MINISTERE DE L'EQUIPEMENT,
DES TRANSPORTS ET DU DESENCLAVEMENT

SECRETARIAT GENERAL

COMMISSION D'ENQUETE SUR LES
ACCIDENTS ET INCIDENTS
D'AVIATION CIVILE

REPUBLIQUE DU MALI
UN PEUPLE – UN BUT – UNE FOI

INTERIM REPORT

Accident
on 24 July 2014
in the region of Gossi in Mali
to the MD-83 registered EC-LTV
operated by Swiftair S.A.

Approved on 20 September 2014

N'Faly CISSE

FOREWORD

The objective of Safety Investigations into civil aviation accidents and incidents is to establish the facts, the conditions and the circumstances of the accident or incident, in order to determine the probable causes, in order that appropriate steps can be taken to prevent any further accident or incident of a similar type, and the factors that caused it.

In accordance with Annex 13 to the Convention on International Civil Aviation, the investigation is intended neither to apportion blame, nor to assess individual or collective responsibility. The sole objective is to draw lessons from this occurrence which may help to prevent future accidents or incidents.

This interim report has been prepared on the basis of the initial information gathered during the investigation, without any analysis. Some of the points covered may evolve with time. Nothing in the presentation of this interim report or in the points that are raised herein should be interpreted as an indication on the orientation or indeed the conclusions of the investigation.

Special Foreword to English Edition

This report has been translated to make its reading easier for English-speaking people. As accurate as the translation may be, the original text in French is the work of reference.

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GLOSSARY

AAIB	Air Accident Investigation Board (United Kingdom)
AOC	Air Operator's Certificate
AP	Autopilot
CCR	Centre de Contrôle en Route (Air route traffic control centre)
CIAIAC	Comisión de Investigación de Accidentes e Incidentes de Aviación Civil (Civil aviation accident and incident investigation commission) (Spain)
CSMU	Crash Survivable Memory Unit
CVR	Cockpit Voice Recorder
DFGC	Digital Flight Guidance Computer
EPR	Engine Pressure Ratio
FAA	Federal Aviation Administration (USA)
FCOM	Flight Crew Operations Manual
FD	Flight Director
FDR	Flight Data Recorder
FGCP	Flight Guidance Control Panel
FL	Flight Level
FMA	Flight Mode Annunciator
LMC	Last Minute Change
ND	Navigation Display
NTSB	National Transportation Safety Board (USA)
PFD	Primary Flight Display
SAT	Static Air Temperature
STC	Supplemental Type Certificate
TAT	True Air Temperature
THS	Trimmable Horizontal Stabilizer
TRP	Thrust Rating Panel

SYNOPSIS

Aircraft	MD-83[1] registered EC-LTV
Date and time	24 July 2014 at 1 h 47[2]
Operator	Swiftair S.A.
Place of accident	80 km northwest of Gossi, Mali
Type of flight	International public transport of passengers Scheduled flight AH5017 Ouagadougou (Burkina Faso) – Algiers (Algeria)
Persons on board	Captain; copilot; 4 cabin crew; 110 passengers
Consequences and damage	116 fatalities; aircraft destroyed

The aeroplane took off at night from Ouagadougou airport at about 1 h 15 bound for Algiers. During the climb, the crew made several heading changes to avoid a stormy area before reaching cruise level at FL 310. A few minutes later, the aeroplane's speed decreased, it lost altitude, then dropped suddenly in a turn to the left. It struck the ground at high speed.

[1] Although the official designation is McDonnell Douglas DC-9-83, the abbreviation MD-83 will be used in this report to make it simpler.

[2] Except where otherwise indicated, the times given in this report are expressed in Universal Time Coordinated (UTC), which was also the official time in Mali on the day of the accident.

ORGANISATION OF THE INVESTIGATION

On Thursday 24 July 2014, with no news from flight AH5017 since 1 h 44, the Niamey CCR broadcast an ALERFA message at 3 h 30 then a DETRESFA message at 4 h 38 to all the centres concerned by flight AH5017's planned route. Aerial search aircraft located the wreckage of the aeroplane at around 23 h 50 on 24 July 2014.

Crisis centres were immediately set up in Algeria, Burkina Faso, Spain, France and Mali. The high authorities of several of these states travelled to Gao or to the accident site with the assistance of the French armed forces or of the MINUSMA, present in the region. Of note were:

- The visit of His Excellency Ibrahim Boubacar KEITA, President of the Republic of Mali;
- The visit of His Excellency Blaise COMPAORE, President of Burkina Faso;
- The joint visit of the Minister of Transport of Algeria, the Minister of Infrastructure, Transport and Development of Mali and the Minister of the Interior and Security of Mali;
- The visit of the Minister of Infrastructure, Transport and Development of Burkina Faso.

In accordance with Annex 13 to the Convention on International Civil Aviation, a Safety Investigation was initiated by Mali, the State of Occurrence, which set up a Commission of Inquiry which associated:

- An accredited representative from the NTSB (United States), the aeroplane being of American design and manufacture and with American engines. This made it possible to benefit from the assistance of technical advisors from Boeing and Pratt & Whitney;
- An accredited representative from CIAIAC (Spain), the aeroplane being registered in Spain and operated by a Spanish airline;
- An accredited representative from Algeria;
- An accredited representative from Burkina Faso;
- An accredited representative from Lebanon;
- An expert from the AAIB (United Kingdom), in accordance with article 5.27 of Annex 13;
- An accredited representative from the BEA (France), which the President of the Commission asked to provide technical assistance.

The President of the Malian Commission of Inquiry sent four field investigators to the accident site. In addition, investigators from the Spain and France, under the protection of the French military authorities, arrived at the accident site on the morning of 26 July.

The geopolitical context made it impossible for the other accredited representatives to go there. The mission to the accident site involved the recovery of the two flight recorders, examination of the wreckage, as well as of the accident site.

In the days following the accident, the recorders were transferred by the Malian authorities to the BEA to be read out and analysed in France. This work was undertaken in the presence of the NTSB accredited representative and an investigator from the CIAIAC.

Following this work, a first meeting of the Commission was held with the accredited representatives of Algeria, the USA and Burkina Faso present. The President of the Malian Commission of Inquiry formed three working groups in the following areas: *Aircraft, Operations and Systems*. Investigators from various countries participate actively in the work of these groups. They met several times at the BEA headquarters. The President decided on the publication of an interim report for mid-September 2014.

1 - FACTUAL INFORMATION

1.1 History of flight

Note: the following elements are based on data recorded on the FDR, radio communications and witness statements.

On 24 July 2014, the MD-83 registered EC-LTV was programmed to operate scheduled flight AH 5017 from Ouagadougou and bound for Algiers. One hundred and ten passengers and six crew members were on board.

The flight plan filed planned a departure via Niamey (NY), then ROFER via route UM608.

At 1 h 02 min 20, the crew was cleared to start up for a departure from active runway 22.

At 1 h 10 min 14, the crew was cleared to taxi to runway 22 and said that they wanted flight level FL 330 for cruise, then changed their minds and requested FL 310 initially, because the aeroplane's weight was too high for FL 330.

At 1 h 13 min 05, the controller cleared the crew to perform the departure via EPEPO, towards FL 310, with a turn to the right after takeoff. The controller had prepared for a departure of this flight via GAO through the EPEPO point, through which the aeroplane had passed at the time of its arrival at Ouagadougou from Algiers. The crew read back GUPOV (25 NM west of Ouagadougou) instead of EPEPO. The controller corrected the error. The crew read back correctly.

At 1 h 15 min the crew took off, then turned to the right and took a 023° heading. At an altitude of about 10,500 ft, autopilot 1 was engaged, the autothrottle having been active since takeoff.

Nine minutes after takeoff, the crew said that they were passing through FL 145 and that they estimated EPEPO point at 01 h 38, and Algiers at 05 h 06.

At 1 h 28 min 09, the aeroplane was transferred to the Ouagadougou CCR and the crew said that they were turning to the left on heading 356° due to an avoidance manoeuvre[3].

During the climb towards FL 310, the crew made three heading alterations to the left (of 28°, of 4° then of 8°), then an alteration to the right of 36° to return to heading 019°, close to the initial heading.

At 1 h 37 min 28, the aeroplane levelled off at FL 310 at Mach 0.740. The autopilot then maintained the aeroplane's altitude and heading, while the speed was controlled by the autothrottle. At the same time, the aeroplane was transferred to the Niamey CCR.

In the two minutes following level-off, the aeroplane's speed increased.

From 1 h 38 min 34, and for about 30 seconds, the autothrottle was in MACH ATL[4] mode. The engines' EPR[5] stabilised around 1.92 and the Mach changed from 0.758 to 0.762. The autothrottle then returned to MACH mode and the aeroplane continued to accelerate up to Mach 0.775.

[3] The precise message from the pilot was as follows: *« we are turning left heading 356 to avoid »*.
[4] MACH ATL: see paragraph 1.6.4.3 for a system description.
[5] Ratio between pressure at the engine outlet and that at the inlet.

At 1 h 39 min 36, the aeroplane's speed started to decrease. About one minute later the autothrottle changed back to MACH ATL while the Mach was 0.752. Following that, the altitude remained stable, pitch and EPR increased progressively, while the engines' N1[6] remained stable and the speed continued to decrease.

Between 1 h 41 min 38 and 1 h 44 min 29, the Niamey CCR and flight AH5017 tried to get in contact, but did not manage to do so. Flight RAM543K offered to act as the intermediary. The crew of flight AH5017 said, at 1 h 44 min 29, that they were at FL 310 on an avoidance manoeuvre. The Niamey CCR heard this radio exchange and then gave them the 3235 transponder code. He also asked them to call back passing GAO and to transmit estimates for MOKAT point.

No answer, nor any other messages from flight AH5017, reached the Niamey CCR.

At 1 h 44, EPR and N1 fluctuations on both engines appeared for about 45 seconds. Then, for about 25 seconds, the EPR decreased then increased again on two occasions from 1.6 to about 2.5. The N1s varied between 70% and 91%. Some roll oscillations between 4° to the left and to the right appeared. The autothrottle disengaged between 1 h 45 min 02 and 1 h 45 min 06[7]. This disengagement occurred between the first and second EPR variations.

At 1 h 45 min 06, the calibrated airspeed was 203 kt, the Mach 0.561 and the aeroplane started to descend. Pitch increased until it reached 10° at 1 h 45 min 17, then decreased slightly while the deflection of the elevators and the position of the trimmable horizontal stabiliser continued pitching up. The EPR and the engines' RPM started to decrease towards values corresponding to idle. The roll oscillations continued and the speed continued to decrease.

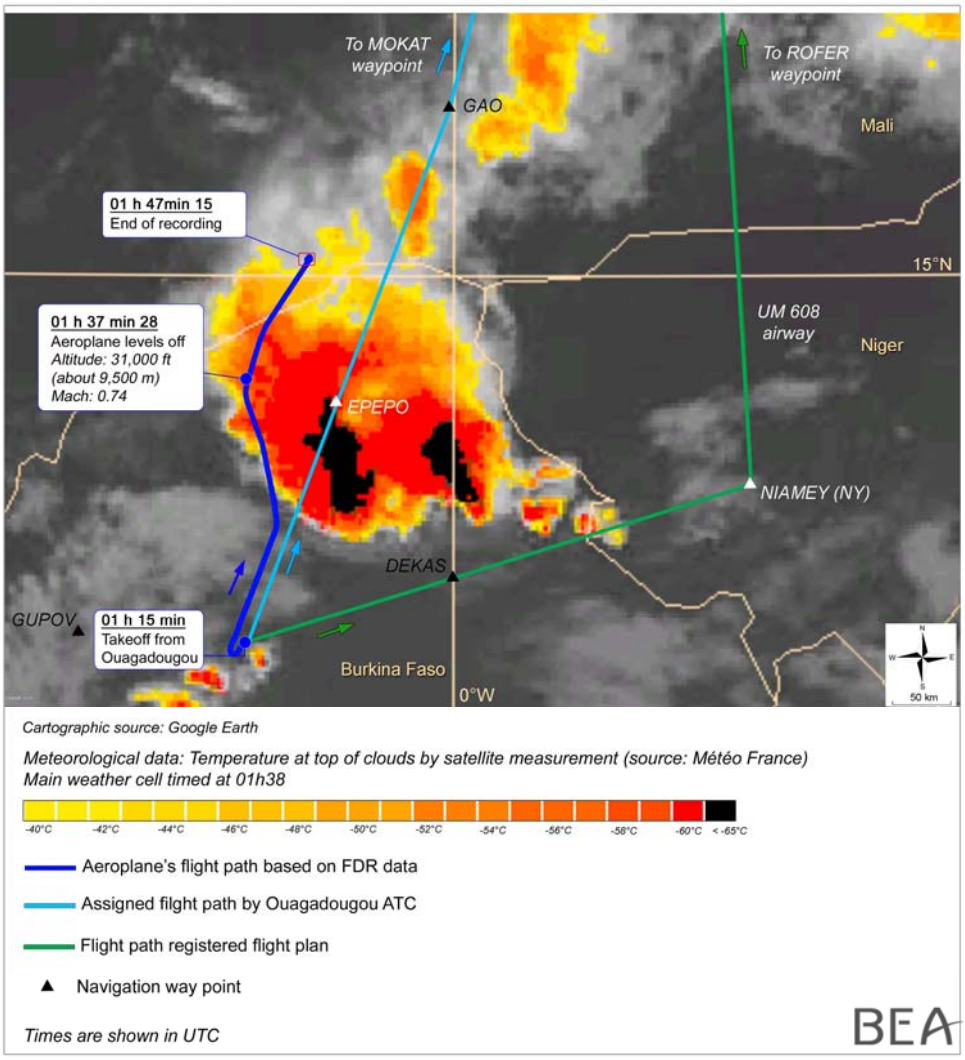
At 1 h 45 min 35, the autopilot disengaged. The altitude decreased by about 1,150 ft in relation to the flight level, the calibrated airspeed was 162 kt, the Mach 0.439 and both engines were almost at idle. The aeroplane's pitch began to decrease and the bank was increasing to the left.

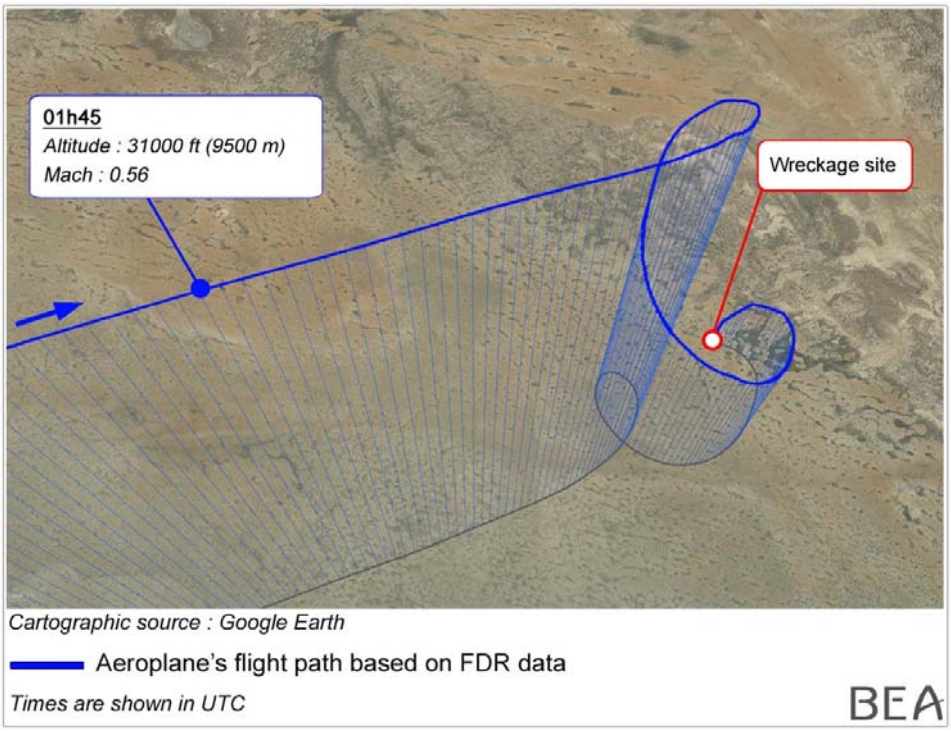
The aeroplane's pitch and bank were then subject to significant changes. They reached, respectively, 80° nose-down and 140° bank to the left. The aeroplane was pitched nose-down and banked to the left until it struck the ground. The heading decreased continuously and the flight control surfaces remained mainly deflected pitch-up and in the direction of a bank to the right. Around twenty seconds before the impact, the engine speed and EPR increased again and reached values close to maximum thrust.

The last values were recorded at 1 h 47 min 15:

- Pressure altitude: 1,601 ft, (in relation to the 1013 hPa isobar)
- Calibrated airspeed: 384 kt
- Pitch: 58° nose-down
- Bank: 10° to the left
- Magnetic heading: 099°

[6] The N1 parameter represents the rotation speed of the engine low pressure compressor, expressed as a percentage of a reference speed.
[7] Autothrottle modes are only recorded every 4 seconds.





Final trajectory

1.2 Injuries to Persons

	Injuries		
	Fatal	**Serious**	**Slight/none**
Crew members	6	-	-
Passengers	110	-	-
Other persons	-	-	-

1.3 Damage to Aircraft

The aeroplane was destroyed.

1.4 Other Damage

Not applicable.

1.5 Personnel Information

1.5.1 Flight Crew

The data below is extracted from documents provided by Swiftair S.A. The number of flying hours only reflects the activity of the captain and of the co-pilot on which Swiftair S.A. had information. This data will thus be subject to further checks and investigation in the context of the investigation under way.

