM from Fuerteventura in a NE direction.

1.9. Flight recorders

Aircraft was equipped with a Digital Flight Data Recorder (DFDR) and a Cockpit Voice Recorder (CVR) whose information relative to the flight was read under the supervision of BFU (German Federal Bureau of Aircraft Accidents Investigation).

1.9.1. Cockpit Voice Recorder (CVR)

A transcription of the cockpit conversation and the interchanges with APP and TWR was handed for the investigation. Time reference is set to the coordinated time adjusted to the TWR and FDR records. Words spoken on the cockpit between the two pilots use to be said in German language with some English words intermixed. Herein, only the more relevant pieces of those conversations for the investigation are reproduced in translation:

1.9.1.1. First approach

From the airplane-APP interchanges it is inferred that an initial direct approach on VOR radial 005 is made which is captured with the help of radar vector guidance provided by ATC.

- 12:58:45 Check list is made and at the FO call out for landing speeds, the PIC answers: 132, 147, 219².
- 13:03:07 Pass over fix FAF at 9 NM DME is reported.
- 13:04:01 FO suggests, «I' look out, you keep it inside». PIC answers: «No, we have to check all cross».
- 13:04:43 PIC: «Nothing yet?». They still do not see the ground.
- 13:04:54 FO: «Now you are exactly on the correct altitude, so next is approximately 1,100 or so». It seems they refer to MDA (1,050 ft).
- 13:05:01 PIC «Ground contact, now you look outside».
- 13:05:03 FO: «Yes, I look out and to the ground».
- 13:05:04 PIC: «What's that exactly?».
- 13:05:17 FO: «Yes, I have the ground here, the desert». They see the town Puerto del Rosario and a pair of houses.
- 13:06:33 PIC asks: «Look for the radial». FO answers: «1, 4». PIC: «What does it mean 1.4? Am I to the left or to the right?». FO. «We are... you have to go to the left to the left, there is the path³».
- 13:06:44 PIC: «Flap 40°, oh stop, 15°, go-around, gear up».

1.9.1.2. Second approach and landing

The captain decides a VOR manual approach. «This time, he said, we do it conversely, now you tracks normal and I guide and then with you... follow raw data, exact». With the expression «raw data», PIC may refer to use primary instrumentation instead of using FMS elaborated data.

- 13:11:30 While they fly a northerly course to initial approach fix PIC asks himself. «If I knew, what QN has the RWY, ah, how is it call, QFF, or what? 188, ah». It seems he refers to QFU or RWY magnetic heading which was at the time 188°, to select the appropriate VOR radial.
- 13:13:37 They are established on radial 005.
- 13:14:11 ATC: «HF-7291, you are not in sight, cleared to land RWY 19, wind 120, 24».
- 13:15:17 FO: «5 miles».
- 13:15:29 PIC: «Now, I see the ground».
- 13:15:31 FO: «Okay».
- 13:15:32 PIC: «Do you also, don't you?».
- 13:15:33 FO: «Yes, exactly, I do also but only a little». They continue reading the check list.

² The refer to Vref 40°, Vref 15° and Manuover speed flap up. In point 1.14.3 an estimate of those speed values is made for the flight under study.

³ In German the use the word Bahn («road»), that it is being translated as path. It seems they refer to the approach lights.

13:16:03 FO: «Then you has to have the path to the left, but of-course, with the cross wind, or, no to the right the path».

13:16:12 PIC: «Now, we track exactly 2 miles out,... passed».

13:16:33 PIC: «Flap 40».

13:16:44 FO: «Now, we are here over the coast».

13:16:51 PIC: «I look outside».

13:16:55 GPWS: 3 times «SINK RATE».
FO: «SPEED».
GPWS: tour times «PULL UP».
GPWS: «SINK RATE».

13:17:17 PIC: Expletive.

No standard calls-out for «approaching minimum», «at minimum», «five hundred», nor malfunctioning of instruments or aids to navigation or descend rates were made.

1.9.2. Digital Flight Data Recorder (DFDR)

At the commission disposal was the FDR data in paper and graphic format (see Annex B), as well as, a computer animation simulating the first approach and go-around and the second approach and landing.

Making reference to the UTC time several events and observations are shown below:

TABLE 1. First approach

Time (hh:mm:ss)	ALT (ft)	RH (ft)	ROD (ft/min)	HDG (°)	IAS (kt)	GS (kt)	Wind (°/kt)	Flap (°)	PWR (%N1)	Observations
13:06:41	224	160	0	167	142	128	135/22	30	45	Heading correction
13:06:45	183	126	-643	162	140	126	131/21	33	55	Slight power increment
13:06:48	160	108	-901	159	145	132	139/21	28	95	TOGA
13:06:52	224	143	143	158	158	141	147/18	15	95	
13:06:55	276	206	1,206	164	166	150	116/16	15	95	

In graphic Annex B-1 a change of heading of 18° is noticed 10 seconds before go-around and bank 20° to the left, followed by a 12° heading change to the right. It is observed a descent to 105 ft radio height and the power increase for go-around.

Approach was performed initially in automatic flight engaging A/P with FMS in L-NAV mode.

TABLE 2. 2.^a approach and landing

Time (hh:mm:ss)	ALT (ft)	RH (ft)	ROD (ft/min)	HDG (°)	IAS (kt)	GS (kt)	Wind (°/kt)	Flap (°)	PWR (%N1)	Observations
13:16:53	493	541	-1,968	177	144	129	126/28	40	30	
13:17:00	257	298	-1,776	189	141	133	125/22	40	30	Turning right
13:17:02	192	168	-4,655	192	143	135	125/18	40	30	
13:17:04	131	92	-2,640	189	142	134	129/18	40	30	Turning left
13:17:06	66	23	-1,795	179	137	131	129/20	40	30	Ground contact. Drift to right
13:17:10	33	-4	-32	182	119	112	133/16	40	30	
13:17:12	64	-4	0	178	104	98	145/20	40	30	
13:17:14	64	-4	0	175	93	88	177/25	40	30	
13:17:18	64	-4	0	173	79	71	91/35	40	30	
13:17:23	64	-4	0	174	67	54	58/...	40	30	Crossing RWY centreline to the left
13:17:30	64	-4	0	172	46	39	54/...	40	30	
13:17:35	64	-4	0	159	45	26	40	30	
13:17:40	64	-4	0	158	45	32	40	30	
13:17:43	64	-4	0	156	0	32	40	30	

In graph Annex B-3 it is clearly observable the instant ground contact was accomplished, when a 3 g's vertical acceleration was recorded. In the last 30 seconds in the glide path ROD was greater than 1,000 ft/min, reaching in some moments 2,200 ft/min.

