Published March 2014

Report

Accident on **16 October 2012**
at **Lorient Lann Bihoué (56) Aerodrome**
to the **the Bombardier CRJ-700**
registered **F-GRZE**
operated by **Brit Air**

BEA
Bureau d'Enquêtes et d'Analyses
pour la sécurité de l'aviation civile
Ministère de l'Ecologie, du Développement durable et de l'Energie

Safety Investigations

The BEA is the French Civil Aviation Safety Investigation Authority. Its investigations are conducted with the sole objective of improving aviation safety and are not intended to apportion blame or liability.

BEA investigations are independent, separate and conducted without prejudice to any judicial or administrative action that may be taken to determine blame or liability.

SPECIAL FOREWORD TO ENGLISH EDITION

This is a courtesy translation by the BEA of the Final Report on the Safety Investigation. As accurate as the translation may be, the original text in French is the work of reference.

Table of Contents

Glossary

AD	Aerodrome
AOC	Aircraft Operator Certificate
AP	Autopilot
ASR	Air Safety Report
ATIS	Automatic Terminal Information Service
ATPL	Airline Transport Pilot Licence
CAS	Calibrated Airspeed
CHEA	Approval of Aerodromes and Aerodrome Operating Procedures
CRM	Crew Resource Management
CVR	Cockpit Voice Recorder
DGAC	Direction Generale de l'Aviation Civile (General civil aviation Directorate)
DH	Decision Height
DIRCAM	Directorate of Military Air Traffic
DSAC	Direction de la Securité de l'Aviation Civile (Civil aviation safety directorate)
EASA	European Aviation Safety Agency
ECAST	European Commercial Aviation Safety Team
FC	Flight Crew
FCOM	Flight Crew Operating Manual
FDR	Flight Data Recorder
FON	Flight Operations Note
FPT	Flight Proficiency Training
ft	Feet
HDG	Heading
ICAO	International Civil Aviation Organisation
ILS	Instrument Landing System
kt	Knot
LC	Line Check
LDA	Landing Distance Available
LOC	Localizer
MANEX	Manuel d'Exploitation Operations manual
METAR	Aerodrome routine meteorological report
MSN	Manufacturer's Serial Number
NAB	Naval Air Base
NSP	National Safety Plan
OCV	Organisme de Contrôle en Vol Flight Control Organisation

OPL	Officier Pilote de Ligne First Officer
OSV	Officier de la Sécurité des Vos Flight Safety Officer
PAPI	Precision Approach Path Indicator
PAR	Precision Approach Radar
PC	Proficiency Check
PEPN	Flight crew expertise centre
PF	Pilot Flying
PM	Pilot Monitoring
PNC	Personnel Naviguant Commercial Cabin crew
PNF	Pilot Not Flying
QRH	Quick Reference Handbook
RA	Radio Altitude
RFFS	Rescue and Fire Fighting Service
RPG	Recommended Practices Guide
RTC	Recurrent Training and Checks
SASV	Service Analyses et Sécurité des Vols Flight Safety and Analysis Service
SDLR	Simulated Deck Landing On Runway
SMS	Safety Management System
SOP	Standard Operating Procedures
STAC	Service Technique de l'Aviation Civile Civil Aviation Technical Centre
TAF	Aerodrome Forecast
TEM	Threat and Error Management
UA	Unstabilised Approach

Synopsis

Longitudinal runway excursion during landing on a runway contaminated by water

Aircraft	Bombardier CRJ-700 registred F-GRZE
Date and time	16 October 2012 at 19 h 22[1]
Operator	Brit Air
Place	Lorient Lann Bihoué AD (56)
Type of flight	Public transport of passengers
Persons on board	2 flight crew, 2 cabin crew, 53 passen-gers
Consequences and damages	Aeroplane severly damaged

[1]Unless otherwise specified, the times in this report are expressed in Universal Time Coordinated (UTC). Two hours should be added to obtain the legal time applicable in Metropolitan France on the day of the event.

The crew was cleared for an ILS RWY 25 approach. During the descent, the controller informed them of a wind from 160° at 17 kt with gusts up to 26 kt and a lasting, severe squall. Visibility was reduced to between 2,000 and 3,000 m and the runway was wet with water puddles. The controller reported that the previous aircraft had encountered difficulties during landing due to "*aquaplaning*".

The crew made the approach in the flaps 30° configuration.

The ILS 25 approach was stable at 1,000 ft. The autopilot was disengaged at around 500 feet.

The aeroplane's main landing gear touched down on the runway about 1,100 m from the end.

The aeroplane overran the runway, its left wing striking the localizer antennae, before coming to rest in a grass field about 200 m from the threshold of runway 07.

An emergency evacuation order was given. The 53 passengers evacuated through the left front door and the overwing exits.

The investigation showed that the accident was due to the crew's failure to decide to carry out a missed approach when they had not made themselves aware of the runway contamination or of the remaining length of runway available.

Continuing the landing can be explained by:

- ❐ Insufficient situational awareness due to:
  - The level of crew performance, additionally degraded by fatigue and routine;
  - Unfamiliarity with safety margins and inadequate TEM training;
- ❐ An approach to safety by the operator that did not encourage crews to question their plan of action.

The following factors contributed to the event:

- The crew's underestimation of the meteorological conditions;
- Operational instructions that were sometimes unclear, thereby undermining teamwork;
- The characteristics of runway 25, which were not documented in the Brit Air Operations Manual;
- The organisation of aerodrome operations preventing deviations identified concerning runway 25 from being corrected in a timely manner;
- Lack of a common phraseology that prevented both crews and the controllers from having a shared understanding of the real condition of the runway;
- The organisation of training and checks that prevented the operator from knowing and improving its safety performance;
- Inadequate management by the airline of fatigue risk.

The BEA addressed a total of fifteen safety recommendations to EASA, DGAC, DIRCAM and the French Navy General Staff relating to:

- Runway lighting;
- Areas of water retention on runway 07/25;
- Threat and error management;
- Crews levels of professionalism;
- Fatigue risk management;
- Clarification of the Operations Manual and the reduced documentation;
- DGAC symposiums;
- The European plan of action for the prevention of runway excursions;
- Certification of the aerodrome operator.

1 - FACTUAL INFORMATION

1.1 History of the Flight

The crew took off from Paris Orly at 18 h 30 bound for Lorient Lann Bihoué. It was the fifth and last flight of the day. The captain was at the controls (PF).

At around 19 h 00 just before the descent, he reviewed the ATIS WHISKY information indicating that runway 07 was active with a PAR procedure.[2]

At around 19 h 04, the crew contacted the approach controller and reviewed the wind conditions: 160°/17kt with gusts of 26 kt. They asked permission to perform an ILS 25 (CAT I) approach and chose to make the landing in the flaps 30° configuration[3]. They announced they would use an airspeed reading of 140 kt, without specifying whether it was the approach airspeed (VAPP) or the reference airspeed (VREF).

At about 19 h 06 the crew began their descent. The approach briefing was made by the co-pilot (PM) saying: *"Ok standard, I have no questions to ask you."* The Descent checklist was carried out.

At around 19 h 10, the controller reminded the crew[4] of the wind conditions and said *"the runway is wet with puddles"* and that the preceding aeroplane had encountered difficulties when landing due to a phenomenon *"of aquaplaning"*. The PM shared this information with the PF. Shortly afterwards, the controller stated there were showers at the aerodrome and that the visibility had decreased to 2,000 m.

At 19 h 12, the crew was cleared to descend to 3,000 ft. The PF asked the PM for the Approach checklist. The latter waited for the report from the cabin crew and, while waiting, reported the inconvenience caused by the screen displaying *"Cabin Ready"*. At the same time, the controller stated that precipitation was heavy and would last about another hour. He stated that an inspection carried out half an hour earlier revealed that the runway was *"wet with puddles"*. He again stated that the preceding aeroplane had been subject to *"aquaplaning"* and that the landing had been *"a little complicated"*.

The crew received the report from the cabin crew and carried out the Approach checklist. It was interrupted by the controller who transmitted the latest wind report (150°/17kt with gusts of 25 kt) and cleared the crew for the ILS 25 approach. The checklist was resumed without the altimeters being set.

At around 19 h 20, the aircraft was established on the ILS at an altitude of approximately 1,900 ft and a speed of 180 kt. The autopilot was engaged. The crew extended the landing gear, called out and displayed a VAPP of 140 kt and positioned the flaps at 30°. At 1,500 ft, they performed the landing checklist during which they readjusted the altimeters and wondered whether the approach checklist had been carried out.

One minute later, the controller cleared the crew for landing and gave a latest wind report (160°/14kt with gusts of 24 kt). The flight data recorder showed that at that moment the aeroplane was subject to a tailwind component of approximately 4 kt[5].

Descending through 1,000 ft radio altimeter height, the aeroplane was established on the ILS with a speed of 144 kt. The PF called out *"Stable, continue approach"*.

[2]Precision approach under radio / radar vectoring from the approach ATC.

[3]The CVR recording suggests that this choice was made for passenger comfort. Interviews with the crew showed that this configuration was chosen, during flight preparation, due to the risk of windshear.

[4]At that moment, the PF was talking via the intercom with a cabin crew member in the cabin.

[5]This tendency remained observable until touchdown.

At 600 ft radio altimeter height, the crew saw the runway approach lights. The PF requested maximum speed for the windscreen wipers. For about ten seconds, the airspeed increased above 150 kt with a maximum of 155 kt. The aeroplane went through 500 ft radio altimeter height at a speed of 154 kt. The PM called out *"ready, cleared"* and the PF agreed. The AP was disconnected at 400 ft.

Around 200 ft radio altimeter height, the PF stated that he was *"working with a high airspeed indicator slightly over"*. The PM approved his choice. The airspeed was 147 kt.

At 150 ft, the aeroplane pitch attitude was 0° and began to gradually increase. Between 100 ft and touchdown, numerous roll inputs were recorded.

The aeroplane crossed threshold 25 at a radio altimeter height of 56 feet. The airspeed was 153 kt with a 4 kt tailwind.

The PM reported to the PF that visibility was bad and that the aeroplane was to the left of the runway centre line. Nine seconds later, the main landing gear touched the ground about 1,130 m from threshold 25. The ground speed was 140 kt. The spoilers were extended. The crew deployed the thrust reversers and then applied *"Max reverse"* thrust. The aeroplane decelerated.

After nine seconds, the PF reported he could not brake(6). The aeroplane left the runway twelve seconds later at a ground speed of 66 kt. It hit the Localizer antennae before coming to rest approximately 200 m past the threshold of runway 07.

(6)No parameter relating to the application of an input by the crew on the brakes is recorded in the FDR.

The crew made a distress call and ordered the evacuation of the aeroplane. The emergency services arrived at the accident site a few minutes later.

1.2 Injuries to Persons

	Injuries		
	Fatal	Serious	None
Crew members	-	-	4
Passengers	-	-	53
Other persons	-	-	-

1.3 Damage to the Aircraft

The main landing gear and the nose gear suffered significant damage requiring their replacement.

Major structural damage was found.

Both engines were removed and sent for repair.

1.4 Other Damage

The LOC antennae were damaged when the aeroplane collided with them.

1.5 Personnel Information

1.5.1 Captain

Male, 42 years old.

- Commercial Pilot Licence issued by France on 7 January 1997.
- Airline Transport Pilot Licence ATPL(A) issued by France on 13 February 2004.
- Captain since 7 August 2007.
- CRJ-700 type rating issued on 17 November 2001, extended every year.
- Last line check carried out on 20 August 2012 on CRJ-700.
- Last proficiency check carried out on 4 June 2012 on CRJ-100.
- Last CRM training carried out on 4 April 2012, including a TEM session.
- Class 1 medical certificate valid until 30 September 2013.

Expérience

- Total: 6,910 flying hours including 3,363 as captain.
- On type: 4,025 flying hours including 3,128 as captain.
- In the last three months: 137 flying hours, 7 night landings including that of the accident and 3 daytime landings on runway 25 at Lorient Lann Bihoué.
- In the last month: 48 flying hours, 3 night landings including that of the accident and 2 daytime landings on runway 25 at Lorient Lann Bihoué.
- In the last 24 hours: 5 hours and 36 minutes, 1 daytime landing on runway 25 of Lorient Lann Bihoué.

Activities the previous day in local time (see schedule in Appendix 1)

On 13 and 14 October 2012, he was resting at his home in southwest France.

On 15 October 2012, he got up at 04 h 45 and took a flight to Paris Charles de Gaulle. He made a Paris Charles de Gaulle - Genoa return flight taking off at 10 h 15 am and returning at 14 h 45. He remained in Paris and went to bed at around 22 h 00.

On 16 October 2012, he got up at 07 h 00 for a five-leg flight - Paris Orly – Quimper – Paris Orly – Lorient – Paris Orly – Lorient.

Professional expérience

The captain was hired on 19 March 1992 as cabin crew. After training for his airline transport pilot licence, he was promoted to flight crew on 23 August 1999. He was a CRM trainer from 1 February 2010 to 6 April 2011.

Recurrent training and checks (RTC))

The captain was declared *"fit for duty"* in all of his RTC.

His professional level was qualified as *"good"* according to the check sheets.

1.5.2 Co-pilot

Male, 45 years old.

- Commercial Pilot Licence issued by France on 24 October 1995.
- Airline Transport Pilot License ATPL(A) issued by France on 27 July 2003.
- Appointed FO on 5 July 2004.
- CRJ-700 type ratingissued on 21 September 2004, extended every year.
- CRJ-1000 type[7] rating issued on 23 July 2011, extended every year.
- Last line check carried out on 15 August 2012 on CRJ-1000.
- Last proficiency check carried out on 19 May 2012 on CRJ-700.
- Last CRM training carried out on 10 January 2012.
- He had not yet attended TEM training.
- Class 1 medical certificate valid until 31 October 2013.

<u>Experience</u>

- Total: 5,244 flying hours, of which 3,014 hours on type.
- In the last three months: 179 flying hours, 8 night landings including that of the accident and 2 daytime landings on runway 25 at Lorient Lann Bihoué.
- In the last month: 59 flying hours, 4 night landings including that of the accident and 1 daytime landing on runway 25 at Lorient Lann Bihoué.
- In the last 24 hours: 5 hours and 36 minutes, 1 daytime landing on runway 25 of Lorient Lann Bihoué.

<u>Activities the previous day in local time (see schedule in Appendix 1)</u>

On 11 and 12 October 2012, he was resting at his home in the south of France.

He flew three-leg flights on 13 and 14 October 2012.

On 15 October 2012, he got up at 7 h 00 and took a flight to Paris Charles de Gaulle. He made a four-leg flight taking off at 13 h 15 and returning at 20 h 40. He remained in Paris and went to bed at around 22 h 30.

On 16 October 2012, he got up at around 9 h 00 for a five-leg flight - Paris Orly – Quimper – Paris Orly – Lorient – Paris Orly – Lorient.