1.5.1.1 Captain

Male, 47 years old

- ATPL(A) license issued on 17 March 2000 by the Spanish civil aviation authority, valid until 30 April 2015
- CPL (A) license issued on 15 December 1989
- PPL (A) license issued on 24 November 1986
- DC9/MD-80 type rating valid until 30 April 2015
- TRI qualification for DC9/MD-80 valid until 23 January 2015
- TRE qualification for DC9/MD-80 valid until 4 October 2015
- Class 1 medical certificate valid until 20 September 2014

Experience

- Total: 14,268 flying hours, of which 9,969 as captain
- On type: 10,013 flying hours, of which 6,161 as captain
- Since the start of operations with Air Algérie on 20 June 2014, the captain had carried out 45 flights and 100 flying hours, including:
  - One flight from Algiers to Ouagadougou on 21 July
  - One flight from Ouagadougou to Algiers on 22 July
  - One flight from Algiers to Ouagadougou on 23 July

Aviation career history

- From 1994 to 1996: co-pilot on MD-80s for Centennial (CNA)
- From 1997 to 2012: co-pilot then captain on MD-80s for Spanair
- Joined Swiftair S.A. on 15 June 2012 as captain on MD-80s

Flying experience in Africa

Between 1997 and 2012, the captain flew, as co-pilot then as captain for Spanair, to various airports in Africa, including Ouagadougou. From 12 July 2012 to 1st October 2013, he carried out 456 flying hours for the UN as captain on MD-80.

1.5.1.2 Co-pilot

Female, 42 years old

- ATPL(A) license issued on 10 May 2002 by the Spanish civil aviation authority, valid until 31 May 2015
- CPL (A) license issued on 16 June 1993
- PPL (A) license issued on 19 June 1992
- DC9/MD-80 type rating valid until 31 May 2015
- Airbus A320 type rating valid until 31 March 2015
- Class 1 medical certificate valid until 16 July 2015.

Experience

- Total: 6,900 flying hours as co-pilot
- On type: 6,064 flying hours as co-pilot
- Since the start of operations with Air Algérie on 20 June 2014, the co-pilot had carried out 43 flights and 93 flying hours, including:
  - One flight from Algiers to Ouagadougou on 21 July
  - One flight from Ouagadougou to Algiers on 22 July
  - One flight from Algiers to Ouagadougou on 23 July

Aviation career history

- From 1995 to 1998: flight dispatcher for Spanair
- From 1998 to 2012: co-pilot on MD-80s for Spanair
- Joined Swiftair S.A. on 1st June 2013 as co-pilot on MD 80

Flying experience in Africa

Between 1998 and 2012, she flew, as co-pilot for Spanair, to various airports in Africa, including Ouagadougou.

1.5.2 Cabin crew

The four members of the cabin crew all had valid licenses, qualifications and medical certificates.

1.5.3 Rotations of Swiftair S.A. crews in the context of lease operations

Three crews were assembled in Algiers for as long as the flights were chartered by Air Algérie. A relief crew was available in Madrid if needed.

Since the beginning of the charter arrangement, the captain and the co-pilot had carried out almost all of their flights together (43 flights out of 45 for the captain, and all 43 flights for the co-pilot).

1.6 Aircraft Information

The first Boeing MD-80, certified by the FAA in August 1980, entered service in October 1980. Five different models were developed: the MD-81, MD-82, MD-83, MD-87 and MD88. It was manufactured in Long Beach by the Boeing commercial aircraft division until December 1999.

1.6.1 Airframe

1.6.1.1 Characteristics (data supplied by Swiftair S.A.)

Manufacturer	McDonnell Douglas (Boeing)
Type	MD-83
Serial number	53190
Year of manufacture	1996
Registration	EC-LTV
Certificate of registration (expiry date)	25 October 2015
Airworthiness Review Certificate (expiry date)	27 December 2014
Owner	Balcargo, S.L.
Operator	Swiftair S.A.
Charterer	Air Algérie
Maximum Operational Passenger Seating Configuration (MOPSC)	172
Passenger seat configuration	165, single class
Operating Empty Weight (OEW)	85,198.74 lb (38,645 kg)
Maximum Zero Fuel Weight (MZFW)	122,000 lb (55,338 kg)
Maximum Landing Weight (MLW)	139,500 lb (63,276 kg)
Maximum Take-Off Weight (MTOW)	160,000 lb (72,574 kg)
Total aircraft flying time[8]	38,362 hrs and 55 min
Total aircraft flight cycles	32,390
Last maintenance check	19 June 2014 (1A Check)
Last maintenance servicing	23 July 2014
Last weighing	7 October 2012

[8] Before the accident flight.

1.6.1.2 History of ownership

Date	Operator	Owner	Registration	Notes
1989	AWAS	AWAS	SU-ZCA	Aeroplane ordered
23/08/1996	Heliopolis	AWAS		Delivered to Heliopolis Airlines Merger with Flash Group (Flash Airlines)
09/12/1997	AWAS	*Not known at this stage of the investigation*	N190AN	End of charter Stored
10/02/1998	Avianca		HK-4137X	Charter
17/08/2000			N190AN	Change of registration
02/12/2006	AWAS			End of charter Stored
02/12/2006		AWMS I	N190AN	Purchase
16/01/2007	Austral		LV-BHN	Charter
15/05/2008				Stored
13/07/2008				Ferry flight Stored
28/08/2008				Return to service
01/02/2012				Stored
30/03/2012	AWAS		N190AN	Stored
08/04/2012				Ferry flight Stored
07/08/2012				Ferry flight Stored
25/10/2012	Swiftair S.A.	Balcargo, SL	EC-LTV	Purchase and charter
04/12/2012				Ferry flight Stored
01/01/2013				Ferry flight Stored
27/02/2013				Issue of registration certificate
20/06/2014				Charter (ACMI[9])

[9] Aircraft complete crew maintenance and insurance.

1.6.2 Engines

The aeroplane was equipped with two Pratt & Whitney JT8D-219 engines. They are dual-flux engines with an average by-pass ratio. The first engine in the D-200 series was certified on 22 June 1979. The JT8D-219 was certified on 22 February 1985.

	Engine #1	**Engine #2**
Manufacturer	Pratt & Whitney	Pratt & Whitney
Model	JT8D-219	JT8D-219
Serial number	708184	728104
Total time	44,779 hrs 04 min	26,161 hrs 55 min
Total cycles	27,728	22,012
Time since last check	183 hrs 55 min	3,956 hrs 55 min
Cycles since last check	100	2,043
Last overhaul	20 March 2013	7 May 2010

Characteristics of engines

1.6.3 Weight and balance

The aeroplane left the stand with a weight of 151,697 lb (68,808 kg) calculated by the crew. The weight was distributed as follows:

- Operating Empty Weight of 86,924 lb (39,428 kg);
- passenger weight (99 adults and 12 children) of 19,239 lb (8,726 kg);
- hold weight (baggage[10]) of 6,034 lb (2,736 kg);
- fuel weight of 39,500 lb (17,916 kg).

The estimated taxiing fuel weight was 500 lb. The estimated takeoff weight was 151,197 lb (68,581 kg). The maximum authorised takeoff weight is 160,000 lb (72,574 kg).

A last-minute change (LMC) corrected the final weight to take into account the no-show of one passenger.

For this flight, the weight and balance determined by the crew of the aeroplane were within the limits defined by the manufacturer.

[10] There was no cargo on board the flight according to the load sheet.

1.6.4 Description of automatic systems

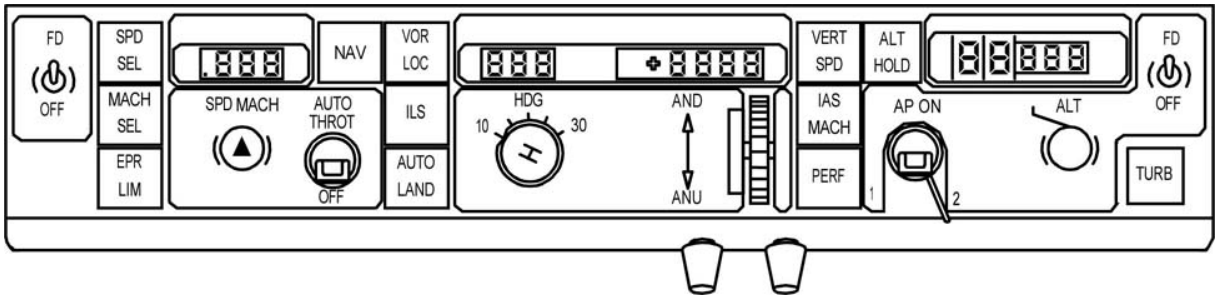
1.6.4.1 General

The MD-83 is equipped with two Digital Flight Guidance Computers (DFGC), which determine the data required for the following functions, among others:

- Flight Director (FD) calculations
- autopilot (AP)
- autothrottle
- thrust rating

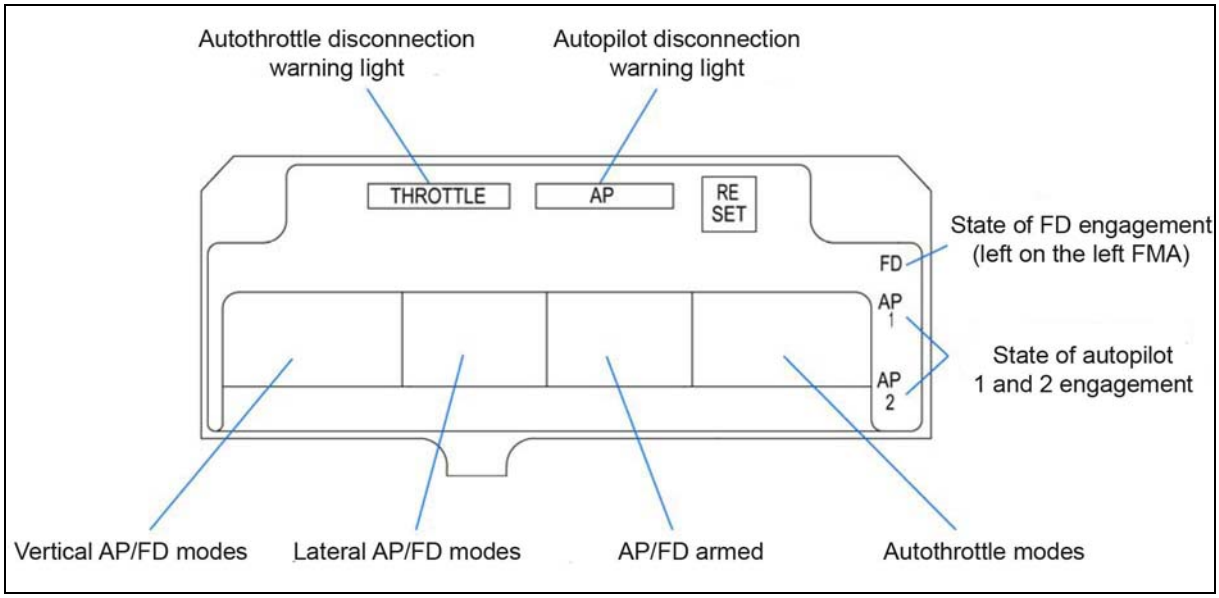
In normal operation, the DFGC1 determines the Flight Director (FD) commands displayed on the left PFD, and the DGFC2 determines the FD commands displayed on the right PFD. In order to display FD commands on a PFD, the corresponding *"FD"* switch, located on the Flight Guidance Control Panel (FGCP), must be set to *"FD"*. Active modes are then displayed on the corresponding Flight Mode Annunciator (FMA).

Photo of an MD-83 FGCP



Flight Guidance Control Panel (FGCP) (source Swiftair S.A. FCOM)

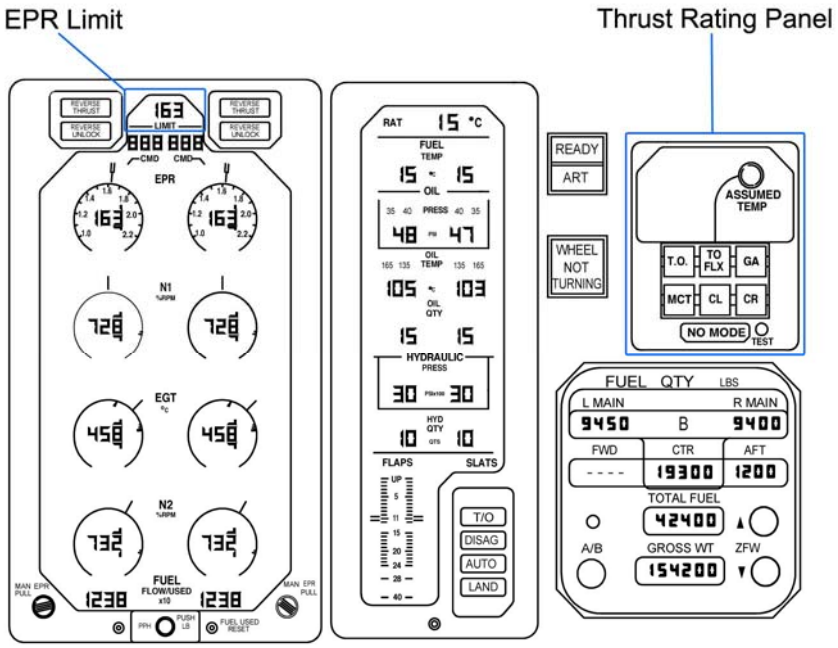
Photo of an FMA



Flight Mode Annunciator (FMA) (source Swiftair S.A. FCOM)

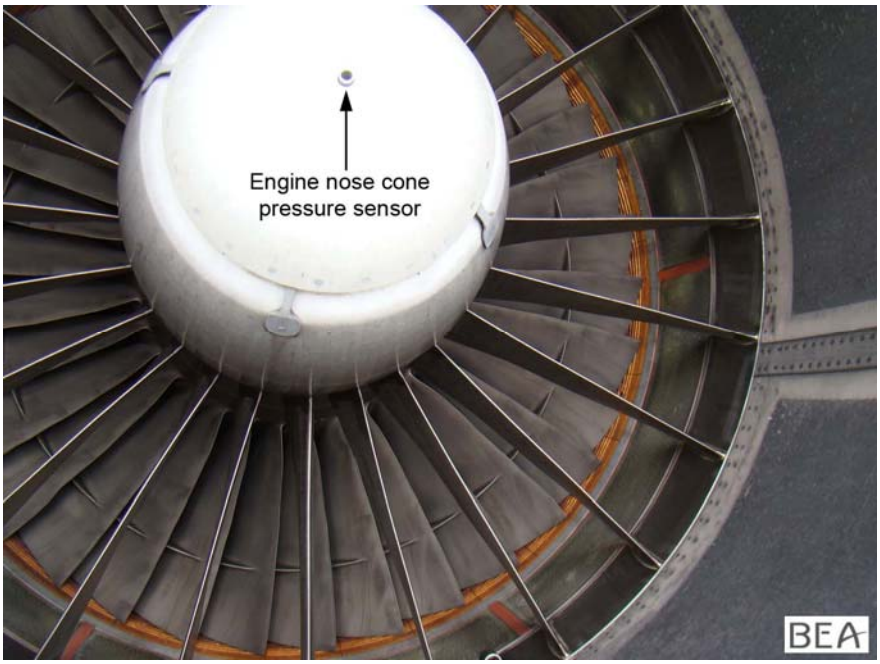
1.6.4.2 Engine Thrust Rating System

The Engine Thrust Rating System enables the crew to select a maximum level of EPR corresponding to a given phase of flight. This selection is made by the crew via the Thrust Rating Panel (TRP). The possible modes are TO (Take Off), TO FLX (Take Off Flex), GA (Go Around), MCT (Maximum Continuous Thrust), CL (Climb) and CR (Cruise). The DFGC then calculates the EPR limit value based on the total temperature, altitude, and engine bleed configurations. This value is displayed on the central panel and used by the autothrottle in relation to the active mode.



Part of the central panel relating to the engines (source Swiftair S.A. FCOM)

Note: the EPR is the ratio between the total pressure at the output of the engine, measured at the outlet of the low-pressure turbine, and the total pressure at the inlet of the engine measured at the engine nose cone.



Engine nose cone pressure sensor

The EPR is a measure of the thrust delivered by the engines. It is displayed for each engine on the central panel. The parameter is used on this type of aircraft to control thrust, either manually by the crew or automatically via the autothrottle.

1.6.4.3 Autothrottle

The autothrottle is engaged by setting the *"AUTO THROT"* switch on the FGCP to the AUTO THROT position. This control remains in the AUTO THROT position as long as the conditions for engaging the autothrottle are met. Otherwise, the switch automatically returns to the OFF position and the red THROTTLE light comes on the left and right FMA. Pressing the disconnect buttons of the autothrottle located on the thrust levers, or repositioning the AUTO THROT switch to the AUTO THROT position turns off the light.

Three main modes can be selected by the crew on the FGCP: SPD SEL, MACH SEL and EPR LIM. So-called *"secondary"* modes are activated automatically, including the MACH ATL mode. These modes are described briefly below.

SPD SEL and MACH SEL	The SPD SEL and MACH SEL modes can be engaged in every phase of flight except takeoff. When the autothrottle is in one of these modes, it maintains the speed or Mach selected by the crew and is displayed in the SPD MACH window of the FGCP unless the selected value is less than the *"Alpha Speed*[11]*"*. In that case, the autothrottle maintains this speed and the FMA indicates ALFA SPD.
EPR LIM	This mode is engaged by pressing the EPR LIM button on the FGCP either during takeoff or a go-around. In this case, the autothrottle maintains a thrust corresponding to the EPR limit value based on the EPR rating, selected by the crew on the Thrust Rating Panel (TRP). When the selected altitude is captured, the autothrottle automatically switches from EPR LIM mode to SPD SEL mode or MACH SEL mode, unless TO FLX or GA thrust has been selected on the TRP. The autothrottle then maintains the target speed or Mach displayed in the SPD MACH window of the FGCP.
MACH ATL	This mode automatically engages when the autothrottle is engaged in MACH mode and the engine thrust needed to achieve the Mach target displayed on the FGCP is greater than the thrust corresponding to the EPR limit value displayed on the central panel. The commanded thrust is then that corresponding to the EPR limit. As soon as this condition no longer applies, the autothrottle reverts to the mode that preceded the activation of the MACH ATL mode.

[11] Alpha speed is computed by the DFGC so as to maintain a margin in relation to the stall speed in the current configuration.

1.6.5 Airborne Weather Radar

The aeroplane was equipped with Collins airborne weather radar. The information from the radar is displayed on the Navigation Displays (ND) when they are in the ARC mode (this display mode gives an indication of distances and headings) or MAP mode (this display mode makes it possible to visualize the aeroplane in its environment as well as the route followed).