In graph Annex B-4 a change in heading of 12° to the right can be seen, five seconds before touch-down when RH was 200 ft. Also aggressive use of aileron and bank angle can be observed a few seconds before touch-down.

Approach was flown with A/P initially engaged to VOR.

In Annex C-1 a reconstruction of aircraft path on both approaches, —made by BFU from FDR data—, is shown.

1.10. Communications

The crew held communication with ATC services of APP and TWR.

A transcription of the TWR recordings was granted. Some phrases of these conversations are reproduced herein with reference to the adjusted time to FDR time.

At 12.45 h UTC before first approach and at 13:10 h UTC, before second approach in several conversations among TWR, APP and METEO they comment: «...it is pretty

obscure, horizontal visibility some 500 m». «... dust and sand storm, vertical visibility not appreciable».

13:14:11 TWR say to HF-7291 that he is not in sight.

1.11. Wreckage and impact information

1.11.1. *Tracks and signs on the runway*

The aircraft touch down in the first third of the runway and centred on it on the right main landing leg.

It came to rest some 1,200 m from threshold 19 and in the middle of its width. Heading of the stopped plane was some 145°, that is, about 45° to the left of runway orientation and landing heading.

1.11.2. *Inspection of the aircraft after the incident*

Inspection of the aircraft landing gear after the incident showed that two main tires had burst. Failure of torque link strut lug let the struts twist or pivot, adopting the wheels a position not parallel to the airplane main axis. Breakage of other elements as hydraulic lines, drainage valve of the right strut, etc was observed.

In other zones of the aircraft contact damage due to interference of flap and engine #2 thrust reverser fairing was experienced, as well as buckling of rear fuselage skin, behind the wings, specially in the left hand side, which are not unusual in cases of hard landings.

From the stopped airplane 3,500 kg of kerosene were de-fuelled. The works or aircraft retrieval and runway cleaning operation concluded next day, January, 7th, at 11:15.

Initial repairs were made in-situ and the aircraft flew back in ferry flight to its maintenance base with the authorization received from LBA (German Civil Aviation Authority).

1.12. Fire

Fire brigade arrived immediately and no fire was started.

TWR advised of the aircraft position when it came to stop in its landing roll out, as «...after BRAVO» meaning the taxi way.

At 13:19:20 TWR said to HF-7291 that fire brigade was arriving.

1.13. Survival aspects

Occupants de-boarded the plane through its stairways and they were taken to the terminal building on apron buses.

1.14. Tests and research

1.14.1. *Fuerteventura approach chart*

The actual approach chart to RWY 19 of Fuerteventura, used by the crew, has not been inspected. The approach chart that has been studied is the one which was valid in AIP Spain at the date, in January, 2002.

A VOR-DME approach is a non-precision approach where electronic instrumentation does not give vertical guidance or glide path information. VOR signal is used directly in manual flight or in automatic flight feeding the signal to the A/P to give horizontal guidance or lateral deviation in respect to the landing course. A/P can receive signals directly or through the FMS (Flight Management System) in L-NAV (lateral navigation) mode.

According the procedure described in approach chart to Fuerteventura that was in force at that date, once established in the point FAF (Final Approach Fix) in the 19 runway prolongation, at 9 NM, DME distance and 2800 ft altitude, a descent is initiated passing through an intermediate point in RWY CL extension at 5 NM-DME with an altitude of 1,500 ft. Final descent continues until MDA, 1,050 ft, when a decision is to be made, to land if the PIC see, distinguish and identify the runway (or a part of it, or light systems), continuing landing in visual contact or to initiate the go-around procedure. The point for the go-around is MAPT (Missed Approach Point) and is identified by its DME distance of 1 NM. (See Annex A-1).

Procedures assume that the aircraft is stabilized in the final segment. Normally, before descending below 1,000 ft in IMC (or 500 ft in VMC) the aircraft must be aligned with the runway, only small corrections on heading and pitch are allowed. Speed must be in the range $V_{ref} - V_{ref} + 20$. The aircraft must be in landing configuration and its vertical speed or ROD must be less than 1,000 ft/min. When in final, in IMC and below 1,000 ft, if flying becomes un-stabilized an immediate go-around has to be initiated.

Company procedures define the check list to be accomplished before over flying the fixes, the instruments cross checks, the functions of PIC and those of FO, and also the call-outs that the pilots have to give each other in case of deviations or when some positions have been reached.

Call-out of any of the pilots about de-stabilization of the flight and GPWS warnings in IMC below 1,000 ft requires an immediate procedure of climbing and go-around.

1.14.2. *Glide slope and landing run estimation*

By speed integration during the landing run out it is been possible to estimate a longitude of the landing run of about 900 m from first ground touch to aircraft stop on the runway.

Ground speed, GS, during final approach was pretty steady around 132 kt. In the last 10 seconds the aircraft descended from 400 ft and covered 680 m. Glide slope gradient was as an average greater than 16%.

1.14.3. *Landing speeds estimation*

Aircraft weight in landing configuration is assumed to be:

— Dry operating weight:	36,430 kg
— Reserve fuel:	4,262 kg
— Traffic load:	7,527 kg
Landing weight:	48,219 kg

It was not available for consultation the actual manuals applicable to the incident aircraft. On consulting other manuals applicable to aircraft of same series, following speeds have been found for above determined weight:

— Vref 40°:	134 kt
— Vref 15°:	147 kt
— Vmaneuver 0°:	220 kt

To the reference speeds a correction amounting 50% of the head wind component has to be added (aprox 6 kt) and another correction for gust value ($27 - 20 = 7$). In total a correction of 14 kt is to be added.

