Bureau Enquêtes-Accidents

R E P O R T

on the events to the MD83
registered F-GHEI and F-GFZB
operated by Air Liberté
on December 2 1997
at Orly (94)

F-EI971202A
F-ZB971202A

MINISTERE DE L'EQUIPEMENT, DES TRANSPORTS ET DU LOGEMENT
INSPECTION GENERALE DE L'AVIATION CIVILE ET DE LA METEOROLOGIE
FRANCE

FOREWORD

This report presents the technical conclusions reached by the Accident Investigation Office (Bureau Enquêtes-Accidents) on the circumstances and causes of this incident.

In accordance with Annex 13 of the Convention on International Civil Aviation and with directive 94/56, the analysis of the incident and the conclusions and safety recommendations contained in this report are 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.

Consequently, the use of this report for any purpose other than for the prevention of future accidents could lead to erroneous interpretations

SPECIAL FOREWORD TO ENGLISH EDITION

This report has been translated and published by the Bureau Enquêtes-Accidents to make its reading easier for English-speaking people. As accurate as the translation may be, please refer to the original text in French.

GLOSSARY

ADP	Aéroports de Paris
ALI	Air Liberté Industrie
EGT	Exhaust Gas Temperature
EPR	Engine Pressure Ratio
FCOM	Flight Crew Operating Manual
hPa	hectoPascal
ILS	Instrument landing System
ISO	International Standards Organization
METAR	Regular Meteorological Observation report for Aviation
MHz	MegaHertz
NV	Snow and Ice
P&W	Pratt & Whitney
PF	flying pilot
PNF	non flying pilot
RFFS	Rescue and Fire Fighting Service
SCEM	Central Meteorological Office (in Toulouse)
V1	decision speed (take off)

S Y N O P S I S

Date and times
December 2 1997
at 09 h 43 and 10 h 24[1]

Site of accidents
Paris-Orly Airport

Type of flight
Public Transport (passengers)
Scheduled Domestic Flights
F-GHEI : Flight TA 769MB
F-GFZB : Flight TA 673 ED

Aircraft
Douglas DC-9 83 (MD 83)
Registered F-GHEI and F-GFZB

Owner
FINOVA Capital, London

Operator
Air Liberté

Persons on board
F-GHEI : 2 Flight Crew, 4 Cabin Crew, 127 passengers
F-GFZB : 2 Flight Crew, 4 Cabin Crew, 61 passengers

Summary

Heavy snow falls in the night required the clearing of runways and taxiways as well as the removal of snow and de-icing of the aircraft. Following these two operations, two MD-83's operated by Air Liberté took off at a 40 minute interval.
F-GHEI : At 09 h 43, as the aircraft was on its initial climb, the crew heard an explosion and noticed that the right engine FIRE warning light was illuminated. They applied the " Engine Failure " emergency procedure, discharged the two extinguishers and performed an emergency landing.
The engine had absorbed a massive amount of slush which damaged the air intake, caused the rupture of eleven fan blades and damaged the leading edges of the remaining blades. Two fan blades in the left engine were also damaged.
F-GFZB : At 10 h 24, during acceleration for takeoff, as the speed reached 65 knots, the left engine suffered a surge. The crew interrupted the acceleration phase. The engine had absorbed slush which damaged fifteen fan blades.

Consequences

In both cases, the damage was limited to the engines.

[1] All times in this report are UTC, except where otherwise specified. One hour should be added to express local official time on the day of the accident.

1 - FACTUAL INFORMATION

1.1 History of the Flight

On December 2 1997, at around 02 h 30, snow began to fall on the southern suburbs of Paris, covering the runways, taxiways and aprons at Orly airport. Falling onto wet ground, the snow took some time to settle. At about 07 h 00, the thickness of the snow layer was 6 to 7 cm.

On that morning, execution of the airport “snow and ice” plan began late. Clearing operations on the taxiways and on runway 07, which was dealt with first, began at 07 h 00.

The condition of the runways and taxiways caused the effective closure of Orly from 05 h 00 until 08 h 35. At 08 h 35, the taxiways and runway 07 were opened. The first aircraft to use the runway was a Boeing 767 operated by American Airlines, which landed at 08 h 54. The first takeoff was performed at 09 h 21 by an Air Liberté MD83 registered F-GHHO (see para 1.16.3.3). At 10 h 00, runway 08 was in turn opened. It was assigned to takeoffs.

In this context, two Air Liberté MD 83’s prepared to undertake their flights.

1.1.1 F-GHEI

Aircraft F-GHEI was undertaking scheduled flight TA 769 bound for Toulouse. The pilot flying (PF) was the co-pilot. He was performing a line familiarization flight following his recent type rating for the MD 83. The Captain was performing the functions of non-flying pilot (PNF). There were four cabin crew.

The aircraft was at Orly Sud parking area D0. It was cleared of snow by ramp service personnel from ALI (Air Liberté Industrie), the company which undertakes maintenance on Air Liberté aircraft.

After the snow clearing operation, the boarding of the 127 passengers took place, with the APU in operation. The de-icing, which consisted of spraying warm de-icing fluid over the aircraft, was carried out by an ADP de-icing unit after the passenger walkway was withdrawn.

Chronologically :

- snow clearing was performed from 07 h 00 to 08 h 45
- the passengers boarded between 08 h 45 and 09 h 00
- de-icing was performed from 09 h 00 to 09 h 20
- the aircraft was pushed back at 09 h 24

After the aircraft pushback onto an apron not cleared of snow, engine start and taxiing on cleared taxiways N° 2 and 47, the aircraft lined up on runway 07 (see plan of runways and taxiways in appendix 1).

Takeoff commenced at 09 h 41. As the aircraft reached 30 to 40 knots, the crew noticed a slight slipping sensation, with a " hissing " sound. The engine parameters checked at 85/90 knots were normal, as well as at V1 (100 knots) and at rotation speed. A few seconds later, the radio altimeter indicating 131 feet, vertical speed indicator positive, the crew heard an explosion, immediately followed by the right engine " FIRE " alarm. The PNF made a MAYDAY call at which the control tower alerted the Rescue and Fire Fighting Service (RFFS). The crew discharged the first extinguisher, then the second, shut down the right engine with the fuel shut-off valve and extended the flaps from 11° to 15°. The right engine " FIRE " alarm turned off. The PF turned the aircraft to the left to go downwind on runway 07 with radar assistance.

The single-engine landing took place at 09 h 51 under surveillance from the RFFS. The aircraft left the runway and returned to the parking area where the passengers were disembarked.

Right engine fan blades were missing, destroyed or severely damaged (see appendix 4, plate 1).

1.1.2 F-GFZB

Aircraft F-GFZB was undertaking scheduled flight TA 673 ED bound for Strasbourg. The Captain was the pilot flying (PF). There were four cabin crew.

The aircraft, at parking area D 08, was cleared of snow by ramp service personnel from ALI.

After the snow clearing operation, the boarding of the 61 passengers took place, with the auxiliary power unit in operation. De-icing was carried out by an ADP de-icing unit after the passenger walkway was withdrawn.

Chronologically :

- snow clearing was performed from 07 h 30 to 09 h 30
- the passengers boarded between 09 h 30 and 09 h 45
- de-icing was performed from 09 h 55 to 10 h 15
- the aircraft was pushed back at 10 h 15

After pushback, the aircraft proceeded along the taxiways. Successive instructions from the control tower were to proceed towards the threshold of runway 08, then towards the threshold of runway 07, then again towards runway 08. Since the aircraft was on taxiway 47C and was unable to turn back to take runway 08, (see plan in appendix 1), the tower had the aircraft continue on to runway 07.

With the aircraft lined up, the brakes were released at 10 h 24. At about 60 knots, the crew had the impression that the aircraft was " scrubbing " to the left. The PNF noted a slight fluctuation in the left engine EPR (a parameter measuring power). The PF rejected the takeoff. The aircraft returned to parking area D08.

1.2 Injuries to Persons

Not applicable.

1.3 Damage to Aircraft

In both cases, the engines were damaged.

1.4 Other Damage

None.

1.5 Flight Crew

1.5.1 F-GHEI

Captain

- Male, aged 50 years
- Licenses :
  Airline Transport Pilot's License obtained on October 3 1979, valid to June 30 1998. Air transport instructor's license valid till December 31 1999
- Type Ratings : Caravelle SE210, Boeing 727, MD83
- Line check : May 19 1997
- Base check (simulator) : January 17 1997
- Flying Experience
  Total : 13,256 flying hours of which 1,915 on MD83
  In the previous month : 35 hours plus 4 h 30 on simulator

First Officer

- Male, aged 52 years
- Licenses
  Airline Transport Pilot's License obtained on September 5 1990, valid to June 30 1998.
- Type Ratings : ATR, DC6, DC8, MD83
- Line check : December 17 1997
- Base check (simulator) : October 27 1997
- Flying Experience
  Total : 12,328 flying hours of which 40 on MD 83
  In the previous month : 40 hours, all on MD83

1.5.2 F-GFZB

Captain

- Male, aged 55 years, of Swiss nationality
- Licenses
  French Airline Transport Pilot's License obtained on January 30 1998, valid to June 30 1998.
- Type Ratings : DC8, Caravelle SE210, MD83
- Line check : June 30 1997
- Base check (simulator) : November 30 1997
- Flying Experience
  Total : 18,401 flying hours of which 5,648 on MD83
  In the previous month : 57 hours, all on MD83

First Officer

- Male, aged 44 years
- Licenses
  Airline Transport Pilot's License obtained on October 24 1979, valid to May 31 1998.
- Type Ratings : Nord 2501, Twin Otter DHC6, Nord 262, MD83
- Line check : June 26 1997
- Base check : November 15 1997
- Flying Experience
  Total : 8,643 flying hours of which 1720 on MD 83
  In the previous month : 57 hours, all on MD83

1.6 Aircraft Information

- Manufacturer : McDonnell-Douglas Corp.
- Type : Douglas DC 9-83 (MD 83)
- Engines : Pratt & Whitney type JT8D-219

	F-GHEI	F-GFZB
Constructor's number	49968	49707
Year of construction	1990	1988
Airworthiness certificate	valid to June 2 1999 " V situation "	valid to May 5 1999 " V situation "
Total flying hours to December 2 1997	16 799	23 069
Takeoff weight	57,576 kg for a maximum authorized takeoff weight of 72,576 kg	55,306 kg for a maximum authorized takeoff weight of 72,576 kg
Balance	within authorized limits	within authorized limits
Engine serial numbers	engine 1 engine 2 718-780 718-184	engine 1 engine 2 718-079 718-558
Total engine hours	17 606 18 803	20 825 16 344
Engine hours since overhaul	4916 4165	1678 4181

1.7 Meteorological Information

1.7.1 General Situation

At altitude :

A depression extended from the Norwegian Alps to the Gulf of Genoa. It produced a moderate northwest to north airflow over the east and center of France.