The display scale of the radar information ranges from 10 to 320 NM. The weather radar is designed to detect water in liquid form (rain or wet hail) by measuring the rate of precipitation. Depending on the detected rate of precipitation and the selected gain, echoes with different colours are displayed on the ND. Areas with a higher density of precipitation are shown in red, areas with an average density of precipitation in yellow and areas with the lowest density of precipitation are shown in green. When "WX - T" mode is selected on the radar control box, areas of turbulence are shown in magenta within a maximum radius of 50 NM.

The radar hardly detects water in solid form, such as ice crystals or dry snow.

Setting the tilt (tilting the radar beam up and down) determines the area crossed by the radar beam and therefore the echoes that are detected and displayed on the ND. By adjusting the gain, the radar can be adapted to the reflectivity of the precipitation encountered. Depending on the tilt setting, clouds situated in front of the aeroplane but not crossed by the beam are not visible on the radar.

1.7 Meteorological Information

1.7.1 General Situation

Between May and October, there is an inter-tropical front over Africa. This front is an area of conflict between the masses of dry air over the Sahara and the masses of moist air from the Atlantic. The contrast causes the development of thick convective clouds of the cumulonimbus type and heavy rainfall (monsoon rains).

Over West Africa, the monsoon is often associated with violent squall lines as well as vast cloud formations that extend over several degrees of latitude and longitude. These disturbances cross the continent from east to west at intervals of three to five days. This phenomenon is called the easterly wave. The activity of these waves is subject to diurnal variations. They develop between 12 h 00 and 18 h 00, are at a maximum at the start of the night, weakening between 3 h 00 and 9 h 00.

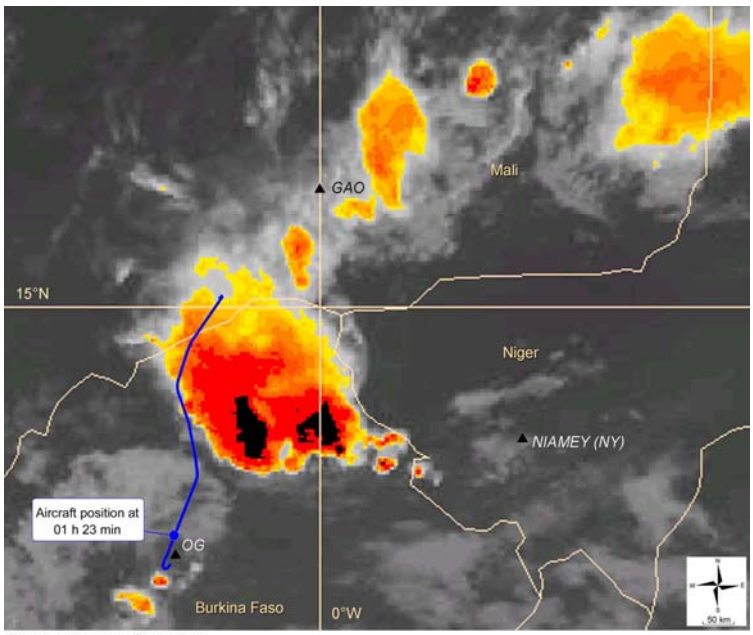
The size of the thermal contrasts and the amount of moisture generate storm cells whose horizontal dimension can be hundreds of kilometres and whose vertical development extends throughout the atmosphere, often exceeding 15,000 metres.

In the evening and night of 23 July 2014, the inter-tropical front was positioned over northern Mali.

1.7.2 Conditions encountered

Satellite observations of the night of July 23 to 24 showed a convection zone that grew from 20 h 00 over northern Burkina Faso as it moved to the southwest. On the following image, two black areas can be seen representing the two coldest zones which are therefore the highest and most dynamic. They culminate well above the level of FL 400. The highest number of lightning strikes occurs in these zones.

After takeoff from Ouagadougou, the crew changed heading. The aeroplane passed along the western edge of the convection zone. From 1 h 30 to 1 h 45 the aeroplane was flying in a saturated environment, probably in the cloud layer between 24,000ft and 31,000ft.



Cartographic source: Google Earth

Meteorological data: Temperature at top of clouds by satellite measurement (source: Météo France)
Main weather cell timed at 01h23

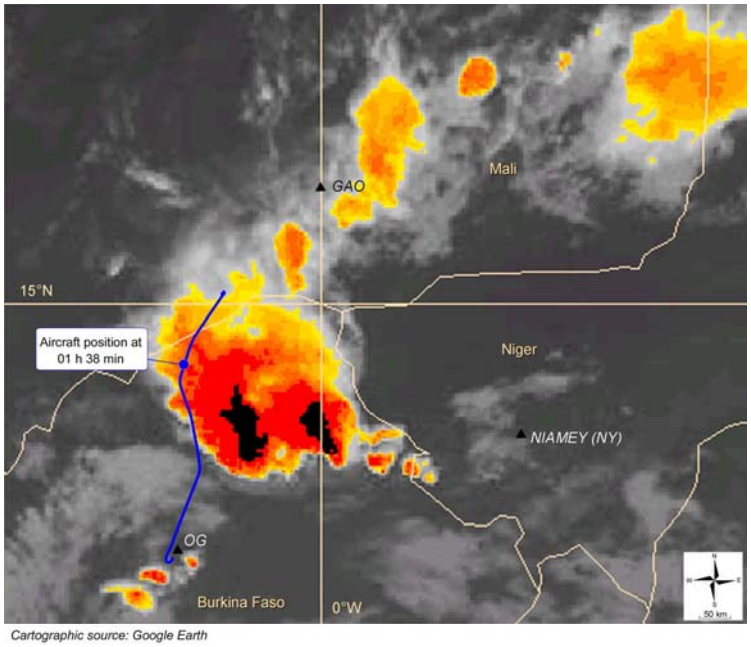
-40°C -42°C -44°C -46°C -48°C -50°C -52°C -54°C -56°C -58°C -60°C < -65°C

Aeroplane's flight path based on FDR data

▲ Navigation way point

Times are shown in UTC

BEA



Cartographic source: Google Earth

Meteorological data: Temperature at top of clouds by satellite measurement (source: Météo France)
Main weather cell timed at 01h38

-40°C -42°C -44°C -46°C -48°C -50°C -52°C -54°C -56°C -58°C -60°C < -65°C

Aeroplane's flight path based on FDR data

▲ Navigation way point

Times are shown in UTC

BEA

Infrared images and overlaid flight path

The FDR data analysis indicates that:

- the outside air temperatures encountered changed from -16°C à -32 °C during the climb;
- The aeroplane did not encounter any significant turbulence.

Outside air temperatures below -20°C are often considered not to be conducive to airframe icing, in particular for stratiform clouds. Icing conditions, however, have been observed at lower temperatures in dynamic convective clouds.

This type of zone can be particularly active and highly dynamic, creating risks of severe icing and/or severe turbulence.

1.8 Aids to Navigation

No malfunctions in the ground radio-navigation equipment involved in the departure procedures described in paragraph 1.10 were reported on the day of the event.

1.9 Communications

Flight AH 5017 was successively in radio contact with Ouagadougou tower and approach, grouped together on the 118.1 Mhz frequency, then the Ouagadougou CCR on the 120.3 Mhz frequency, and the Niamey CCR on the 131.3 Mhz frequency.

The transcript of the radio-telephone exchanges is in the appendices.

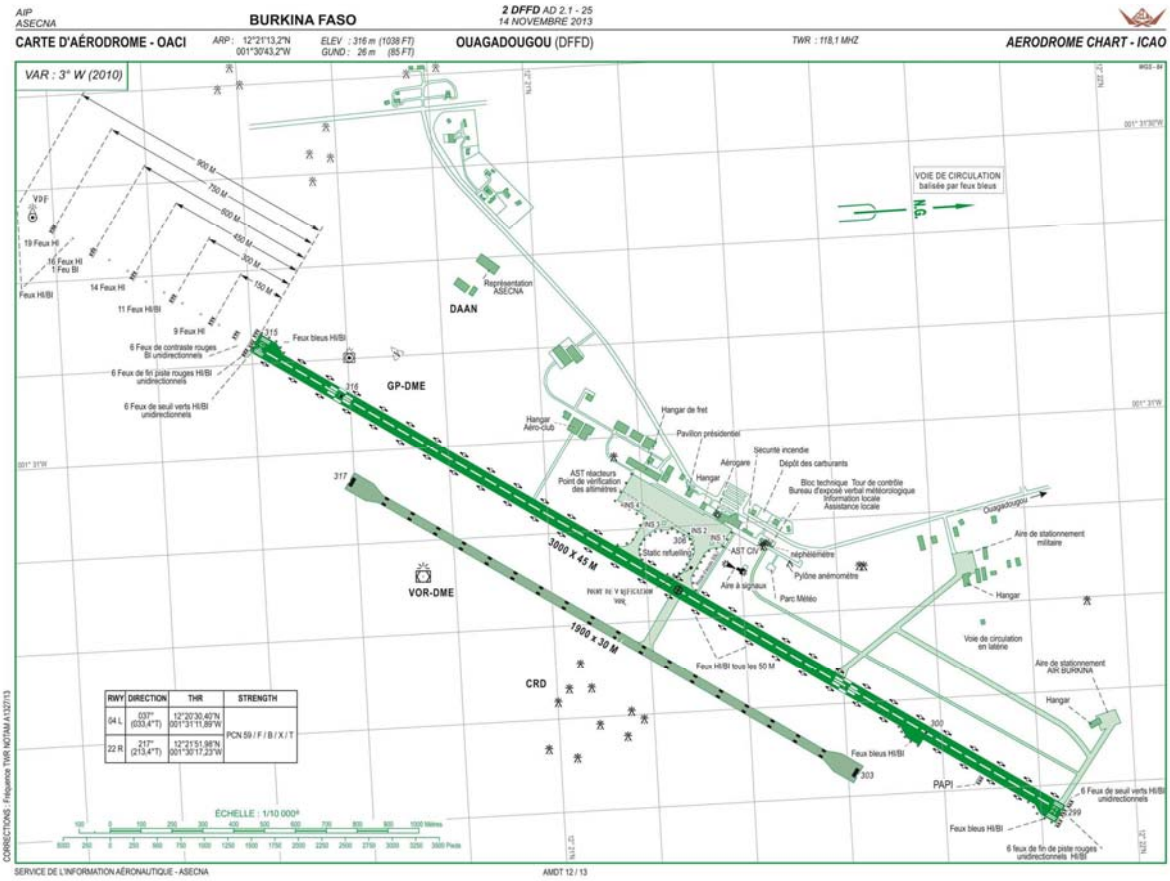
1.10 Aerodrome Information

1.10.1 Characteristics of Ouagadougou aerodrome

Ouagadougou aerodrome has two runways:

- A main runway 04L/22R made of tarmac, 3,000 m long and 45 m wide;
- A secondary runway 04R/22L, made of laterite, 1,900 m and 30 m wide.

The aerodrome's reference altitude is 316 m, that's to say 1,038 ft.



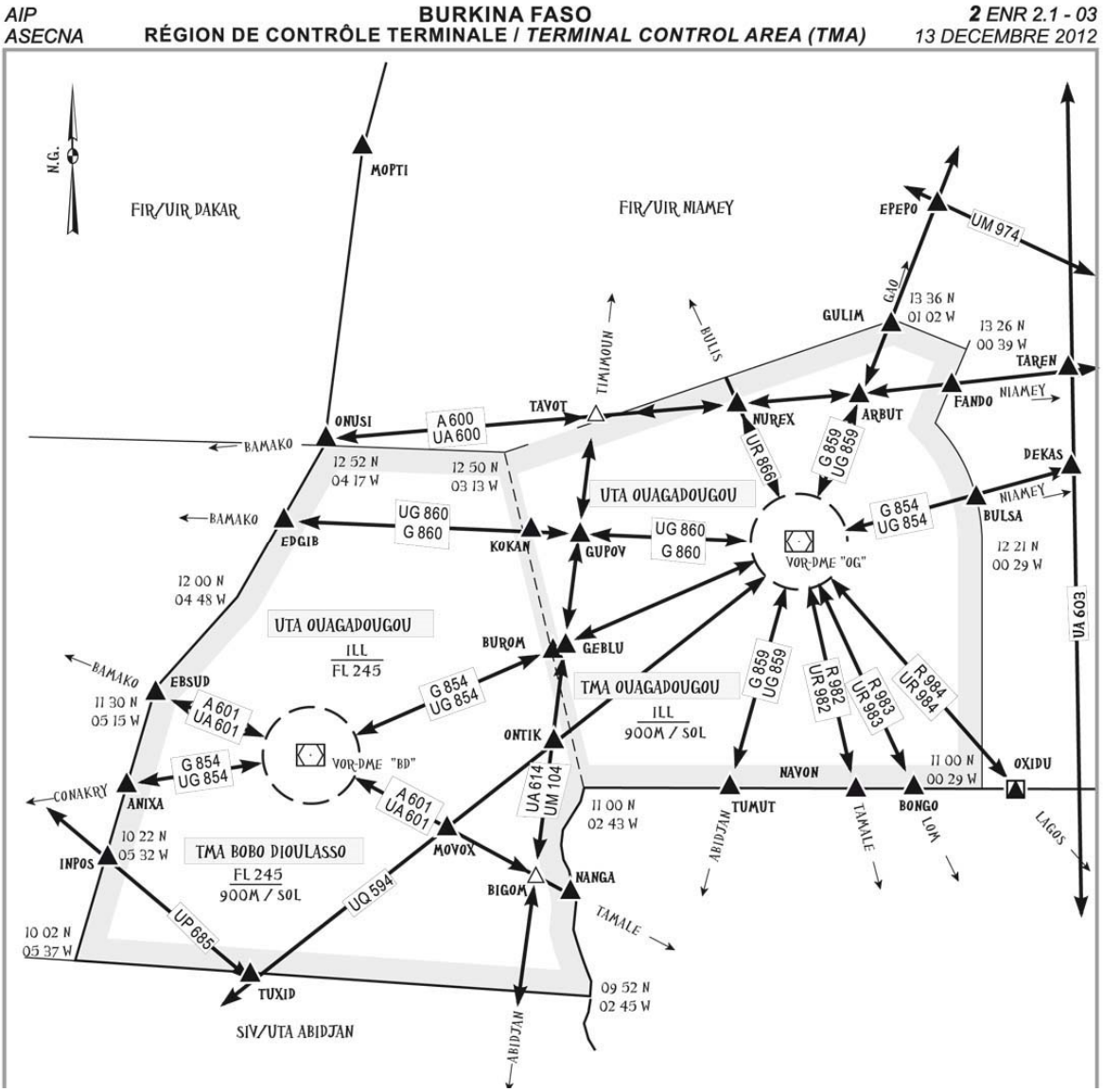
Ouagadougou aerodrome chart

On the day of the event, runway 22R was active.

1.10.2 Ouagadougou aerodrome departure procedures

IFR departures are omnidirectional. For IFR departures towards the north, two routes are possible:

- Route G 854 towards DEKAS then NIAMEY (NY);
- route G 859 towards EPEPO then GAO.



Aerial routes on departure and arrival at Ouagadougou

1.11 Flight Recorders

1.11.1 Opening and readout operations of the flight recorders

The two regulatory recorders were sent to the BEA by the judicial authorities of Mali and France on 28 July 2014.

FDR (on the left) and CVR (on the right)

Flight Data Recorder (FDR)

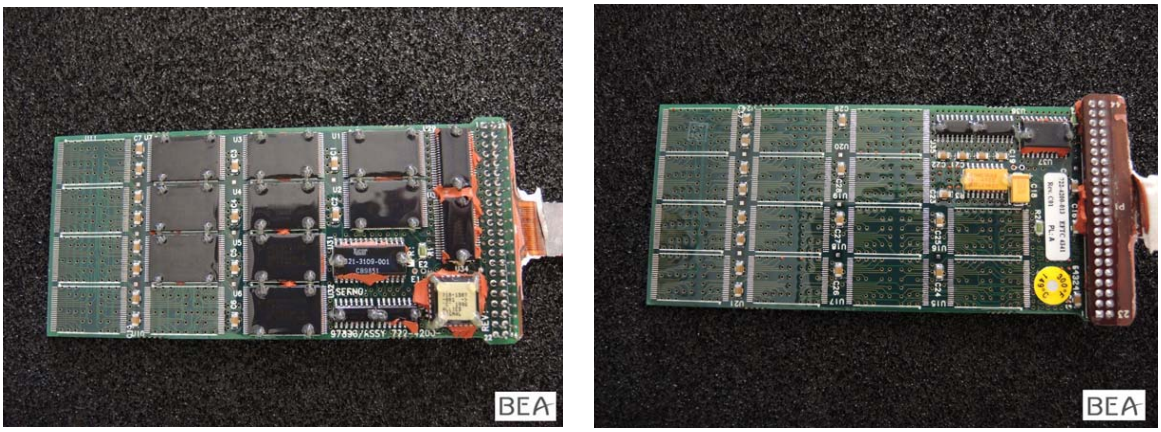
- Make: Honeywell
- Model: 4700
- Type number (P/N): 980-4700-003
- Serial number (S/N): 5139

Only the protected housing (CSMU) was sent to the BEA. This module contains the electronic card that records the flight data. The protected enclosure was separated from its frame and the underwater locator beacon (ULB) was not present. It was slightly damaged and showed some signs of impacts.

The protected housing was opened and the various internal protection layers were removed. The memory card was extracted, and its protective coating was removed.

Electronic card in the CSMU

Electronic card with the protective layer



Electronic card without the protective layer

Visual examinations showed no apparent damage to the card. Entry impedance measurements on the electronic card were made. The values recorded were in accordance with Honeywell specifications.

The electronic card was connected to the BEA readout chassis. The data readout was performed with the official equipment provided by Honeywell, the manufacturer (RPGSE). The downloaded raw data file contained around 52 hours of flight data, including that relating to the accident flight.

Cockpit Voice Recorder - (CVR)

- Make: Fairchild
- Model: A100
- Type number (P/N) 93-A100-8X
- Serial number (S/N): unreadable

The CVR was significantly damaged. The recorder was compressed and deformed during the accident. However, it was not exposed to fire.

Initial state of the CVR

Given the condition of the recorder, access to the protected module was not possible using a conventional opening method. It was necessary to cut the chassis.

Opening of the chassis

Visual examination of the protected module revealed that it was also damaged during the accident. In order to access the magnetic tape on which data are recorded, it was necessary to open the protected module using a grinder.