Then, the corrected speeds on landing would have been:

— Vref 40° corr.:	147 kt
— Vref 15° corr.:	160 kt
— Vmaniobra 0°:	220 kt

And the approach should have been flown at a speed between Vref corr. and Vref corr.+5, that is, for flap 40°, between 147 kt and 152 kt.

1.15. Organizational and management information

1.15.1. *Company procedures for landing*

According to the company procedures (OM, Part A Chapter 08.01.03, Page 4 of 10, date 13 July 2001, a pilot may not continue a CAT I or non-precision approach below DA(H) or MDA(H), unless the airplane is in a position from which a normal approach to the runway of intended landing can be made, and at least one of the following visual references is clearly visible and identifiable to the pilot:

- Elements of the approach lighting system;
- Visual glide path indicator;
- Threshold, threshold marking, threshold lights, threshold identification lights;
- Touchdown zone, touchdown zone lights, touchdown zone markings;
- Runway edge lights;
- Other visual references accepted by the authority (non-precision approach only).

The «call out» procedures establish that: The pilot who is not flying, PNF, must call out the following items:

- Deviation from the flight path;
- Deviation from the required airplane configuration;
- Deviation from altitudes specified for the approach procedures;
- Rates of descent in excess of:
 - 3,000 ft/min below 3,000 ft AGL
 - 2,000 ft/min below 2,000 ft AGL
 - 1,000 ft/min below 1,000 ft AGL
- Deviation from target speed of plus 10 kt / minus 5 kt and more, together with the tendency of change (increasing / decreasing);
- Malfunction of instruments and nav. Aids;
- Bank angles exceeding 30 degrees;
- 1,000 ft before reaching the assigned altitude/level: «ONE THOUSAND».

Herein it follows some of the mandatory call outs that the PNF must do during the approaches:

Condition	Call-out	CM
When visual references are in sight	Runway (approach lights) ahead (left/right)	PNF
If landing is not possible	Go around	PF/PNF
500 ft above touchdown zone elevation *	Five hundred	PNF
Approaching Minimum	Approaching minimum	PNF
At Minimum	Minimum	PNF

* Disregard 500 ft call when conflicting with approaching minimum or minimum call.

1.16. Additional information

1.16.1. Crew statements

The captain said that he knew landing direction 19 where he had previously landed twice and that the «yellow haze» phenomena were known to him.

In the first approach, after recognising the runway and realizing that the airplane was too far to the right, a go-around was initiated. Visibility was 2 to 3 km.

In the second approach, after recognising the runway, the airplane was somewhat left of the runway. While the autopilot (A/P) was disengaged, the left wing received a strong upward impulse by some meteorological influence. He recalled that the engine power was reduced pretty early during the landing.

As for the co-pilot, he had no previous experience in runway 19; he landed runway 19 for the first time. He said that standard call-outs like «approaching minimum» or «minimum» were not made. He affirmed that if the RWY should have not been visible they would not have descended below 1,000 ft.

The precision approach path indicator (PAPI), (set to 3.2°) was not used. He recalls having indicated that speed was too low shortly before landing.

Some queries raised by BFU concerning limitations at «Non Precision Approach» could not be answered by crew.

1.16.2. Other information from ATC

The TRW log book include the information of two flights which were diverted to Lanzarote (GCRR), one at 08:20 and the other, which previously made a go-around, at 11:47. Another flight was diverted to Las Palmas airport (CGLP), after a go-around, at 10:59 UTC.

At 13:08 UTC flight HLF aborts landing. «... land at 13:18, bounces and smoke begins to come out from the wheels». «... it comes to a halt after sliding a long way».

During that day morning two airplanes succeeded in landing, one at 09:15, the second at 10:10 h.

2. ANALYSIS

2.1. Flight preparation

On the day January, 6th, meteorological conditions were adverse in, Fuerteventura, destination airport for flight HF 7291. Significant weather, «dust storm» caused a drastic visibility reduction and the cross wind, as well, impose a strong drift, estimated in 8°,

in the airplane course. It is not very usual to get those meteorological conditions neither to have comparable operative conditions. Normally, when low visibility conditions due to fog prevail, wind use to be weak and when wind blows the atmosphere use to be clean, save cases of blizzard and snow storm. Sand and dust storm is regarded as an infrequent phenomenon unless the operation is commonly carried out in deserts. Flight HF 7291 over flew its destination with a good fuel reserve of 4,262 kg, to be able to reach the alternative airport.

2.2. First approach and go-around

Crew was informed of the IMC conditions, caused by the reduced visibility, and the cross wind strength affecting the runway. The captain had previous experience in landing on runway 19 and, for that reason; he knew the instrumental non-precision approach procedures for that runway.

There were certain complications in this occasion because the wind would made it hard to keep the course in the RWY CL extension and there would be little visual clues for land recognition. The runway and approach lights could be better observed from the right hand side of the airplane as its drift was 8° to compensate the current left cross wind.

Initially the approach was normal; the check lists were read and the go-around procedure rehearsed. Regarding the cockpit functions of pilot and co-pilot, and according to CVR conversations, could have been no very precisely defined; so, when the captain said that they have to check all cross, or when defining who was looking out and who cared of the instruments. In the first approach the airplane deviated to the west one kilometre distance, (see ANNEX C-1), and it flew parallel to the RWY CL extension until arriving to a few hundred meters from the threshold. In the last seconds it flew over the inland instead of over flying the coast line, without that been noticed, which indicate that visibility was low in fact. It was only six seconds before go-around when the co-pilot recognise the 1.4 DOT localizer deviation and inclusive, a misunderstanding arise between the crew about the sense, left or right, the deviation was. The approach was made engaging A/P to FMS in L-NAV mode. The approach would have been more precise if VOR-DMR raw data would have been used.

The aircraft had already been at a radio height of 124 ft at a distance of DME 2.3 NM (approximately 1.5 NM prior to the threshold of runway 19) and had no visual contact with the runway. At this point, the Flight Director Mode «ALT HOLD» was engaged, approximately 35 s, until go-around was initiated.