On the ground :

At 12 h 00 on December 1st, an Atlantic depression with a pressure of 1005 hPa at its center, approached Brittany while deepening. It moved east and was situated north of Le Mans on December 2nd at 00 h. Pressure at its center fell to 992 hPa. The depression continued east-south-east and was situated near Gien at 06 h, the pressure at its center having stabilized.
The associated weather pattern generated heavy rain accompanied by snow and 10 to 20 knot winds from the east on the north and east sides.

1.7.2 In the Paris Region

From 02 h 30, sleet began to fall on the south and then the east of the Paris region. At the same time the wind switched from 100° to 020°, 10 to 15 knots. The screen temperature dropped slowly to around 0 °C.

Subsequently, snowfall intensified slowly until, by the end of the morning, there was a layer around 7 centimeters deep.

The chronology of these events, in thirty minute segments, is featured in the following table, based on the METAR reports issued by the Orly Meteorological Center from December 1st at 23 h 00 to December 2nd at 08 h 00.

Date/Time	Air and Dewpoint Temperature (° C)	Wind (speed in knots)	Precipitation	Observations
01/2330	05/03	110°/11	Rain	
02/0000	04/03	120°/12	Rain	
02/0030	04/03	120°/12	Rain	
02/0100	03/02	120°/13	Rain	
02/0130	03/02	120°/16	Rain	
02/0200	02/01	110°/14	Rain	
02/0230	02/01	100°/12	Rain/Snow	Mixed light snow and rain
02/0300	01/01	090°/13	Snow	Light snow
02/0330	01/00	080°/12	Snow	
02/0400	00/00	060°/12	Snow	
02/0430	00/00	050°/12	Snow	
02/0500	00/00	040°/12	Snow	3 cm layer
02/0530	00/00	040°/12	Snow	5 cm layer
02/0600	00/00	030°/12	Snow	7 cm layer
02/0630	01/00	010°/11	Snow	
02/0700	01/00	010°/10	Snow	
02/0730	01/00	020°/09	Snow	
02/0800	01/00	020°/14	Snow	

The temperature fall at 02 h 30 corresponds to the beginning of the snowfall. At 06 h 00, the thickness of the layer of snow reached seven centimeters. The snow was wet and heavy and, under the effect of the wind, tended to be transformed into ice.

After 08 h 00, the snowfall persisted until about 12 h 00, the extra depth of snow being about two centimeters.

1.7.3 Reports from the Orly Meteorological Station

In the context of its " Snow-Ice " instructions, the Orly station issues daily snow-ice forecasts.

The snow-ice bulletin of December 1st 1997, issued at 13 h 30, is reproduced in appendix 2 : it forecasts that for the night of December 1st and 2nd " *there will be no ice. Sleet is possible at the end of the night. No snow will settle (ground too warm)* ". This report was made by the station forecaster based on analyses of the local meteorological situation and on the bulletin from the Central Meteorological Office (SCEM, Toulouse).

On December 2nd at 03 h 00, the duty officer in the runway office, noticing that the sleet which was falling had given way to snow became concerned and telephoned the station.

At 03 h 54, the forecaster issued an Airport Warning Report because the screen temperature and the dewpoint were at 0 °C. The station issued two further reports, at 05 h 20 and 08 h 30 respectively. The three reports are reproduced in appendix 3.

- The 03 h 54 report forecast snow falls until 07 h 00, the depth of the layer reaching 1 or 2 centimeters.
- The 05 h 20 report forecast that , between 05 h 30 and 08 h 30, the depth of the snow layer would reach from 5 to 10 cm.
- The 08 h 30 report forecast that until 12 h 30 the snowfalls would change to sleet and end towards the end of the morning.

1.7.4 SNOWTAM Reports

Reports coded SNOWTAM give useful information concerning the evolution of the condition of the airport following snowfalls. They are issued by the local air traffic control organization.

The SNOWTAM reports issued by Orly are reproduced in appendix 2.

- Reports 8 and 9 issued on December 2nd at 06 h 55 warned of snow covering runways 07 and 08.
- Report 10 issued at 08 h 23 followed entry into service of runway 07 after snow clearance operations : the runway was wet, totally cleared of snow; its friction factor was good. Runway 08 was not in service.
- Report 11 issued at 10 h 02 followed entry into service of runway 08. The runway was wet and totally cleared of snow. Its friction factor, measured by the " IMAG " was 63.

1.8 Aids to Navigation

F-GHEI's emergency landing was performed using the following equipment :

- runway 07's ILS,
- the outer marker and the inner marker,
- the lighting systems.

This equipment functioned normally.

1.9 Communications

A transcript of radio communications between Orly Tower (frequency 118.700 Mhz) and the following aircraft can be found in appendix 3 :

- An American airlines Boeing 767 landing at 08 h 54. This aircraft was the first to use runway 07 after the snow clearing operations. In response to the question from the controller " Can you tell me about braking action? " the crew replied " the braking action fair ... We'd call it fair ".
- F-GHEI (emergency procedure after fire in right engine, MAYDAY message, RFFS action).
- F-GFZB (taxiing to threshold of runway 07 then acceleration/stop).

1.10 Airdrome Information

Paris Orly Airport is an airdrome under civil control, open to public transport aircraft, operated by Aéroports de Paris (ADP).

This section concentrates on the airport's equipment for clearing snow from runways and taxiways and on equipment for de-icing aircraft.

1.10.1 Snow Clearing Equipment for Movement Areas

To proceed with snow clearing operations, ADP possesses heavy machinery (blower-sweepers, snow plows, dispersal equipment ...). Operations are managed by a snow control center activated by the ADP engineer on duty " *as soon as the snow begins to settle on the ground (see Snow-Ice Season 1997/1998 instructions of October 28 1997)* ".

The chronology of snow clearing operations on December 2 1997 is in appendix 5 along with the duty forms of the clearance teams. In brief, it should be noted that :

- the snow control center was activated at 04 h 45. The duty engineer arrived at 05 h 15, the representative of the maintenance services at 05 h 30.
- actual snow clearing operations began at 07 h 00. The teams responsible for clearing the snow, not being on permanent duty at the airport, had difficulty in reaching the airport, given the condition of the snow-covered roads.

1.10.2 Aircraft De-icing Equipment

The ADP de-icing unit is equipped with special vehicles called " de-icers ". These vehicles are equipped with tanks of a de-icing product. At Orly, the product used is of the type II, ADN104N, concentrated 75%, with 25% water. The de-icer is manned by a two-man team, a driver and a gondola operator. The operator can

vary the height of the gondola so as to be at the appropriate height to spray the de-icing fluid from a nozzle at a temperature of 69 °C onto the part of the aircraft within range. The driver, in radio contact with the operator in the gondola, maneuvers following instructions from the former so as to carry out the de-icing. A supervisor oversees the de-icing operations.

At Orly, some airlines have their own de-icing equipment. For its part, Air Liberté has its aircraft de-iced by ADP.

1.11 Flight Recorders

In accordance with applicable regulations, each aircraft was equipped with two flight recorders.

1.11.1 F-GHEI

- a Cockpit Voice Recorder (CVR) manufactured by Sunstrand, N° 11489 (30 minute recording capacity)
- a Flight Data Recorder (FDR), manufactured by Sunstrand, N° 6191.

CVR : The recorder was not stopped after the landing. The 30 minutes of recorded dialogue are subsequent to the event. The recording contains no information relevant to the investigation.

FDR : The graph in appendix 6 shows the evolution of both engines' EPR parameters. A slight fluctuation in the right engine's EPR occurs at 9 h 40 mn 37 at a speed of 36 knots. A sudden loss of power in the right engine occurs at 9 h 41 mn 10, at a radio-height of 131 feet and aircraft speed of 178 knots.

1.11.2 F-GFZB

- a 30-minute recording capacity CVR which was not read out.
- a Sunstrand DFR N° 4579

CVR : The recorder was not read out. In fact, the aircraft flew again after the overhaul of the left The recorder ran for over 30 minutes and the recording of the event was wiped out.

FDR - The graph in appendix 6 shows the evolution of both engines' EPR, EGT, Fuel Flow and N1 parameters. At 10 h 24 mn 05 we can see the following fluctuations in the left engine, the aircraft's speed being 61 knots and accelerating :

- distinct loss of power (EPR),
- distinct increase in temperature (EGT).

These variations indicate a surge. The takeoff was aborted. The maximum speed reached was 74 knots.

1.12 Wreckage and Impact Information

1.12.1 F-GHEI

Right engine

The photos in appendix 4 show the severity of the damage sustained.

For the fan :

- four blades, including three in a row, were broken off at the root,
- seven blades were broken off at the base of the sponsons,
- the leading edges of all of the other blades were damaged.

Deformations can be seen on the air inlet and the nose cap.

In addition, a fire, limited to the lower part of the forward part of the engine, broke out at the level of the low-pressure compressor. It was caused by the dislocation of the low-pressure compressor casing and a fuel leak in the area of the fuel/oil heat exchanger.

Left engine

- Two consecutive fan blades were slightly damaged on the leading edge (see photo 4),
- Endoscope examination showed that a high pressure compressor seventh stage blade was twisted.

1.12.2 F-GFZB

Left engine

- Inspection of the fan showed that the leading edges of fifteen blades were damaged.

1.13 Medical and Pathological Information

Not relevant

1.14 Fire

The fire in the right engine of F-GHEI was extinguished by the crew who discharged both extinguishers.

1.15 Survival Aspects

F-GHEI's Chief Steward was informed of the right engine fire by one of his colleagues, a fire confirmed by one of the airline's pilots who was in transit sitting on the right. The Chief Steward made a first announcement to the passengers, stating that the fire had been brought under control. The cabin crew then prepared the passengers for an emergency landing, checking in particular that the center aisle and the emergency exits were clear. In a second announcement, the Chief Steward informed the passengers that the emergency exits were ready for any possible evacuation.

The passengers remained calm and collected.