<u>Professional Experience</u>

He was hired on 5 July 2004 as a co-pilot.

<u>RTC</u>

He was declared *"fit"* in all his RTC.

His professional level was qualified as "good" according to the check sheets.

[7] The CRJ 700 and CRJ type ratings are the same with a difference training.

1.6 Aircraft Information

1.6.1 General

F-GRZE was manufactured in 2002. It had a maximum take-off weight of 31,990 kg, a maximum landing weight of 30,391 kg and a payload capacity of 72 passengers. It was equipped with two General Electric CF34-8C5B1 type engines.

Manufacturer	Bombardier
Type	CL–600–2C10
Serial number	10 032
Entry into service	6 February 2002
Certificate of airworthiness	N°. 117603 issued on 13 December 2007 by France, valid until 4 February 2013
Airworthiness inspection certificate	N°. 10-G0010-016 dated 3 January 2012
Use as of 16 October 2012	19,841 hours and 19,063 cycles
Use since the *"major service"* overhaul on 6 June 2011	2,211 hours and 2,061 cycles

The aeroplane was maintained by Brit Air in accordance with a maintenance program approved by DSAC Ouest.

1.6.2 Weight and Balance

Weight and balance were within the limits set by the manufacturer.

The weight recorded on landing was 28.6 t.

1.6.3 Performance

1.6.3.1 Reference airspeed (VREF)

Weight 29 t:

- Flaps 45°: 132 kt
- Flaps 30°: 140 kt

1.6.3.2 Landing distance

Required landing distance: This is the regulatory distance (referred to as the *"legal distance"* in the Brit Air Operations Manual) to be calculated during the flight preparation for destination and alternate aerodromes. This distance, which is greater than the actual landing distance, includes safety margins.[8]

The operational flight plan and load sheet indicated an expected landing weight of 28,367 kg.The crew recorded a weight of 29 t. The required landing distances at VAPP are:

[8]It is equal to the actual distance multiplied by 1.67 on a dry runway. For a wet runway, it is equal to the required landing distance on a dry runway multiplied by 1.15. For a contaminated runway, it corresponds to the greater of the following distances: the required landing distance on a wet runway or the actual landing distance on a contaminated runway multiplied by 1.15.

Configuration and VAPP (weight 29 t)	Wet runway[9]	Runway contaminated by water[10]
Flaps 45° VAPP = VREF	1,725 m	1,890 m
Flaps 30° VAPP = VREF	2,156 m	2,362 m
Flaps 45° VAPP = VREF + 5 kt	1,725 m	1,990 m
Flaps 30° VAPP = VREF + 5 kt	2,156 m	2,487 m
Flaps 45° VAPP = VREF + 10 kt	1,725 m	2,090 m
Flaps 30° VAPP = VREF + 10 kt	2,156 m	2,737 m

Note:

Runway 25 at Lorient Lann Bihoué is 2,230 m long (see paragraph 1.10).

The landing distance is increased:

- On a wet runway: + 42 m per kt of tailwind
- On a contaminated runway: + 45 m per kt of tailwind

Landing distance: the distance between passing 50 ft over the threshold of the runway and the complete stop of the aeroplane, taking into account maximum braking .

Configuration and VAPP (weight 29 t)	Wet runway[11]	Runway contaminated by water[12]
Flaps 45° VAPP = VREF	1,035 m	1,694 m
Flaps 30° VAPP = VREF	1,294 m	2,117 m
Flaps 45° VAPP = VREF + 5 kt	1,035 m	1,784 m
Flaps 30° VAPP = VREF + 5 kt	1,294 m	2,230 m
Flaps 45° VAPP = VREF + 10 kt	1,035 m	1,874 m
Flaps 30° VAPP = VREF + 10 kt	1,294 m	2,342 m

Note: The landing distance is increased:

- Wet runway: + 25 m per kt of tailwind
- Contaminated runway: + 40 m per kt of tailwind

1.7 Meteorological Information

A westerly / southwest wind disturbance with showers and frequent thunderstorms was forecast over Brittany.

The 14 h 00 TAF, available during the flight preparation, forecast wind from 150° for 12 kt with gusts at 20 kt between 17 h 00 and 19 h 00 increasing between 20 h 00 and 22 h 00 to 35 kt with a cloud ceiling at 1000 ft. Rain with visibility reduced to 2,000 m was scheduled from 20 h 00 with a ceiling of 500 ft.

Only the METAR at 18 h 00 and 19 h 30 mentioned the presence of rain on the aerodrome. That at 19 h 30 indicated wind from 150° for 14 kt, visibility of 1,800 m and a ceiling of 500 ft.

The weather forecasting service of the Naval Air Base (NAB) recorded the following data about the wind and rain:

- Minute wind conditions at 19 h 22 (the time of the accident)
  - Average wind: 160°/16 kt,
  - Max. wind: 180°/25 kt;

[9]The margins, taken into account by the regulation, cover an increase of the VREF. This explains why, for a given configuration, the legal [i.e. regulatory] landing distances do not vary for different VAPP.

[10]According to Regulation (EC) No 859/2008 of the Commission of 20 August 2008 and Annex 6 to the Convention on International Civil Aviation, a runway is considered to be contaminated by water when more than 25% of the surface area, whether in isolated locations or not, bounded by the required length and width being used, is covered by a layer of water more than 3 mm deep.

[11]Called "real landing distance" in the Brit Air Operations Manual.

[12]Data from the Brit Air documentation. The Bombardier QRH provides a correction of + 22 m per kt above VREF in the flaps 45° configuration and + 24 m per kt in the flaps 30° configuration.

- Rain started to fall at 17 h 42;
- The following amounts of precipitation were measured:
  - From 17 h 42 to 19 h 00: 1.2 mm,
  - From 19 h 00 to 19 h 22: 1 mm ;
- From 19 h 00 to 19 h 22, the amount of precipitation alternated from low to moderate.

1.8 Aids to Navigation

Runways 02/20 are not equipped for instrument approaches.

Runways 07/25 are equipped to enable instrument approaches with radar vectoring.

Only Runway 25 is equipped with an ILS, certified CAT I.

The instrument approach procedure is based on approach file ILS RWY 25 included in appendix 2.

1.9 Communications

1.9.1 ATIS

- *"WHISKY"* information at 18 h 20:
  PAR 07 – 150°/14 kt – 10 km – BKN 800 ft BKN 2200 ft BKN 3600 ft - 13/12 - 1003
- *"X-RAY"* information at 19 h 00:
  PAR 07- Runway wet with puddles – 170°/18 kt – 10 km – BKN 1000FT BKN 1500FT BKN 2000FT - 14/12 – 1002

1.9.2 Lorient Lann Bihoué ATC

The transcript of the radio communications between the Lorient Lann Bihoué controller and the crews of the accident CRJ-700 (call sign BZ 937 QL) and of the Regional Embraer 145 (call sign 446 DJ RA) is included in Appendix 3.

1.10 Aerodrome Information

1.10.1 General

The Lorient Lann Bihoué aerodrome is a restricted aerodrome. It is for mixed use, the controlling authority being the French ministry of Defence for the requirements of the French Navy. The aerodrome receives civil traffic according to the conditions defined by an agreement between the users.

The Lann Bihoué NAB operates the aerodrome. Its commander performs the functions of aerodrome manager.

The aerodrome is served daily by two airlines, one of which is Brit Air. It has two intersecting runways 07/25 and 02/20.

1.10.2 Runway 07/25

The main runway was rebuilt in 1989 with continuous reinforced concrete.

2,403 m long and 45 m wide, it is equipped with two PAPI's with a 3° slope and has the following LDA's:

- Runway 25: 2,230 m;
- Runway 07: 2,403 m.

1.10.3 Certification of Runway 07/25

The Lorient Lann Bihoué aerodrome, receiving civil traffic, must meet the requirements of the Decree of 28 August 2003, known as the CHEA Decree, as amended by the Decree of 14 March 2007 on the certification conditions and operating procedures of French civil aerodromes.

Approval for civil operations is provided by the DIRCAM in collaboration with the DSAC Ouest.

Checks are carried out by a joint team of officials from DSAC and DIRCAM. The DSAC then publishes reports in which any deviations from the regulations are specified. In reply, the aerodrome operator must submit a corrective action plan to the DIRCAM and the DSAC. The plan includes timelines. Its implementation is regularly monitored by the DSAC.

Note: A civilian operator has two months to provide its corrective action plan. No time limit is imposed for a military operator.

The last inspection was carried out from 27 to 30 September 2011 for the renewal of certification in 2006. The DSAC Ouest report published on 10 January 2012 indicated 37 deviations, 8 of which involved runway 07/25 (appendix 4). None of them was classified as significant or major preventing certification for civilian use. These deviations included:

- Deviation n°7: Presence of numerous rubber marks that mask the daytime markings and appear to alter the friction characteristics when the runway is wet.
- Deviation n°13: The daytime markings are generally in very poor condition and do not guarantee any contrast, even less so because the surface is made of concrete.
- Deviation n°14: There are no side markings on the main runway used for precision approaches.
- Deviation n°16: The markings for the touchdown zone on the main runway only measure 1.70 m wide (instead of 3 m minimum).

All the runways of the Lorient Lann Bihoué aerodrome were approved on 25 September 2012(13). However, their use is only allowed under conditions with cross-winds less than or equal to 25 kt on dry runways and to 20 kt on wet runways(14).

On 26 September 2012, the corrective action plan was released by the NAB. The deadline to correct the four deviations indicated above was set for 31 December 2012(15). As of the date of the accident, these deviations had not yet been corrected.

On 17 October 2012, it was decided to postpone the reconditioning of the ground markings until the spring of 2013 due to meteorological constraints.

(13)The NAB only received the decision on 17 October 2012 after a request to the DSAC West.

(14)Due to the presence of optical landing devices and infrastructures associated with the stop strips in the track.

(15)This deadline is not regulatory in nature. The deadline for the other deviations was set for 30 June 2013.

1.10.4 Daytime Marking of Runway 25

The runway threshold and identification markings met the requirements of the CHEA Decree except for the anomalies pointed out in deviation n^{os}14 and 16 (see previous paragraph).

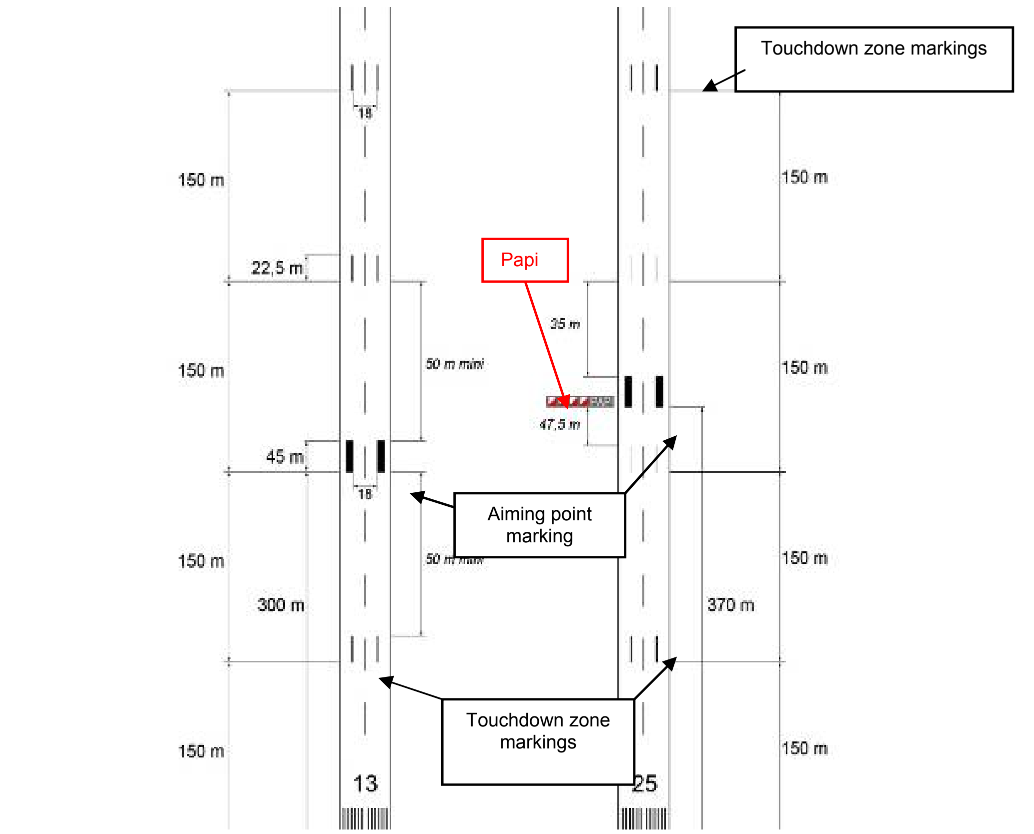
The runway had centre line markings without Runway lighting.

The CHEA Decree provides that for a runway 2,230 m long, the markings of the ILS endpoint (aiming point markings) are located 300 m from the runway threshold and are 45 m long.These markings must coincide with the position of the PAPI if the runway is equipped with one.

The markings defining the touchdown zone are located every 150 m from the threshold. However, those that coincide with the aiming point markings or are located less than 50 m away from them are not to be placed.

At Lorient Lann Bihoué, the PAPI is located 370 m from the threshold of runway 25. The aiming point markings are therefore also located in the same place. Touchdown zone markings are placed 150 and 600 m from the runway threshold. The other touchdown zone markings (theoretically 300 and 450 m from the runway threshold) are not apparent due to their proximity to the aiming point markings.

Diagram of regulatory markings of a runway 2230 m long with no visual approach slope indicator system (PAPI) (left) and Runway 25 of Lorient Lann Bihoué (right)



On 14 November 2012, an inspection of runway 25 showed that the ground markings lacked a significant amount of paint (see appendix 5).

The numerous close runway threshold markings and the large aiming point markings remained visible however.

The touchdown zone markings were not very visible.

The runway centre line markings were not visible between 300 and 900 m from the threshold due to the presence of numerous traces of rubber.

On 18 October 2011, a Brit Air crew stated in an Air Safety Report (ASR) that during a landing by night in a CRJ-700 on runway 25 when dry, they had not seen the ground markings. In reply, the DSAC Ouest stated that an inspection had been carried out in September 2011 and would be transmitted to the military authorities for the implementation of a corrective action plan.

1.10.5 Runway Lighting on Runway 25

In Volume I of Annex 14, ICAO recommends installing centre line lights on runways intended for Category 1 precision approaches. The installation must include white lights between the threshold and a point 900 m from the end of the runway, alternating red and white lights between 900 and 300 m and red lights between 300 m and the runway end.

A system such as this is expensive to install and requires complete reconditioning of the runway in order to bury the lighting.