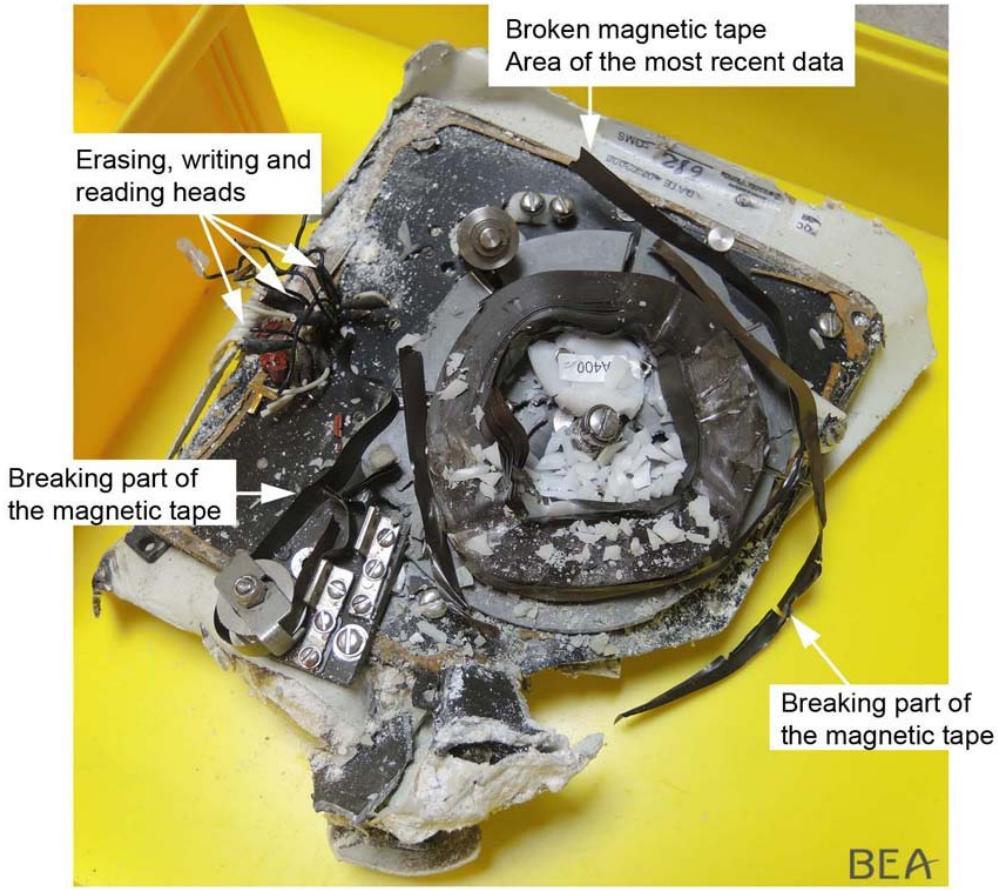
Protected Module after extraction

Heat protection of the data media

After removing the heat shield, it was noted that the tape mechanism had been destroyed and the tape was damaged. It was broken in several places.

Magnetic tape mechanism after extraction

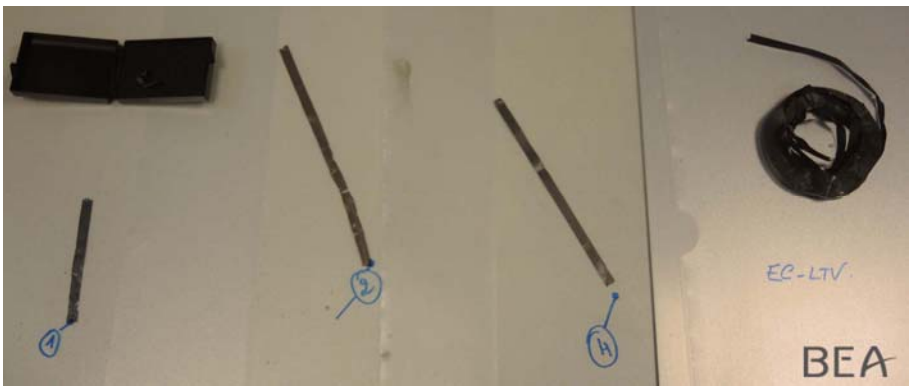
Zoom - Magnetic tape drive mechanism



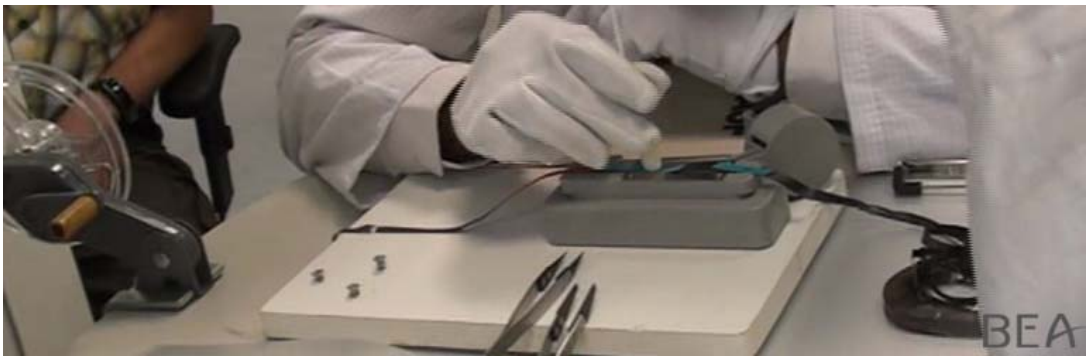
Magnetic Data storage

The various pieces of tape were identified and numbered. To read the tape in its entirety, repair operations were necessary.

These operations consisted in reinforcing the magnetic tape at the locations where damage was greatest.



Pieces of magnetic tape recovered during opening operations



Reconstruction operations of the magnetic tape

Once the magnetic tape had been reconstituted, readout was performed using special equipment. The analogue data contained on the magnetic medium was digitized.

Readout of the magnetic tape made it possible to recover the data contained on the four tracks of the magnetic tape. Four audio files with duration of 31 minutes and 54 seconds were generated.

1.11.2 Analysis of FDR Data

1.11.2.1 Parameter decoding

The data contained in the FDR raw file was decoded using the documentation provided by the aeroplane operator and manufacturer. The set of recorded parameters could be decoded and used, except for the following parameters:

- Angle of attack;
- Control column position;
- Control wheel position (LH/RH) (lateral position of the control column);
- Rudder pedal position.

The angle of attack decoding function as specified in the documents provided by the operator and the manufacturer was not valid. Further work is being carried out with the manufacturer in order to determine and validate the conversion function.

Control wheel and rudder pedal positions are additional parameters that were not recorded when the aeroplane was delivered. These parameters were added via the STC (Supplemental Type Certificate) ST09949SC issued in 2002 to the company SIP Technical Services by the FAA. Therefore, the manufacturer was unable to provide the decoding functions for these parameters. These functions not having been provided in the documents given to BEA, and not being in the last calibration report on the FDR, further inquiries are under way to obtain them.

1.11.2.2 Analysis of data

The analysis of recorded parameters is ongoing. At this stage of the investigation, it has been possible to draft a history of the flight based on the decoded and validated FDR parameters. The corresponding graphs of the recorded parameters are presented in appendix 1.

The FDR data was synchronized with the radio communications between the crew and the control centres of Ouagadougou and Niamey (whose transcripts are available in appendices 2 and 3), based on the number of times the buttons were pressed on the half-duplex VHF radio recorded by the FDR.

1.11.3 Analysis of data from the CVR

Listening to the four tracks of the CVR showed that data on most of the magnetic tape is barely intelligible, or even completely unintelligible, at this stage of the investigation.

The initial work carried out on the audio recordings seems to indicate a failure in the eraser mechanism, leading to overlaying the data related to a large number of flights.

Note: Recording of data on a magnetic tape is carried out in two steps:

- *Step 1: Erasing the oldest data using an eraser head;*
- *Step 2: Recording new data to replace erased data, using a writing head.*

Further work, in cooperation with expert centres outside the BEA, is under way to confirm this failure mode and to try to improve the quality of the recorded signal.

Nevertheless, initial listening work enabled the transcription of a few messages between the crew and control centres, without making it possible to determine whether these communications were made during the accident flight or not. A subsequent comparison with ATC communications showed that several messages recorded on the CVR were actually from the accident flight. This comparison confirms that the CVR did record data during the accident flight.

1.12 Wreckage and Impact Information

1.12.1 Description of crash site

The accident occurrence site is located in Mali, in the Gourma-Rharous Circle and the region of Timbuktu. The impact area is about 80 km southeast of the town of Gossi, which is 160 km southwest of the town of Gao. The geographic coordinates[12] of the wreckage are: 15°08'04''N – 1°04 W.

Given local security constraints, examination of the wreckage could only take place in the area secured by French armed forces, and lasted three days.

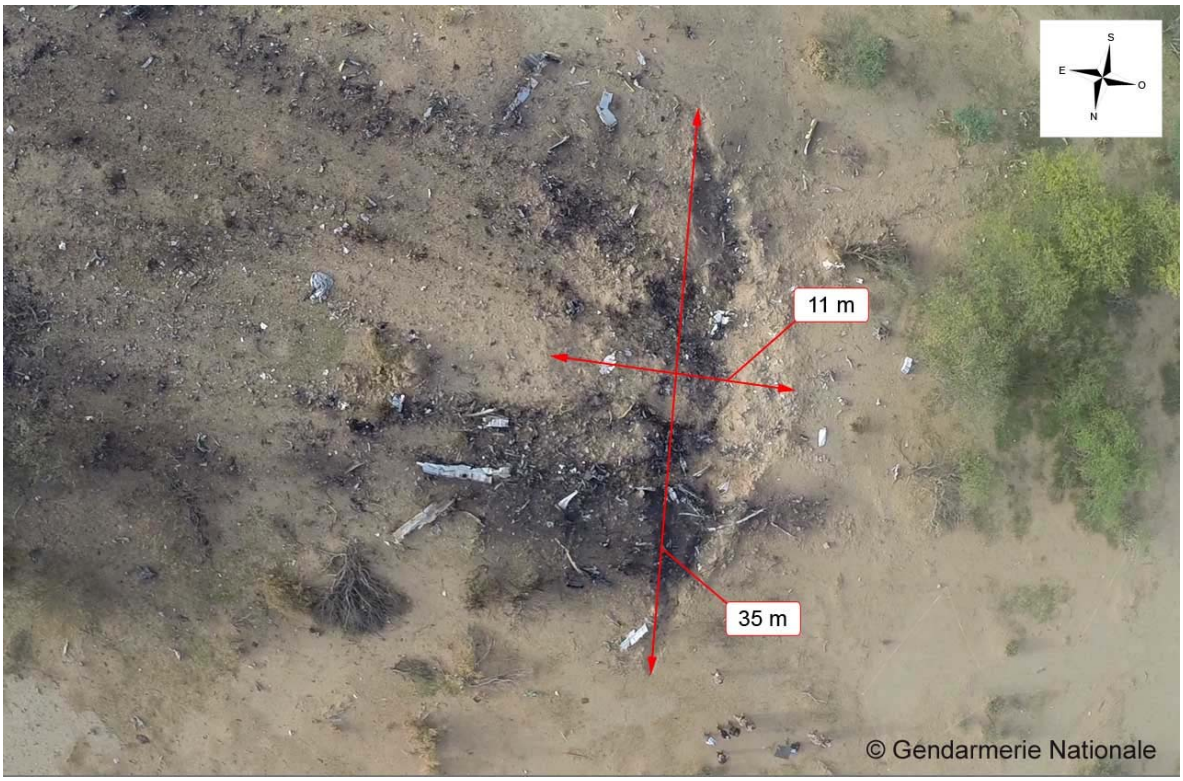
Location of crash site

The area is flat, located at an average altitude of 270 m and the only visible obstacle consists of sparse vegetation of a height not exceeding 5 m. The natural terrain consists of bedrock covered by a 50 cm layer consisting of a mixture of sand and clay, in varying proportions.

[12] In the WSGS84 referential

1.12.2 Distribution of wreckage

On aeroplane impact with the ground, a crater approximately 35 m long, 11 m wide and 1 m deep was formed[13].

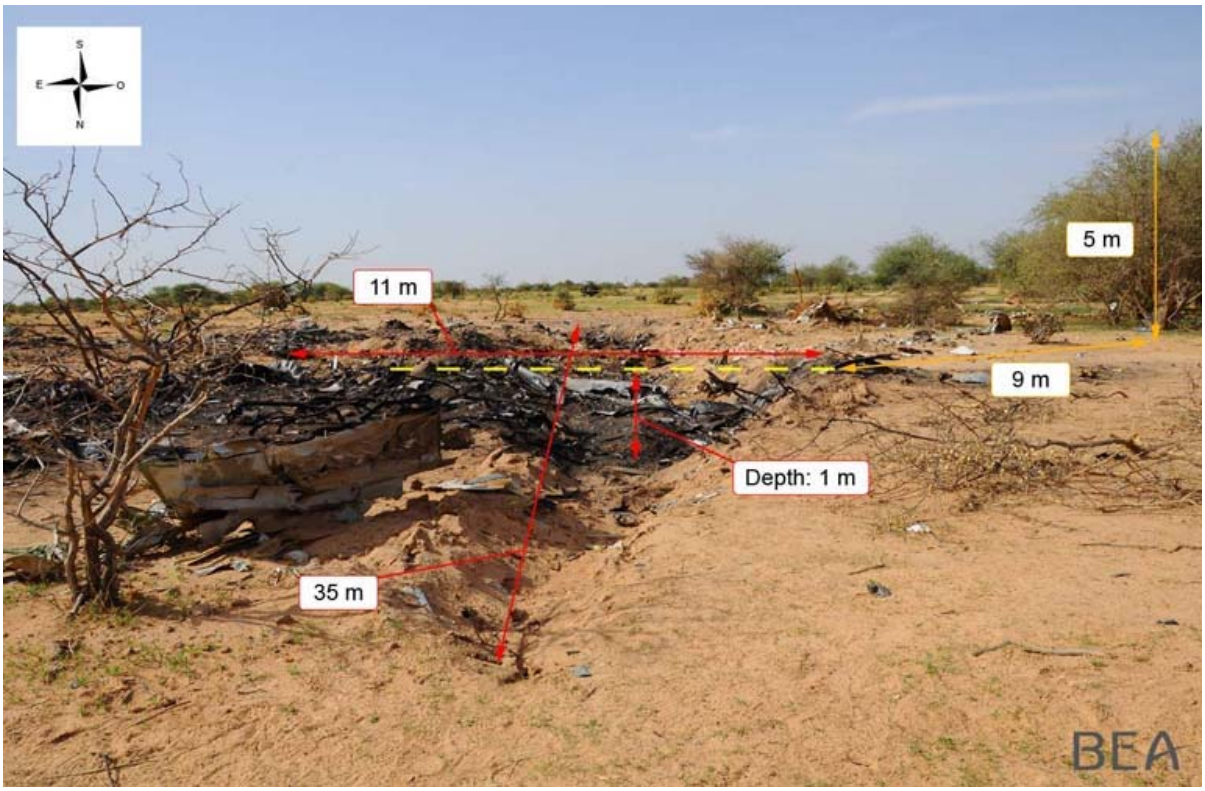


Top view of the crater

The wreckage was spread over a triangular area with a length of 420 m, the summit of which was the point of impact, which spread out to a width of 340 m. The general distribution of the debris was along a mean axis oriented at 090°.

Trees, about 5 m high and located about ten metres before the impact point, were not cut off. A few elements of the tail section, as well as the rear door and the tail skid, were discovered near these trees.

[13] The wingspan of the aircraft is 32.8 m.



Side view of the crater

From the impact zone[14] and moving eastward, three debris distribution areas were defined:

- The first mainly had a concentration of large pieces of wreckage (around one metre or more) and of average density. The debris was mainly parts from the engines, the wings, the fin, the nose gear and the upper parts (shafts) from the main landing gear.
- In the second area, the size (of a few dozen cm) and density of debris were lower than previously observed. Most of the human remains as well as most of the elements from the instrument panel and the windshield were found in this area.
- Finally, in the third area, the debris was medium volume (decametric to metric) and high density. It consisted of engine pieces and lower parts (axles) of the main landing gear.

[14] The centre of the crater is the reference point for the distances in this paragraph.

Aerial view of the debris field

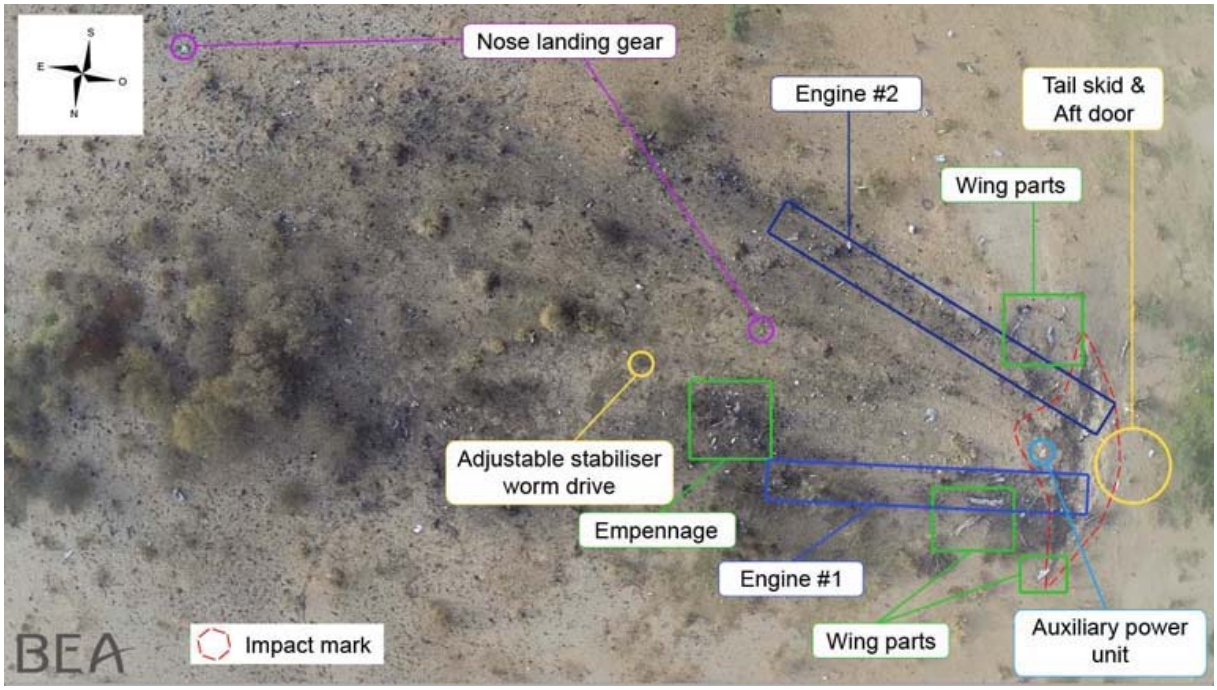
Area 1

The debris found in the impact crater was mainly pieces from the wings, from the auxiliary power unit, as well as from the nacelles and engine accessories.