1.16 Tests and Research

1.16.1 Examination of Engines

1.16.1.1 F-GHEI Engines

Right engine

A preliminary examination of the air inlet and the engine was carried out on the spot in the presence of the engine manufacturer's representative. Examination of the impacts on the lower part of the air inlet and the nose cone of the engine (see photo 3 in appendix 4) established that the damage to the fan were characteristic of ingestion of a soft body (bird, ice, slush). In fact, soft bodies cause very different damage to that resulting from the ingestion of hard bodies (stones, bolts ...). The following step was the disassembly and examination of the engine, carried out in January 1998 in Madrid by Iberia, the holder of the maintenance contract for Air Liberté's engines, with the participation of the Pratt & Whitney representative.

The following conclusions were reached :

- *a single block was ingested, of twenty pounds or more,*
- *the impact on the fan occurred on the three consecutive blades which were broken off at the root (see photo 2),*
- *the absence of any metallisation of the combustion chambers and the turbine blades as well as the good condition of the high pressure compressor leads to the conclusion that the engine decelerated immediately after the damage to fan*

blades, apparently following a compressor surge, which is coherent with the data from the FDR,

- *the absence of any organic debris (bird debris) on the fan blades leads to the conclusion that the engine ingested slush from below, from the ground or from the landing gear (not from the wings or fuselage). In fact, the blades examined were covered with debris and sand, which shows that the snow was dirty.*

Pratt & Whitney stated that in the 20 year life of the JT8D engine, this was the first time that damage to the fan due to ingestion of a massive soft body had been so extensive.

Note that the MD83, due to the position of the engines behind the main landing gear and in line with it, is particularly vulnerable to ingestion of all kinds through the air inlet (debris from burst tires, stones, slush ...).

Left engine

The minor damage noted on the leading edges of two consecutive fan blades (see photo 4) were caused by a soft body, of the same type ass that involved in the right engine damage.

1.16.1.2 F-GFZB Left Engine

Fifteen fan blades had sustained minor damage to the leading edges. This damage are of the same type as that sustained by F-GHEI's left engine. The engine, which experienced a significant surge, was able to be repaired after replacement of the twenty-seven blades (in addition to the 15 damaged blades it was necessary to replace 12 others for reasons of balance).

1.16.2 Regulations Relating to De-Icing

The main regulations relating to de-icing and anti-icing for aircraft are the following :

- the ISO standard 11076 (1993) relating to " *Aircraft de-icing/anti-icing methods using fluids* ". At the time of the accident, this standard specified :
- *- 8.1.4 <u>Elimination of snow</u> the nozzle must be adjusted with sufficient flow to eliminate deposits. Note 9 : the operating mode selected will depend on the equipment available as well as the type of snow(light and dry or heavy and wet). In general, the heavier the deposit is, the higher the rate of flow lust be to eliminate the deposit effectively from the surfaces of the aircraft ... A significant accumulation of snow will always be difficult to eliminate from aircraft surfaces and any attempt will invariably consume large quantities of liquid. In this situation serious consideration should be given to removing the majority of the snow by hand before trying normal de-icing*.
- The instruction of November 5 1987 which stipulates " *that an aircraft can only be used if it is first cleaned of all deposits of snow, ice ... which may affect its performance* " and that the Captain may not take off if this operation has not been carried out.

- The MD80 FCOM which specifies : " *once the de-icing has been carried out, the aircraft must be inspected by trained and qualified ground personnel or by the flight crew so as to ensure that the results of the de-icing are good. If any doubt remains about the condition of the critical surfaces, the aircraft must be checked again by the flight crew or by trained and qualified ground personnel before beginning taxiing and takeoff* ".
- The Air Liberté Operating Manual which repeats the same instructions, notably in chapter 07.06 page 1, De-icing and anti-icing. Generalities : " *it is forbidden to allow an aircraft to take off when ice, snow or rime is present on the fuselage, the wings, the tail assembly, the flight control surfaces, air inlets ... Experience has shown that a large number of aviation accidents are caused by icing ..; A visual and manual check must be performed by ramp service personnel or by the captain in the absence of ramp service personnel. The captain is the person with overall responsibility for de-icing/anti-icing operations* ".

Furthermore, the following information can be found in the Orly ADP station service instructions :
" *ADP's responsibility is limited to providing a de-icing product in conformity with specifications. Inspection of de-icing operations is the responsibility of the startup mechanic "* .

The contract between ADP and Air Liberté for de-icing services specifies two types of de-icing :

- partial de-icing limited to the wings and the tail,
- complete de-icing.

1.16.3 Testimony

The following study is based on statements by persons who all played a role at one time or another : technicians, runway assistants, crew members, de-icer gondola operator, technical controller.

1.16.3.1 F-GHEI

<u>Snow removal</u>

Manual removal of the snow on the wings and the air inlets was carried out by four ALI ramp service personnel using brooms. This operation was difficult because the snow was heavy and frozen and stuck in some places to the aircraft skin. To work safely, the ramp service personnel attached themselves by rope to a hook on the wing. Snow clearance of the top of the fuselage, inaccessible with brooms alone, was not carried out.

The copilot stated : " *I noticed that the wings were covered with a thick layer of snow about 5 cm thick. A wing sweeping operation got under way. This proved extremely difficult given the nature of the snow. I asked that both engines' air*

inlets be inspected and allso that deposits of snow on the top of the inlets be swept off. "

De-icing

This was carried out by an ADP de-icer :

- the gondola operator stated that the de-icing service requested by an ALI mechanic was limited to a partial de-icing,
- the crew being in audio contact from the cockpit with the runway assistant, the captain asked for the fuselage to be de-iced,
- the runway assistant told the captain that the fuselage de-icing had been performed,
- during the interviews after the event, the gondola operator (ADP) stated that only a partial de-icing had been performed. . He added " *there was still snow on the top of the fuselage* ".

Taxiing before takeoff

- Taxiing was carried out by the copilot who stated : " I avoided running over heaps of snow built up at taxiway crossroads by snow clearance equipment. Taxiways 47B, 47C, 47D were cleared of snow ".
- During taxiing, the chief steward who saw an accumulation of snow on the wings (mixture of snow and de-icing fluid), mentioned this to the captain.
- A pilot who was a passenger at the rear of the aircraft confirmed the presence of snow on the wings.

1.16.3.2 F-GFZB

Snow removal

Snow removal was carried out under the same conditions as for F-GHEI, with the same ramp service personnel having the same equipment. Snow removal was also limited to the wings and the engine air inlets. The difficulties encountered in the manual clearing of snow from the aircraft were the same as those encountered with F-GHEI.

De-icing

This was carried out by the same ADP team with the same de-icer.

- The gondola operator explained that the de-icing service requested by an ALI mechanic was limited to partial de-icing.
- The captain then intervened to ask for a full airframe de-ice, which meant complete de-icing. This was carried out.

Taxiing before attempted takeoff

The captain stated that during the ground roll, : " *the taxiways used were inadequately cleared, with piles of melting snow in various places* ".

1.16.3.3 Supplementary Testimony

Before the events which occurred to F-GHEI and F-GFZB, one of the first aircraft cleared for takeoff from runway 07, meaning after the landing of the American Airlines B767, was an air Liberté MD83 registered F-GHHO. This takeoff occurred without incident. The captain stated : " *I could not be sure of correct de-icing of the since the procedures in place at Air Liberté were not respected. This obliged me to carry out a visual inspection of my aircraft before deciding to undertake the flight.* "

After the F-GHEI and F-GFZB events, the Air Liberté Operations department sent a technical inspector to the threshold of the runway to check the condition of the airline's MD83's landing gear before takeoff.

This inspector explained that he had inspected three MD83's (F-GJHQ, F-GHHP and F-GHEQ). He was able to state that " the landing gears were covered with snow ".

- on the nose gear , between the rims, above the shoes,
- on the main landing gear, the snow being between the wheels inside the rims and on the shoes.

The aircraft took off after cleaning of the landing gear.

2 - ANALYSIS

The damage to both engines of F-GHEI and to the left engine of F-GFZB was produced by the same cause, linked to the prevailing meteorological conditions : the ingestion of slush during takeoff or during acceleration for takeoff. The investigation was able to establish that the wet mass ingested by the engines could only have been slush.

Based on this, it is necessary to establish the origin of the slush. Thus, we will examine successively the clearing of snow in the movement areas at Orly and the de-icing of the two aircraft.

The final paragraph will deal with the meteorological forecasts.

2.1 Snow Clearing in the Movement Areas

The most significant event is the loss of power and in-flight fire of the right engine of F-GHEI. This event was linked to the ingestion of a block of slush, weighing over twenty pounds, which came from the ground or from the landing gear.

F-GHEI left parking area DO at Orly Sud, an area not cleared of snow, to proceed to the threshold of runway 07 via taxiways 2 and 47. This long route was imposed by the priority given to runway 07 during snow clearing procedures at the airport. On departure from the parking bay, the main landing gear, protected by the wings, was certainly unencumbered. Taxiing, first on the uncleared parking area and subsequently on the taxiways where, according to corresponding witness statements, lumps of snow remained at the crossroads, may have caused buildup of snow on the landing gear. This phenomenon was also noted later by the technical controller positioned at the threshold of the runway on three MD 83's. This controller had to clear off lumps of snow which had accumulated on the landing gear of these aircraft before they took off.

As to the condition of the runway itself, we may note that the crew of the American Airlines Boeing 767, the first aircraft authorized to use it after the snow-clearing operations, when asked by the controller, made no mention of problems. It is therefore quite likely that the buildup of snow on the landing gear of F-GHEI occurred during taxiing rather that on the runway itself.

Note should be made of the difficulties encountered in the deployment of snow clearing equipment in the movement areas. In fact, the " snow-ice " report from the Orly meteorological station on December 13 at 13 h 30, though forecasting the possibility of falls of snow and sleet at the end of the night, forecast that there would be no snow cover on the ground, since the ground would be too warm for it to settle. As a result, the teams charged with putting the snow clearing equipment into place had not been called into service on the spot and could only join up later.

In this hurried context, it is likely that the clearance of the taxiways leading to runway 07 was not undertaken in optimal fashion.

2.2 De-icing of F-GHEI and F-GFZB

The snow which covered the aircraft in the parking area that morning was wet and heavy and, in places, it was transformed into ice which stuck to the skin of the aircraft, considerably complicating the preparation of the flight.

The ramp service personnel, considering the equipment available to them (brooms) were unable to remove the snow from the upper side of the aircraft, which was inaccessible to them.

This method of snow removal conforms to the indications in the ISO standard (para. 1.16.2) : it is logical to remove the majority of the snow manually before trying the normal de-icing procedure.

After this necessarily incomplete snow removal operation, the same ADP de-icing machine was used for both aircraft. Various witness statements shown in para. 1.16.3. allowed us to determine how operations were performed in each case.