In DGAC *"Safety Information"* N° 2012/02 dated 10 June 2012, the DGAC recommended that aerodrome operators schedule the installation of yellow runway edge lights when they are intended for precision approaches and are not equipped with centre line lighting.These lights must be installed on the last 600 m (or the last third when the length of the runway is less than 1800 m). They are intended to inform the pilot of the runway end.

This type of installation is also mentioned in the CHEA Decree.

Runway 25 is approved for Category 1 approaches and meets the regulatory requirements of the CHEA Decree.

It is not equipped with an illuminated centre line and its runway edge lights are fixed and white.

It also has distance remaining signs. Spaced 300 m apart, these use two digits to indicate the remaining distance in hundreds of metres. These signs are used by pilots of military aircraft.

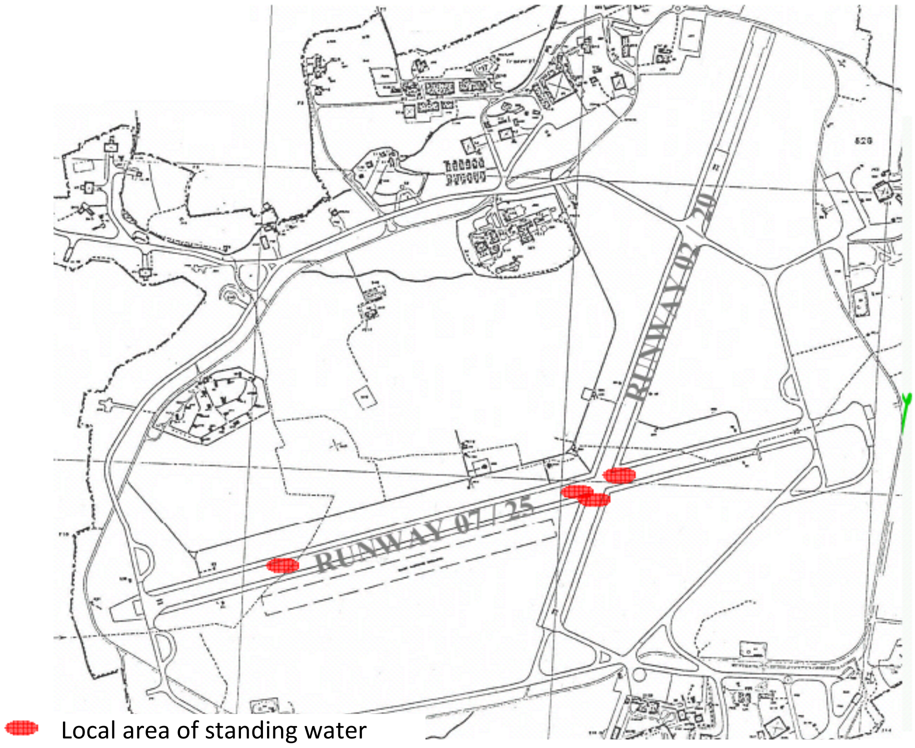
1.10.6 Water retention on runway 25

In April 2010, after two runway excursions by military aircraft in May 2008 and November 2009, the General Staff of the French Navy contacted the STAC to address the problems of water retention on Runway 07/25 (see map below).

After approving the grooving proposed by the STAC, the General Staff of the French Navy commissioned its implementation. As of the date of the accident, no reconditioning had yet been undertaken.

APPENDIX I

RUNWAY PROFILE CORRECTION ZONES TO ELIMINATE RAINWATER RETENTION AND PHOTOGRAPHS OF THE RUNWAY IN RAINY WEATHER



After the accident, two fire trucks poured water on the south side of the runway over the last 1,200 m. Water retention zones were found on certain sections[16].

[16]The STAC indicated that the measured depth of the water was about 1 to 2 mm.

1.10.7 Measurements of Functional Gripping Power of Runway 07/25

The purpose of measuring the functional gripping power of a runway is to determine its intrinsic characteristics and to compare them with the regulatory standards. Aerodrome operators are required to make these measurements every two years.

The STAC made these measurements from 14 to 15 November 2012. It concluded that no action was necessary, except for the reconditioning of four areas including that between 1,400 and 1,600 m from the runway threshold on which the aeroplane landed. These measurements are indicated in the tables in Appendix 6.

The previous measurements were made on 4 October 2010. The STAC report concluded that the overall adherence of runway 07/25 was satisfactory.

1.11 Flight Recorders

The aircraft was equipped with two flight recorders in accordance with the current regulations. They were received at the BEA on 19 October 2012. They were in apparent good condition and were read out using the readout software from the manufacturer L3-COM.

Flight Data Recorder (FDR)

This is a solid state recorder with a recording capacity of at least 25 hours containing 300 parameters[17]. No parameter on brake pressures is recorded.

- Manufacturer: L3-COM
- Model: FA2100
- Type number: 2100-2042-00
- Serial number: 439785

Cockpit Voice Recorder (CVR)

This is a solid state recorder with a recording capacity of at least 2 hours in standard quality and 30 minutes in high quality.

The recording contains the communications between members of the flight crew and with the cabin crew members, passenger briefings, radio communications and the aural environment of the cockpit.

- Manufacturer: L3-COM
- Model: FA2100
- Type number: 2100-1020-00
- Serial number: 107366

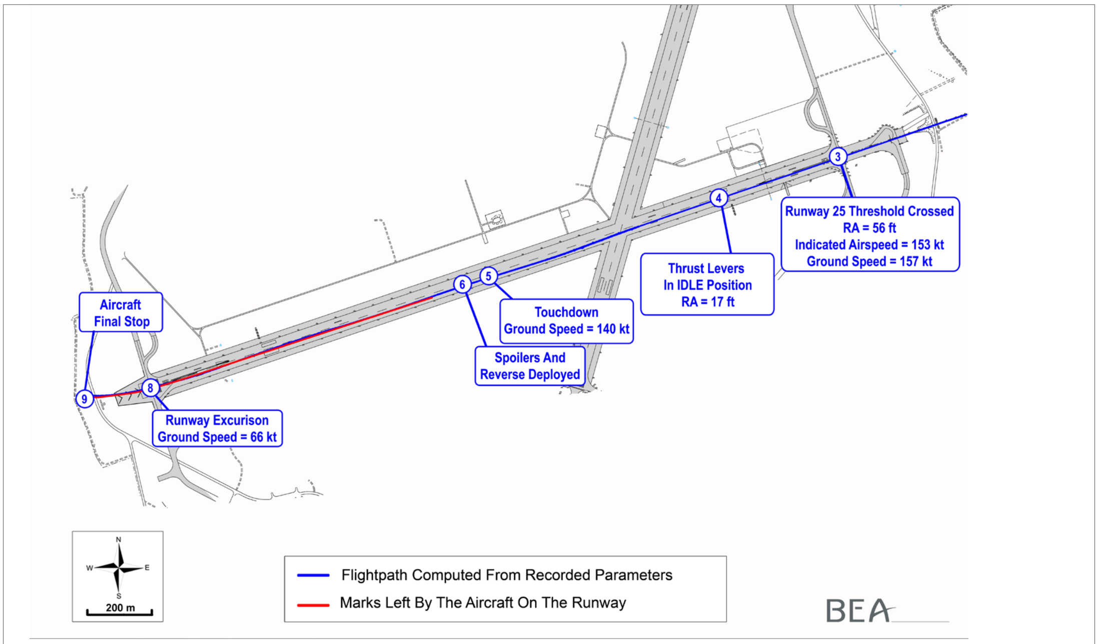
The event was recorded on the FDR and CVR.

1.11.1 Parameter Readout

The graphs for the event are in Appendix 7.

1.11.1.1 Aeroplane's flight path

The flight path of the aeroplane was calculated from its ground speed, magnetic heading[18] and drift recorded on the FDR. It was consistent with the marks left by the aeroplane on the runway.



The positioning of the thrust levers to IDLE and touchdown of the main landing gear occurred respectively at 330 and 1.130 m from the threshold of runway 25.

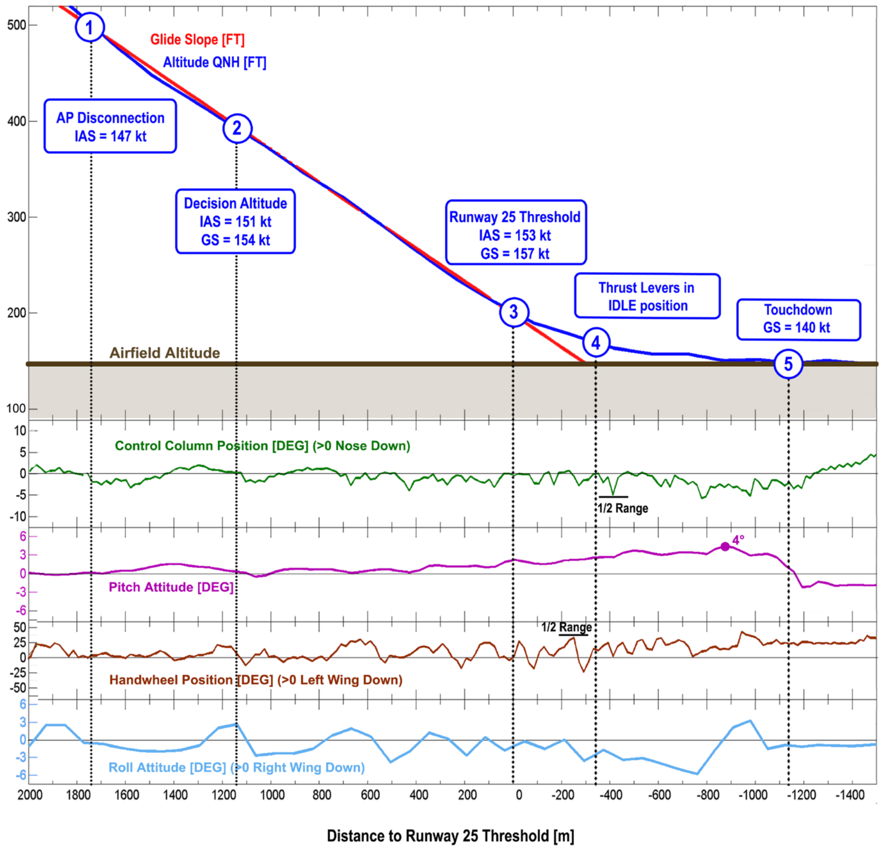
[17] The data were decoded using the grid provided by the manufacturer and referenced CRJ700/900-SL-31-008 Rev. D.

[18] The magnetic heading was corrected for the magnetic variation (-2°) on the day of the event at the Lorient aerodrome.

1.11.1.2 Descent Profile

A comparative graph of the aeroplane's descent profile and the glide path of the ILS 25 approach was made from the moment the AP was disconnected until touchdown.

This graph also shows the attitudes and control column inputs.



The following specific points can be noted:

- ❒ From the disengagement of the AP to 50 ft above ground level, the aircraft was on the glide path to runway 25;
- ❒ On final approach, the roll inputs were substantial (up to half of the maximum amplitude);
- ❒ The aeroplane passed the runway threshold at a height of 56 ft with 4 knots of tailwind;
- ❒ Between reducing the thrust 17 ft from the ground and touchdown, the aeroplane travelled approximately 800 m.

1.11.2 Readout of Data from the CVR

The CVR recording enabled the following points to be noted:

- ❒ The crew repeatedly expressed their fatigue and weariness;
- ❒ Extra-professional conversations were exchanged during all the phases of the flight;
- ❒ The crew omitted some technical callouts.

1.12 Wreckage and Impact Information

The aeroplane came to a stop in a field within the aerodrome boundaries, near a service road and about 200 m beyond the threshold of runway 07.

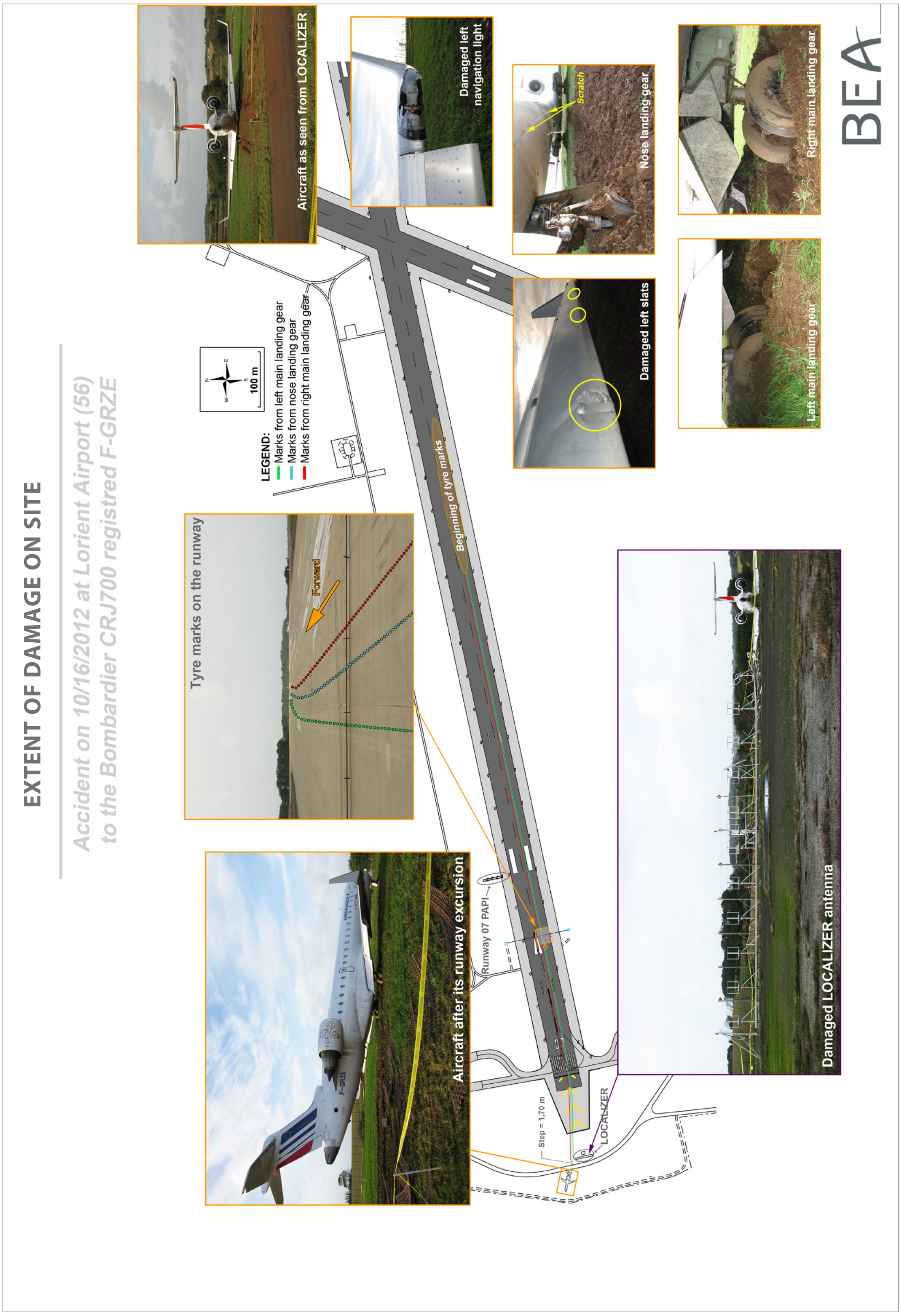
The runway showed signs of white-coloured tyre tread beginning over 1,000 m from the threshold. They were rectilinear, located to the left of the runway centre line, and then turned to the right approximately 300 m from the end of the runway. The white colour suggested aquaplaning.