Visibility may have change every second. Sometimes sight would be better and sometimes worst, but apparently the aircraft was allowed to descend to 105 ft RH, without recognising, identifying, the airport or some of its areas, and in the descent no call-outs of «approaching minimum» or «minimum» were spoken.

Approach was been held with flap 30° and, in the same second before go-around, a flap 40° was beginning to be set, changing airplane configuration in final at a little more than 105 ft RH.

In this first approach runway was reached by its right side and the plane over flew its first third part, with a heading 20° to the left from runway heading, what caused the go-around.

2.3. Second approach

In the second approach A/P was engaged to VOR/LOC, supposedly, to avoid possible errors introduced by the Flight Management System (FMS). In this occasion the course coincided better with the runway centre line extension with a minimal error, but this error or deviation was not noticed until few hundreds meters from the threshold. At some ten seconds before touch down it is observed, alike as in first approach, the bit of confusion among the pilots regarding its own functions: who is looking inside, who is looking outside. Apparently both pilots look outside and recognise the town and the coast line, although with difficulty.

Visibility was scarce and they did not identify the runway until the last second, because of that, they had to change heading about 12° with an aggressive use of flight controls just before the threshold.

Since the pilot flying conducted the approach on the wrong radial (188°) —184° would have been correct— the approach was offset parallel to the runway. Once the runway came into view the aircraft had to be piloted first to the right and then to the left towards the runway. This caused the high roll rate (18°/s) at touch down and led to the damage of the aircraft together with the rate of descent.

Before, in the last flight seconds, concentrated in distinguishing the outside world, they did not pay attention to the high rate of descent, (about 2,000 ft/min, flying below 1,000 ft), at least they did not call-out the event as prescribed. Neither the co-pilot gave the call-out for minimum and the system calls of «SINK RATE» and «PULL UP» were ignored. Glide slope gradient was greater than 16% and, of course they did not use the visual aid PAPI (3.2° gradient), which probably were not visible in the condition of brightness and poor visibility on that environment.

Speed of 142 kt was low in comparison with speed in first approach as well as in comparison with the assumed speed of 147-152 kt as estimated in point 1.14.3. The co-pilot advised, without telling whether it was high or low, of a speed deviation as recorded in CVR. Engine power was low also, according to the captain statement.

The speeds spelled out in the before landing check list, did not included the speeds additives for head wind and gusts although the crew could have made the correction when they changed the speed bugs in their anemometers.

2.4. Landing

The aircraft reached the runway while making the last corrections in heading and bank and without completely having absorbed the vertical descend velocity at the flare, that is why it bounced hard on the runway as was seen from the TWR, 400 m away.

DFDR readouts showed that the bank angle shortly before touch down was not caused by a gust of wind as the captain has stated. The bank angle was definitely caused by the captain's control input.

May be a gust coincided in this very moment as the PIC declared; the low speed, low engine power and the lowered manoeuvrability of the airplane in 40° configuration posed more difficulty to the control of the aircraft on the ground. First contact of the airplane landing gear —reaching a vertical acceleration of 3 g's—, with the airplane lightly oriented to the wind and slipping could give origin to torsion stresses on the main struts where the upper torque links lugs broke off. Twisting or pivoting of the struts resulted in skidding of wheels oriented across their course and then two tires blew off. The aircraft covered 900 m in contact with the runway until it stopped 1,200 m from the threshold. Its heading was controlled by nose wheel steering; airplane prow was oriented finally 45° leftwards of runway heading and the main wheels and the struts twisted in respect the airplane main axis.

As there was no fire and the aircraft position was in the middle width of the runway, retrieval of passengers and their luggage was accomplished without difficulty.

2.5. Considerations about the procedures

Many times it has been revealed the importance of a stabilized approach in order to perform a good landing. It will be no novelty to insist in the need to adapt company procedures and approach flying procedures to the requirements some international organizations have been issuing along the times.

In this case, poor cockpit coordination and when both pilots concentration were focused on looking for the airport, neglecting to do proper instruments cross-check, possibly contributed to the incident.

3. CONCLUSION

3.1. Findings

- According to the documentation available, the crew held valid pilots licenses.
- The crew's rest period before the day of the incident was 36 hours.

- Weather situation was characterized by a dust storm. During these approaches horizontal visibility remained by 500 m and vertical visibility could not be determined.
- Airplane in approach flight encounter conditions of low visibility, due to dust storm, together with strong cross wind and gusts.
- Approach was not flown according non-precision VOR-DME procedures published by Spanish AIP.
- The airplane made a first approach in which the runway was nor identified or seen clearly until the last seconds, descending to 105 ft RH. The flight was not in steady stabilized path compatible with safe landing and then a go-around procedure was initiated.
- In the second approach the airplane got to the runway with minor deviations regarding heading but with high rates of descend few seconds before touch down. Low visibility impaired timely heading corrections.
- The latest aggressive manoeuvres to cope with lateral and vertical speed deviation did not preclude a hard landing.
- In the landing severe damage was inflicted to the landing gear.
- The co-pilot as pilot non flying did not make the correct company standard call outs during the VOR-DME approaches.
- The captain descended below the MDA for the standard VOR-DME approach to RWY 19.
- The co-pilot made no attempt to prevent the continuation of the flight below the MDA.
- None of the pilots had visual contact with the runway or with the approach light system as prescribed by the company procedure. Therefore the requirements for going below the MDA and continuing the final approach visually were not met.
- The minimum visibility which applied at the time of the incident for a standard VOR-DME approach 19 for aircraft categories C and D was 2,000 m runway visual range according to Spanish AIP.
- The crew did not make an appropriate correction to the reference speed on landing.
- At a distance of approximately 1.5 NM to the threshold of runway 19, the aircraft was already at a radio height of 124 ft without visual contact to the runway and the terrain avoidance procedure was ignored.

3.2. Causes

The incident is attributable to the fact that the flight crew continued the descent under instrument meteorological conditions (IMC) below the minimum descent altitude (MDA) for the approach without meeting the necessary requirements.