By comparing the manner in which the de-icing operations were carried out with the prescribed method, it appears that :

- the requests for partial de-icing forwarded by ALI to ADP were inappropriate to the situation. In this particular case, only a complete de-icing operation, with de-icing hose nozzles set at a high rate of flow; could have completely removed the ice stuck to the skin of the aircraft,
- the Captains, who had final responsibility for de-icing/anti-icing operations, depended on the ramp service personnel,
- the ramp servicemen, who have no training to judge correct execution of de-icing operations, played a role transmitting information between the crew and the ramp service personnel and, at least in the case of F-GHEI, gave erroneous information to the crew.

In addition, the Captain of Air Liberté aircraft R-GHHO, which took off from runway 07 at 09 h 21 without incident, noted that " *he was not certain that the de-icing procedure had been correctly carried out, since the Air Liberté procedures were not respected* ".

In this context we may have doubts as to the correct de-icing of the aircraft especially as, in the case of F-GHEI, the testimony of the Chief Steward and of one passenger confirm that there was a mixture of snow and de-icing fluid on the wings.

Since the investigation was not able to establish the origin of the slush ingested by the left engine of F-GHEI and that ingested by the left engine of F-GFZB, we cannot exclude the possibility that it was the de-icing/anti-icing procedure which caused ingestion of slush by the engines and not the state of the taxiways.

2.3 The December 1st Ice-Snow Forecast

The forecast was erroneous, since the snow cover reached an overall thickness of around seven centimeters.

Precipitation occurred throughout the night. A part of it evaporated and, adding to the action of the wind, increased chilling of the air. In the second part of the night, snow began to fall and simultaneously with night cooling, the air and ground temperature dropped to 0°C. The snow thus began to settle on the ground from about 03 h 45. Next, precipitation intensified though the screen temperature remained positive, close to zero.

The depression and its associated front moved towards the south-east instead of following a path to the south-west which would have produced rapid warming. Thus, by passing further south than forecast, the precipitation at the front of the warm front led to more snow south-west of the Seine than to the north-east.

3 - CONCLUSIONS

3.1 Findings

- ###snow-clearing operations on the movement areas started late as a result of a partially incorrect weather forecast;
- ###de-icing procedures on F-GHEI and F-GFZB did not entirely conform to standard procedures;
- s###now accumulated on the landing gear of the aircraft during taxiing on the taxiways, which were incompletely cleared;
- ###the right engine of F-GHEI ingested a massive block of slush, an ingestion which caused the destruction of the fan and led to a fire which was extinguished when the crew discharged the two extinguishers;
- t###his block of slush probably came from the right main landing gear or the nose gear;
- ###the left engines of F-GHEI and F-GFZB also ingested slush, which caused damage to the fans in both cases;
- ###faced with difficult situations, the crews applied emergency procedures successfully.

3.2 Causes

Both events resulted from ingestion of slush by the engines during critical phases of flight. These ingestions were caused by :

- ###an imprecise and optimistic weather forecast,
- ###an incompletely performed snow clearing operation on the airport movement areas,
- ###a de-icing/anti-icing procedure performed on the aircraft concerned with insufficient application.

4 - RECOMMENDATIONS

Considering the above conclusions, the Bureau Enquêtes-Accidents recommends :

- **that ADP :**

  re-examine its procedures for removing snow from aircraft movement areas.

- **that Air Liberté :**

  complete its de-icing/anti-icing procedures so as to ensure that such operations can only be performed in conformity with the regulations.

Note : after the events of December 2 1997, ADP and Air Liberté took various measures, which are summarized hereafter :

ADP :

- Annual publication of the snow plan with particular attention paid to services in charge of snow removal so as to eliminate buildup of snow (banks of snow on the edges of taxiways),
- Development of a minimal program (checklist) to avoid buildup of snow at crossroads.

Air Liberté :

- In case of risky meteorological conditions :
- creation of a de-icing group which, under the authority of the operations manager, supervises flights,
- appointment of one ramp service mechanic per aircraft, responsible for all de-icing and anti-icing operations,
- setting up of a procedure to inspect landing gear near the threshold in order to check its condition.
- Overhaul of training for ramp service personnel and runway assistants on de-icing.
- Reminders to all crews of instructions for de-icing and the use of aircraft in cold weather.

Appendices

APPENDIX 1
Runways and taxiways at Orly Airport

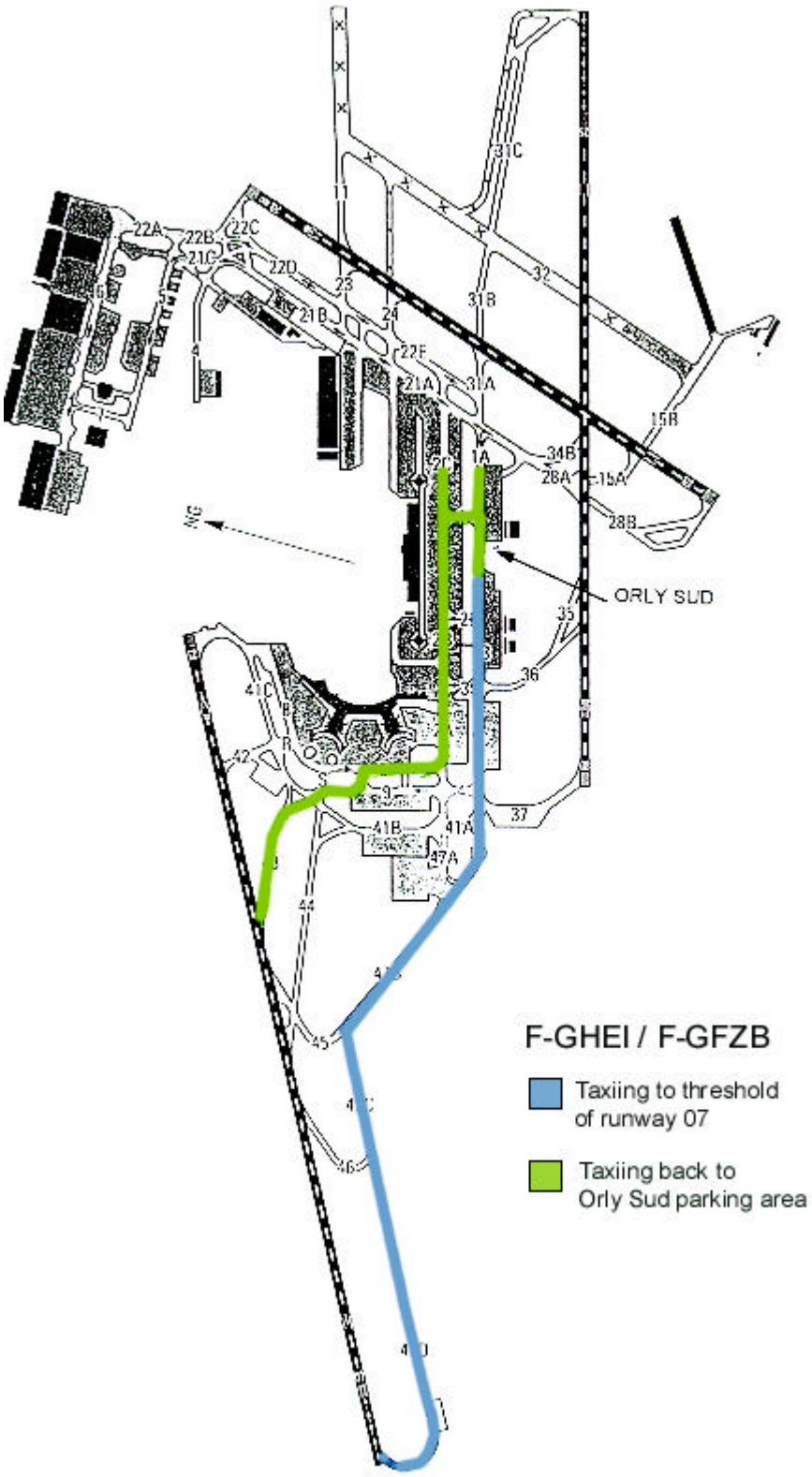
APPENDIX 2
Meteorological forecast reports and Snowtams

APPENDIX 3
Transcripts of radio communications

APPENDIX 4
Photos of damage to F-GHEI's engines

APPENDIX 5
Snow clearing operations on runways and taxiways

APPENDIX 6
FDR read-out


ORLY SUD
F-GHEI / F-GFZB
Taxiing to threshold of runway 07
Taxiing back to Orly Sud parking area

The Snow-Ice bulletin of December 1st 1997 issued at 13 h 30

Messages NV du 01/12/97 :

ZCZC OWA084 1138
DD LFPOYMYX
011326 LFPOYMYX
M E T E O - F R A N C E

MESSAGE NEIGE ET VERGLAS DE LA STATION METEOROLOGIQUE D'ORLY
EMIS LE 01/12/97 A 1330 UTC
PREVISIONS POUR LA NUIT DU 01/12 AU 02/12
PAS DE VERGLAS.
PLUIE ET NEIGE MELEES POSSIBLE EN FIN DE NUIT. PAS DE
COUCHE AU SOL (SOL TROP CHAUD)
- TEMPERATURE MINIMALE SOUS ABRI PREVUE : + 1 DG

TENDANCE POUR LES 3 JOURS A VENIR
PAS DE VERGLAS. AVERSES DE PLUIE ET NEIGE POSSIBLES LES
JOURNEES DU 02/12 ET 04/12. PAS DE COUCHE AU SOL.
-TEMPERATURES MINIMALES : 0 A -1 DG
-TEMPERATURES MAXIMALES : 13 A 14 DG-
NNNN

ZCZC OWA095 1553
DD LFPOYMYX
011552 LFPOYMYX
M E T E O - F R A N C E

MESSAGE NEIGE ET VERGLAS DE LA STATION METEOROLOGIQUE D'ORLY
CONFIRMATION DU BULLETIN N.V DU 01/12/97 A 1330UTC=
NNNN

The Airport Warning Reports

ZCZC OWA025 0353
DD LFPOYMYX **Message de 3 h 54**
020354 LFPOYMYX
.
MESSAGE D'AVERTISSEMENT D'AERODROME DU 02/12/97
.
PREVISION DE NEIGE VALABLE DE 0300 A 0700 UTC
TEXTE : DES CHUTES DE NEIGE EN PROVENANCE DU NORD EST POURRAIENT ATTEINDRE UNE EPAISSEUR DE 1 A 2 CM=
NNNN