The LOC antennae were damaged.

The aeroplane flaps were symmetrically extended in a position close to 30°. The flap control lever in the cockpit was set to *"30"*.

The thrust reversers were retracted but the presence of mud splashes on the fuselage indicates that they were deployed during the overrun.

The antiskid switch was found in the *"armed"* position.



1.13 Medical and Pathological Information

Not applicable.

1.14 Fire

Not applicable.

1.15 Survival Aspects

An emergency evacuation was carried out on the orders of the flight crew. The 53 passengers evacuated through the left front door and the over-wing exits.

1.16 Tests and Research

1.16.1 Inspections

Examination of the tyres, brake system and landing lights was carried out by referring to the manufacturer's maintenance manual. This did not reveal any anomalies that may have contributed to the accident.

The control servo-valve on the left antiskid did not relax the brake pressure nominally. This malfunction can lead to brake locking. No trace of vulcanisation on the tyres was detected, however.

1.16.2 Assessment of the State of Runway Contamination

Calculations were made by the manufacturer in order to assess the condition of the runway. They took into account the data below that is based on the FDR parameters at touchdown and assume maximum braking[19] from wheel touchdown:

Weight	28.5 t
Ground speed	140 kt
Configuration	Slats extended and flaps 30°
Ground spoilers	Deployed on touchdown
Thrust reversers	*"Max Rev"* applied on touchdown

The calculations were made by the manufacturer for three different runway conditions:

Condition of runway	Average deceleration [g]
dry	0.53
wet	0.30
Contaminated by water[20]	0.21

During the landing roll, the average deceleration recorded on the FDR between touchdown and overrunning the threshold of runway 07 was 0.22 g.

These results show that, if maximum braking is assumed, the aeroplane performance on landing was typical of that with water contamination on runway 25.

1.16.3 Study of Aeroplane Performance

1.16.3.1 Landing roll distance

Calculations were made by the manufacturer to determine the distance required to decelerate the aeroplane under the accident conditions, from touchdown to standstill after maximum braking on wet, dry and contaminated runways.

[19]Functioning braking system and maximum pressure applied to the brakes by the crew.

[20]Calculations made for a water depth of 1/8 in (3.175 mm).

The results are presented in the table below:

Condition of runway	Roll distance [m]
Dry	625
Wet	925
Contaminated	1,358

For the accident flight, the remaining runway length at touchdown was 1,100 m. This length was therefore sufficient for a complete stop of the aeroplane on a dry or wet runway. It was inadequate on a contaminated runway.

1.16.3.2 Landing distances

The actual landing distance is the distance between passing 50 ft above ground level and the aeroplane coming to a stop, taking maximum braking into account.

The landing distance was calculated by the manufacturer in the following two cases[21]:

- ❒ A case representative of the accident;
- ❒ A case corresponding to the conditions described in the airline's standard operating procedures (SOP).

[21]The calculations do not take into account crew inputs on the control column.

1st case, representative of the event:

Weight	28.5 t
Configuration	Slats extended and flaps 30°
Speed at 50 ft above ground	153 kt
Braking	Maximum
Ground spoilers	Deployed on touchdown
Thrust reversers	*"Max Rev"* applied on touchdown
Wind	4 kt tailwind

For the accident flight, the aeroplane passed threshold 25 at 56 ft above ground. If we consider that the aeroplane followed a slope of 3° between 56 ft and 50 ft, 36 m should be added to the actual landing distance. The results in this case were as follows:

Condition of runway	Actual landing distance [m] (passing threshold at 50 ft)	Actual landing distance [m] (passing threshold at 560 ft)
Dry	1,182	1,218
Wet	1,557	1,593
Contaminated	2,018	2,054

Under the event flight conditions, aeroplane performance would theoretically permit it to land on a contaminated runway, even if the remaining length of runway after the aeroplane came to a complete stop had only been 176 m.

2nd case, representative of SOP's:

During the accident, the wind speed was 15 kt with gusts at 25 kt. In this case, the operational procedures of the airline indicate an approach airspeed of 5 kt greater than VREF should be adopted. This gives an approach airspeed of 144 kt.

The parameters used for the calculation were as follows:

Weight	28.5 t
Configuration	Slats extended and flaps 30°
Speed at 50 ft above ground	144 kt
Braking	Maximum
Ground spoilers	Deployed on touchdown
Thrust reversers	*"Max Rev"* applied on touchdown
Wind	4 kt tailwind

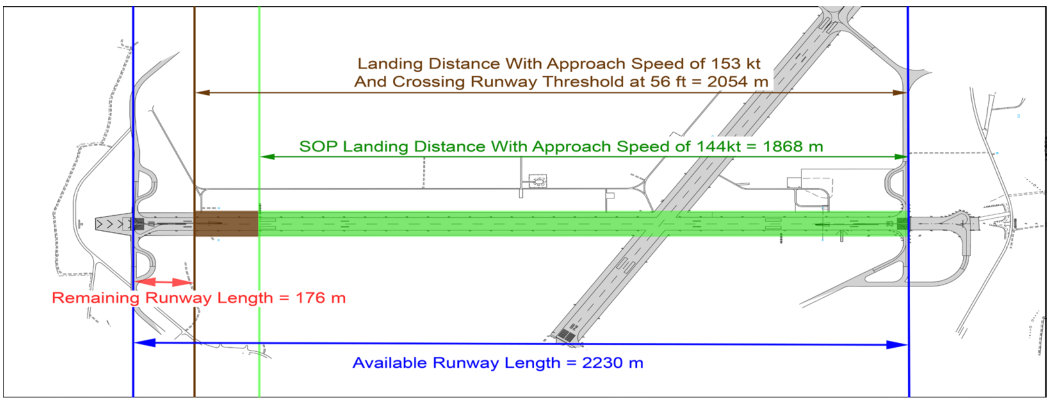
The results were as follows:

Condition of runway	Actual landing distance [m] (passing threshold at 50 ft)
Dry	1,094
Wet	1,422
Contaminated	1,868

This showed that with the approach airspeed recommended in the SOP, the gain in runway length would have been the following:

Condition of runway	Gain in runway length wigh SOP compared with that of the event
Dry	124
Wet	171
Contaminated	186

The diagram below summarizes the previous results for the contaminated runway:



1.16.3.3 Previous landings

The BEA asked the manufacturer for data from flight tests representing a standard flare in the flaps 30° configuration. The information was not available because the manufacturer did not carry out the corresponding flight tests.

A calculation of the distance between the runway threshold and touchdown (see Appendix 8) was made using the parameters recorded during the three previous flights (Paris Orly, Lorient Lann Bihoué and Quimper) made on the same day by the same crew:

- At Lorient Lann Bihoué, touchdown occurred 950 m from the runway threshold. The landing took place during daytime with good visibility;
- At Paris Orly, touchdown occurred at 690 m;
- At Quimper, touchdown occurred at the beginning of this zone, at 385 m.

Three of the four previous landings occurred beyond the zone recommended by the airline.

1.17 Information on Organisations and Management

1.17.1 Brit Air

On the day of the accident, the regional airline Brit Air, founded in 1973, had an Air Operator Certificate valid until 31 March 2014. It served thirty destinations in France and abroad and had a fleet of forty-one Bombardier aeroplanes: 13 CRJ-100, 15 CRJ-700 and 13 CRJ-1000.

1.17.1.1 Training

1.17.1.1.1 Recurrent training and checks (RTC)

The recurrent training and checks program is established for a year (from April in year N to March of year N+1). It is defined in terms of the regulatory requirements, the Recommended Practices Guide published by the DGAC (PEPN) and safety occurrences at the airline.

The RTC consist of:

- Ground training;
- A C1 check: flight proficiency training (FPT) on a simulator (4h) and flight pro-ficiency check (FPC) with extension of the type rating on simulator, 4h;
- A C2 check: FPC on simulator, 4h;
- An LC (line check).

Study of the RTC scenarios for 2010-2011-2012 showed that:

- There was only one scenario per simulator session, in accordance with the regulation;
- There was no night-time scenario.

The limitations of the simulator are as follows:

- The runway ground markings are always visible and are not always indicative of actual markings;
- Conditions with runway water contamination cannot be simulated;
- The touchdown point on landing cannot be easily or appropriately determined;
- The simulation of ground effect and aeroplane behaviour in the flare is not entirely representative of reality.

The courses on aeroplane performance are held during briefings before the simulator sessions. These briefings do not include TEM issues[22].

[22]Threat and Error Management: concept designed to allow crews to:
- Identify the threats to which they are exposed and identify the errors that can be committed,
- Define one or strategies suitable for the identified threats and errors,
- Decide and implement the strategy that seems most appropriate,
- Change the strategy if it no longer seems appropriate, only ICAO Annex 6 specifies that pilots should be trained in TEM.

1.17.1.1.2 Ground training

Each pilot follows three days of ground training in the following areas: operational procedures and regulations, safety recycling, aeroplane system, recycling on dangerous goods, safety security recycling, CRM/HF and SASV (accident/incident report).

<u>Flight Safety and Analysis Service course (SASV)</u>

The following topics were specifically addressed:

- 2010: Fatigue, unstabilised approach (UA);
- 2011: Go-around after a UA;
- 2012: Typology of Accidents (UA statistics, overshoots, hard landings, fatigue, etc.).

<u>CRM course</u>

From 2012, 2 h 30 of classes were provided for flight crews with 1 h 30 in common with cabin crews.

In addition to systematic case studies, the following topics in particular were addressed in joint courses:

- 2010: Vigilance *"below FL100 the cockpit must be professional"*, crew synergy,
- 2011: Situational awareness, fatigue and vigilance,
- 2012: TEM. It was the first time that this topic was discussed. The course provided concrete examples of hazard identification and the solutions that need to be considered. Nevertheless, crews did not have an operational method to apply on how to specifically integrate TEM in briefings.

The Brit Air CRM training course was judged to be in accordance with the regulatory provisions by DSAC.

The lessons learned and best practices issued at the DGAC symposium on 25 November 2010 on *"degraded meteorological conditions and assistance for crew decision making for approach and landing"* were not addressed in the ground training course. An *"executive summary"* and a *"Best practices guide for use by aircraft crews and operators"* were pubished by the DGAC/DSAC.

1.17.1.1.3 Coordination of the work of instructors and examiners

In order to harmonise the training courses, two annual meetings are held to give directives. In November 2011 and March 2012, the instructors and examiners were asked to have *"zero tolerance"* with regard in particular to approach stabilisation and observance of landing distances.

1.17.1.1.4 RTC Assessment

The crew assessment grid, in accordance with the regulation, is binary, contains no instructions for filling it in, and cannot be used to assess their actual level. In 2010, the inadequacy of the assessment grid was identified by DSAC in the context of a deviation relating to assessment of CRM during line checks. A new grid is currently being defined.

The assessments and comments of instructors and examiners are limited to general formulas such as *"piloting good"*, *"CRM good."* They cannot be used to accurately assess the work done and do not indicate possible areas for improvement. In addition, certain instructors and examiners indicate that they do not formalize their debriefings in writing for fear of making entries that could be prejudicial to them in the event of legal proceedings. The DSAC stated that the spaces reserved for comments are in fact used to justify a postponement.

1.17.1.2 Flight Safety and Analysis Service (SASV)

The SASV is responsible for the analysis and safety of the airline's flights. It carries out a systematic analysis of all flights.

1.17.1.2.1 SASV Publications

The SASV is in charge of publication of the flight safety bulletins (*"Flysafe"* and *"Warning"*).

The following topics were specifically addressed:

- ❒ UA issues (Unstabilised Approach) (*"Flysafe"* 30 July 2012)
- ❒ Overshoot (*"Flysafe"* 31 November 2012)
- ❒ Error generating situations (*"Flysafe"* 28 August 2011)
- ❒ Landing on contaminated runways (*"Warning"* 27 Winter 2010-2011)
- ❒ Landing by night (*"Warning" 18* November 2005).

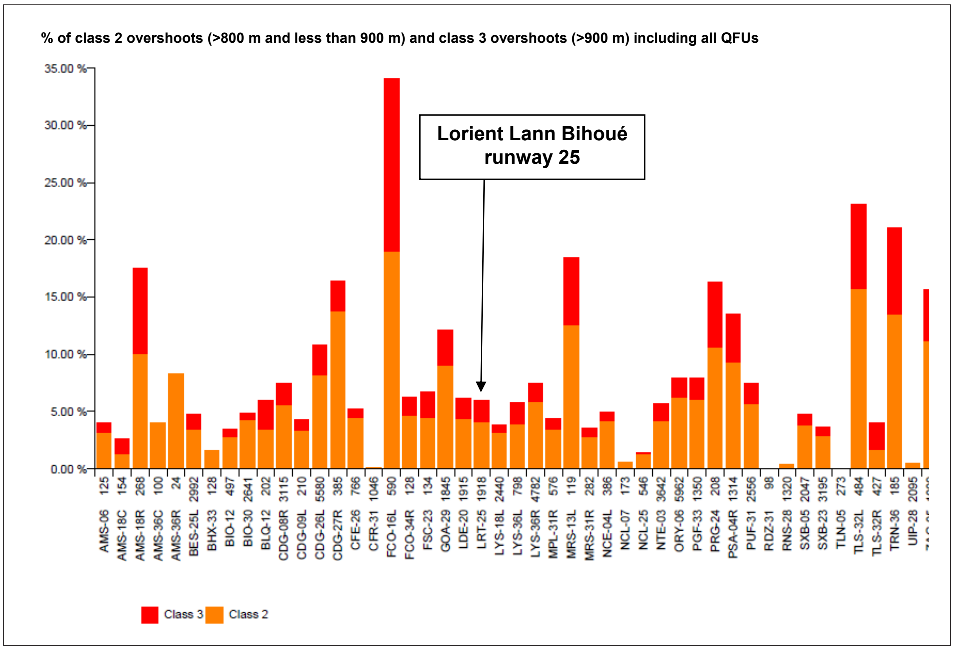
1.17.1.2.2 Overshoots

From the end of 2010, when the CRJ-700 entered service, SASV has studied landings made on this aeroplane 600 m after the runway threshold. The first results related to Lyon Saint-Exupéry airport (runway 36L) and showed a significant number of overshoots: 68 out of 125 landings. (See Appendix 9)

Various causes were considered such as the significant length of the runway or the allocation of a taxiway at the end of the runway.