These engines pieces were spread over approximately 50 m.

The upper parts of the nose gear were found 50 m away and its lower part, 125 m from the impact crater.

The fin was about 50 m away and the trimmable horizontal stabilizer (THS) jackscrew was about 65 m away.



Distribution of debris in the first area

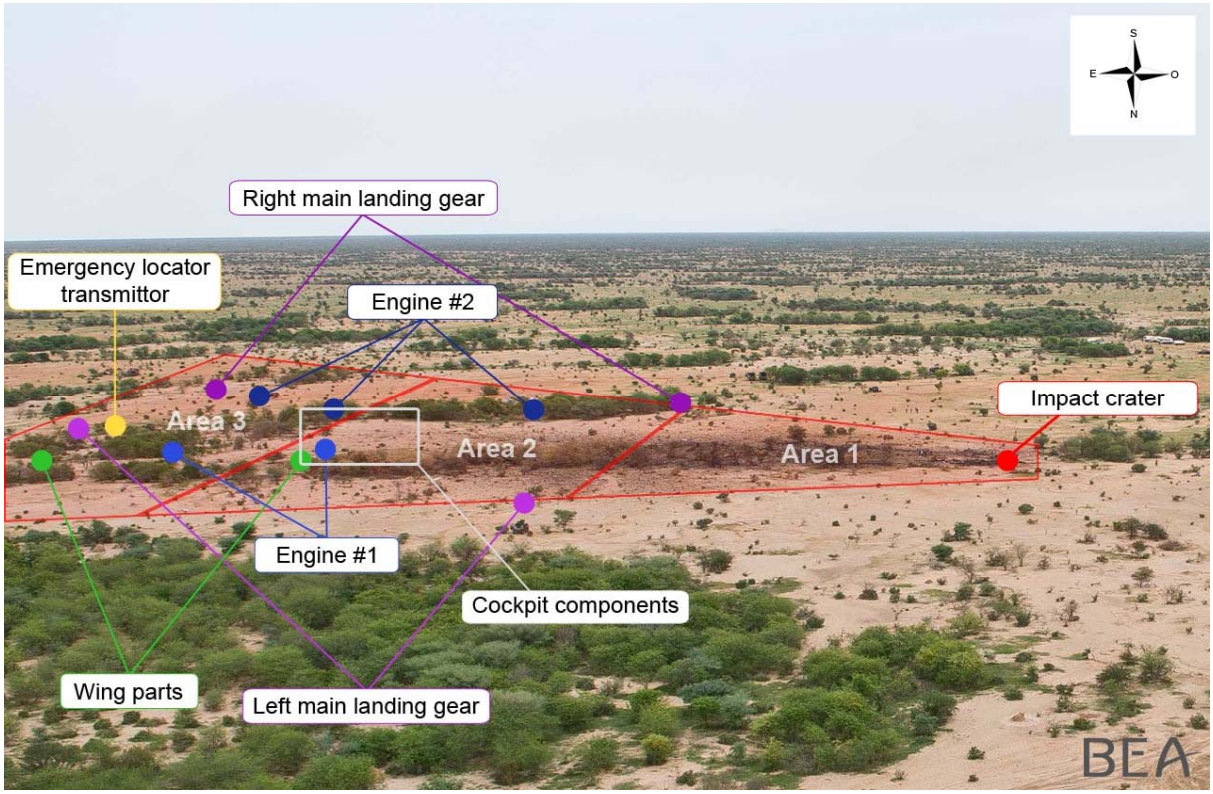
Areas 2 and 3

The upper parts of the main landing gear were found 120 m from the impact crater for the left gear and 205 m away for the right gear.

From 130 m away, the smallest debris was found.

This area, between 170 m and 190 m from the impact crater contained parts of the instrument panel (altimeter, speed indicators, circuit breaker panel) and a piece of windshield.

Parts from engine n°1 were found 160 m and 230 m away. Parts from engine n°2 were found 185 m, 260 and 300 m away Two pieces of the wing were found 140 m and 240 m away. The final parts belonged to the lower parts of the main landing gear; the left main landing gear was 295 m and the right 375 m away.



Distribution of wreckage in areas 2 and 3

The French armed forces preserved the flight recorders as soon as they arrived on site.

1.12.3 Controls and control surfaces

Parts of the flap extension mechanism were found. Their positions were documented.

The jackscrew from the THS was found. At this stage of the investigation, the position of the THS has not been determined.

1.12.4 Engines

Both engines were destroyed. All of the equipment attached to the periphery of the fan housing was torn out and scattered over the site.

All of the fan blades were broken. The rotating components of the engines were badly damaged.

The identified engine elements presented no visible traces of fire.

1.12.5 Doors

The rear door was found 2 m away from the point of impact. It was deformed as a result of upwards compression loads.

1.12.6 Emergency transmitters

The aeroplane was equipped with one fixed automatic emergency locator transmitter connected to an antenna. This emergency locator transmitter was found damaged on the site. No signal from this transmitter was detected.

1.12.7 Summary

The shape of the impact crater and its position in relation to the preceding trees showed that the aeroplane collided with the ground at high speed, with a low bank angle and a steep nose-down pitch attitude. The aeroplane disintegrated upon impact. The debris was spread over a distance of about 420 m with a mean magnetic direction of 90°.

The damage to the engines showed that they were delivering power.

1.13 Medical and Pathological Information

Due to the violence of the impact, it was not possible to perform any toxicological analyses on the crew members.

1.14 Fire

Examination of the site showed burned groups of trees and bushes, from the impact crater on, between headings 065 and 120, over a distance of about 140 metres. Observation of the damage to the vegetation made it possible to conclude that the fire was subsequent to the aeroplane’s collision with the ground and did not spread after the impact.

1.15 Survival Aspects

The force of the impact led to the immediate decease of all the occupants of the aircraft.

1.16 Tests and Research

Additional work in cooperation with the aircraft manufacturer, the engine manufacturer, as well as the NTSB (National Transportation Safety Board) is under way. The objectives of this work will include the determination of the cause of the speed decrease just after the beginning of cruise. It will also detail the conditions in which the loss of altitude and the changes in aircraft attitude occurred during the last few minutes of the flight. To do this, a study of aeroplane and engine performance under the conditions encountered in flight is required, in particular the balance between the thrust delivered by the engines and aircraft drag, as well as the aeroplane's situation in relation to the limits of its flight envelope.

1.17 Information on Organisations and Management

1.17.1 Operator Swiftair S.A.

Swiftair S.A. is a Spanish private company, founded in 1986. It is based in Madrid and employs around 500 people.

1.17.1 1 Fleet

As of 1 September 2014 had a fleet of 42 aeroplanes and made passenger and cargo flights in Europe, Central Africa and the Middle East. Since 2005, it has also operated flights for the benefit of the United Nations.

The fleet consists of six B737-300s, one B737-400, three MD-83s, six ATR 42-300s, sixteen ATR-72s, and ten Embraer 120s.

1.17.1.2 Organisation

The airline has an air operator's certificate (AOC) renewed by the Spanish authority on 25 April 2014 in compliance with annex III of European Regulation 3922/91.

1.17.2 Flight Preparation

In Ouagadougou, the flight documentation was prepared by the Ground handling agency (RACGAE). The agent in charge of the flight documentation collected all the items necessary for the departure of the flight, particularly those concerning passengers and fuel on board and the calculation of the aircraft weight and balance. The crew then filled in and validated the aircraft weight and balance sheet, taking into account the no-show by one passenger at the last moment.

The RACGAE agent then collected the weather package from the ASECNA weather office. The file containing the weather information applicable at 22 h 30 was picked up at 22 h 59 and handed to the crew on their arrival.

It included:

- The weather conditions on the ground;
- The winds aloft charts at various altitudes;
- The TAFs and METARs for the on-route aerodromes;
- An IR satellite map of weather conditions (see appendix 4).

The flight plan included the following route information:

DFFD 0045
N0463 F290 DCT OG UG854 NY/N0459 F310 UM608 ROFER/N0453 F330 UG859
DAAG 0347

Note: The departure via NY (Niamey) is systematically chosen by the airline for flights from Ouagadougou to Algiers.

1.17.3 Terms of Charter

A charter agreement of the ACMI type (Aircraft / Crew / Maintenance / Insurance or *"wet lease"*) was established between Air Algérie and Swiftair S.A. through the Avico Company, based in Spain.

In this case, the contract was established for the period from 20 June 2014 to 23 September 2014. It provided for the positioning by Swiftair S.A., in Algiers, for the duration of the contract, of:

- The aeroplane registered EC-LTV. This aeroplane could be replaced if needed;
- Three flight and cabin crews. A fourth back-up crew was in Madrid.

1.18 Testimony

1.18.1 The dispatcher of the Ground handling agency (RACGAE)

The RACGAE dispatcher was in charge of the preparation of this flight. He stated that the aeroplane arrived at the ramp about 15 minutes late due to saturation of the parking area at that time. This had no impact on the flight preparation, which took place quite normally. The only difference with other flights to Ouagadougou was that the Swiftair S.A. crew wanted to produce the loading plan and the weight and balance sheet themselves. The turnaround lasted about 50 minutes. The crew was calm and conscientious. The captain requested the quantity of luggage to take on-board. The co-pilot decided on the distribution of luggage in the holds giving priority to loading the aft cargo hold. She then calculated the weight and balance based on data provided by the dispatcher. The dispatcher then took the flight plan to the aeronautical information bureau.

1.18.2 Air Algérie station agent at Ouagadougou

The Air Algérie station agent's testimony indicates that the crew were under no pressure and that the flight preparation was normal.

The agent welcomed the crew on their arrival at Ouagadougou and accompanied them until the doors closed before the aeroplane's departure.

He stated that the turnaround time was quite standard. The crew reviewed the flight documentation carefully. During refuelling, the captain checked the fuel level and then personally checked that the holds were closed. The co-pilot carefully filled in the weight and balance sheet and presented it to the captain. The captain examined and approved it by signing it.

1.18.3 The air traffic controller on duty at the Ouagadougou control tower

The controller explained that during the phone call from the controller in Niamey informing him of the arrival of flight AH 5016[15], he did not have the flight plan of the aeroplane. He added that this was very common for arrivals from Algiers and was not surprised. The aeroplane arrived via EPEPO. During the telephone coordination, the controller wrote a flight strip containing the elements of the flight and then manually prepared a strip in advance for the upcoming departure, indicating a departure via EPEPO.

When the flight plan filed by the crew had been processed, the controller received an electronic flight strip indicating a departure via Niamey.

He chose to give the crew a departure clearance via EPEPO because the crew had arrived by that waypoint, which is also an exit point to Algiers.

Aware that this route was different from that requested by the crew in the flight plan, he stated that the crew could express disagreement at any time.

He added that the controllers did not have a radar display of the weather conditions in the region.

1.18.4 Flight crew of Flight AH 5005

Flight AH5005 was on the Ouagadougou - EPEPO route at FL370 with an estimated time at EPEPO at 1 hour 56, that is to say 18 minutes after flight AH5017.

The crew, who were contacted for the purposes of the investigation, stated that:

- CB-type clouds were present in all the areas west and northwest of Niamey and from EPEPO waypoint to the north of Gao;
- at FL370 the TAT temperature was -22°C, the SAT was -48°C. At FL 310 the SAT was -36°C.

The crew of flight AH 5005 said they often asked to change course to avoid storm cells, for 46 minutes, from south of Ouagadougou to the northwest of Gao.

They heard a call from flight AH5017 (female voice) on the Niamey frequency (131.3 MHz). The crew called out *"abeam GAO, FL 310 request heading 350 to avoid."* The Niamey control centre did not read back. They called the crew of flight AH5005 in order to relay with flight AH5017. The relay was attempted several times, unsuccessfully, on all possible frequencies (4 VHF and 1 HF).

[15] On arrival from Algiers, the flight number was AH5016.

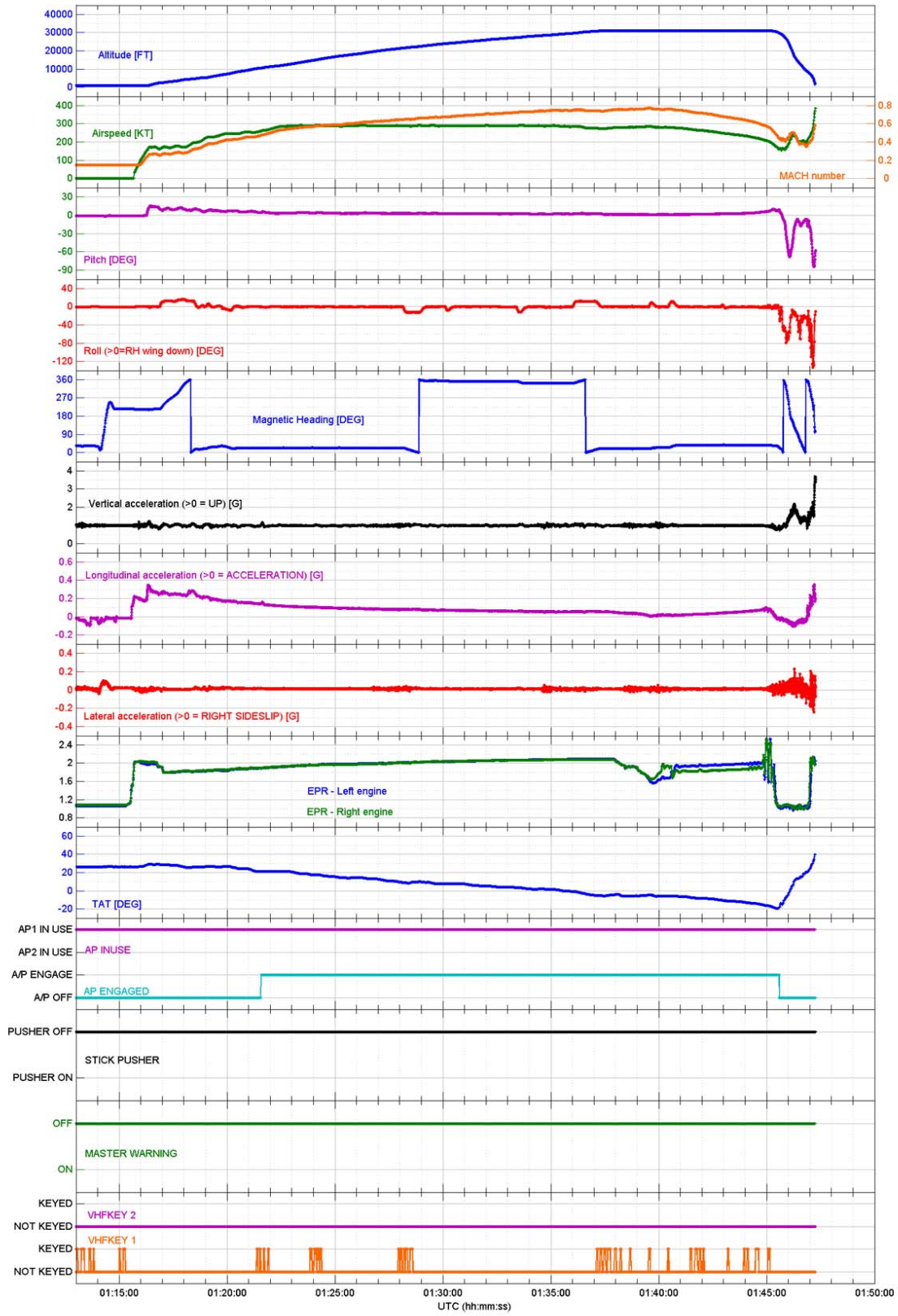
2 - INITIAL FINDINGS

On the basis of the initial information gathered during the course of the investigation, the following facts have been determined:

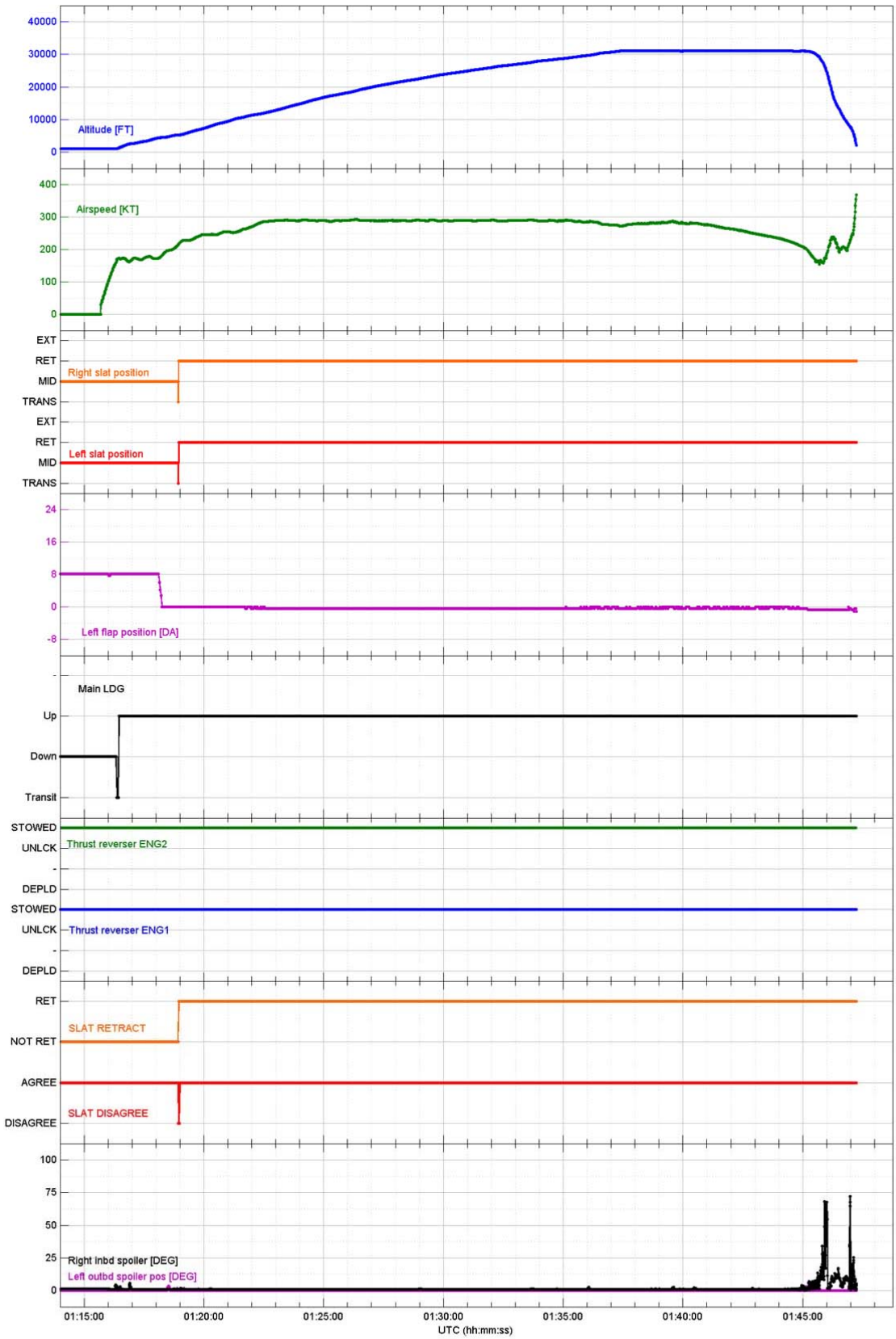
- The aeroplane possessed a valid certificate of airworthiness.
- The aeroplane had taken off from Ouagadougou bound for Algiers with 116 people on board.
- The meteorological situation was what could be expected for that encountered at that time of the year in the intertropical convergence zone.
- The crew of flight AH5017 were successively in contact with the Ouagadougou tower and CCR, then with the Niamey CCR.
- During climb to FL310, the crew made some heading changes to avoid a stormy area.
- When levelling off, the autopilot was in altitude and heading hold mode while the speed was controlled by the autothrottle.
- About two minutes after levelling off, the aeroplane's speed started to decrease and the altitude remained stable while the EPR of both engines and the pitch attitude increased progressively.
- During level flight, the autothrottle changed several times from MACH mode to MACH ATL mode.
- After the flight was transferred to the Niamey CCR, radio contact with the aeroplane was not established immediately. Flight RAM543K, flying in the area, acted as a relay between flight AH5017 and the Niamey CCR.
- The controller at the Niamey CCR then heard the crew of Flight AH5017 announcing that they were stable at FL310 and undertaking an avoidance manoeuvre.
- The Niamey controller asked the crew to call back passing GAO. No answer from the crew of flight AH5017 was received by the Niamey CCR. No messages from the crew of flight AH5017 were received by the Niamey CCR after that.
- About 7 minutes after levelling off, EPR fluctuations on both engines started, followed by two variations of greater amplitude. The autothrottle disengaged during these two variations in EPR and the aeroplane started to descend.
- About ten seconds after the beginning of the descent, the pitch attitude reached a maximum of 10° then decreased.
- The autopilot disengaged about thirty seconds after the autothrottle disengagement. Both engines were then almost at idle.
- During the descent, the pitch attitude and the bank of the aeroplane changed significantly. The aeroplane continued to pitch down with a left bank angle down to the ground. The control surfaces remained mainly deflected pitch up and in the direction of a bank to the right.
- No problems were mentioned by the crew during their contacts with the Ouagadougou and Niamey air traffic controllers.
- No distress messages were received by the control centres.
- The last recorded values on the FDR were a 58° pitch-down attitude, a 10° bank to the left and a calibrated airspeed of 384 kt.