4. SAFETY ACTIONS

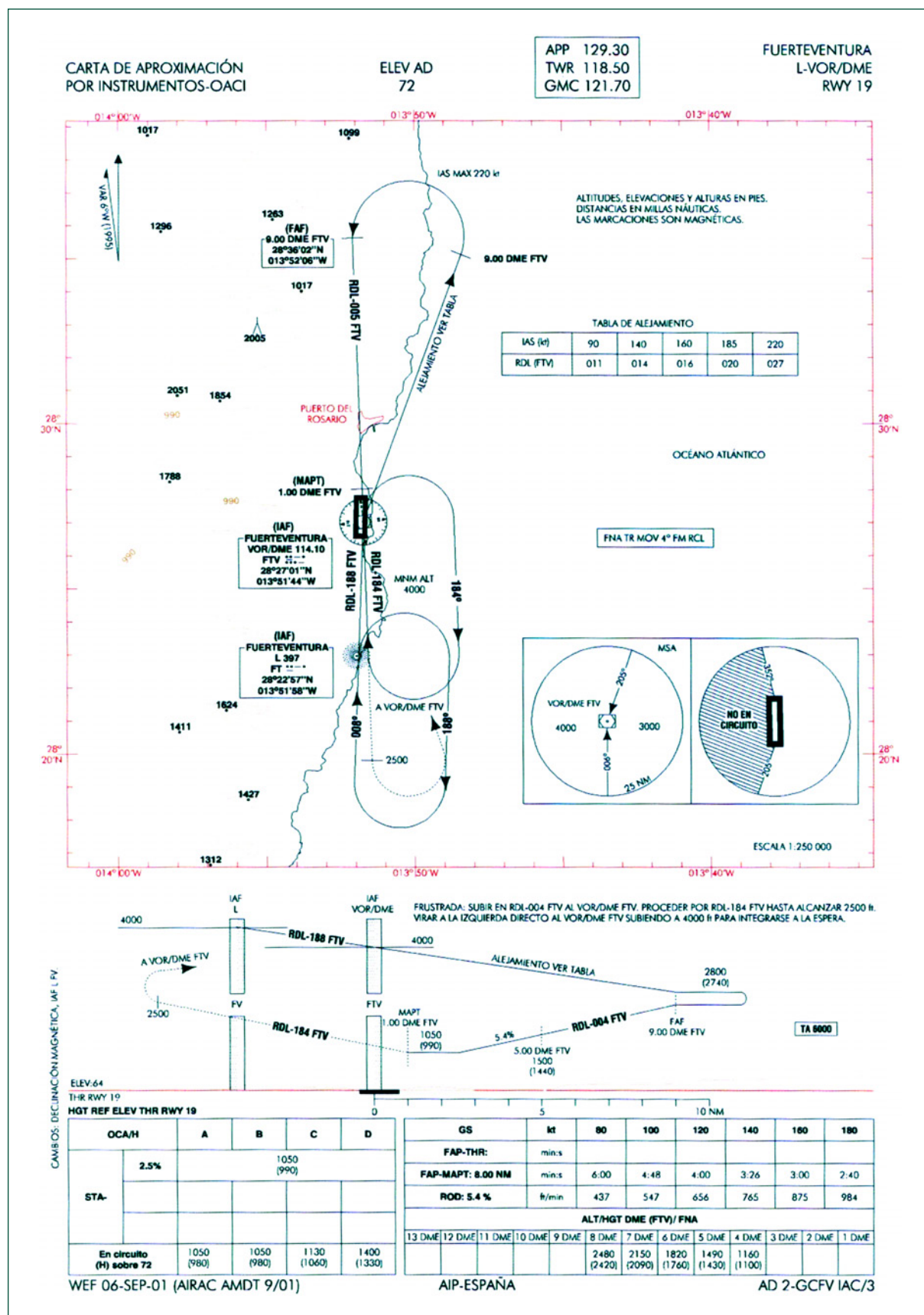
After this incident occurrence, Hapag Lloyd's Airline analysed its company procedures looking for deficiencies and possible improvements. As a consequence of this process, it was decided to implement within the company the items that follow:

1. Non-precision approach training. The main points which should be stressed, are:
Cabin Coordination Concept, Limitations and Call-outs
2. Adaptation of Cabin Resources Management (CRM) courses.
3. Improvement of first officers status within the company. Consequently, previous measures taken in this respect will be kept in force.
4. Training programs of crews, captains and first officers, will comprise specific tuition on accident prevention.

Due to the fact that the safety actions that can be derived from this incident investigation would be already included in the implemented measures of the operator, no safety recommendations are issued.