In the summer of 2012, a similar analysis was undertaken for the CRJ-700. As of the date of the accident, the operator had identified certain aerodromes at which overshoots were the most numerous.

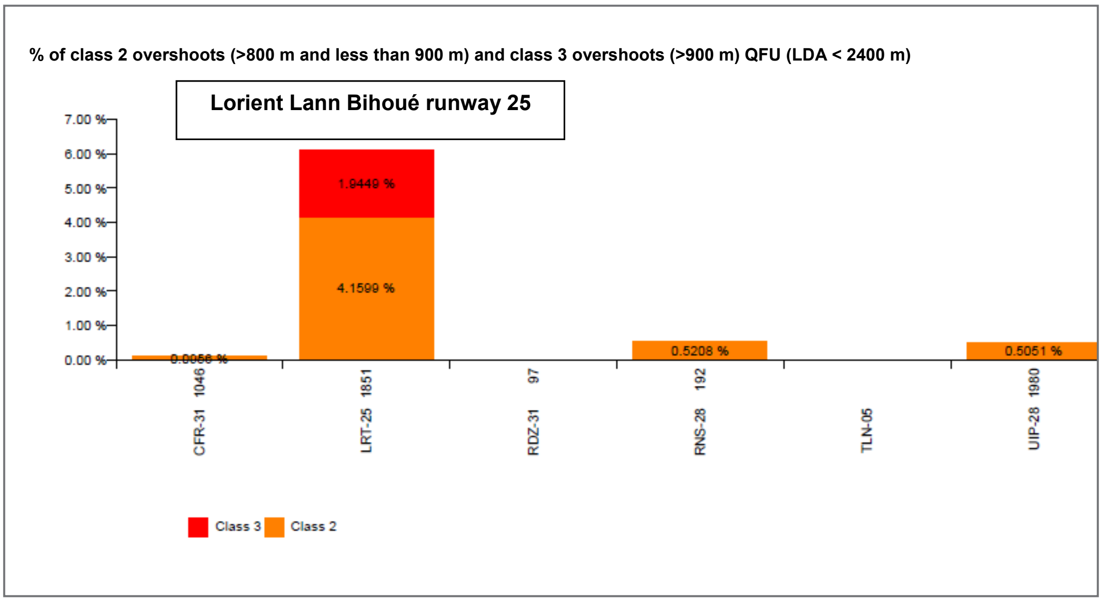
The results for Lorient Lann Bihoué did not appear to be significant.



At the request of the BEA, the airline forwarded the graph for overshoots by CRJ-700 on runways where the LDA is less than 2,400 m. It shows that 551 out of 1,680 landings occurred more than 650 m from the threshold, i.e. 32.8% of the landings (see Appendix 9). In this classification, it can be seen that the largest number of overshoots occurred at Lorient Lann Bihoué.

It should also be noted that only 9.8% of the overshoots were due to unstabilised approaches (UA). The latter, therefore, do not seem to be a contributing factor.

11 of the 12 landings more than 950 m from the threshold of runway 25 at Lorient Lann Bihoué did not follow a UA.



1.17.1.2.3 Unstabilised approaches

Three classes (see appendix 10) of UA were defined by the airline.

The UA rate was approximately 2.92% in 2011 and approximately 2.52% in 2012.

UAs rarely resulted in a go-around:

- In 2011, 2.21% of all UAs were followed by a go-around (without it being possible to attribute the go-around to the non stabilisation of the approach);
- In 2012, 2.19% of all UAs were followed by a go-around.

1.17.1.3 Safety Management System and fatigue risk

SMS[23] has been in use at Brit Air since 1 January 2012.

Risk mapping[24] was defined, including that relating to overruns.

The implementation of SMS on that date did not contribute to the PTCs that were supposed to start in March 2012. However, after the accident, the 2013 PTCs were designed to add issues involving landing on short or limited runways and heighten crew awareness about landing distances or the loss of visual references under the DH, as well as techniques for missed landings.

[23] Called SMS by Brit Air

[24] Risk identification, assessment and prioritization process so that they can be positioned on scales in order to deal with them.

The existence of a Safety Management System for fatigue risk – FR-SMS is a requirement of the supervisory authority for five-leg flights followed by a reduced rest period[25]. The Brit Air SMS contains provisions relating to fatigue in general but does not include measures specific to this type of flight. Since 28 November 2011, the *"practical guide for implementation of safety management systems for public transport airlines and maintenance organisations"* requires, in the context of SMS, that the number of legs flown be taken into account when assessing fatigue risk.

[25] Rest time equal to or less than 10 hours.

Managers from the airline stated that five-leg flights could be tiring. They stated that this type of organisation was in accordance with the regulations.

1.17.1.4 Brit Air Operating Procedures

Crews have the following specific documents:

- Operations Manual (MANEX), Parts A, B and C;
- Reduced Documentation (RD);
- QRH;
- Operational Flight Plan (OFP).

1.17.1.4.1 Sterile cockpit and conversations in the cockpit

The Operations Manual provides the following definitions:

- The cockpit is sterile *"from the point when no further intervention in the cockpit or on intercom by the cabin crew is permitted except in cases of emergency";*
- *"Conversations"* and *"callouts"* in the cockpit *"will be limited"* during *"critical phases of flight (takeoff, approach, landing, go-around) to the minimum necessary for the proper conduct of the operation in progress"*. Moreover, it is also specified that *"while taxiing, conversations in the cockpit should be limited to the minimum necessary."*

1.17.1.4.2 Approach speed (VAPP)

The Operations Manual defines this as follows:

- VAPP = VREF (reference speed) + wind correction.

VREF is determined based on the configuration and weight of the aeroplane.

The *"wind correction is equal to:*

- *If gust ≤ 15 kt: + 5 kt;*
- *If gust > 15 kt: + 10 kt"*.

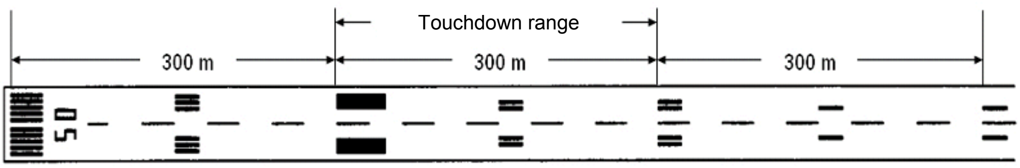
Brit Air officials have said that the term *"gust"* should be understood as the difference between the average wind speed and maximum wind speed.

1.17.1.4.3 Landing technique

- In the *"Piloting technique"* paragraph in the Operations Manual:
  - *"Aim for touchdown (flush marker lights) approximately 300 m beyond the runway threshold, in the centre line"*,
  - *"Pass the runway threshold at an altitude of 50 ft radio altimeter height at approach airspeed"*,
  - *"Reduce thrust to idle between 50 ft and 30 ft radio altimeter height"*,
  - *"Flare between 30 ft and 20 ft"*;

- In the paragraph *"Technical order Aircraft change – to CRJ-700"* of the RD:
  - *"reduce to IDLE between 30 and 20ft"*,
  - *"flare at 20 ft, pitch attitude to - 4°"*;
- The Bombardier FCOM indicates:
  - Reduce slowly to IDLE below 50ft ground,
  - Commence flare between 30 and 20 ft ground.
- The Operations Manual states that: *"From passing the threshold, stabilised, the flare consists in flying the flight path to a touchdown area located between the flush marker lights (endpoint of the ILS) and 300 m after the lights. The marks painted on the runway should allow you to judge the touchdown position"*.

Fig. 1: Landing technique



- In case of cross wind:
  - *"Place the wheel firmly windward"*,
  - Landing is prohibited if the cross wind[26] is greater than 30 kt on a dry or wet runway ;
- On a contaminated runway[27]:
  - Land with the flaps in the 45° position,
  - Make a firm landing,
  - Landing is prohibited if the cross wind is greater than 10 kt and if braking is poor.
- Missed landing:
  - *"The manoeuvre is initiated when the thrust levers are set approximately to idle thrust and the altitude is less than 50ft"*;
  - *"Do not attempt a go-around after initiating reverse thrust."*

1.17.1.4.4 Landing with suspected or confirmed windshear

Part A of the Operations Manual recommends the following:

"Avoiding windshear phenomena is the best means of prevention. To do so, proceed as follows:

- *Listen to any reports of windshear made by other pilots;*
- *Use the weather radar on takeoff and approach to properly locate storm cells;*
- *Scan the instrument panel frequently.*

However, it is not always easy to identify the presence of windshear. For this reason, certain precautions are necessary if the presence of windshear is suspected:

[26] Average wind.

[27] If more than 25% of its surface area is covered by a film of water more than 3 mm deep, or more than 3 mm slush or sleet, or more than 20 mm of dry snow, compact snow or ice.

- *During the approach:*
  - *Use the longest and the most favourable runway available,*
  - *If conditions so permit, adopt the flap configuration recommended by the manufacturer,*
  - *Add an appropriate wind correction to the final approach airspeed,*
  - *Use the autopilot for as long as possible,*
  - *Do not make major thrust reductions or major changes in trim in order to follow very brief fluctuations in airspeed."*

In Part B of the Operations Manual, the operator suggests landing with a flaps 30° configuration.

Before 23 March 2010, an FCOM supplement issued by Bombardier (CRJ-100/200/440 and CRJ-700) recommended, in the case of suspected or confirmed windshear, to extend the minimum flaps compatible with the available runway length for landing.

Brit Air decided to choose the flaps 30° configuration.

On 23 March 2010, Bombardier issued *"Temporary Revision RJ700-163"* which removed this instruction for the CRJ-700. Bombardier stated to the BEA that this instruction had been removed because the different types of aeroplane were certified only for the standard flaps 45° configuration.

After this publication, Brit Air retained the flaps 30° configuration for reasons that could not be given to the BEA.

Since 22 November 2012, Brit Air has banned approaches in the flaps 30° configuration with suspected or declared windshear.

1.17.1.4.5 Landing distances

The Operations Manual and RD include performance charts for *"legal [i.e. regulatory] landing distance"* and *"true landing distance"* on dry, wet and contaminated runways. In case of suspected or confirmed windshear, it specifies *"for a flaps 30° landing, increase the landing distance by 25%"*.

Brit Air tells its crews to determine and verify the parameters before the arrival briefing. This *"in-flight determination of the landing distance should be based on the latest available information, if possible obtained less than 30 minutes before the estimated time of landing."*

The Operations Manual states that this landing distance is the legal [i.e. regulatory] landing distance.

1.17.1.4.6 Deviations on approach below 1,000 ft

Deviations on approach below 1,000 ft relate to certain parameters, including the indicated airspeed, which should be between VAPP - 5kt and VAPP + 10 kt.

When a deviation occurs, the PM calls it out. If no immediate correction is made, a go-around is imperative.

1.17.1.4.7 Flight Crew Briefings

- *"At least three Flight Crew briefings must be made during each flight: departure briefing, takeoff briefing and arrival briefing."*

- *"The captain or PF should, whenever s/he considers that the circumstances require it, initiate a specific or additional briefing."*
- *"When the conditions taken into account at the time of the briefing change, it must be repeated."*
- *"A good briefing should be short, and understood by all crew members. It must be reconstructed for each flight and highlight the specifics of the day".*
- The structure of the arrival briefing is described in detail. It specifically asks that the crew *"take into account certain factors that may affect the landing distance such as weather related hazards (e.g. windshear or changing meteorological conditions that can result in a wet or contaminated runway), and be aware of any kind of deviation leading to a go-around decision (e.g. excess airspeed, too high an approach slope, height of passage over threshold of more than 50 ft)".*

1.17.1.4.8 Specific features of Lorient Lann Bihoué

Part C of the Operations Manual does not mention any specific features relating to the ground markings or water retention at Lorient Lann Bihoué aerodrome.

1.17.1.4.9 Definitions

- Phases of flight

"The whole flight is broken down into phases of flight. Each of them has an expanded guide and a check-list".

- Expanded guide

"The expanded guide corresponds to all of the chronological actions of a given phase of flight. The extended guide is accompanied by commentaries."

- Check-list

"The check-list concludes a phase of flight and allows the following phases of flight to be prepared by making the crew formally check that actions essential to safety have been correctly executed, all the while in accordance with cross checking procedures."

1.17.1.4.10 Normal Check-list

"Readout of the check-list must be done aloud and intelligibly. When a procedure is involved – and if mentioned in its title – reading must be silent. In case of reading aloud, the crew member who is reading out the check-list only moves on to the following point when he has received the correct answer to the point in question and has checked the item himself".

1.17.2 Lann Bihoué Naval Air Base

1.17.2.1 General

The NAB Services at Lann Bihoué operate the aerodrome and provide the ATC service.

1.17.2.2 Operation of the aerodrome

There is a Quality and Safety Management System (QSMS) in the French Navy that is applicable to all the services involved in aerodrome operation.

There is no defined aerodrome operator at Lorient Lann Bihoué. This is ensured by various services of the NAB, which does not have an aerodrome safety certificate.

1.17.2.3 ATC service provider

ATC service is provided by the local aerodrome control (CLA). This service is certified according to European civilian aviation requirements.

1.17.2.3.1 Inspection of runways

A runway inspection was carried out by the local aerodrome control (CLA) between 18 h 30 and 18 h 55. It was done in the rain. In accordance with established procedures, it was designed to specifically check the status of the runway surface and its markings. The controller noted and transmitted the information that the runway was wet with puddles. He did not determine the depth of the water because he considered that such a measurement was not useful.

1.17.2.3.2 Contamination of runways

- The Control Tower shift supervisor sent a member of staff to identify the nature of the contamination and determine the depth. In the case of proven contamination, the CLA watch officer calls in the services concerned to treat the contamination and issues a NOTAM.
- The information to be provided to aircraft on runway conditions by the CLA must comply with ICAO Annex 14 recommendations:
  - Damp: the surface shows a change in colour due to the presence of humidity,
  - Wet: the surface is wet but there is no standing water,
  - Puddles: many pools of standing water are visible (depth < 3 mm),
  - Flooded: broad patches of standing water are visible (depth > 3 mm);
- A measuring shim, placed in all inspection vehicles, is provided in order to determine the depth of the puddles, but there is no tool or method to determine whether the water level is present over a surface area greater than 25% of the width and length used.

1.17.2.3.3 DGAC Symposium on 25 November 2010

The NAB was not informed about this symposium and received neither the *"executive summary"* nor the *"Best practices guide for use by aircraft crews and operators"* published by the DGAC.