ZCZC OWA036 0521
DD LFPOYMYX **Message de 5 h 20**
020520 LFPOYMYX
.
MESSAGE D'AVERTISSEMENT D'AERODROME DU 02/12/97
.
PREVISION DE NEIGE VALABLE DE 0530 A 0830 UTC
TEXTE : LES CHUTES DE NEIGE CONCERNENT ENCORE L'AEROPORT. LA COUCHE DE NEIGE ATTEINDRA UNE EPAISSEUR DE 5 A 10 CM=
NNNN

ZCZC OWA060 0831
DD LFPOYMYX **Message de 8 h 30**
020830 LFPOYMYX
.
MESSAGE D'AVERTISSEMENT D'AERODROME DU 02/12/97 A 0830
.
PREVISION DE NEIGE POUR LE 02/12/97 DE 0830 A 1230UTC
TEXTE :LES CHUTES DE NEIGE VONT PROGRESSIVEMENT SE TRANSFORMER EN PLUIE ET NEIGE MELEES PUIS SE CALMER EN FIN DE MATINEE AVANT DE REPRENDRE SOUS FORME D'AVERSES EN FIN D'ECHEANCE.
NNNN

The SNOWTAM reports

```
ZCZC LOA023 0655
FF LFPOSNOW LFZZONVB LFZZSZLF LFPOZDRG
020655 LFPOZPZX
SWLF0003 LFPO 12010645
SNOWTAM0008
A)LFPO  B) 12020645
C)07 D)0 F)5/5/5 G)50/50/50 H)1/1/1 T)100 POUR CENT
C)08 D)0 F)5/5/5 G)50/50/50 H)1/1/1 T)100 POUR CENT
--SENT TO--
LFPOSNOW LFZZONVB LFZZSZLF LFPOZDRG


ZCZC LOA024 0655
FF LFPOSNOW LFZZONVB LFZZSZLF LFPOZDRG
020656 LFPOZPZX
SWLF0009 LFPO 12010645
SNOWTAM0009
A)LFPO  B) 12020645
C)07 D)0 F)5/5/5 G)50/50/50 H)1/1/1 T)100 POUR CENT
C)08 D)0 F)5/5/5 G)50/50/50 H)1/1/1 T)100 POUR CENT
--SENT TO--
LFPOSNOW LFZZONVB LFZZSZLF LFPOZDRG


ZCZC LOA032 0823
FF LFPOSNOW LFZZONVB LFZZSZLF LFPOZDRG LFMPZPZX
020823 LFPOZPZX
SWLF0010 LFPO 12020815
SNOWTAM0010
A)LFPO  B) 12020815
C)07 F)2/2/2 G)0/0/0 H)5/5/5
C)08 D)0 F)5/5/5 G)50/50/50 H)1/1/1 T)100 POUR CENT
--SENT TO--
LFPOSNOW LFZZONVB LFZZSZLF LFPOZDRG LFMPZPZX


ZCZC LOA038 1002
FF LFPOSNOW LFZZONVB LFZZSZLF LFPOZDRG LFMPZPZX
021002 LFPOZPZX
SWLF0011 LFPO 12021000
SNOWTAM0011
A)LFPO  B) 12021000
C)07 F)2/2/2 G)0/0/0 H)5/5/5
C)08 F)2/2/2 G)0/0/0 H)63/63/63 TNAC
--SENT TO--
LFPOSNOW LFZZONVB LFZZSZLF LFPOZDRG LFMPZPZX
```

APPENDIX : TRANSCRIPT

FOREWORD

The following is a transcript of elements which were comprehensible, at the time of the preparation of the present report, from listening to the recordings of radio communications with air taffic control.

GLOSSARY

(*)	: Words or groups of words not understood
TWR	: Control Tower

ATC Transcript frequency 118.7 Orly TWR / AMERICAN AIRLINE G2

TRANSMITTING STATION	RECEIVING STATION	UTC TIME	COMMUNICATIONS
G2	Orly/TWR	08h 57mn 00	Good morning Orly American G2 is 17 miles out of the 07 runway
Orly/TWR	G2		American G2 good morning you are number one report outer marker runway 07 wind 360° 15 knots minimum 10 maximum 22 and braking action is good all along the runway
G2	Orly/TWR		Ok we call the outer marker and copied the wind American G2
Orly/TWR	G2	08h 58mn 30	American G2 for information exits 41 42 and 43 are open
G2	Orly/TWR		Ok thank you American G2
Orly/TWR	G2		And runway is wet
G2	Orly/TWR		Roger American G2
Orly/TWR	G2	09h 00mn 45	American G2 cleared to land runway 07 wind 360 degrees 1.5 knots minimum 10 maximum 24
G2	Orly/TWR		Cleared to land on 07 thank you American G2
Orly/TWR	G2	09h 03mn 50	American G2 can you tell me about braking action
G2	Orly/TWR		Call the braking action fair American G2
Orly/TWR	G2		Confirm is good
G2	Orly/TWR		We'd call it fair
Orly/TWR	G2		Fair roger now you call ground 121.7 bye bye
G2	Orly/TWR		Goodbye 121.7 American G2

ATC Transcript frequency 118.7 Orly TWR / F-GHEI (TAT MB)

TRANSMITTING STATION	RECEIVING STATION	UTC TIME	COMMUNICATION
TAT-MB	Orly/TWR	09h 40mn 08	Tower T A T err Mike Bravo good morning
Orly/TWR	TAT-MB		Mike Bravo good morning are you approaching the threshold ?
TAT-MB	Orly/TWR		Affirmative we are approaching the threshold of zero seven
Orly/TWR	TAT-MB		How long before you will be ready to take off ?
TAT-MB	Orly/TWR		Oh in thirty seconds
Orly/TWR	TAT-MB		OK Mike Bravo line up and takeoff on runway zero seven the wind is three hundred fifty degrees sixteen knots
TAT-MB	Orly TWR		We line up and takeoff on runway zero seven
AOM 602	Orly TWR	09h 42mn 44	Orly good morning French Line six hundred two
Orly TWR	AOM 602		French Line six hundred two good morning you advise me Oscar Romeo Whisky on final runway zero seven
AOM 602	Orly TWR		Yes we will call you back Oscar Romeo Whisky and we are slowing to one forty four knots here French Line six hundred two and the latest wind please?
Orly TWR	AOM 602		Latest wind three hundred fifty degrees thirteen knots braking conditions fair on the runway, and err it's completely cleared of all ....
TAT MB	Orly TWR	09h 43mn 06	Mayday mayday mayday... (*) on fire an engine on fire
Orly TWR	TAT MB		Who has an engine on fire ? Mike Bravo ?
TAT MB	Orly TWR		Ah Mike Bravo an engine on fire
Orly TWR	AOM 602		Six hundred two plan a go around
AOM 602	Orly TWR		Yes roger, right away ?
Orly TWR	AOM 602		Affirmative plan a go around
AOM 602	Orly TWR		Yes we will go around what level do you want us to go to?
Orly TWR	TAT-MB		... ke Bravo are you in the air ?
Orly TWR	TAT-MB		... ke Bravo you come round to the right to find ILS zero seven
TAT-MB	Orly TWR		We turn left for zero seven we are at thirteen hundred feet
Orly TWR	TAT-MB		Okay stay at thirteen hundred feet you come round by the left for runway zero seven one heading two nine zero
AOM 602	Orly TWR		French Line six hundred two we are up
TAT-MB	Orly TWR		We are turning left two nine zero
AOM 602	Orly TWR		... one ninety knots
Orly TWR	AOM 602		(*) six hundred two right heading one hundred eighty
AOM 602	Orly TWR		right heading one hundred eighty six hundred two
Orly TWR	TAT-MB		... ke Bravo we're going to have you land on runway zero seven so you come back to runway zero seven

TRANSMITTING STATION	RECEIVING STATION	UTC TIME	COMMUNICATION
TAT-MB	Orly TWR		Yes we turn on zero seven
Orly TWR	TAT-MB		OK your flight conditions ?
TAT-MB	Orly TWR		I M C
Orly TWR	TAT-MB		Okay and the condition of the fire?
TAT-MB	Orly TWR		(*) the fire for us still alight
Orly TWR	AOM 602		French Line six hundred two you turn right to heading one eighty I confirm
AOM 602	Orly TWR		One eighty six hundred two
TAT-032CB	Orly TWR	09h 44mn 24	Orly T A T zero thirty two Charlie Bravo on long final sixteen miles three thousand feet
Orly TWR	TAT-032CB		Yes Bravo you climb to four thousand immediately four thousand feet immediately the airport is going to be closed red alert
TAT-032CB	Orly TWR		Four thousand feet Charlie Bravo
Orly TWR	AOM 602	09h 44mn 48	French Line still on heading one eighty you contact Orly Departures one twenty seven seventy five
AOM 602	Orly TWR		Orly Departures one twenty seven seventy five
TAT-MB	Orly TWR	09h 44mn 55	Mike Bravo instructions ? For us in principle it's out.
Orly TWR	TAT-MB		Roger Mike Bravo you still want a landing anyway?
TAT-MB	Orly TWR		Absolutely I'm returning to land immediately
Orly TWR	TAT-MB		Okay Mike Bravo you maintain heading you're crossing north of the airport you maintain altitude I'll call you back
TAT-MB	Orly TWR		Yes we maintain altitude
?	?		Yes ?
Orly TWR	TAT-032CB		Yes Bravo you maintain the heading for the moment I will call you back regulation you will do another circuit
TAT-MB	Orly TWR		Yes err we maintain heading for the time being
TAT-032CB	Orly TWR	09h 45mn 36	TAT Charlie Bravo four thousand we maintain heading
Orly TWR	TAT-032CB		four thousand you maintain heading I will call you back in a while
TAT-032CB	Orly TWR		Roger
Orly TWR	TAT-032CB	09h 45mn 47	Mike Bravo you turn right I confirm you turn right to heading one sixty
TAT-MB	Orly TWR		Right to heading one sixty unit six zero
Orly TWR	TAT-032CB		For Charlie Bravo I confirm Charlie Bravo
TAT-MB	Orly TWR		Ah OK it's Mike Bravo go on at the heading
Orly TWR	TAT-MB		...(*) at the heading you're still a bit far to make a precise approach
TAT-MB	Orly TWR		Orly Tower we maintain heading two seven zero Mike Bravo
Orly TWR	TAT-032CB		Charlie Bravo I confirm right to heading one sixty and Orly Departures one twenty seven seventy five goodbye