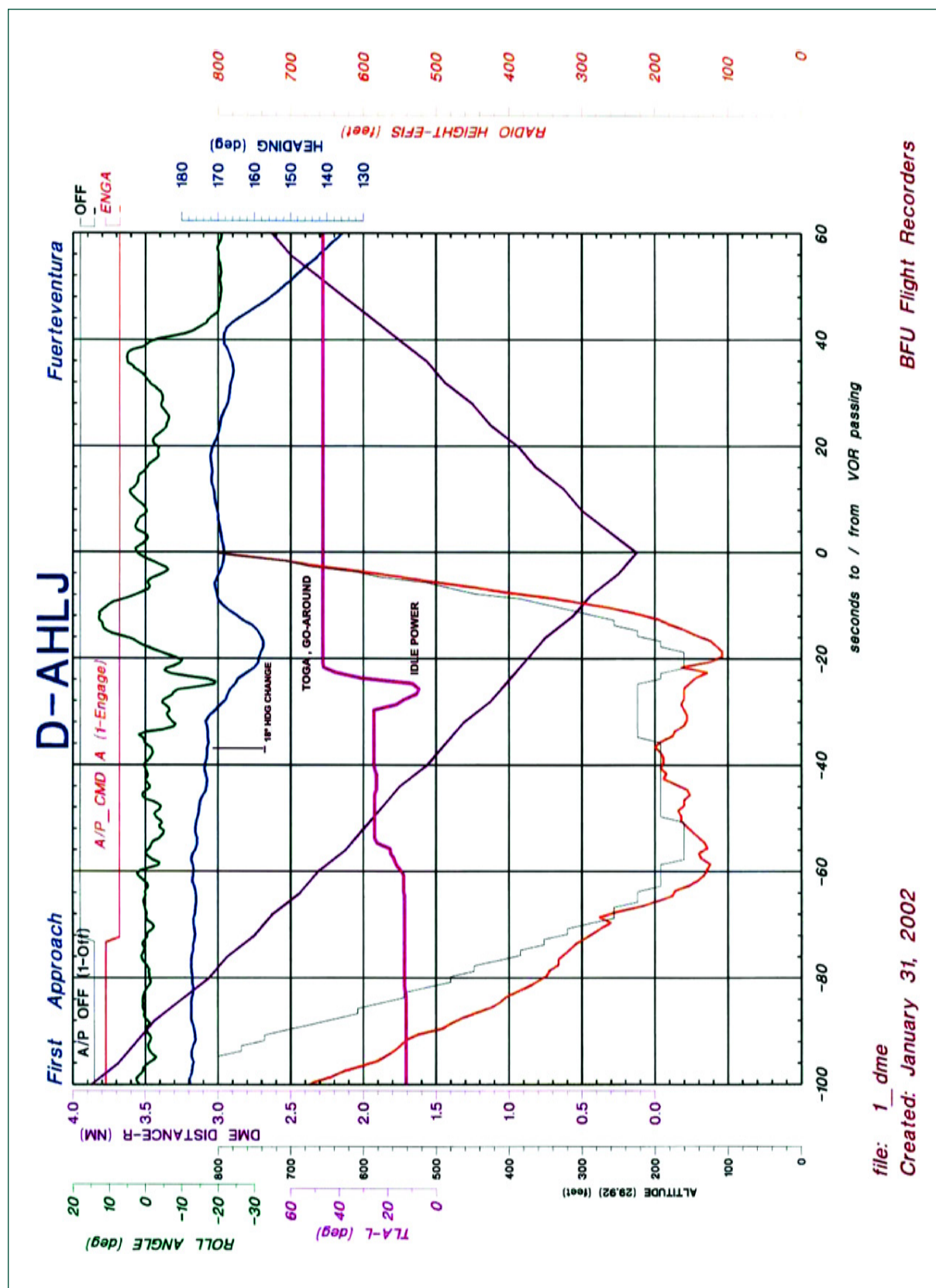
ANNEX A

VOR-DME approach chart to Fuerteventura Airport

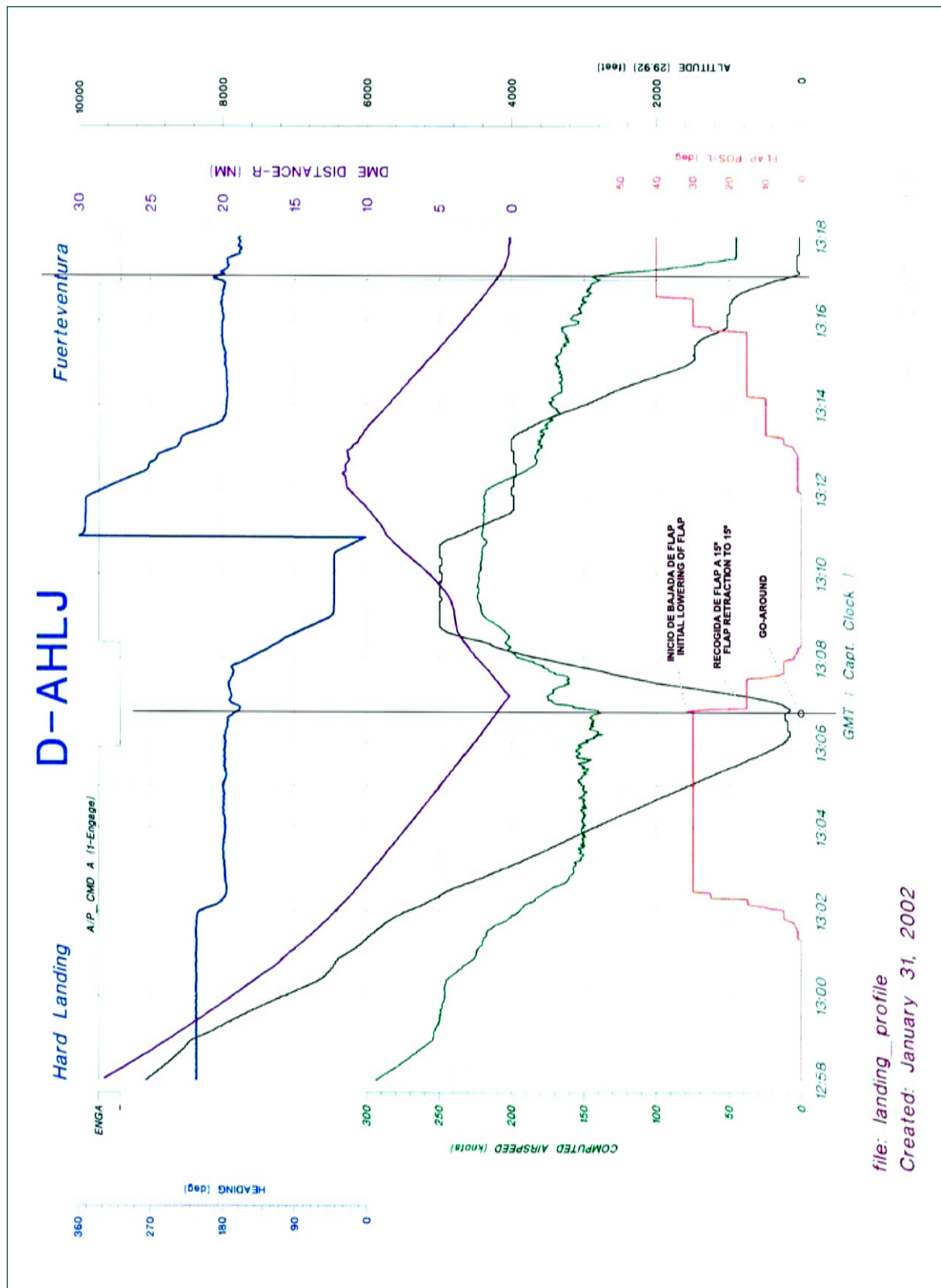


ANNEX B

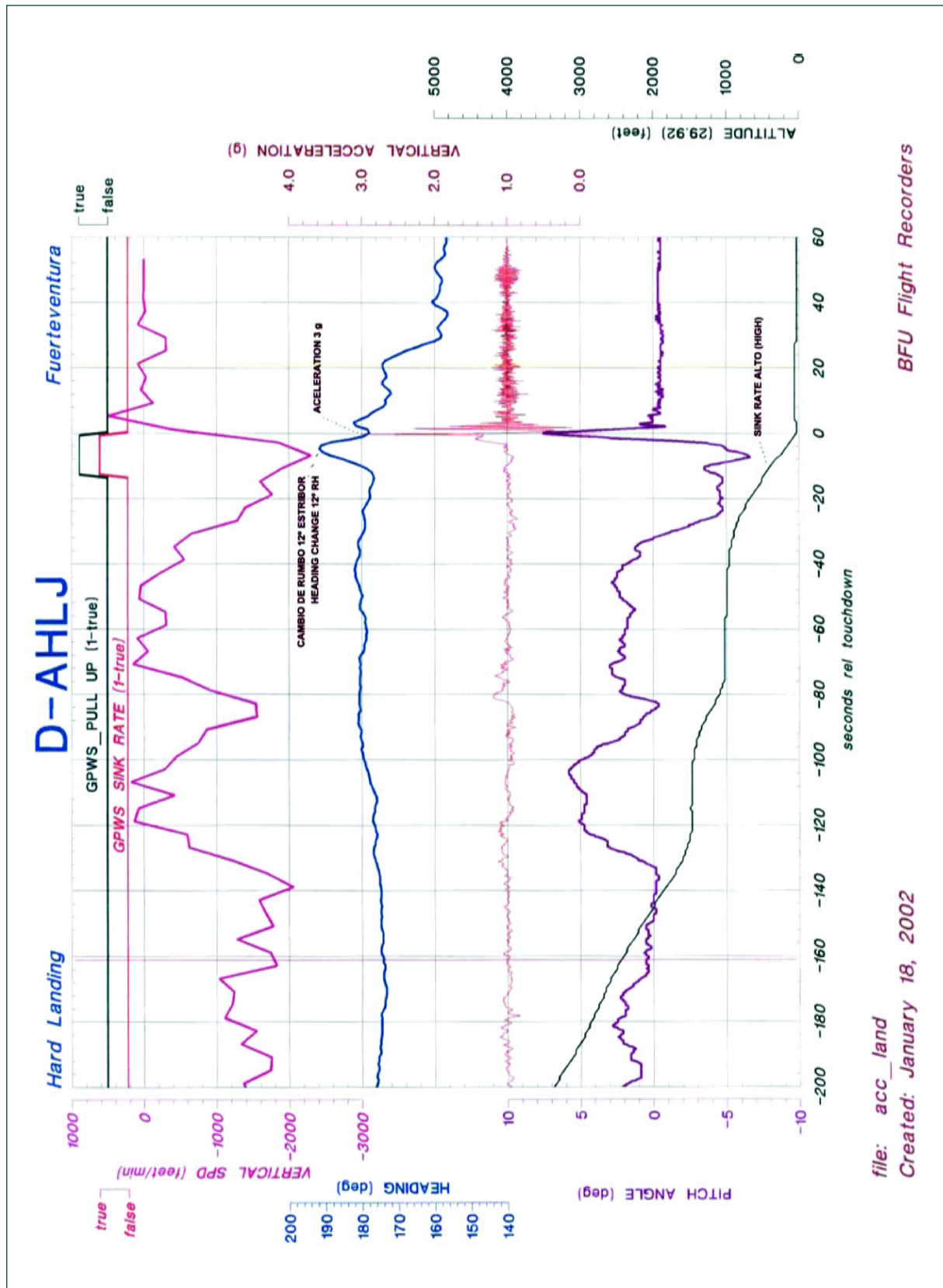