The DIRCAM was attached to a new Defence agency in September 2010. It was not invited to the symposium and received no documentation in relation to it.

1.17.3 Oversight of Brit Air

1.17.3.1 Organisation and conduct of oversight by DSAC Ouest

Oversight of Brit Air operations is undertaken by DSAC Ouest.

It is based on audits, the subjects of which are defined in the Technical Control Manual - Public Transport (MCT-TP). All of its subjects must be covered over a two year cycle.

During the audits, DSAC Ouest checks compliance of operations with the regulations. A report details the major deviations(28) and deviations(29) from the regulations, as well as any remarks(30).

Continuing oversight is complemented by checks carried out by the DSAC Flight crew expertise centre (PEPN) and/or the flight check organisation (OCV) at the request of DSAC Ouest. The OCV also undertakes random checks in the context of its control mission.

(28)Finding concerning a non-compliance requiring immediate or very fast action in order not to create a potentially dangerous situation.

(29)Finding concerning a non-major non-compliance.

(30)Finding concerning an area for improvement.

1.17.3.2 Results of surveillance audits by DSAC Ouest

From the beginning of 2010 until September 2012, no major deviation was noted. In 2012, two deviations and nine remarks were issued. The deviations concerned CRM training and grids in particular.

The FR-SMS had not been audited since 2009.

1.17.3.3 PEPN inspections

Only one inspection was conducted between 2011 and 2012. It was held on 26 March 2012 and resulted in no findings.

1.17.3.4 OCV inspections

The reports from spot checks by the OCV are sent to the DSAC Ouest. The latter assesses whether the findings are to be considered as deviations or remarks. The observations made are sent to Brit Air with the report by the OCV.

From January 2011 to October 2012, the OCV carried out 11 in-flight checks that led to the issuing of 50 findings. These only gave rise to remarks by DSAC Ouest. The findings focused specifically on the following topics:

- ❒ Joint plan of action or TEM;
- ❒ Updating of landing distances in the arrival briefing;
- ❒ Overshoots.

Note: TEM was only implemented from April 2012 by Brit Air.

In December 2012, a finding concerning the failure to update the landing distance by the crew was notified as a deviation by DSAC Ouest.

1.17.3.5 Validation of Brit Air RTC by the oversight authority

Each year PEPN publishes recommended practices guides (RPG) in addition to the regulatory requirements of the EU-OPS. These guides are designed to assist operators in the development of their RTC program and the oversight authority in the approval of these programmes.

DSAC Ouest validates the regulatory compliance and consistency of the RTC with the assistance of PEPN. The latter made no remarks on the 2011 and 2012 Brit Air RTC.

An additional note to the RPG for the 2012 RTC stated that ground training would include the DGAC symposium of 25 November 2010 in the form of a summary for crews.

Note: The lessons learned from the symposium are not included in the Brit Air RTC.

1.18 Additional Information

1.18.1 ASR by the Crew of the Preceding Aeroplane (Embraer 145)

The crew landed at 19 h 06 on runway 25 using thrust reversers and manual braking. The captain and co-pilot each wrote an ASR (see appendix 11). In it they reported moderate rain, puddles on the runway, the runway being slippery, a phenomenon of aquaplaning and a temporary loss of control at the end of the first third of the runway. One of ASR's states that runway 25 is known to be in poor condition with the frequent presence of persistent puddles after some precipitation.

1.18.2 Previous events at Lorient Lann Bihoué

- 22 May 2008: Rafale F2 landing on runway 25 wet with puddles:
  - Aquaplaning noted,
  - Safety recommendation for a study on the possibility of improving the grip and drainage of the runway;
- 2 November 2009: Super Etendard landing on runway 25 wet with puddles:
  - Aquaplaning noted,
  - Recommendation on controller phraseology in order to provide more precise information on the condition of the runway,
  - Same safety recommendations on improving adherence and drainage of the runway.

1.18.3 Rules and Specific Points concerning Runways that are Wet or Contaminated by Water

- General

In relation to the presence of water on the runway, there are differences in vocabulary between ICAO Annex 6 (Operation of Aircraft) for airlines and 14 (Aerodromes) for aerodrome operators.

Annex 6, defines the terms wet(31) and contaminated(32) while Annex 14 defines the terms, damp(33), wet(34), puddles(35) and flooded(36) to characterize the condition of the runway.

EU-OPS [Regulation (EC) N° 859/2008 of the Commission of 20 August 2008] only uses the terms damp(37), wet(38) and contaminated(39).

Bombardier uses the terms from Annex 6 for establishing the performance characteristics of CRJ aircraft.

- Determination of runway contamination for a water contaminant

The STAC published a Technical Information Note (2nd edition January 2012) for aerodrome operators on the *"Characterization of runway surfaces in degraded meteorological conditions"*. This note provides recommendations to assist operators in the development and implementation of procedures for the supervision of aerodromes during degraded meteorological conditions.

The note emphasizes that water is a specific contaminant. Its distribution on the paved surface changes rapidly and defects in runway geometry makes its depth on the paved surface highly variable. Under these conditions, it is very difficult to assess the depth of any contamination.

(31) Runway that is neither contaminated nor dry.

(32) Runway on which more than 25% of the surface area bounded by the required length and width being used (whether in isolated locations or not) is covered with a film of water more than 3 mm deep.

(33) The surface indicates a change in colour due to the presence of humidity

(34) The surface is wet but there is no standing water.

(35) Many pools of standing water are visible.

(36) Broad patches of standing water are visible.

(37) The surface is not dry but the humidity does not give it a shiny appearance.

(38) The surface is covered with water to a depth of less than 3 mm or surface moisture is sufficient to make it reflective but without large puddles.

(39) Ditto footnote 27.

1.18.4 DGAC Action plan

Following the DGAC symposium on 25 November 2010, an action plan was developed by the DGAC.

The plan included the following:

- Aircraft operators: promotion of the Best practices guide for use by aircraft crews and operators;
- Aerodrome operators: organisation of feedback concerning the application of the Technical Information Note (2011 edition) on the *"Characterization of runway surfaces in degraded meteorological conditions"*;
- Promotion of the work of the symposium in international groups, especially within the European PES or ECAST[40].

[40]European Civil Aviation Safety Team.

1.18.5 Interviews with the Flight Crew

1.18.5.1 Captain

- Flight preparation

The captain considered that he had enough meteorological information to prepare the flight. The preparation was done in the cockpit because of the short turnaround time. Rain and a crosswind of 15 to 20 kt had been forecast. He felt there was a risk of windshear and therefore considered landing on a wet runway in the flaps 30° configuration. He stated he had checked that the landing distance was consistent with this strategy.

- Flight

During the descent the controller announced a squall, a wet runway with puddles and aquaplaning for the preceding aeroplane. The captain switched on the weather radar and found large areas of rain but no storm cell. He then switched it off. He considered the information *"wet runway with puddles"* from the controller as information usually corresponding in Brittany to a wet runway. He noted the aquaplaning information but remained focused on wet runway conditions. The meteorological and runway conditions being those forecast during the flight preparation, he felt that it was not necessary to reassess the landing distance and decided to continue his initial strategy, meaning a wet runway in the flaps 30° configuration because of the risk of windshear.

The approach for him was *"standard and according to norms"*.

The aeroplane broke through the cloud cover at 800 ft. He could clearly see the runway but it was raining and the wipers were in the full speed position. He said he was hindered by the luminous displays used for the *"cabin ready"*.

He thought that he flared out slightly too high. He felt the aeroplane float. He was focused on keeping to the centre line. He stated that keeping to the centre line was not easy because of the wind, the inefficiency of the CRJ-700 landing lights, the deficient ground markings of the runway centre line and the absence of lighting on the runway centre line. He saw an aiming point marking.

The touchdown was soft but that was not his objective.

He did not have the feeling the flare was long. He was unable to specify where the wheels touched the runway. He did not see the panels indicating the remaining runway length or the taxiway crossing. As soon as touchdown occurred, he felt the aeroplane sliding. He applied maximum braking as soon as he could and set the thrust reversers to maximum.

❒ Working method and personal experience

He explained that he was accustomed to landing in the flaps 30° configuration. He had done most of his flights on the CRJ-700.

He stated he had never landed on runways contaminated with water.

With regard to the landing, he applied the same landing technique in the flaps 30° and flaps 45° configuration. He flared with a pitch attitude of approximately 2° and positioned the thrust levers to IDLE between 10 and 20 ft. He aimed for the aiming point markings and touchdown occurred shortly afterwards. He had no time reference or other means of assessing the distance.

Regarding the use of the *"IAS bug"*, he said that he normally selected the VAPP but during this flight, he may have selected the VREF due to an old habit he acquired during his first flights with Brit Air.

❒ Previous flights with the co-pilot

The atmosphere during day time flights was good. The co-pilot carried out the first three legs as PF and handed over the controls for the last two.

The flight made as PM to Lorient Lann Bihoué on the same day went well. The runway was dry. He had no memory of a long flare and it seemed to him that the touchdown was made at the aiming point markings.

❒ Human Factors

The captain stated that he felt tired before the start of the fifth leg. In general, five-leg flights are tiring. This is felt by a majority of pilots, but few pilots, including him, inform the airline of this. He stated that he did not feel more tired than during previous five-leg flights. He had never cancelled a flight for reasons relating to fatigue.

He was used to five-leg flights, which he made approximately two to three times per month.

He explained that night flights, which are more numerous at that time of year, are more tiring. He carried out the two night landings during this day with five flights.

He stated that he was not aware of the condition of the runway 25 (water retention areas, lighting and ground markings).

1.18.5.2 Co-pilot

❒ Flight preparation

The co-pilot stated that during flight preparation, the captain had told him the weather forecasts were bad with the presence of rain at around 19 h 00 or 20 h 00 and crosswind. A landing in the flaps 30° configuration on a wet runway was chosen because of the suspected windshear. The captain and the co-pilot discussed the landing distance required with the configuration and the condition of the runway. It was consistent with a landing on runway 07/25.

❒ Flight

The co-pilot went over the checklists, using them as a guide for action and not as a means of ensuring that these actions had been performed.

During the descent, the meteorological conditions called out corresponded to wet runway conditions identical to those originally forecast. He did not feel the need to reassess the landing distance. Although the controller sent him information from the previous crew about aquaplaning, he did not associate this term with a potentially contaminated runway since the controller did not formally announce this contamination.

He considered that the controller gave meteorological information late and it was not accurate.

The approach was stable. No airspeed deviation was called out during the approach since the airspeed was correctly maintained by the captain. He realised it was a little high but felt it was within acceptable limits for the approach.

He stated that they saw the runway approach lights at around 800 ft.

The rain was quite heavy. The speed of the windscreen wipers was set to the fastest position. He said he saw the approach end of the runway but not the aiming point markings.

He did not feel that the flare was long. He stated that the lighting on the CRJ-700 is not effective and that runway 25, which is not equipped with centre line lighting, was not very visible.

He explained that the touchdown was soft. He was unable to estimate the distance from the threshold. He saw neither the runway crossing nor the distance remaining signs present on the edge of the runway.

As soon as touchdown occurred, he felt the aeroplane sliding. He asked the captain if he was braking. Since the latter told him he couldn't manage it, he then immediately applied full brakes.

❒ Working method and personal experience

Since obtaining his CRJ-1000 type qualification, the co-pilot had carried out the flights needed to maintain his CRJ-1000 type qualification. It was the first flight he was making on this type of aeroplane since the screen to display the *"cabin ready"* from the cabin crew had been installed. He stated that the screen illuminated the cockpit and that the system slightly disturbed him during the approach. He considered the system inappropriate and inconvenient for night flights.

That day was his first flight for more than a year bound for Lorient Lann Bihoué.

He explained that for a wind with gusts of 25 kt, he increased the VREF 10 kt since the gusts were greater than 15 kt. He displayed the VAPP at the *"IAS bug"* but stated that some Brit Air captains display the VREF. He preferred the airspeed to be above the *"IAS bug"* but avoided being below it at all costs.

He had already encountered the phenomenon of aquaplaning and landing on runways contaminated by snow.

The co-pilot had no apprehensions about a go-around. However, he stated he had never done this manoeuvre below the minima.

With regard to the landing, he flared at 30 ft and reduced speed at 20 ft aiming for the aiming point markings. He landed shortly afterwards. He had no time reference or other means of assessing the distance.

❒ Previous flights with the captain

The atmosphere during daytime flights was good. It seemed to him that the flight made as PF to Lorient Lann Bihoué the same day went well. He did not remember having made a long flare or a touchdown far from the runway threshold.

❒ Human Factors

He explained that he was tired before the start of the fifth leg. However, he stated that he did not feel more tired than during other five-leg flights. According to him, the meteorological conditions at this time of the year start to get a little worse and cause more fatigue. He considered that five-leg flights are too tiring and should not be maintained. Not many are made on CRJ-1000.

1.18.6 Onboard Runway Excursion Prevention System

This type of system is already available on certain aeroplanes. It is an interactive system that informs the crew in real time during the approach and landing phases. It continuously calculates the actual landing distance and the remaining distance on the ground for the aeroplane to stop. It provides, where appropriate, visual and oral alert messages to the crew. Installation of such equipment is not required by the regulations.

EASA initiated a notice of proposed rule making (NPA 2013-09 *"Reduction of runway excursions"* on 10 May 2013) aimed at defining certification standards (CS 25 and CS 26) for onboard landing assistance systemsand their mandatory installation on future aeroplanes used for public transport.

1.18.7 Assessment, Assimilation and Standardisation of the Transmission of the Condition of the Runway

The operational performance characteristics of aeroplanes when landing and taking off are highly dependent on the surface condition of runways. For this reason, information on the state of contamination of the runway is needed by crews to determine the configuration of the aeroplane and the margins available for landing, especially in terms of landing distances. Methods and means already exist and others are being evaluated.

Information on the characterisation of the condition of the runway and gripping power must be sent to the crews. However, there is no standardization of this information. This leads crews and controllers to interpret the information.

Work is currently being carried out by working groups (TALPA ARC and EASA) to define standards for reporting the runway conditions that are usable by crews and controllers alike.

1.18.8 Safety Actions Since the Accident

1.18.8.1 Brit Air

Brit Air has implemented numerous safety actions since the accident, including:

- Publication of flight safety bulletin *"Flysafe N°. 31"*;
- Publication of the Flight Safety Flash Info n°. 03/12 of 24 October 2012;
- Planned Compliance Audit of the Operations Manual part B1 and B2 with the manufacturer FCOM normal procedures and limitations to identify deviations and modify if necessary the Operations Manual;
- Starting an internal SMS investigation;
- The publication on 22 November 2012 of a note stating that landings in suspected windshear conditions must be made with flaps 45°;
- Publication on 22 March 2013 of a note modifying the airline landing instructions (touchdown as near as possible to the aiming points with a tolerance of 300 m);
- Publication on 22 March 2013 of a note defining the meaning of the VAPP in the FCOM;
- During ground training on the ECP 2013 *"OPS procedures and regulations"*, about one third of the time is spent on calculating limitations on landing, landing technique and TEM;
- A new crew assessment grid for RTC is being defined and will be presented to the DSAC Ouest;
- Modification of the notation of the ongoing CEL and CHL with the same approach as the crew evaluation grid;
- A new safety objective in 2013: halve the number of overshoots beyond 300 m in relation to the aiming point markings.