LIST OF APPENDICES

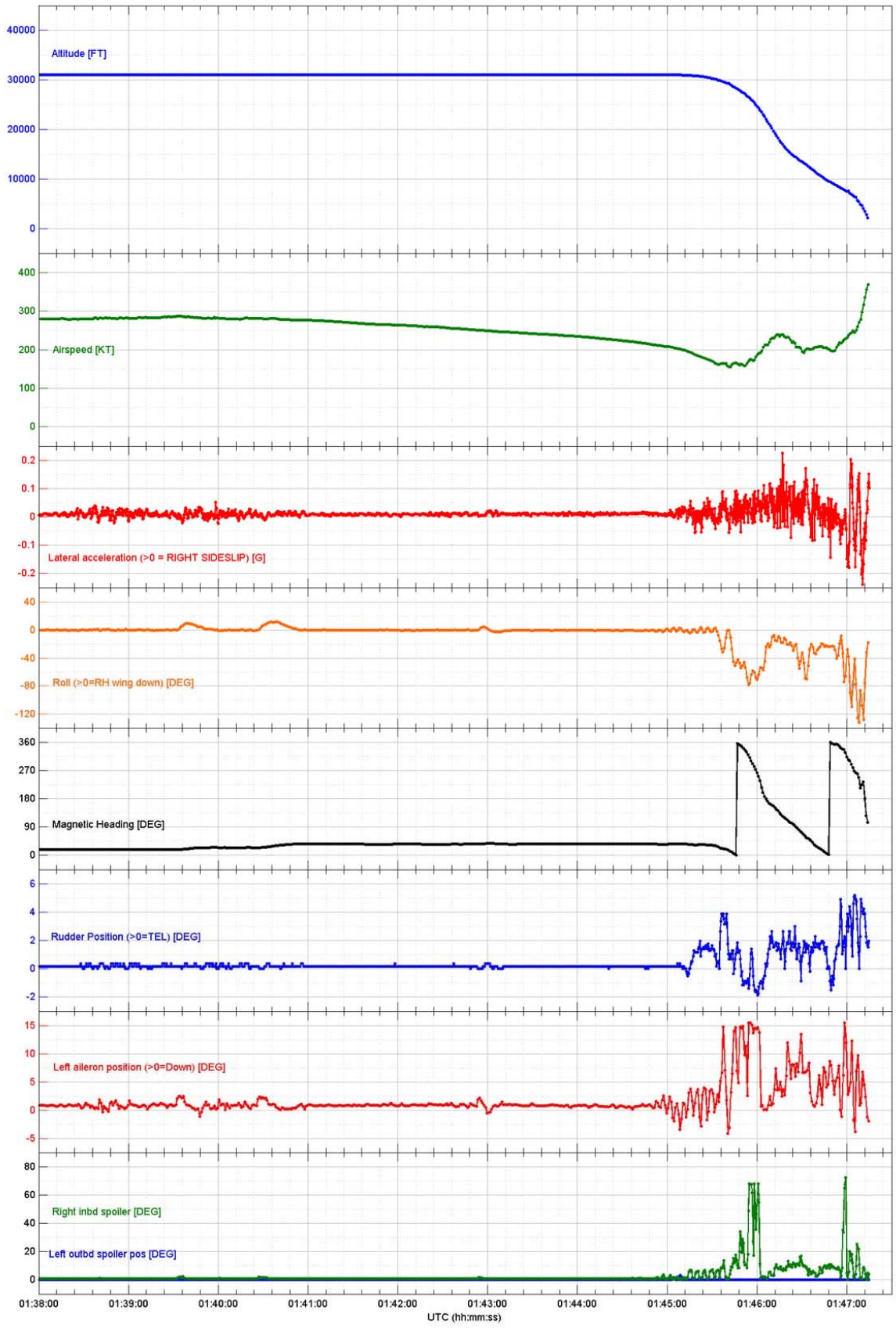
Appendix 1
FDR parameter graphs



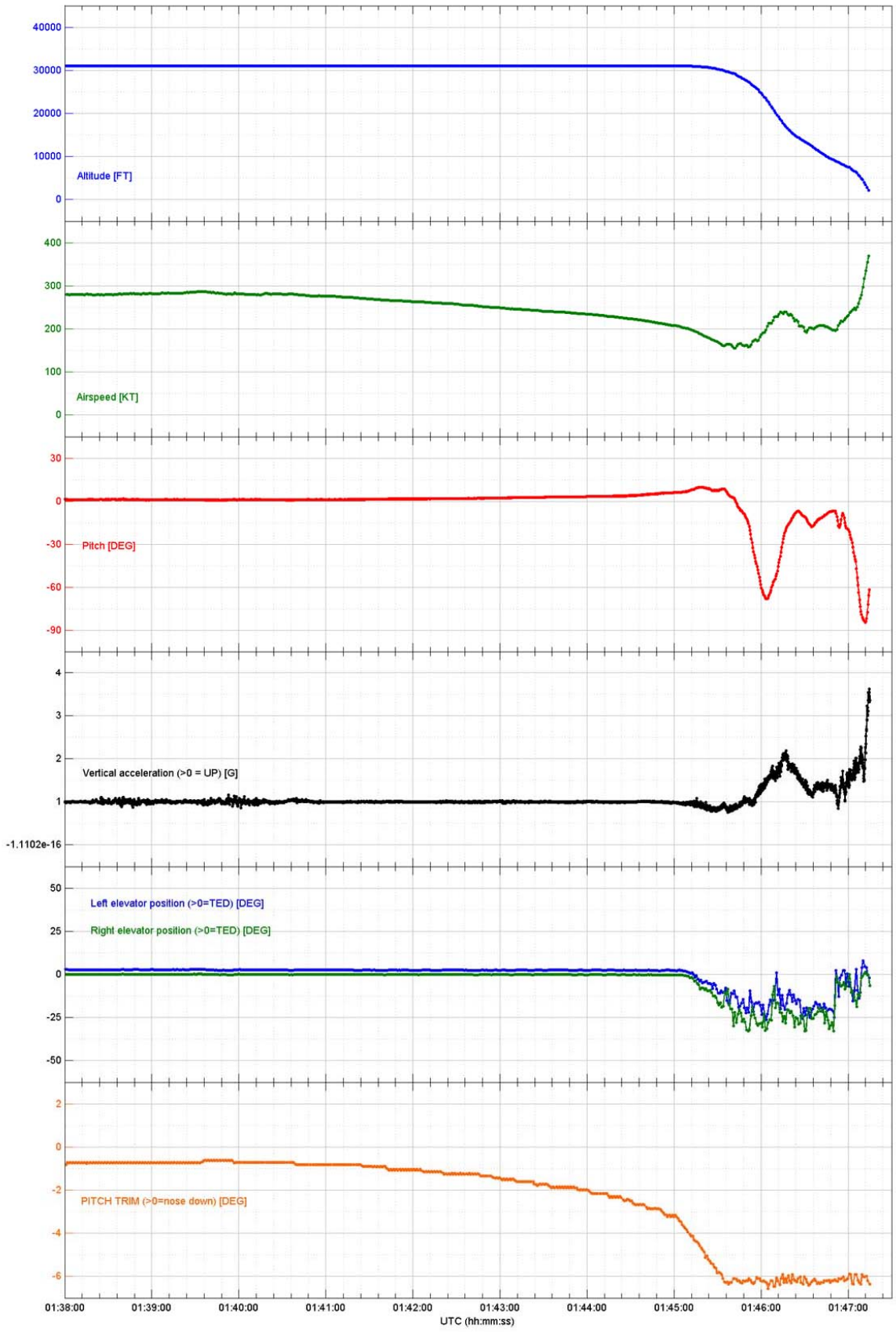
General parameters



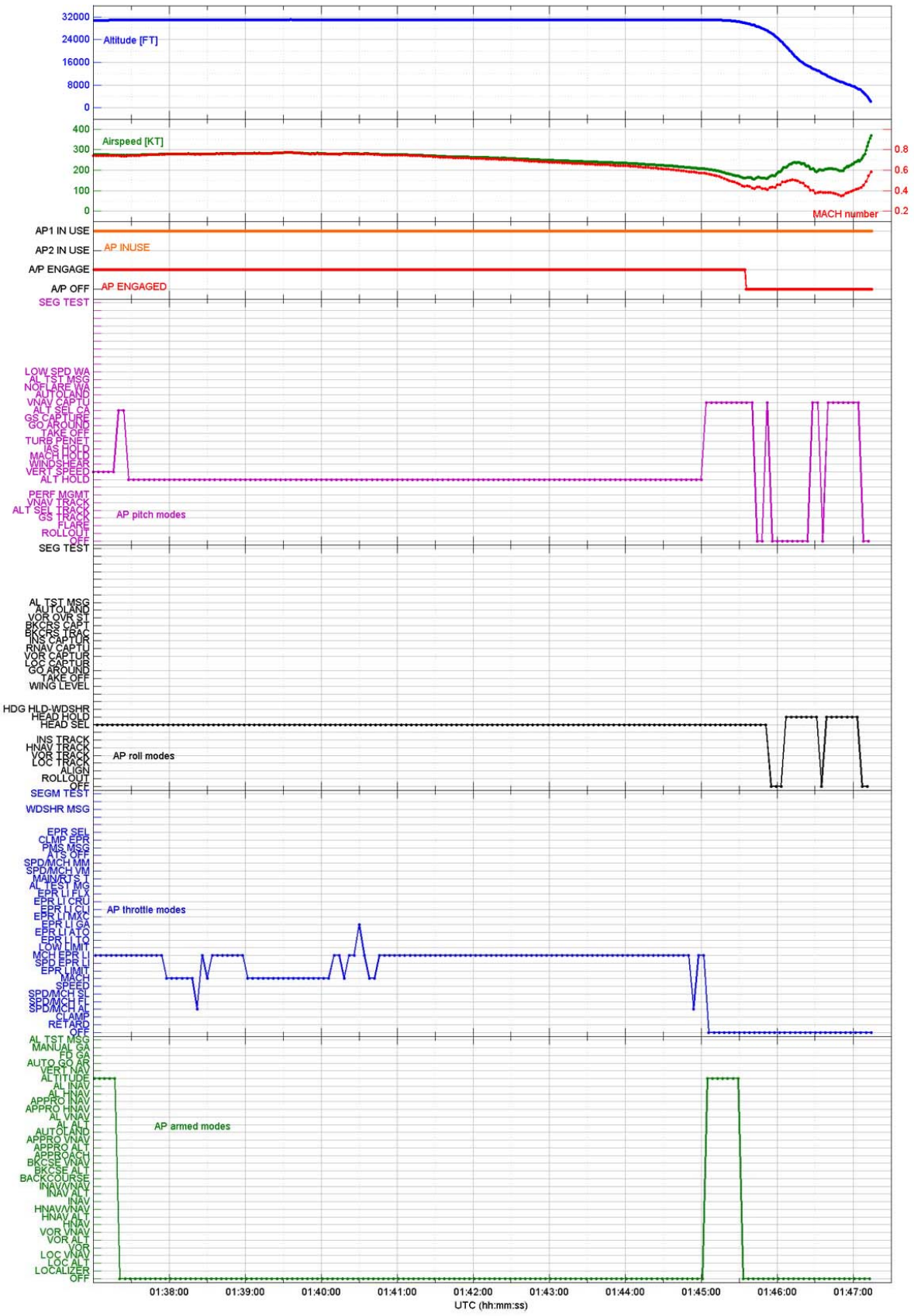
Aeroplane configuration



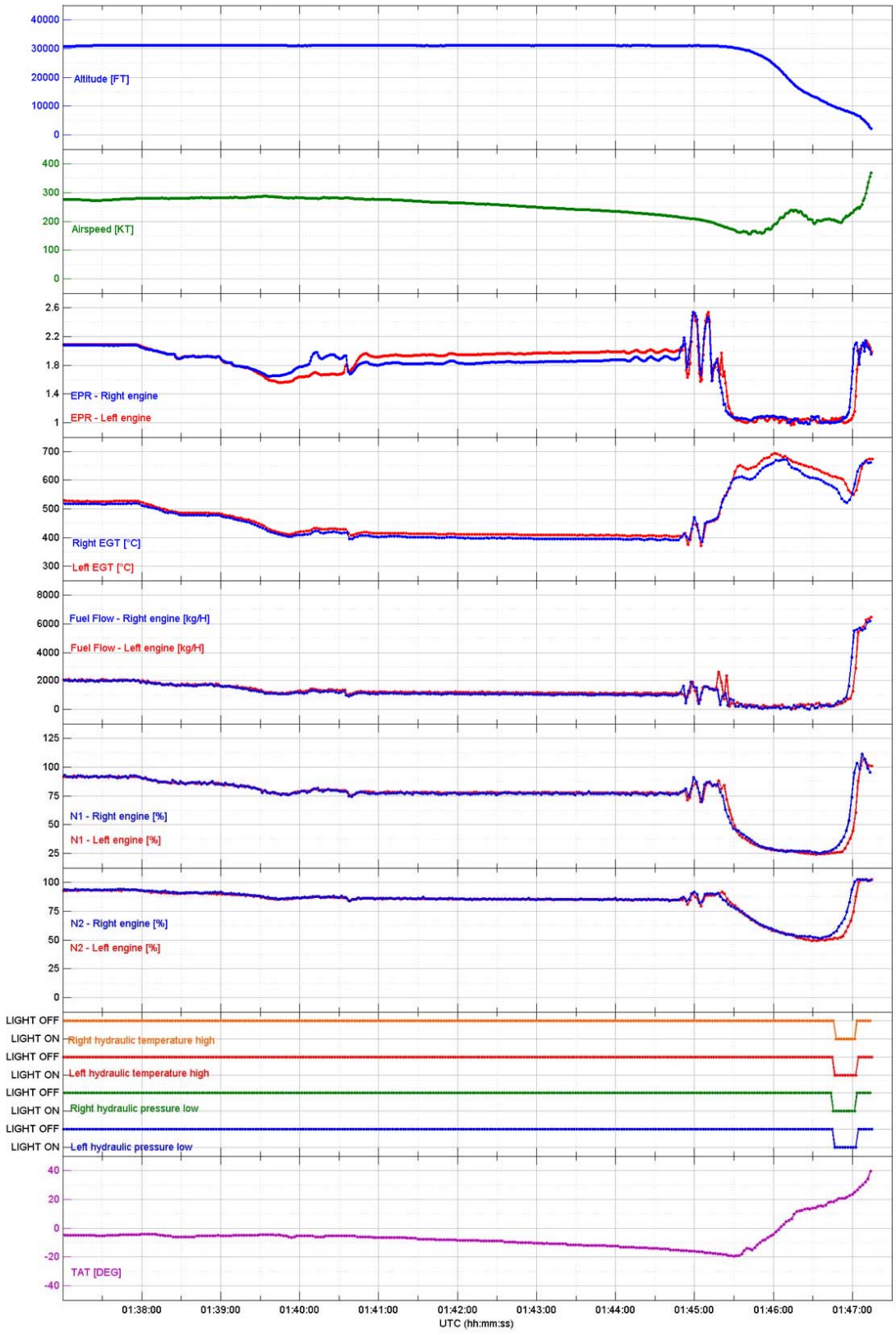
Lateral parameters



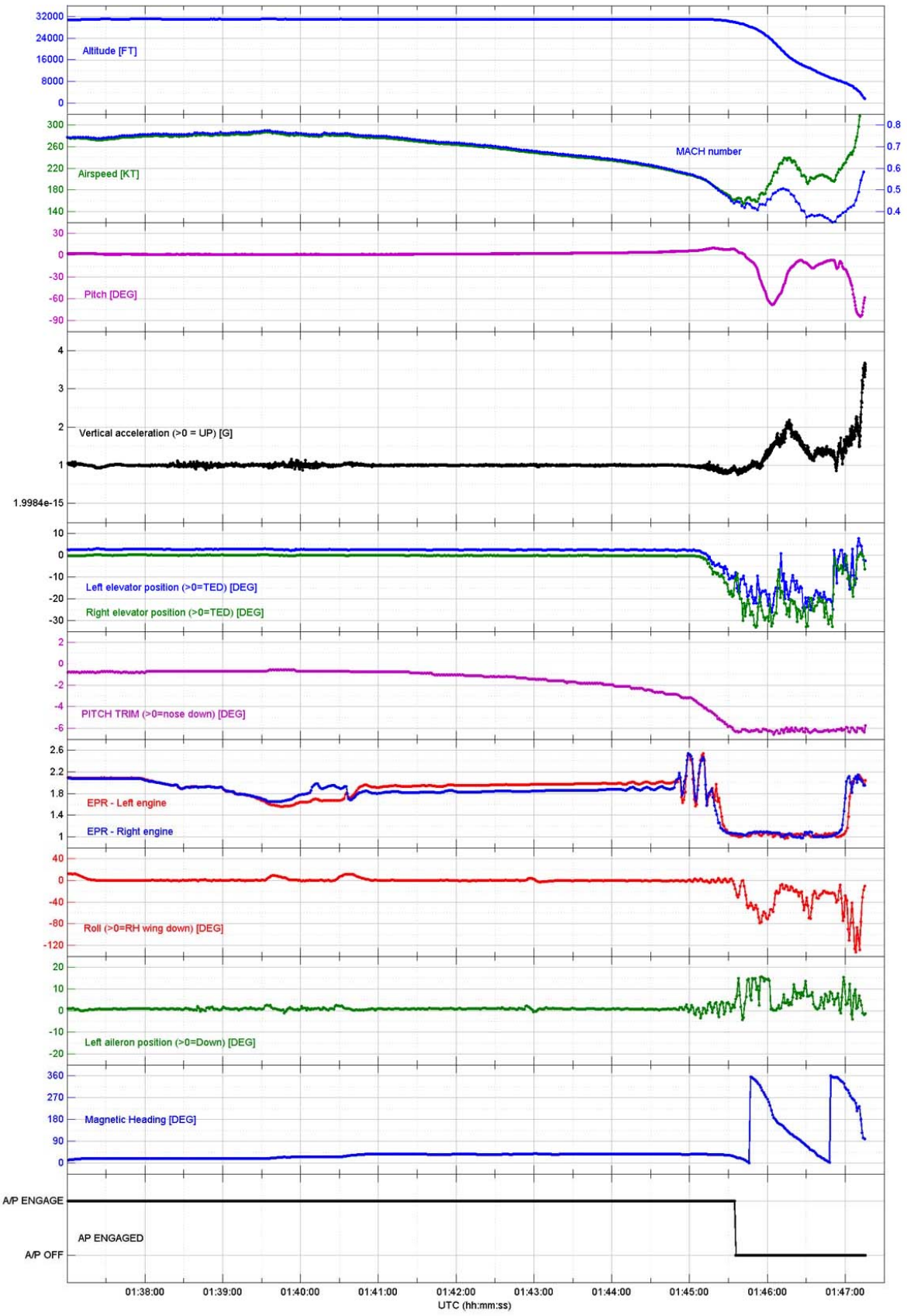
Longitudinal parameters



Automatic systems



Engine parameters



Summary of data

Appendix 2
Transcript of ATC communications from Ouagadougou ATC centre recordings

FOREWORD

The following is a transcript of the elements which were comprehensible at the time of the readout of the cockpit voice recorder. This transcript contains conversations between crew members, radiotelephonic messages and various noises corresponding, for example, to the movement of selectors or to alarms.

The reader's attention is drawn to the fact that the recording and transcript of the CVR are only a partial reflection of events and of the atmosphere in a cockpit. Consequently, the utmost care is required in the interpretation of this document.

Note: The times given are UTC synchronized with the aeroplane's FDR.

GLOSSARY

UTC time	Universal Time Coordinated
[xxx]	Controller on the frequency in use (for example: [TWR] for tower).
#xxx#	Telephone conversation between two control centres
( )	Words or groups of words in parentheses are doubtful
(*)	Words or groups of words not understood

UTC Time	Speaker	Messages	Notes, noses
00 h 48 min 47	Beginning of transcript		
00 h 48 min 48	AH 5017	Tower salam 'aleïkoum, Algérie five zero one seven	
00 h 48 min 54	**[Ouaga TWR] (118.1)**	Algérie five zero one seven, Ouaga Tower, good evening, go ahead	
00 h 48 min 58	AH 5017	Yes, we will be ready for the start up in four minutes	
00 h 49 min 03	**[TWR]**	Heu roger, copied. You copy runway 22 in use, wind is 250 degrees, 07 knots, visibility 10 km, temperature 26, dew point 23, QNH 1015. Time check 00 49. Report for start-up	
00 h 49 min 21	AH 5017	We will call you ready for the start-up and QNH 1015, Algérie five zero one seven	
01 h 00 min 52	**[TWR]**	Cargolux 805, airborn 00 58, report for estimates	
01 h 00 min 57	CLX 805	Cargolux 805 I call you back	
01 h 02 min 14	AH 5017	Algérie four zero one seven, ready for the start up	
01 h 02 min 20	**[TWR]**	Algérie five zero one seven, start up is approved runway 22, wind 240 degrees, 10 knots. Temperature is 26, dew point 23, QNH 1015, time 01 03, report for taxi	
01 h 02 min 35	AH 5017	Start-up approved Algérie four zero one seven, we will call you ready for taxi	
01 h 02 min 47	CLX 805	Ouaga Cargolux 805	
01 h 02 min 52	**[TWR]**	805, go ahead	
01 h 02 min 53	CLX 805	So we estimate EPEPO at 01 15, GAO 01 33 and MOKAT 02 10 and we climbing now... we passing out of flight level 155 to... for climbing for flight level 370.	
01 h 03 min 12	**[TWR]**	And say estimates for destination	
01 h 03 min 18	CLX 805	Estimate destination 06 00, Cargolux 805	
01 h 03 min 24	**[TWR]**	Roger, contact Control, 120.3, good bye	
01 h 03 min 27	CLX 805	At 120.3, bonne nuit Cargolux 805	
01 h 04 min 04	CLX 805	Ouaga Control good morning Cargolux 805	
01 h 04 min 10	**[Ouaga CCR] (120.3)**	805, Ouaga Control, good morning, cleared EPEPO, flight level 370, report EPEPO	
01 h 04 min 20	CLX 805	Cleared to EPEPO and climbing flight level 370, I you call back EPEPO, Cargolux 805	
01 h 07 min 07	*#Ouaga CCR#*	Allô	
01 h 07 min 08	*#Niamey CCR#*	Oui Ouaga pour le Cargolux qui va au 370, oui allez-y	
01 h 07 min 12	*#Ouaga CCR#*	Oui EPEPO à 01h15, GAO à 33, niveau 370	
01 h 07 min 21	*#Niamey CCR#*	D'accord alors à quelle heure il a décollé, s'il vous plait?	
01 h 07 min 23	*#Ouaga CCR#*	Il a décollé à 00h58 et puis Air Algérie derrière... qui demande niveau 350	
01 h 07 min 33	*#Niamey CCR#*	C'est Algérie cinq mille cinq?	
01 h 07 min 36	*#Ouaga CCR#*	Cinq mille..., cinq mille... Algérie five zero one seven, cinq mille dix-sept, il va à Alger	
01 h 07 min 41	*#Niamey CCR#*	Heu d'accord, lui le 350 approuvé pour lui	

UTC Time	Speaker	Messages	Notes, noses
01 h 07 min 46	*#Ouaga CCR#*	Hum d'accord	
01 h 09 min 54	AH 5017	Algérie five zero one seven, ready to taxi	
01 h 10 min 02	**[TWR]**	Five zero one seven taxi, enter and backtrack runway 22, confirm level	
01 h 10 min 14	AH 5017	Taxi... taxi for holding point runway 22 and backtrack. We request flight level 320... 330	
01 h 10 min 23	**[TWR]**	Roger call you back	
01 h 10 min 29	AH 5017	By the moment 310, too heavy, Algérie five zero one seven	
01 h 10 min 45	**[TWR]**	Please say again, Algérie	
01 h 10 min 46	AH 5017	Yes, flight level 310, 310, Algérie five zero one seven	
01 h 10 min 51	**[TWR]**	Roger	
01 h 12 min 12	*#Niamey CCR#*	Allô	
01 h 12 min 13	*#Ouaga CCR#*	Allô Niamey	
01 h 12 min 15	*#Niamey CCR#*	Oui Ouaga	
01 h 12 min 16	*#Ouaga CCR#*	Oui heu, le Cargolux demande le niveau 410 et Air Algérie niveau 310	
01 h 12 min 21	*#Niamey CCR#*	Non le 370 s'il vous plait, j'ai du trafic c'est pour cela que je l'ai limité initialement au 370	
01 h 12 min 27	*#Ouaga CCR#*	D'accord... et l'Air Algérie, 310?	
01 h 12 min 30	*#Niamey CCR#*	Air Algérie, 350 initial	
01 h 12 min 32	*#Ouaga CCR#*	310 qu'il demande	
01 h 12 min 35	*#Niamey CCR#*	3-10?	
01 h 12 min 35	*#Ouaga CCR#*	Voilà	
01 h 12 min 37	*#Niamey CCR#*	Ok lui c'est 3-10 et le Cargolux 370	
01 h 12 min 40	*#Ouaga CCR#*	Ok	
01 h 12 min 42	*#Niamey CCR#*	Ok merci	
01 h 13 min 01	AH 5017	Algérie five zero one seven, we are ready to copy	
01 h 13 min 05	**[TWR]**	Algérie five zero one seven, clear Ouagadougou to Alger via EPEPO, level 310, after departure runway 22, right turn	
01 h 13 min 15	AH 5017	Heu... clear destination, initially flight level 310. After takeoff, right turn to (GUPOV)	
01 h 13 min 31	**[TWR]**	Algérie five zero one seven heu... right turn to EPEPO	
01 h 13 min 37	AH 5017	Heu copied, right turn to EPEPO	
01 h 13 min 41	**[TWR]**	Correct, report ready	
01 h 13 min 49	AH 5017	We will call you ready	
01 h 15 min 01	AH 5017	Ready, Algérie five zero one seven	
01 h 15 min 03	CLX 805	Ouagadougou, Ouaga Control, Cargolux 805	
01 h 15 min 06	**[TWR]**	Algérie five zero one seven, clear for takeoff runway 22, wind is 230 degrees, 09 knots, right turn	
01 h 15 min 12	AH 5017	Clear for takeoff, 22 and when airborn, right turn, Algérie five zero one seven	
01 h 15 min 13	**[Ouaga CCR]**	Cargolux 805, Ouaga, you contact Niamey for higher, Niamey is one three one decimal three. Safe flight	

UTC Time	Speaker	Messages	Notes, noses
01 h 15 min 21			DAH 5017 calls out V1 (alternat pressed)
01 h 15 min 23	CLX 805	Niamey one three one decimal three for higher. Have a good night Cargolux 805. Au revoir.	
01 h 15 min 29	**[Ouaga CCR]**	Au revoir	
01 h 18 min 25	*#BIA#*	Oui allô	
01 h 18 min 26	*#Ouaga CCR#*	Oui Algérie 5017 en vol à 01h17	
01 h 18 min 28	*#BIA#*	17 minutes...	
01 h 20 min 36	RAM 543K	Tower, Air Maroc 543 Kilo, request taxi	
01 h 20 min 44	**[TWR]**	543 Kilo taxi, enter and backtrack runway 22 and follow... do you have a marshaller?	
01 h 20 min 52	RAM 543K	We have the marshaller, we follow marshaller instruction and we... enter and backtrack runway 22, Royal Air Maroc 543 Kilo	
01 h 21 min 01	**[TWR]**	Hum confirm level requested	
01 h 21 min 05	RAM 543K	270, Royal Air Maroc 543 Kilo	
01 h 21 min 09	**[TWR]**	Roger, I call you back for ATC clearance	
01 h 21 min 12	**[TWR]**	Algérie five zero one seven, airborn time 01 17, report for estimates	
01 h 21 min 22	AH 5017	Are you calling, Algérie five zero one seven?	
01 h 21 min 25	**[TWR]**	Algérie five zero one seven, correct, report for estimates	
01 h 21 min 31	AH 5017	Say again, Algérie five zero one seven	
01 h 21 min 34	**[TWR]**	Air Algérie five zero one seven, airborn time 01 17, report for estimates	
01 h 21 min 42	AH 5017	Standing by, Algérie five zero one seven	
01 h 21 min 49	**[TWR]**	Five zero one seven, standing by for estimates, standing by	
01 h 21 min 54	AH 5017	Standing by, Algérie five zero one seven	
01 h 22 min 53	RAM 543K	Tower, Royal Air Maroc 543 Kilo, ready to copy (ATC)	
01 h 22 min 59	**[TWR]**	Maroc 543 Kilo is cleared Ouagadougou Niamey via DEKAS level 270, after departure runway 22, climb runway heading, 5 miles, then left turn	
01 h 23 min 13	RAM 543K	Clear to Niamey via DEKAS, we climb flight level 270, after takeoff we maintain runway heading then left t urn (*) Royal Air Maroc 543 Kilo	
01 h 23 min 26	**[TWR]**	543 Kilo correct, report ready	
01 h 23 min 29	RAM 543K	Call you back when ready, Royal Air Maroc 543 Kilo	
01 h 23 min 48	**[TWR]**	Air Algérie five zero one seven, say level passing	
01 h 23 min 51	AH 5017	We are passing flight level 145, Algérie four zero one seven	
01 h 23 min 57	**[TWR]**	Roger... and say estimates EPEPO... and arrival time Alger	
01 h 24 min 05	AH 5017	...PO at 01 38, Algérie five zero one seven	

UTC Time	Speaker	Messages	Notes, noses
01 h 24 min 10	**[TWR]**	Please, say again estimates EPEPO?	
01 h 24 min 12	AH 5017	01 38, 01 38	
01 h 24 min 16	**[TWR]**	Roger. Estimate arrival time Alger?	
01 h 24 min 20	AH 5017	Estimated time Alger, stand by please	
01 h 24 min 51	RAM 543K	Tower, Royal Air Maroc 543 Kilo, ready for take off	
01 h 24 min 55	**[TWR]**	543 Kilo, clear for takeoff runway 22, wind is 240 degrees, 06 knots	
01 h 25 min 00	RAM 543K	Cleared take off 22, Royal Air Maroc 543 Kilo,	
01 h 25 min 38	*#Niamey CCR#*	Allô?	
01 h 25 min 39	*#Ouaga CCR#*	Oui Algérie 5017, en vol à 01h17	
01 h 25 min 42	*#Niamey CCR#*	Une seconde	
01 h 27 min 10	*#Ouaga CCR#*	Allô	
01 h 27 min 12	*#Niamey CCR#*	Oui Ouaga, je t'ai mis en stand-by, tu as préféré quitter?	
01 h 27 min 14	*#Ouaga CCR#*	Voilà, comme tu étais pris	
01 h 27 min 17	*#Niamey CCR#*	D'accord, oui on y va	
01 h 27 min 18	*#Ouaga CCR#*	Donc 01h17 en vol, Algérie 5017	
01 h 27 min 22	*#Niamey CCR#*	5017, oui	
01 h 27 min 23	*#Ouaga CCR#*	EPEPO à 01h38, niveau...	
01 h 27 min 26	*#Niamey CCR#*	S'il te plait, il a décollé à quelle heure?	
01 h 27 min 28	*#Ouaga CCR#*	01h17	
01 h 27 min 30	*#Niamey CCR#*	Oui	
01 h 27 min 31	*#Ouaga CCR#*	EPEPO à 01h38, niveau 310. Et derrière tu as Maroc 543 K, niveau 270 sur DEKAS	
01 h 27 min 44	*#Niamey CCR#*	D'accord, il n'a pas encore décollé?	
01 h 27 min 45	*#Ouaga CCR#*	Heu il vient de décoller mais je n'ai pas... il a décollé juste à 27	
01 h 27 min 49	*#Niamey CCR#*	27? D'accord, reçu.	
01 h 27 min 53	*#Ouaga CCR#*	Toute à l'heure pour ses estimées	
01 h 27 min 56	AH 5017	Heu Radar, Algérie five zero one seven	
01 h 28 min 01	**[TWR]**	Heu... go ahead	
01 h 28 min 02	AH 5017	The estimate is Alger at 05 06	
01 h 28 min 09	**[TWR]**	Contact Control, one two zero decimal three	
01 h 28 min 11	AH 5017	One two zero three, Algérie four zero one seven, choukrane (“merci” en langue arabe)	
01 h 28 min 16	AH 5017	Radar, salam ’aleïkoum, Algérie five zero one seven, climbing 310	
01 h 28 min 24	**[Ouaga CCR]**	Algérie five zero one seven, cleared EPEPO level 310, report EPEPO	
01 h 28 min 29	AH 5017	Yes, we'll call you EPEPO, we are turning left heading 356 to avoid	
01 h 28 min 37	**[Ouaga CCR]**	Roger	
01 h 29 min 22	*#BIA#*	Allô	
01 h 29 min 22	*#Ouaga CCR#*	Oui, Marco 543 Kilo en vol à 27	