Graphics from Digital Flight Data Recorder



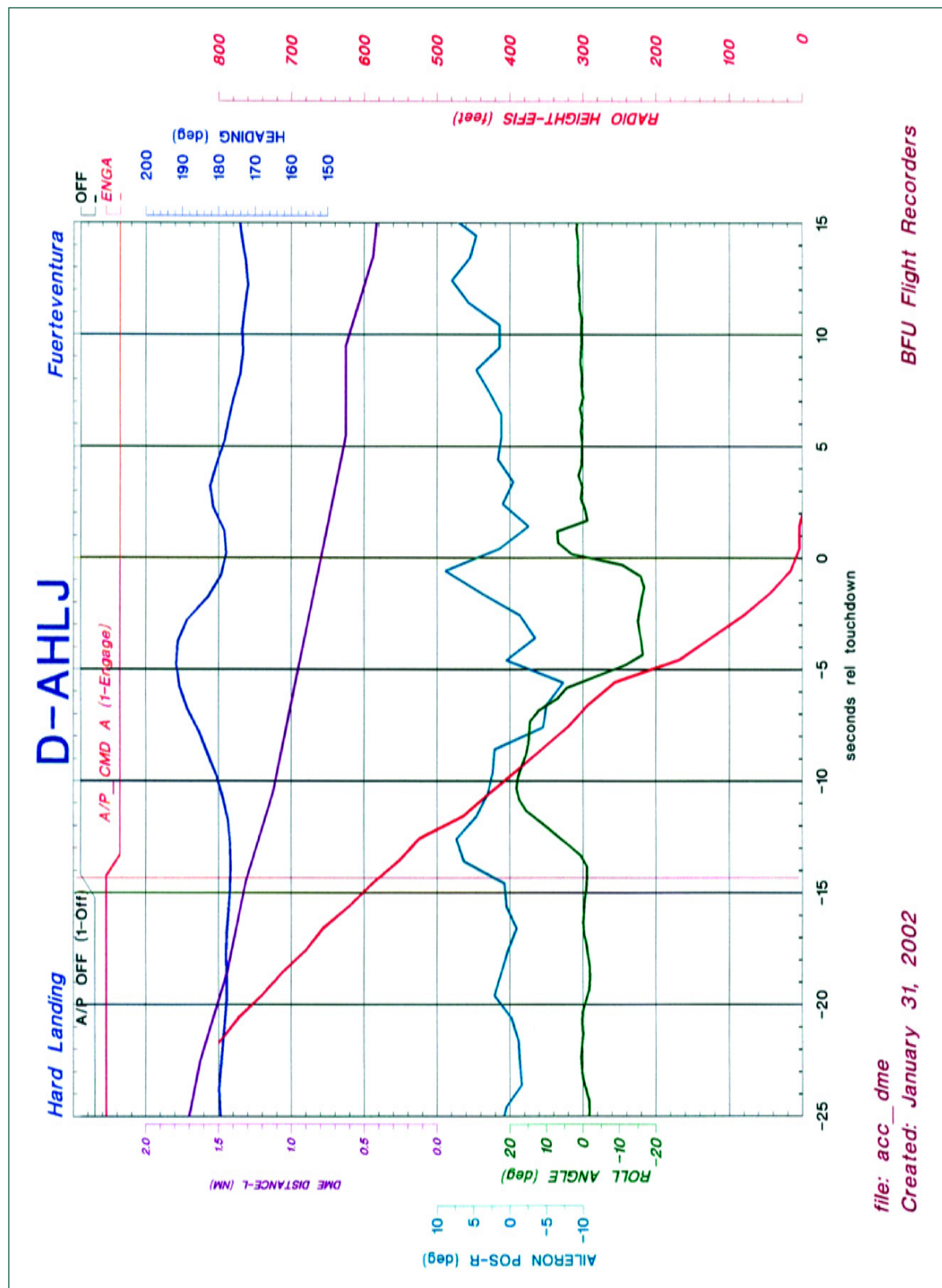
Annex B-1. Distance to/from VOR-DME. ALT, RH, Power, Heading and Roll angle