1.18.8.2 Bombardier

- Publication of the *"Flight Operations Note"* (FON) (CRJ-700/705/900/1000-FON-00-004) on 13 December 2012 on the landing configuration in case of suspected or known windshear. This FON reminded that the *"Temporary Revision RJ700-163"* eliminated all configurations below 45° in this case because these aeroplanes were tested and certified for a normal landing in the flaps 45° configuration.

1.18.8.3 Lorient Lann Bihoué Naval Air Base

- Painting repair work on the daytime markings began in mid-March 2013 and was completed in mid-April 2013.

2 - ANALYSIS

2.1 Scenario

The crew was about to make its fifth flight of the day and spoke about the fatigue they felt. They prepared the final leg in the cockpit due to the short duration of the stopover. They specifically ensured that the landing distance required in the flaps 30° configuration was compatible with the wet runway conditions announced.

Extra-professional conversations were exchanged during the flight, specifically below FL 100 during the descent. They affected flight monitoring and proper use of the checklists.

ATIS information indicated a PAR 07 arrival procedure. The crew planned to carry out the ILS 25 procedure that they knew well and believed to be compatible with the crosswind and gusts announced. The controller cleared this approach. Shortly before the descent, the PM mentioned his fatigue and weariness. He went through the *"Descent"* checklist without waiting for confirmation from the PF after each item and forgot certain callouts.

During the descent, the crew carried out a short briefing in which the landing distance was not recalled. They planned to adopt a flaps 30° configuration and announced a speed of 140 kt corresponding to the VREF for the estimated weight of the aeroplane.

Twelve minutes before landing, the crew contacted the Lorient approach controller. The latter confirmed the bad meteorological conditions, indicated the presence of puddles on the runway and the aquaplaning conditions described by the pilot of the preceding aeroplane. This information did not trigger any particular reaction by the crew or an additional briefing taking into account the potential threats associated with it. The plan to land in the flaps 30° configuration was not queried.

When the PF requested the *"Approach"* checklist, the PM did not immediately reply because of the absence of the cabin report from the cabin crew. He then started a discussion of the inconvenient light from the *"Cabin Ready"* screen.

Nine minutes before landing, the controller again indicated the presence of heavy rain, the condition of the runway, the aquaplaning and the difficulties of the preceding aeroplane. This information did not alert the crew, and did not change their plan of action. Indeed, at the same time, the appearance of the *"Cabin Ready"* message pushed them to begin the *"Approach"* check-list.

A message from the controller interrupted this checklist. It was resumed in the wrong place. As a result of the use of checklists as an action guide and not as a checklist, the crew did not check the altimeter calibration.

The various conversations stopped three minutes before landing at around 3,000 ft with the extension of the landing gear and flaps as well as the call out and display of a VAPP of 140 kt. During the *"Before landing"* checklist, the crew realised that the altimeters were not properly calibrated. The PF asked the PM whether the *"Approach"* checklist had been completed.

On passing through 1,000 ft, the aeroplane was stable on the ILS at a speed of 144 kt and the crew decided to continue the approach.

Below 1,000 ft, the speed increased by more than 10 kt above VAPP without the crew seeming to notice. The callouts and go-around, planned by Brit Air in case of destabilization, were not performed.

The aeroplane flew over the threshold at 154 kt with a tailwind of 4 kt.

The PF had difficulty in estimating the altitude of the aeroplane because of the absence of lighting. He made multiple inputs on the controls to keep the aeroplane on the runway centre line. He seemed to focus on control of the aeroplane because he did not know how far from the threshold he was landing. The crew did not realise that the runway was contaminated and that the landing was long. At no time did they envisage a go-around. Since the aeroplane was not equipped with a system to prevent runway excursions, the crew did not receive any warning.

The remaining distance was insufficient and the aeroplane overran the runway.

2.2 Human Performance

2.2.1 Crew Resource Management

In general, the information received during the flight did not modify the crew's perception of the situation that they had formed since the beginning of the flight.

The desire to complete the flight as soon as possible was mentioned in the cockpit. It may indicate a state of fatigue related to the fifth leg of the day. The lack of assimilation of the related risk may have degraded their overall performance and resulted in the following:

❒ The establishment of a *"non-sterile"* cockpit situation and extra professional conversations. This tendency has already been observed in flight crews unconsciously trying to fight against fatigue and the effect of routine;

❒ Undetected deviations from airline procedures, which specifically require a decision to abort the approach below 1,000 ft in case of excessive speed;

❒ The lack of technical call-outs and the use of checklists as an action guide;

❒ The lack of response to controller information who, though using non standard phraseology, was liable to not alert them to indications of runway contamination;

❒ The arrival briefing in which the landing distance required was not mentioned;

❒ The incomplete assessment of the consequences of choosing the flaps 30° configuration on increasing the landing distance.

2.2.2 Threat and Error Management

This concept leads to the adaptation of the proposed crew actions after identification of current threats and potential errors.

During the ground preparation, the crew stated that they checked that the required landing distance at Lorient Lann Bihoué was compatible with the flight. It only left a margin of about 80 m, however. The crew identified the threat of wet runway but did not think to look for other threats that might affect the actual distance. Consequently, they did not establish a strategy to ensure that the margin would be respected.

During the descent, the crew was informed that the meteorological conditions were more degraded than those forecast on departure. Not having carried out a TEM analysis of the situation during the arrival briefing, they opted for a flap 30° configuration to deal with windshear. Having thus considered that the situation was that provided for during the flight preparation, they did not update their proposed action and did not take into account possible runway contamination.

In this context, they did not realise that the landing distances required in the chosen configuration exceeded the LDA.

In addition, the crew did not perceive the threat of an overshoot when most of the landings made on the same day occurred beyond the recommended touchdown zone.

The threat of an over run was not identified. The intention of landing using the markers and a possible go-around in case of failure were clearly not contemplated. In fact, it appears that compliance with this zone constituted an absolute objective for the airline, without the means to comply being defined.

Good conditions or long runways can incite deviations from crews that may lead them to erase the safety margins offered by respecting operational instructions. When the meteorological conditions are degraded, these margins can then become insufficient.

During the flare phase, the PF's high workload to take into account the crosswind, visual difficulties and the bad condition of the ground markings did not make it possible for the crew to precisely monitor the touchdown point. Since this aspect was not identified as critical, the go-around and the risk of overrun were not envisaged and the runway excursion surprised the crew.

2.3 Operator's Methods

2.3.1 Performance of Crew Training, Recurrent Training and Check Functions

Crew training, recurrent training and checks at the time of the accident made it impossible for crews to understand some of the threats facing them during operations.

Flight crew recurrent ground training has included a TEM part since 2012. This was not put into effect during simulator sessions. In addition, by the date of the accident, only the captain had been given awareness training. The crew therefore was thus not predisposed to apply it.

The flight safety part in their training did not include the lessons learned and best practices from the DGAC symposium of 25 November 2010 relating to assisting landing in degraded meteorological conditions. This symposium specifically addressed the risk of runway excursions.

The SASV had identified that many crews were making overshoots. For this reason, the training department established a zero tolerance policy regarding compliance with the landing zone during recurrent training and proficiency checks or line checks. However, the instructors did not have the means to check this requirement during training sessions on simulators because the latter do not allow for a clear view of the touchdown zone.

The simulator sessions did not include night-time scenarios. Furthermore, simulation of runway contamination is not possible on the simulators used. The operator's crews were not therefore trained to react to certain degraded conditions that they could, however, encounter in operations.

The ground training and Part C of the Operations Manual did not provide the crews with information on the specific details of the aerodromes used, such as poorly visible markings or water retention areas. Nor were these specific details represented in the simulator.

This situation was not compatible with the compliance requirement for landing zones.

2.3.2 Documentation

The investigation showed the differences between the operator's documentation and that of the manufacturer. These differences specifically led the crew to choose the flap configuration that was no longer recommended by the manufacturer in case of suspected or confirmed windshear.

There are differences in the information between the Operations Manual and the reduced documentation on the altitude at which the thrust should be reduced and the flare started.

The Operations Manual method for determining the approach airspeed does not clearly describe the assimilation of gusts of wind. This may lead crews to choose approach airspeeds that are potentially inappropriate.

These differences did not allow the pilots to assimilate and share the airline's standards. They could also affect the efficiency of monitoring by the PM.

The TEM concept is not included in the description of briefing content, that of the arrival briefing in particular. This does not ensure assimilation and operational application of the concept by crews.

2.3.3 Five-leg Flights

The operator developed a Fatigue Risk – Safety Management System (FR-SMS), in accordance with the rules on rest periods for crews but did not take into account, in its SMS, the fatigue risk associated with the number of legs flown.

Some officials from the airline were aware that these flights were tiring.

The crew said they felt fatigue but that it did not seem any greater than that experienced on other flights of this type. The practice was to accept to continue the flight in this type of situation.

It appears that neither the FR-SMS nor the SMA has difficulty in processing complex contextual factors influencing the state of fatigue, private life and the environment. Prevention strategies are provided by the FR-SMS and implemented by pilots but their effectiveness is overestimated. Fatigue can have insidious consequences that cannot always be detected in time.

The operator has put in place some measures to mitigate fatigue but none is specific to five-leg flights. The investigation noted that the FR-SMS, like the SMS, was incapable of mitigating the effects of fatigue when felt by crews during this type of flight.

2.3.4 Safety Culture

The airline's SMS has existed since 1 January 2012. To date it has had little impact on the airline's operations.

Systematic analysis of all the flights by SASV has shown that a very small number of unstabilised approaches are followed by a go-around.

Since the end of 2010, the study of overshoots on CRJ-1000 by Brit Air has led to the creation of an analytical procedure. The airline did identify, on the basis of the initial results in February 2012, the high number of overshoots. This problem was also highlighted in the summer of 2012 on CRJ-700. However, no lessons were learned or contributing factors highlighted before the accident. Overshoots were discussed during ground training in 2012 as a statistical element identified in airline operations. The SASV team had planned to develop this issue in the airline safety bulletin in November 2012.

At the time of the accident, the overshoot rate on CRJ-700 of 32.8% on runway 25 of Lorient Lann Bihoué was not especially prominent compared with other runways served by the airline.

The tools developed by the airline did not succeed in identifying and treating this problem adequately. In particular, they show that the operator's safety culture inadequately integrates calling landing decisions into question.

2.3.5 Assessment and Monitoring of Crews

The check and report methods defined by the airline, did not allow it to identify and follow up possible areas for crew development. As a result, it could not identify pilots who needed additional training or assess the maturity level of its operations. It was therefore incapable of defining areas for improvement.

The checks carried out by the OCV specifically showed that landing distances were not updated during the arrival briefing, and the recurrence of overshoots. These deficiencies were not detected or noted during checks carried out by the operator.

The operator thus had no accurate perception of the safety performance of its operations.

2.4 Aerodrome Operation

2.4.1 Aerodrome Operator

In early 2012, the controlling authority of the aerodrome received a report from the supervisory authority on the condition of the runway. The latter detailed numerous deviations that the supervisory authority did not consider incompatible with continued operation of the runway.

Two reports forwarded to the NAB after two excursions from runway 25 indicated water retention areas. They suggested studying the water drainage of the runway and, if necessary, carrying out work in order to improve this feature.

As of the date of the accident, water retention areas leading to contamination of the runway had been identified and the NAB had decided to carry out the requisite work. However, the exact nature of work and the action plan had not yet been established.

The operators of Lorient Lann Bihoué aerodrome were not subject to an aerodrome safety certification process. For this reason, they are not certified as an *"aerodrome operator"* and are not subject to the requirements of a safety management system enabling a proactive approach to the detection and correction of deviations involving aerodrome facilities.

The lessons learnt from DGAC symposia were not sent to the managers of military aerodromes and the NAB did not receive those of the 25 November 2010 symposium, unlike civilian operators.

The lack of any certification of an aerodrome operator at Lorient Lann Bihoué in an overall system where other entities are certified or approved by the supervisory authority (aircraft operator, ATC service provider and aerodrome facilities) means that the same level of safety as that of a civilian aerodrome with comparable traffic could not be guaranteed.

2.4.2 Runway Characteristics

Although compliant with regulations, the absence of centreline lighting for runway 25 meant that the crew had insufficient assistance during landing, which may partially explain landing quality reduced by real difficulty in keeping to the centreline during the flare.

The optional nature of the DGAC recommendation in *"Safety Info"* N° 2012/02 of 10 June 2012 meant that it was not implemented at the Lorient aerodrome.

2.4.3 Condition of Runway

Determining the status of a runway contaminated by water is complex due to the changing nature of the contaminant. It should be noted that no method of evaluation has been defined either at the national or international levels.

The locally trained staff responsible for inspecting the runway did not see fit to carry out measurements of the water level on the runway, probably because the level would have changed by the end of an operation that lasts 25 minutes.

The phrase *"wet with puddles"* used by the controller does not correspond to standard information and did not lead the crew to awareness of the condition of the runway.

The crew of the preceding aeroplane had reported difficulties related to the condition of the runway that the controller transmitted to the crew of the CRJ-700. Since this type of message is not standardized, it can be interpreted differently depending on the crew that receives it.

A more formatted message might have allowed the crew to realise the consequences of the runway condition on landing performance.

3 - CONCLUSION

3.1 Findings

- The crew possessed the licenses and ratings required to undertake the flight.
- Brit Air had a valid AOC.
- The operator of Lorient Lann Bihoué aerodrome was not certified.
- The ATC service provider was certified in accordance with European civil regulations.
- The aeroplane possessed a valid Certificate of Airworthiness.
- Marks from tyres, consistent with the phenomenon of aquaplaning, were found on the runway more than 1,000 m from the threshold of runway 25.
- Examination of the tyres, the brake system and lights indicated no anomalies.
- Runway 25 was approved.
- Runway 25 had no centreline lighting.
- Areas of water retention existed on runway 25.
- The inspection carried out jointly by the DSAC and the DIRCAM in September 2011 found deviations in the daytime marking of runway 25.
- A corrective action plan for these deviations was issued by the NAB on 26 September 2012 with a deadline of 31 December 2012.
- The crew decided to land in the flaps 30° configuration.
- The crew called out and displayed a VAPP of 140 kt.
- Conducting conversations not directly related to the flight contributed to a lack of situational awareness on the part of the crew.
- The crew showed signs of fatigue and routine several times on the CVR recording.
- The information provided by the controller about the presence of puddles on the runway did not make it possible for the crew to identify runway contamination.
- The phraseology used by the controller was not shared by the pilots.
- The 18 h 20 *"WHISKY"* ATIS did not contain any specific information on the condition of the runway.
- An inspection of the runway, completed at 18 h 55 while it was raining, indicated that runway 25 was wet with puddles of water, but the depth of the water was not determined.
- The crew of the preceding aeroplane stated that there was aquaplaning on the runway.
- The distance required during the flight preparation was compatible with the landing distance available.
- The landing distance required on a wet runway was less than the LDA.
- The landing distance on a contaminated runway was greater than the LDA.