TRANSMITTING STATION	RECEIVING STATION	UTC TIME	COMMUNICATION
TAT-032CB	Orly TWR		Departures one twenty seven seventy five right one sixty Charlie Bravo goodbye
Orly TWR	TAT-MB	09h 46mn 53	Mike Bravo so latest wind conditions are three hundred fifty degrees fourteen knots and I will call back in a while to begin the left turn you are currently crossing outer marker runway zero eight
Orly TWR	TAT-MB		Roger Mike Bravo
Orly TWR	TAT-MB		Mike Bravo do you know the number of passengers on board ?
TAT-MB	Orly TWR		A hundred and twenty seven
Orly TWR	TAT-MB		Thank you
TAT-MB	Orly TWR		In theory we should be able to land and leave the runway normally
Orly TWR	TAT-MB		OK Mike Bravo I'm still taking you on the heading you are currently five miles north of the outer marker I will call you back in thirty seconds to begin the left turn
TAT-MB	Orly TWR		Roger
Orly TWR	TAT-MB	09h 47mn 46	Mike Bravo you turn left on heading one eighty
TAT-MB	Orly TWR		Left on heading one eighty
Orly TWR	TAT-MB	09h 48mn 15	Mike Bravo continue left turn on heading one fifty
TAT-MB	Orly TWR		We continue left turn on heading one fifty
Orly TWR	TAT-MB	09h 48mn 35	Mike Bravo continue on heading one hundred to intercept runway zero seven are you picking up the ILS?
TAT-MB	Orly TWR		Yes heading one hundred for the ILS I think we'll pick it up
Orly TWR	TAT-MB	09h 49mn 03	T A T Mike Bravo you are four miles from the Out... from the Outer Marker you are authorized on final approach latest wind three hundred fifty degrees fourteen knots
TAT-MB	Orly TWR		Authorized on final approach Mike Bravo
Orly TWR	TAT-MB	09h 49mn 14	Is everything OK on board at the moment?
TAT-MB	Orly TWR		No problem
Orly TWR	TAT-MB		Okay for your information since en emergency has been declared you will be followed to the parking area by all the emergency vehicles
TAT-MB	Orly TWR		OK thanks
Orly TWR	TAT-MB	09h 50mn 08	Mike Bravo you are authorized to land three hundred fifty degrees fourteen knots
TAT-MB	Orly TWR		Authorized to land Mike Bravo
Orly TWR	TAT-MB	09h 50mn 27	Mike Bravo for information for the firemen which engine was on fire ?
TAT-MB	Orly TWR		The right
Orly TWR	TAT-MB		OK
Orly TWR	TAT-MB	09h 51mn 34	Latest wind three hundred fifty degrees fourteen knots with gusts to nineteen knots

TRANSMITTING STATION	RECEIVING STATION	UTC TIME	COMMUNICATION
TAT-MB	Orly TWR		Roger err Mike Bravo
TAT-MB	Orly TWR	09h 53mn 04	It's under control Mike Bravo
Orly TWR	TAT-MB		Roger advise me of clear runway
TAT-MB	Orly TWR		Yes we've cleared it
Orly TWR	TAT-MB		Can you taxi to the parking area ?
TAT-MB	Orly TWR		Yes no problem
Orly TWR	TAT-MB		Okay emergency services are following you contact one twenty and one point seven goodbye
TAT-MB	Orly TWR	09h 53mn 18	Thanks for everything goodbye

ATC Transcript frequency 118.7 Orly TWR / F-GFZB (TA 673 ED)

TRANSMITTING STATION	RECEIVING STATION	UTC TIME	COMMUNICATION
TA 673 ED	Orly TWR	10h 19mn 30	Orly Tower good morning T A T seventy three Echo Delta
TA 673 ED	Orly TWR		T A T Echo Delta good morning threshold zero seven
Orly TWR	TA 673 ED		Echo Delta good morning call back when final MD eighty in sight on runway zero seven
TA 673 ED	Orly TWR		Call back when MD eighty in sight on final on runway zero seven Echo Delta
TA 673 ED	Orly TWR	10h 22mn 00	M D eighty in sight T A T Echo Delta
Orly TWR	TA 673 ED		Roger line up behind and wait
TA 673 ED	Orly TWR		We're lining up and waiting zero seven T A T Echo Delta
Orly TWR	TA 673 ED		For information I'm having a plane take off on zero eight before you Echo Delta
TA 673 ED	Orly TWR		We got it thanks
Orly TWR	TA 673 ED		OK
Orly TWR	TA 673 ED	10h 23mn 00	So Echo Delta for information I have an MD eighty which is arriving in four minutes on final I will call you back for a takeoff fairly fast
TA 673 ED	Orly TWR		No problem sir
Orly TWR	TA 673 ED	10h 23mn 50	T A T seventy three Echo Delta authorized to take off now on runway zero seven the wind is three hundred fifty degrees sixteen knots
TA 673 ED	Orly TWR		T A T Echo Delta takeoff can we climb to level ninety without restrictions?
Orly TWR	TA 673 ED		I'll ask for a level variation I'll call you back soon
TA 673 ED	Orly TWR		Okay we're taking off
Orly TWR	TA 673 ED	10h 24mn 20	So Echo Delta level variation to sixty and we'll give you another level then on the departure
TA 673 ED	Orly TWR		So no restriction to level sixty Echo Delta we're taking off
Orly TWR	TA 673 ED		OK
		10h 24mn 40	(It's ready) Echo Delta
Orly TWR	TA 673 ED		Echo Delta have you taken off ?
TA 673 ED	Orly TWR		It's (*)
Orly TWR	TA 673 ED		(*)
TA 673 ED	Orly TWR	10h 25mn 20	We're going off to the right Echo Delta
Orly TWR	TA 673 ED		Did you abort takeoff Echo Delta ?
TA 673 ED	Orly TWR		Affirmative sir
Orly TWR	TA 673 ED		Advise me runway is cleared

TRANSMITTING STATION	RECEIVING STATION	UTC TIME	COMMUNICATION
TA 673 ED	Orly TWR	10h 25mn 35	Cleared Echo Delta
Orly TWR	TA 673 ED		Confirm so I have no ground radar eh the runway services are out of the way, the aircraft can land?
TA 673 ED	Orly TWR		Affirmative the runway is cleared
Orly TWR	TA 673 ED		Roger
Orly TWR	TA 673 ED	10h 25mn 50	Echo Delta what is the reason for the aborted takeoff?
TA 673 ED	Orly TWR		Engine surge
Orly TWR	TA 673 ED		A surge OK err you have time to come back to zero eight for takeoff eh?
TA 673 ED	Orly TWR		Affirmative
Orly TWR	TA 673 ED		You call one twenty and one seven again for taxiing thanks
TA 673 ED	Orly TWR		One twenty and one seven thanks bye.

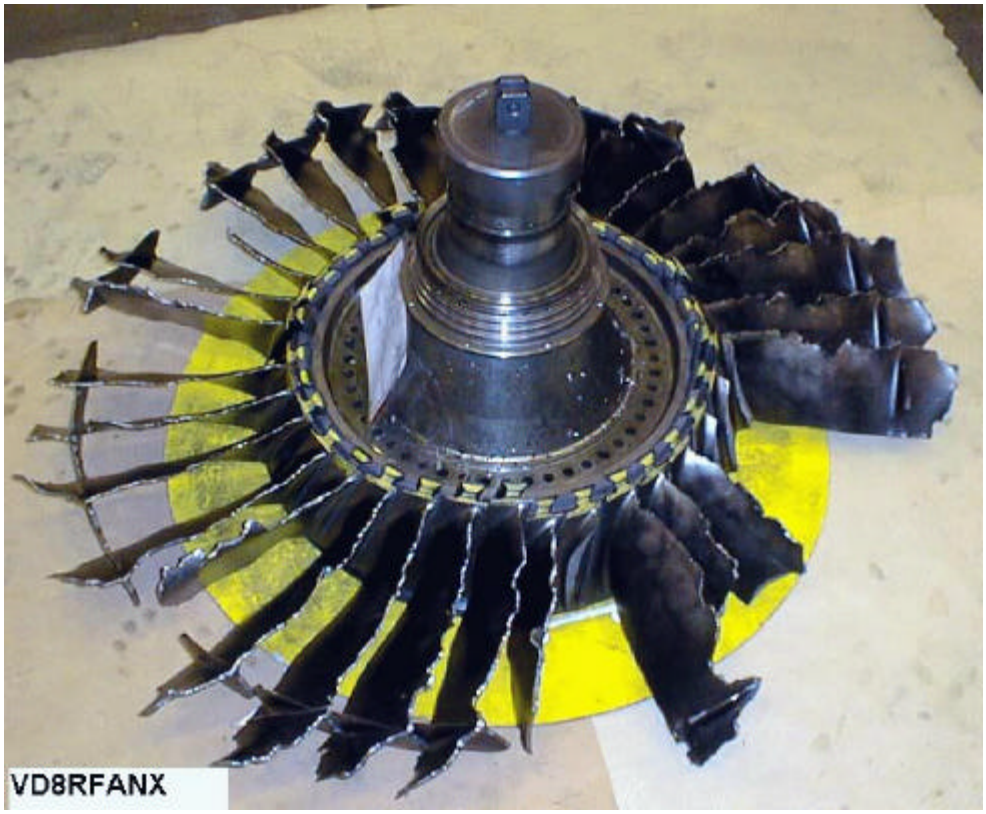


Photo 1 F-GHEI Right Engine
Overall view of the fan blades after disassembly (P&W photo)