Annex B-2. CAS, HDG, Flaps and ALT during first approach, and second approach and landing



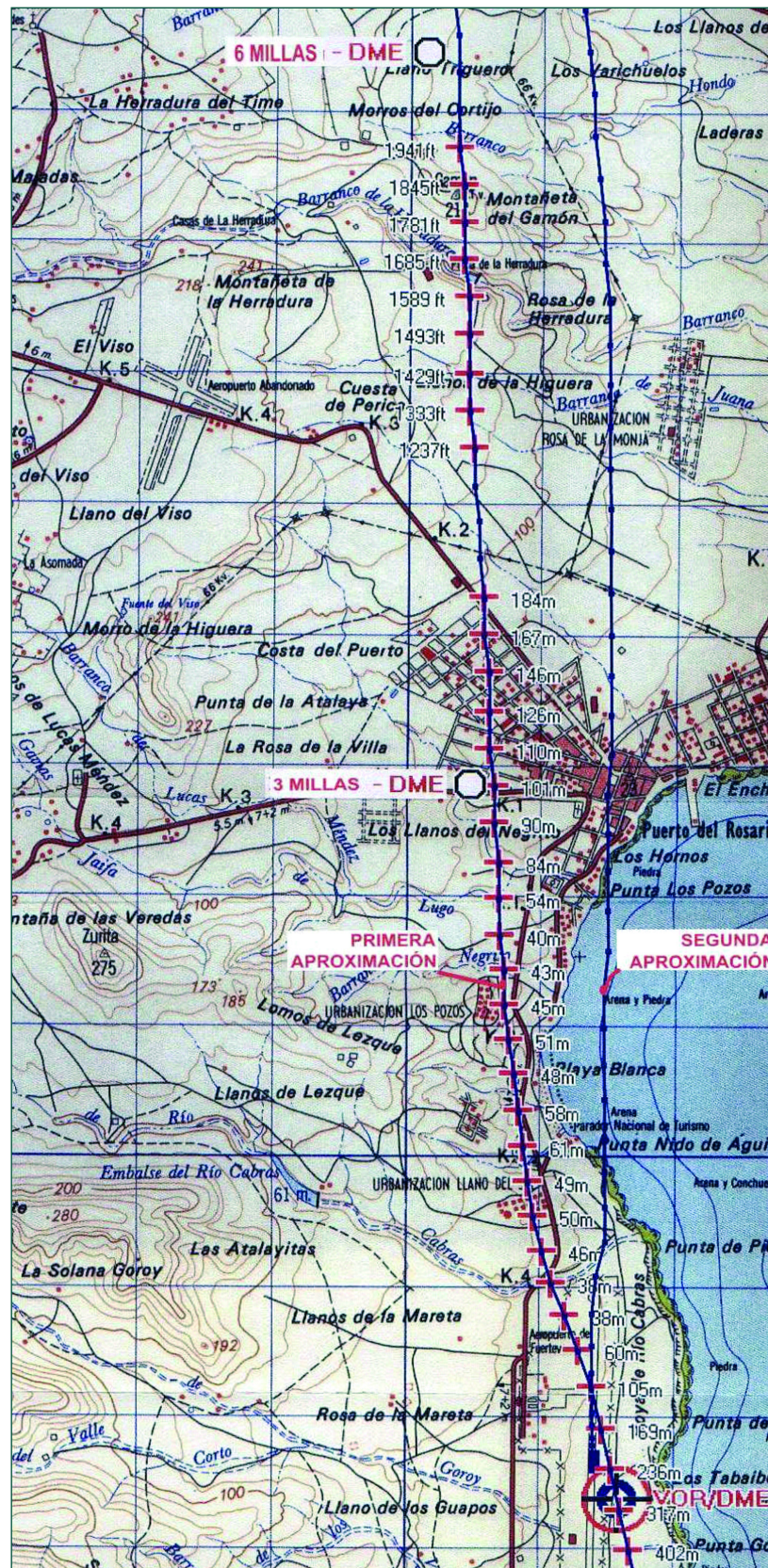
Annex B-3. Second approach and landing



Annex B-4. Last seconds before touching down

ANNEX C

Approach path followed in the two approaches



Map showing the trajectories of both approaches. One-kilometre grid