UTC Time	Speaker	Messages	Notes, noses
01 h 29 min 25	*#BIA#*	27? Reçu	
01 h 29 min 29	**[TWR]**	Maroc 543 Kilo airborn time 01 27 report for estimates	
01 h 29 min 34	RAM 543K	We estimate BULSA at 01 38, DEKAS at 01 42 and destination Niamey at 02 08	
01 h 29 min 46	**[TWR]**	Estimates are copied, climb level 270, report passing 140	
01 h 29 min 48	AH 5005	Ouaga, Ouaga, Air Algérie five zero zero five, bonjour	
01 h 29 min 55	**[Ouaga CCR]**	Algérie 5005 bonjour	
01 h 29 min 57	AH 5005	Bonjour, position TUMUT, 370	
01 h 30 min 04	**[Ouaga CCR]**	Roger clear TUMUT, Oscar Golf, EPEPO 370, say estimates Oscar Golf, EPEPO	
01 h 30 min 10	AH 5005	Roger, Oscar Golf and EPEPO and we estimate Oscar Golf at 01 41 EPEPO 01 56 and we need heading by the right 045 to avoid	
01 h 30 min 31	**[Ouaga CCR]**	Confirm 045 nautical miles right	
01 h 30 min 34	AH 5005	Yes in heu... 8 nautical miles, 8 nautical miles	
01 h 30 min 41	**[Ouaga CCR]**	Roger, that's approved, report back on course	
01 h 30 min 47	AH 5005	Roger	
01 h 31 min 03	RAM543K	140 passing, Royal Air Maroc 543 Kilo	
01 h 31 min 07	**[TWR]**	Roger, contact Control 120.3, good bye	
01 h 31 min 10	RAM 543K	Two zero three, bye bye	
01 h 31 min 13	RAM 543 K	Le Contrôle bonsoir, Royal Air Maroc 543 Kilo	
01 h 31 min 18	**[Ouaga CCR]**	Maroc 543 Kilo, bonsoir, cleared DEKAS level 270, report DEKAS	
01 h 31 min 24	RAM 543K	Call you DEKAS for Air Maroc 543 Kilo	
01 h 32 min 00	*#Niamey CCR#*	Allô?	
01 h 32 min 01	*#Ouaga CCR#*	Oui Niamey, on a deux trafics	
01 h 32 min 04	*#Niamey CCR#*	Oui?	
01 h 32 min 06	*#Ouaga CCR#*	Maroc 543 Kilo, heu en vol à 01h27, DEKAS 01h42, Niamey à 02h08, niveau 270	
01 h 32 min 20	*#Ouaga CCR#*	Le deuxième	
01 h 32 min 25	*#Niamey CCR#*	02h08... oui?	
01 h 32 min 28	*#Ouaga CCR#*	Deuxième, Algérie 5005, EPEPO	
01 h 32 min 31	*#Niamey CCR#*	5005?	
01 h 32 min 34	*#Ouaga CCR#*	EPEPO à 01h56	
01 h 32 min 37	*#Niamey CCR#*	5005 ou 5017?	
01 h 32 min 40	*#Ouaga CCR#*	5005, tu as le 5017, ça c'est un autre, 5005	
01 h 32 min 41	AH 5005	Ouaga, Algérie 5005, we take...take by the right, heading 050	
01 h 32 min 49	**[Ouaga CCR]**	Roger 5005, copied	
01 h 32 min 53	*#Ouaga CCR#*	Algérie 5005, EPEPO à 01h56, niveau 370	
01 h 33 min 01	*#Niamey CCR#*	1-56, niveau?	
01 h 33 min 03	*#Ouaga CCR#*	370	
01 h 33 min 06	*#Niamey CCR#*	Ok	

UTC Time	Speaker	Messages	Notes, noses
01 h 34 min 04	*#Niamey CCR#*	Allô?	
01 h 34 min 05	*#Ouaga CCR#*	Allô les deux Algérie sont en train de dévier, cause météo, j'espère que tu les vois au radar	
01 h 34 min 11	*#Niamey CCR#*	Heu je les av... je ne les vois pas encore	
01 h 34 min 14	*#Ouaga CCR#*	Ok Algérie 5005 dévie à droite et 5017 aussi à droite	
01 h 34 min 22	*#Niamey CCR#*	Ok c'est bon	
01 h 37 min 07	AH 5017	Algérie five zero one seven, Radar	
01 h 37 min 14	**[Ouaga CCR]**	Algérie five zero one seven, go ahead	
01 h 37 min 17	AH 5017	(*)	
01 h 37 min 25	**[Ouaga CCR]**	Roger, contact Niamey, one three one decimal three, good bye	
01 h 37 min 28	AH 5017	One three one three, Algérie five zero one seven, choukrane (*) (“merci ” en langue arabe)	
01 h 40 min 44	AH 5005	Ouaga, Air Algérie 5005, we take by the left to ARBUT	
01 h 40 min 55	**[Ouaga CCR]**	5005 roger, report position ARBUT	
01 h 41 min 01	AH 5005	Roger, we will report position ARBUT and at ARBUT we... I call you back to avoid by the left	
01 h 41 min 11	**[Ouaga CCR]**	Copied	
01 h 41 min 33	RAM 543K	Check in DEKAS, Royal Air Maroc 543 Kilo	
01 h 41 min 41	**[Ouaga CCR]**	Maroc 543 Kilo, contact Niamey, 131.3, good bye	
01 h 41 min 46	RAM 543K	Heu one three one three, bye.	
01 h 45 min 07	AH 5005	Ouaga, Algérie 5005, we take left heading three five zero and I call you back (*) ARBUT	
01 h 45 min 23	**[Ouaga CCR]**	Roger copied… and Algérie 5005, copy Niamey weather... heu sorry, copy Niamey frequency, 131.3, 1 3 1 3, and report contacting Niamey	
01 h 45 min 36	AH 5005	131.3 with Niamey and will report contacting with Niamey, Air Algérie 5005	
01 h 45 min 43	**[Ouaga CCR]**	Roger	
01 h 45 min 46	End of transcript		

Appendix 3
Transcript of ATC communications from Niamey centre

FOREWORD

The following is a transcript of the elements which were comprehensible at the time of the readout of the cockpit voice recorder. This transcript contains conversations between crew members, radiotelephonic messages and various noises corresponding, for example, to the movement of selectors or to alarms.

The reader's attention is drawn to the fact that the recording and transcript of the CVR are only a partial reflection of events and of the atmosphere in a cockpit. Consequently, the utmost care is required in the interpretation of this document.

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GLOSSARY

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#xxx#	Telephone conversation between two control centres
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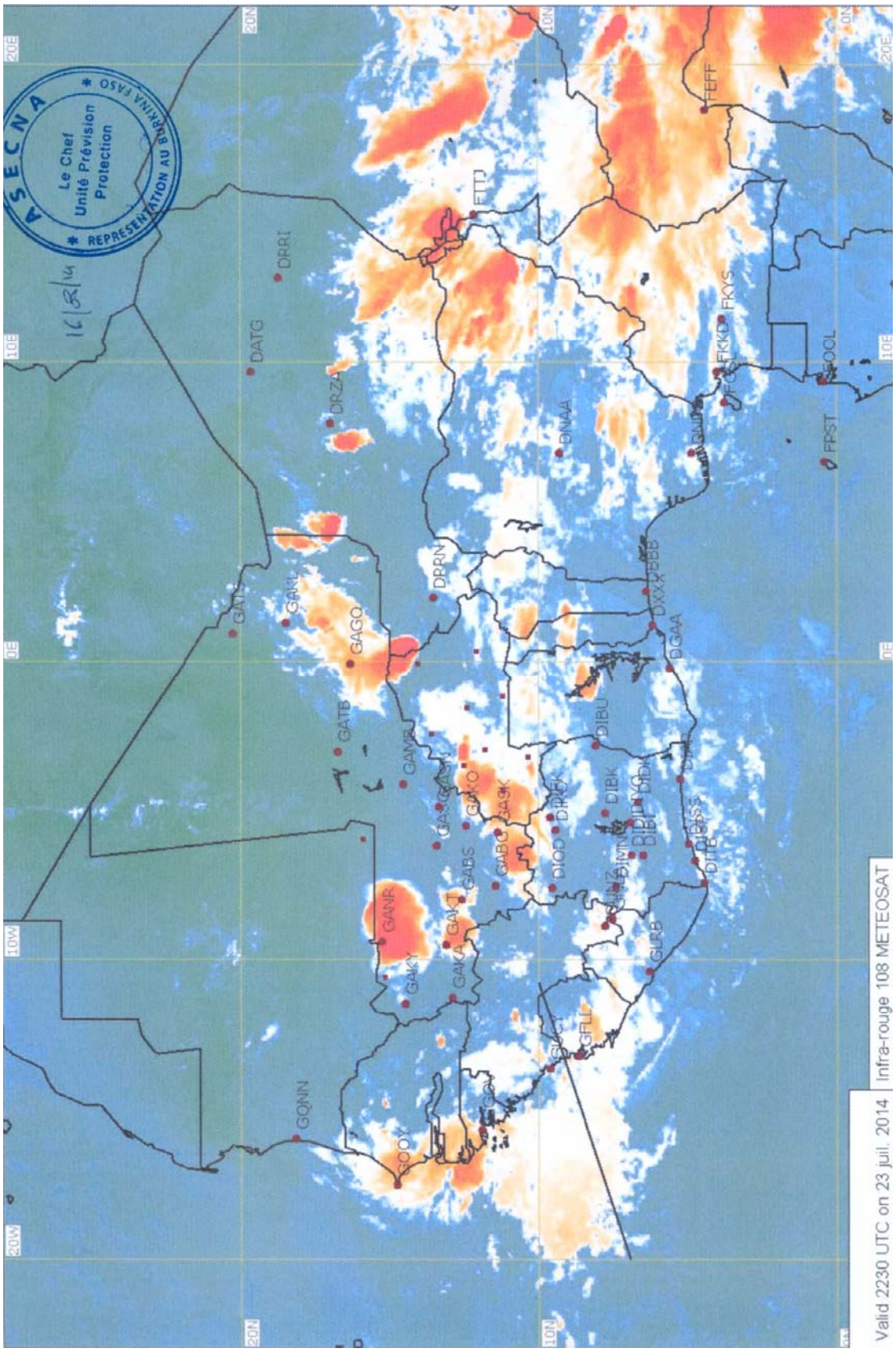
UTC Time	Speaker	Messages	Notes, noses
01 h 37 min 00	Beginning of transcript		
01 h 37 min 04	DRACO 51	Niamey Control, DRACO five one request descent	
01 h 37 min 08	**[Niamey CCR]**	Roger, cleared approach VOR DME runway 27, descent 040, report crossing 145	
01 h 37 min 16	DRACO 51	Level 070, cross... we report crossing fourteen five thousand four DRACO five one	
01 h 41 min 38	**[Niamey CCR]**	Algérie five zero one seven Niamey?	
01 h 41 min 49	**[Niamey CCR]**	Algérie five zero one seven Niamey?	
01 h 42 min 13	RAM 543K	Niamey, Air Maroc 543 K, bonsoir	
01 h 42 min 16	**[Niamey CCR]**	Maroc 543 K, Niamey bonsoir, your squawk is 1 2 2 2, 1 2 2 2. Climb to maintain… maintain level 270, copy Niamey last met report. Wind is 220 degrees, 04 knots, CAVOK, temperature 26, dew point 23 QNH 1013, trend Nosig, go ahead.	
01 h 42 min 42	RAM 543K	1013 to the 09 for landing at Niamey we estimate Niamey at 02 05… euh RITAT at 02 02 and we request a right track to avoid	
01 h 43 min 01	**[Niamey CCR]**	Roger deviation is approved report back on track and report ready for descent	
01 h 43 min 08	RAM 543K	…call you Air Maroc 543 K	RAM refers to DAH 5017
01 h 43 min 13	AH 5017	(*) Algérie five zero one…	
01 h 43 min 22	RAM 543K	Eh Niamey euh pour information il y a Air Algérie qui vous appelle	
01 h 43 min 53	**[Niamey CCR]**	Algérie five zero one seven Niamey?	
01 h 44 min 02	**[Niamey CCR]**	Algérie five zero one seven Niamey?	
01 h 44 min 09	**[Niamey CCR]**	Maroc 543 K, I need… I need a relay	
01 h 44 min 13	RAM 543K	Allez-y pour le relais pour Air Algérie	
01 h 44 min 18	**[Niamey CCR]**	Oui donc qu'il m'appelle sur 131.3	
01 h 44 min 21	RAM 543K	Qu'il vous appelle sur 131 3, il euh...	
01 h 44 min 25	RAM 543K	Alger... Air Algérie allez-y pour votre message	
01 h 44 min 29	AH 5017	Yes Algérie five zero one seven, we are maintaining flight level 310, we are on (*) to avoid	
01 h 44 min 39	RAM 543K	Euh Niamey, Air Maroc 543 K?	
01 h 44 min 42	**[Niamey CCR]**	Oui merci beaucoup, Algérie five zero one seven squawk 3 2 3 5, 3 2 3 5, report passing GAO, report passing GAO and say estimate MOKAT	

UTC Time	Speaker	Messages	Notes, noses
01 h 44 min 56	RAM 543K	Vous avez reçu Air Algérie?	
01 h 45 min 12	RAM 543K	Air Algérie d'Air Maroc 543, vous avez reçu le message de Niamey?	
01 h 45 min 22	RAM 543K	Algérie, Air Maroc 543?	
01 h 45 min 30	RAM 543K	Niamey, Air Maroc 543 K, request descent	
01 h 45 min 36	**[Niamey CCR]**	543K, Niamey, descend level 050, I call you back	
01 h 45 min 41	RAM 543K	Down, flight level 50, Air Maroc 543 K	
01 h 45 min 53	AH 5005	Niamey Niamey Air Algérie 5005 good morning	
01 h 45 min 59	**[Niamey CCR]**	5005, morning go ahead	
01 h 46 min 01	AH 5005	5005 we are…at two eight miles… to… ARBUT and heading 350 to avoid	
01 h 46 min 16	**[Niamey CCR]**	5005 squawk 3 2 2 6, 3 2 2 6, report back on track	
01 h 46 min 23	AH 5005	3 2 2 6, and euh… we come back with Ouaga Control, roger Air Algérie 5005	
01 h 46 min 49	AH 5005	Niamey, Air Algérie 5005 released by Ouaga	
01 h 46 min 57	**[Niamey CCR]**	Algérie... Royal Maroc 543 K descent level 120 initial, 120 initial for LILAM VOR DME runway 27, report at 145.	
01 h 47 min 14	RAM 543K	Called Royal Air Maroc 543 K?	
01 h 47 min 16	**[Niamey CCR]**	Affirm	
01 h 47 min 18	RAM 543K	Down, flight level 120, heading 090 and request runway 09	
01 h 47 min 28	**[Niamey CCR]**	Runway 27 in use due to arrival	
01 h 47 min 32	RAM 543K	We take 27 Royal Air Maroc 543 K	
01 h 47 min 36	**[Niamey CCR]**	Algérie 5005, Niamey?	
01 h 47 min 38	AH 5005	Yes 5005 euh…we are released par Ouagadougou and euh we are taking by the left heading 350 to avoid	
01 h 47 min 50	**[Niamey CCR]**	5005 copied, report back on track	
01 h 47 min 55	AH 5005	Roger 5005	
01 h 52 min 37	RAM 543K	Air Maroc 543 K?	
01 h 52 min 39	**[Niamey CCR]**	Go ahead	
01 h 52 min 40	RAM 543K	Approaching lower routing to ETROT and down 120	
01 h 52 min 47	**[Niamey CCR]**	Continue with Tower 119.7	

UTC Time	Speaker	Messages	Notes, noses
01 h 52 min 50	RAM 543K	Nine seven merci bye bye	
01 h 55 min 33	**[Niamey CCR]**	Algérie five zero one seven Niamey?	
01 h 55 min 37	AH 5005	5005 Ouaga go ahead?	
01 h 55 min 40	**[Niamey CCR]**	I'm calling five zero one seven, Algérie five zero one seven	
01 h 55 min 56	**[Niamey CCR]**	Algérie five zero one seven Niamey?	
01 h 56 min 25	**[Niamey CCR]**	Portugal 289, Niamey?	
01 h 56 min 28	TAP 289	289, go ahead?	
01 h 56 min 30	**[Niamey CCR]**	(*) a relay to Algérie five zero one seven	
01 h 56 min 37	TAP 289	Euh say again the call sign?	
01 h 56 min 40	**[Niamey CCR]**	Algérie five zero one seven	
01 h 56 min 45	TAP 289	Okay five zero one seven go ahead for him	
01 h 56 min 49	**[Niamey CCR]**	Please ask Algérie five zero one seven to contact Niamey on eight eight nine four	
01 h 56 min 58	TAP 289	Wilco 289	
01 h 57 min 00	TAP 289	Algérie five zero one seven, Algérie five zero one seven this is Air Portugal 289	
01 h 57 min 13	TAP 289	Algérie five zero one seven, this is Air Portugal 289 calling Algérie five zero one seven	
01 h 57 min 29	AH 5005	Air Algérie five zero one seven from Air Algérie 5005?	
01 h 57 min 36	TAP 289	I have a relay for Algérie five zero one seven to call... Niamey on eight eight nine four	
01 h 57 min 46	AH 5005	Air Algérie five zero one seven from Air Algérie 5005?	
01 h 58 min 35	TAP 289	Niamey Portugal 289?	
01 h 58 min 39	**[Niamey CCR]**	Go ahead	
01 h 58 min 40	TAP 289	I was unable to contact with Algérie five zero one seven	
01 h 58 min 44	**[Niamey CCR]**	Thank you so much maintain level 350 report passing BATIA	
01 h 58 min 48	TAP 289	350, calling BATIA	
01 h 59 min 00	End of transcript		

Appendix 4
IR satellite chart of the meteorological situation



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