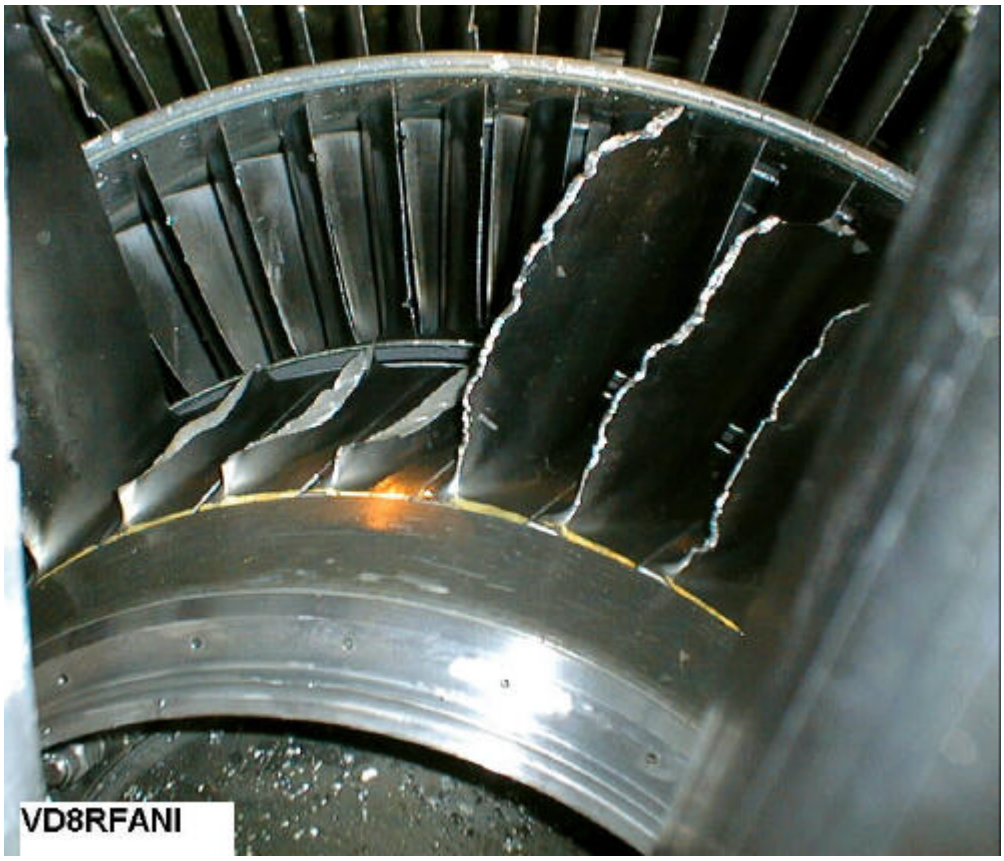


Photo 2 F-GHEI Right Engine
Close-up of the three consecutive blades broken off at the root (P&W photo)

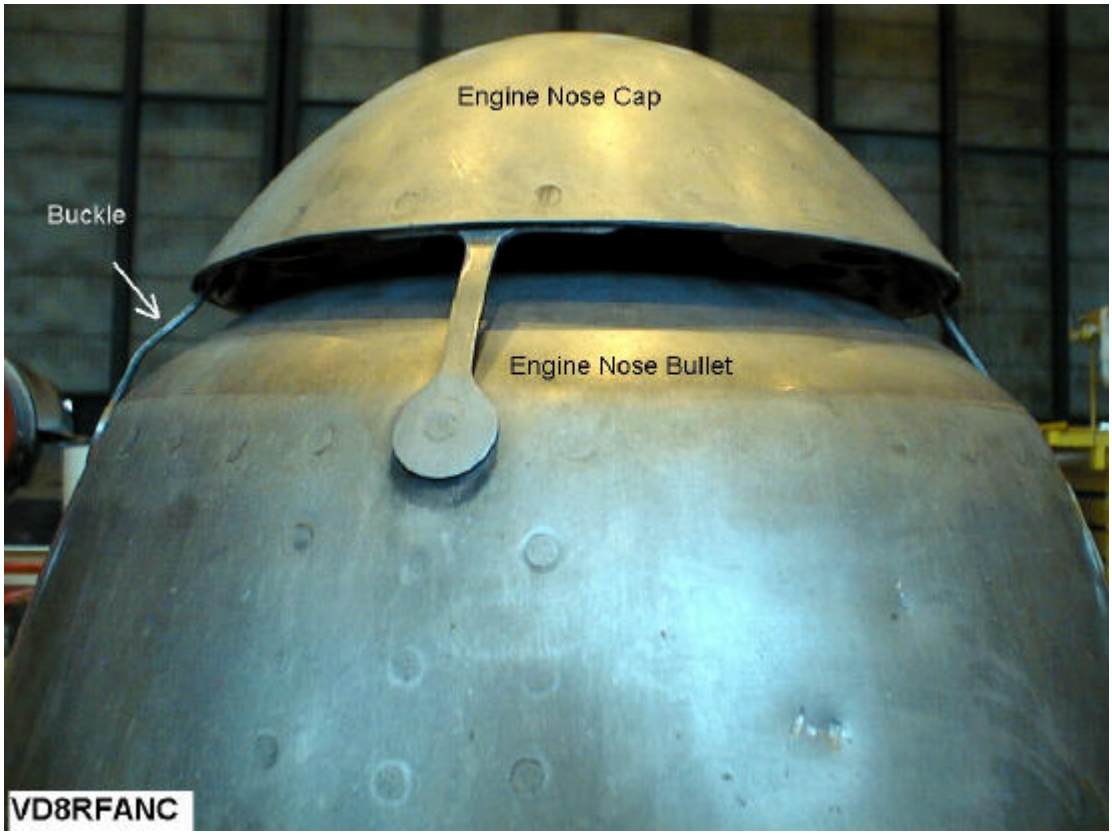


Photo 3 F-GHEI Right Engine
The buckle was distorted by an impact on the engine nose cap (P&W photo)

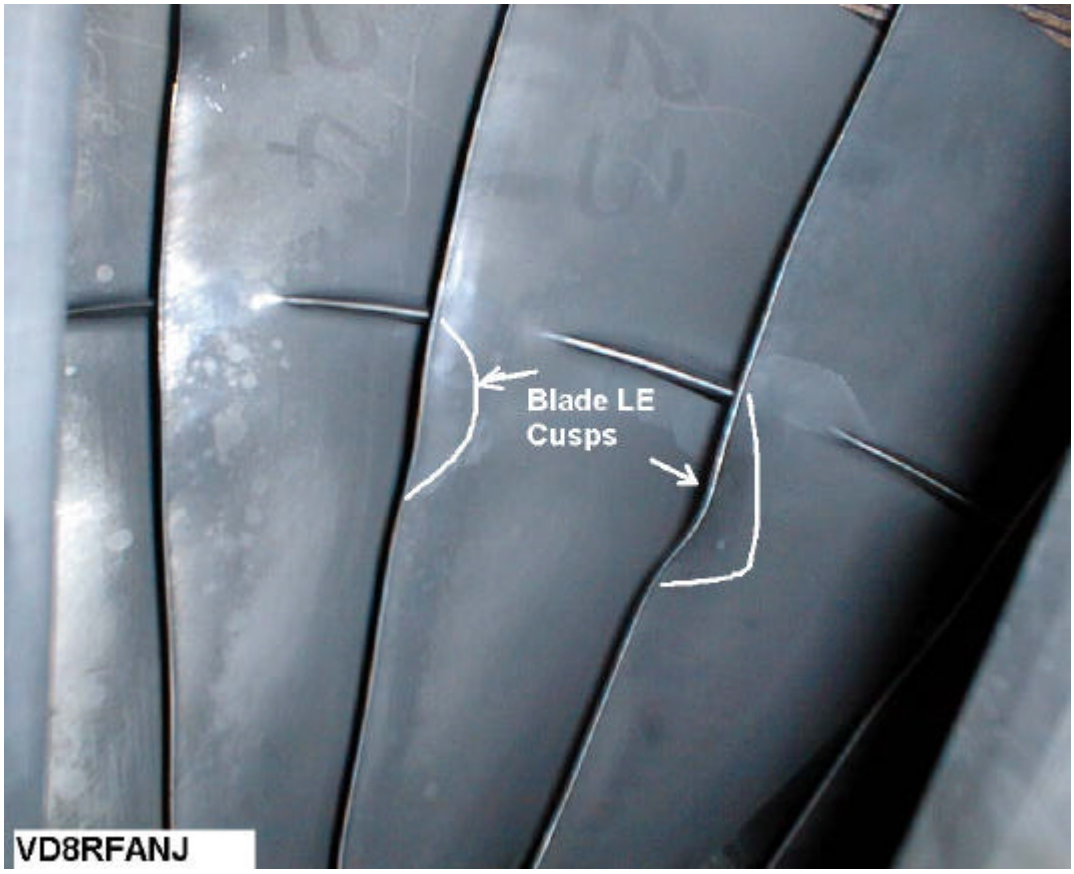


Photo 4 F-GHEI Left Engine
Slight distortion of leading edge of two consecutive fan blades (P&W photo))

2-12-97.XLS

Neige du 2 décembre 1997

Déroulement des opérations en heure locale

03:25	DES se réveille, premiers flocons	
04:30	DES phone MTO, leur demande alerter le BDP	Phénomène conforme aux prévisions MTO de la veille
04:30	Suite contact MTO, le BDP contacte l'IP	
04:45	DES phone BDP. Le CDQ constate: pluie et neige mêlée ne tenant pas au sol	
04:55	CDQ BDP sort contrôler la plate forme	
04:55	MAA: Chutes de neige pouvant atteindre 1 à 2 cm de 4 à 8h	
05:00	DES commence à contacter les agents DES à leur domicile	
05:00	Flyco demande mesures de glissance au SSI	
05:10	Flyco relève 2 cm de contaminant, freinage mauvais	
05:20	Flyco demande à la Tour de contacter l'IP	
05:25	Tour pour info REP demande au Flyco si déclenchement PC neige oui	
05:30	Flyco rentre BDP	
05:45	Suite décision IP, CDQ BDP contacte CRI pour activation PC neige (appel astreinte DES)	
06:30	Arrivée astreinte DESMI, ouverture effective PC neige	
06:33	MAA: chutes de neiges pouvant atteindre 5 à 10cm entre 6h30 et 9h30	
06:51	premier snowtam succinct	
07:00	début arrivée difficile des chauffeurs, til 7h30	
07:25	début 2iem contrôle plate forme	
07:55	2iem snowtam	
08:02	démarrage grand train de neige: 5, 22, 2, 47	
08:43	grand train débute 07/25, pour 3 passes, dégagements 41, 42, 43	
08:50	démarrage petit train de neige: 21, 1, 41	
09:35	07/25 disponible, grand train 9, br47, 37	
09:40	Petit train voie 8, bretelles entre 8 et 9 , et 1 et 2.	
09:45	Grand train débute la 08/26, pour 27 passes, 31, 36	
11:00	ouverture 08/26, pause café?	
12:00	petit train 02/20 til 14h30	
14:45	BDP contrôle négatif 02/20, demande intervention complémentaire	
15:15	SBT contacte DESMI pour intervention urgente 02/20 (vent nord 28kt)	
16:10	début intervention 02/20, poursuite intervention sur les voies	

Service DE S MI
Section Environnement
PC déneigement

Déneigement Déverglaçage
Feuille de Quart __ Déroulement des Opérations
Responsable(s) du P. C: NOBLET. J

Journée du : 02/12/1997
Heure d'ouverture du PC : 6 H 30
Heure de fermeture du PC: 14 H 00

Essais de glissance-Codification	Faible 0,25 et <	Moyens-Faibles 0,26 à 0,29	Moyens 0,30 à 0,35	Moyens -Bons 0,36 à 0,39	Bons 0,40 et >	Les essais de glissance sont effectués par 1/3 de piste
Conditions Atmosphériques à l'ouverture du P. C		Précipitation neigeuse (neige très humide 7 cm environ)				
Evolution en Cours de Journée						

Ouvrages à Traiter	Heures d'intervention Début	Fin	Matériel Utilisé	Observations (Incidents,difficultés,résultat de l'intervention)
Voies 5,21,2,47	08:02		6 balayeuses Shorling	Chef de Train :
Piste 07/25	08:43	09:35	1 Chasse neige	Chef de Train :
Voie 42	09:35	09:40	dito	Chef de Train :
Voie 43	09:40	09:45	dito	Chef de Train :
Voie 9,37	09:45	09:55	dito	Chef de Train :
Piste 08/26	09:55		dito	1ère Passe
Piste 08/26	10:12	10:27	dito	2eme Passe
Piste 08/26,voies36/35	10:27	11:00	dito	3 ème Passe
Piste 02/20(Partie Nord)	12:05	12:50	dito	Chef de Train :

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Service DE S MI
Section Environnement
PC déneigement

Déneigement _ Déverglaçage
Feuille de quart __ Déroulement des Opérations
Responsable(s) du P. C: NOBLET. J

Journée du : 02/12/1997
Heure d'ouverture du PC : 6 H 30
Heure de fermeture du PC:14 H 00

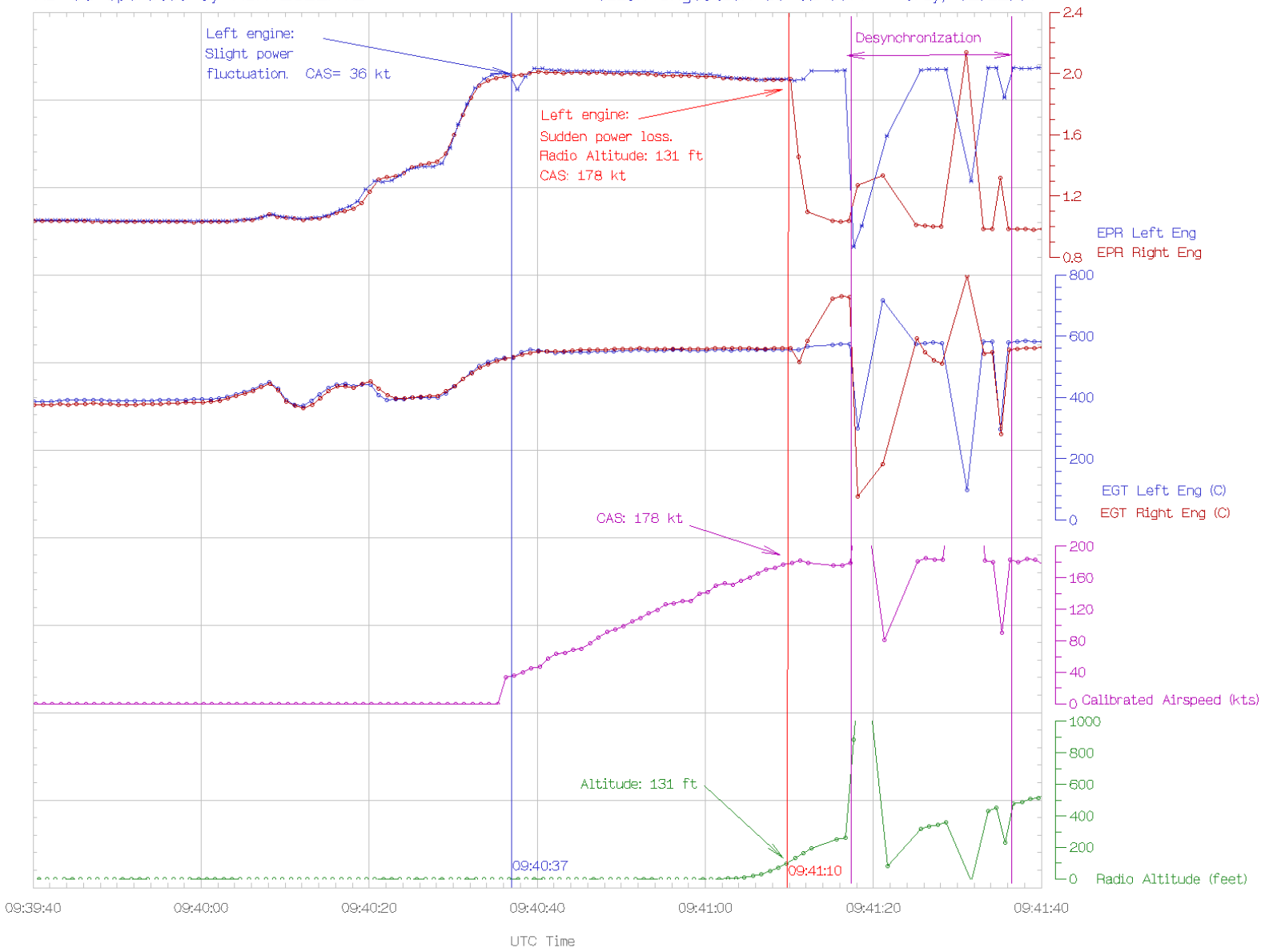
Essais de glissance-Codification	Faible 0,25et K	Moyens-Faibles 0,26 à 0,29	Moyens 0,30 à 0,35	Moyens -Bons 0,36 à 0,39	Bons 0,40>	Les essais de glissance sont effectués par 1/3 de piste

Conditions Atmosphériques à l'ouverture du P. C	Précipitation neigeuse (neige très humide 7 cm environ)
Évolution en Cours de Journée	

Ouvrages à Traiter	Heures d'intervention		Matériel Utilisé	Observations (Incidents,difficultés,résultat de l'intervention)
	Début	Fin		
Voies 22,1,41,8,9	09:00		4 Baleuses Sicard	Chef de train
Bretelles S,T ,U			1 Chasse Neige	Chef de train
Bretelles 1,2,3,4		14:00		Chef de train

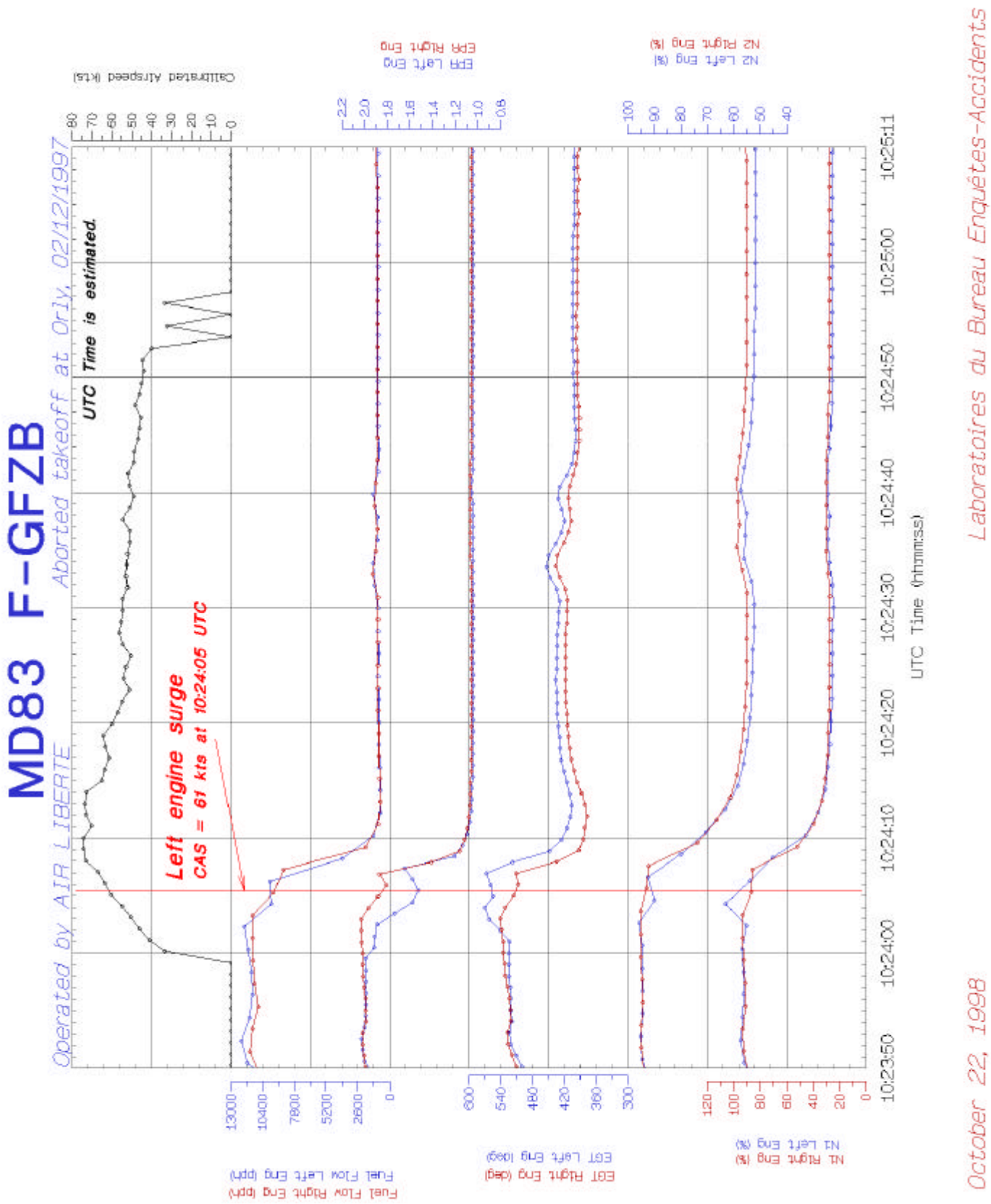
F-GHEI

MD 83 operated by AIR LIBERTE — Slush Ingestion at takeoff - Orly, 02/12/97



Plot 1, 13 October 1998

Laboratoires du Bureau Enquêtes-Accidents



Laboratoires du Bureau Enquêtes-Accidents

October 22, 1998