- The aeroplane crossed the threshold of runway 25 on the ILS with a VAPP of 153 kt and a tailwind of 4 kt.
- The wheels of the aeroplane touched runway 25 at a distance of 1,130 m from the threshold at a speed of 140 kt.
- The remaining distance did not allow the crew to stop before the end of the runway.
- The aeroplane overran the runway at a speed of 66 kt.
- The landing performance of the aeroplane was compatible with water contamination on runway 25.
- During the previous landing at Lorient Lann Bihoué, the touchdown on runway 25 took place during daytime 950 m from the threshold.
- The RTC on simulator does not include a night-time scenario.
- TEM was discussed since 2012 in theoretical classes followed jointly by flight crews and cabin crews.
- The lessons learned and best practices issued during the DGAC symposium of 25 November 2010 were not presented to Brit Air crews.
- The CRJ-700 simulator cannot be used to easily determine the touchdown point or to represent conditions of runway contamination by water and markings that are representative of reality.
- Some of the procedures, in particular those relating to landing technique and wind correction of the VAPP, were unclear.
- Part C of the Operations Manual did not indicate the features of the runway 25 at Lorient Lann Bihoué.
- As of the date of the accident, the system set up by Brit Air had not identified that 32.8% of the CRJ-700 landings on QFU 25 at Lorient Lann Bihoué were overshoots.
- Fatigue risk management by Brit Air) failed to take into account in an operational manner the effects of fatigue during five-leg flights.
- The operator did not have a true picture of the safety performance of its operations.

3.2 Causes of the Accident

The accident was caused by the crew deciding not to abort the landing although they were not aware either of the degree to which runway conditions were contaminated or of the remaining length of runway available.

Continuing the landing can be explained by:

- Insufficient situational awareness linked to:
  - Crew performance degraded by fatigue and routine,
  - Unfamiliarity with safety margins and inadequate TEM training;
- An approach to safety by the operator that did not encourage crews to question their plan of action.

The following factors contributed to the incident:

- The crew's under-estimation of the meteorological conditions;
- Operational instructions that were sometimes unclear or contradictory, thereby undermining teamwork;
- The characteristics of runway 25, which were also not documented in the Brit Air Operations Manual;
- The organisation of aerodrome operations that contributed to the deviations identified concerning runway 25 not being corrected in a timely manner;
- A lack of common phraseology that would guarantee crews and controllers to have a shared comprehension of the true condition of the runway;
- The organisation of training and checks that prevented the operator from recognising and improving its safety performance;
- Incomplete integration of the risks of fatigue by the airline.

4 - SAFETY RECOMMENDATIONS

Note: In accordance with Article 17.3 of European Regulation (EU) 996/2010 of the European Parliament and Council of 20 October 2010 on the investigation and prevention of accidents and incidents in civil aviation, a safety recommendation shall in no case create a presumption of blame or liability for an accident, a serious incident or an incident. The addressee of a safety recommendation shall inform the safety investigation authority which issued the recommendation of the actions taken or under consideration, under the conditions described in Article 18 of the aforementioned Regulation.

4.1 Runway Lighting

The investigation showed that the crew encountered a number of difficulties in positioning themselves in relation to the threshold and runway centreline because of ground markings that were not very visible and the lack of suitable light signalling.

In two investigations the BEA recommended, in 2004 and 2008, that the DGAC study the possibility *"of installing centreline lighting on aerodromes open to public transportation"*.

The installation of centreline lights on a runway approved for Category I precision approaches and RNAV (GNSS) approaches is not mandatory. It is recommended by ICAO for category I precision approaches, particularly when the runway is used by aircraft with high landing speeds. The DGAC has proposed that installation be carried out on the most sensitive runways during compatible scheduled work. In addition, the DGAC has issued *"Safety Info"* N° 2012/02, which is included in the CHEA Decree, recommending the installation of special runway edge lights in the absence of centreline lighting.

Consequently, the BEA recommends that:

- **DGAC ensure that this safety information be known to all aerodrome operators, including those under the Ministry of Defence, that operate aerodromes for use by civil aviation; [Recommendation FRAN-2013-068]**

- **DGAC link renewal of its approvals to the good condition of ground markings; [Recommendation FRAN-2013-069]**

- **EASA study, for aerodromes used by commercial civil aviation, the mandatory installation of additional ground facilities to improve night flight support systems for pilots on runways approved for Cat I precision approaches; [Recommendation FRAN-2013-070]**

- **In the meantime, DGAC make the installation recommended in *"Safety Information"* n°2012/02 mandatory for all operators of aerodromes for use by civil aviation. [Recommendation FRAN-2013-071]**

4.2 Water Retention Areas on Runway 07/25

The areas of water retention reduce tyre adhesion and promote the occurrence of the phenomenon of aquaplaning. This situation increases the risk of runway excursions.

After the two runway excursions in 2008 and 2009, the BEAD recommended that a study be carried out to improve the adhesion and drainage of runway 07/25. The crossing point between runways 07/25 and 02/20 was identified as a water retention area. The solution of creating a transversal groove, together with a complementary study, has been approved but has not yet been carried out.

Examination of the runway in November 2012 showed that there were many other retention areas, particularly in the last 1,200 meters on the south side of runway 25.

Consequently, the BEA recommends that:

- **DIRCAM and DGAC jointly ensure that the French Navy General Staff takes steps to make it possible to improve drainage and to eliminate areas of water retention all over runway 25 in the shortest possible time. [Recommendation FRAN-2013-072]**

4.3 Threat and Error Management

Crews are exposed to errors and threats on every flight. They are thus required to recognize and manage them systematically in order to establish a plan of action that takes them into account. TEM is recommended by ICAO in Annex 6 at the level of flight crew training. EASA issued regulation (UE) n° 1178/2011 on 3 November 2011 which requires that instructors have competence that includes TEM and that the content of the examination for issuance of a CPL include TEM. EASA created a task, referenced RMT.0194 *"Extension of competencybased training to all licences and ratings and extension of TEM principle to all licences and ratings"*, which updates the task originally identified as FCL.006. In addition, the (EU) n° 965/2012 regulation of 5 October 2012 does not take TEM into account in recurrent training and in-flight checks for crews.

The investigation showed that the flight crew's TEM level was weak. This situation was linked to poorly adapted TEM training both in ground training courses and in RTC, in addition to a lack of clear TEM instructions during briefings, allowing crews to identify threats and errors and develop strategies to counter them.

Consequently, the BEA recommends that:

- **EASA integrate TEM into RTC (recurrent training and checks) and into operational procedures by holders of an AOC ; [Recommendation FRAN-2013-073]**

- **In the meantime, DGAC put in place TEM awareness programmes for holders of an AOC. [Recommendation FRAN-2013-074]**

Aircraft operators are exposed to numerous threats that are specific to their operations. They must identify them in order to ensure the safety of their operations and take them into account in their SMS.

Thus, Brit Air undertakes operations on runways, some of which are limited and which have some features that are not known to crews and that are not subject to specific procedures.

Consequently, the BEA recommends that:

- **DGAC check that operators holding an AOC take TEM into account in their SMS. [Recommendation FRAN-2013-075]**

4.4 Professional Level of Crews

Brit Air crews are evaluated during their RTC by instructors and examiners. However, the binary assessment grid made available to them is very limited in scope for providing a detailed appreciation of work performed and the professional level reached. Furthermore, the latter show a marked reticence in formalising remarks that might be prejudicial to them in case of legal issues arising. Thus, appreciations and comments remain very limited and do not provide a true analysis of the work performed, any progress or the professional level of flight crews.

Consequently, the BEA recommends that:

- **DGAC ensure that operators holding an AOC put in place systems allowing representative assessment and follow-up of the proficiency level of their crews. [Recommendation FRAN-2013-076]**

4.5 Fatigue Risk Management

Brit Air developed a risk management system for crew fatigue but without carrying out any specific studies. The airline, which has been authorised to carry out five-leg flights with reduced rest periods, is aware that these flights are tiring and generates greater routine and fatigue.

The *"practical guide for implementation of safety management systems by public transport airlines and maintenance organisations"* requires, in the framework of the SMS, taking into account the risk of fatigue.

At the time of this accident, risk management through the SMS by Brit Air did not prevent the presence of crew fatigue or mitigate its effects.

Consequently, the BEA recommends that:

- **DGAC ensure that the measures implemented within the framework of an SMS are adapted to prevent fatigue and, where appropriate, to mitigate its effects. [Recommendation FRAN-2013-077]**

4.6 Clarification of the Operations Manual and the Reduced Documentation

Brit Air's Operations Manual and reduced documentation contain a certain number of inaccuracies, in particular the VAPP corrections depending on the wind in gusty conditions, and various instructions, such as the height to start the flare or thrust reduction. The instruction on avoiding the flaps 30° configuration in the case of suspected or proven windshear was not updated by the airline.

Furthermore, Part C of the Operations Manual does not indicate all the features of aerodromes that are essential for crews to identify potential threats and carry out landings in the safest conditions possible. For example, the features of the Lorient Lann-Bihoué aerodrome, notably those relating to the markings on touchdown zones, the condition of the runway and the existence of water retention areas on the main runway in the event of rain, are not mentioned.

Consequently, the BEA recommends that DGAC ensure that:

- **The process of checking and updating Brit Air documentation is revised to improve the lead times to take account of changes and the overall consistency of the various items of Brit Air documentation; [Recommendation FRAN-2013-078]**

- **Part C of the Brit Air Operations Manual indicates the features of runways, notably information about their ground markings (details and condition) and surface condition. [Recommendation FRAN-2013-079]**

4.7 DGAC Symposia

The lessons from the *"Degraded meteorological conditions and assistance for crew decision making for approach and landing"* symposium organised by DGAC on 25 November 2010 related to most of the contributory factors involved in this accident. Brit Air was present at the symposium, but the lessons were not effectively used. The DGAC published these lessons and best practices but did not ensure that all operators of aeroplanes and aerodromes used them.

Furthermore, the DIRCAM did not participate in this symposium and received none of the documents issued by the DGAC.

Consequently, the BEA recommends that:

- **DGAC ensure, in the context of its oversight actions, that all operators (of aircraft and aerodromes) and ATC service providers take into account, in the context of their SMS and operations, the lessons learned from the symposia organized by the DGAC.[Recommendation FRAN-2013-080]**

4.8 European Action Plan for Prevention of Runway Excursions

The European Action Plan (EAPPRE) presents recommendations for the prevention of run way excursions. However, it does not contain a formal commitment on their implementation. In addition, these recommendations do not have regulatory value. As such, this action plan does not provide sufficient guarantees for the implementation of the recommendations.

Consequently, the BEA recommends that:

- **DGAC check that operators of aerodromes and of aircraft holding an AOC evaluate the recommendations of the European Action Plan (EAPPRE) through their own SMS. [Recommendation FRAN-2013-081]**

4.9 Certification of Aerodrome Operator

Operators of aerodromes with traffic of over 150,000 passengers per year have, since July 2010, been certified, with the exception of the operators of military aerodromes such as Lorient Lann Bihoué (181,524 passengers in 2011). Thus the latter are not subject to the requirements of a Safety Management System that would enable them to take proactive action on the detection and correction of deviations in relation to the installations.

The investigation showed that corrective actions relating to the deviations observed in the operation of Lorient Lann Bihoué runway 07/25 had not been applied at the time of the accident.

Consequently, the BEA recommends that:

- **DSAC and DIRCAM study the possibility of extending, to military aerodromes that handle civil traffic, the requirements for certification and safety management applicable to civil aerodromes with equivalent traffic. [Recommendation FRAN-2013-082]**

List of Appendices

Appendix 1
Captain's and co-pilot's schedules

Appendix 2
ILS instrument approach to RWY 25.

Appendix 3
Transcript of radio communications

Appendix 4
Relevant deviations in ATC reports from 27 to 30 September 2011

Appendix 5
Daytime marking of runway 25 (14 November 2012)

Appendix 6
Functional skid resistance measurements on 14 and 15 November 2012

Appendix 7
Detailed history of flight based on FDR parameters

Appendix 8
Comparison of touchdown zones

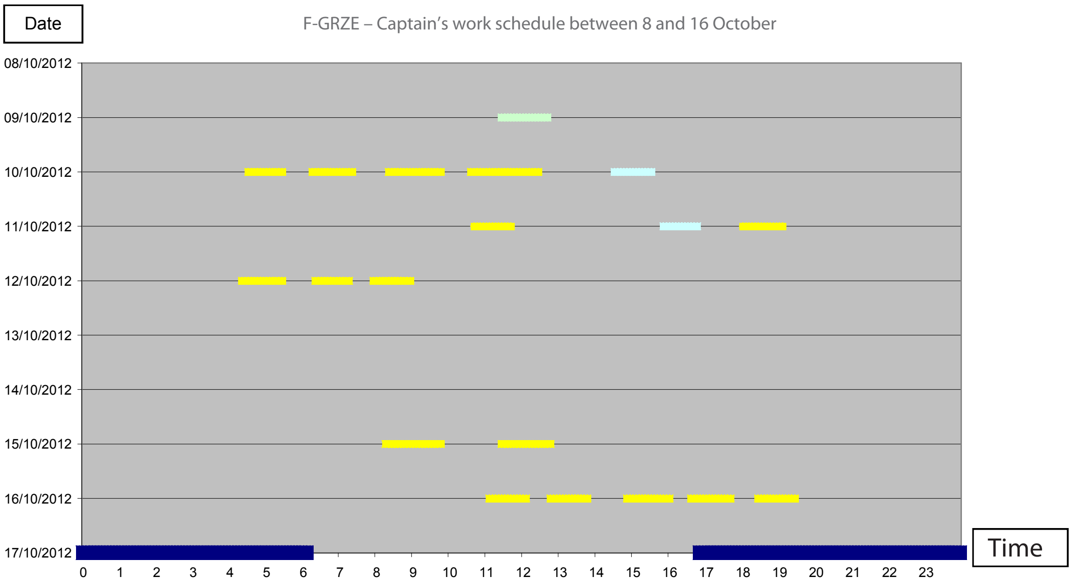
Appendix 9
Brit Air statistics

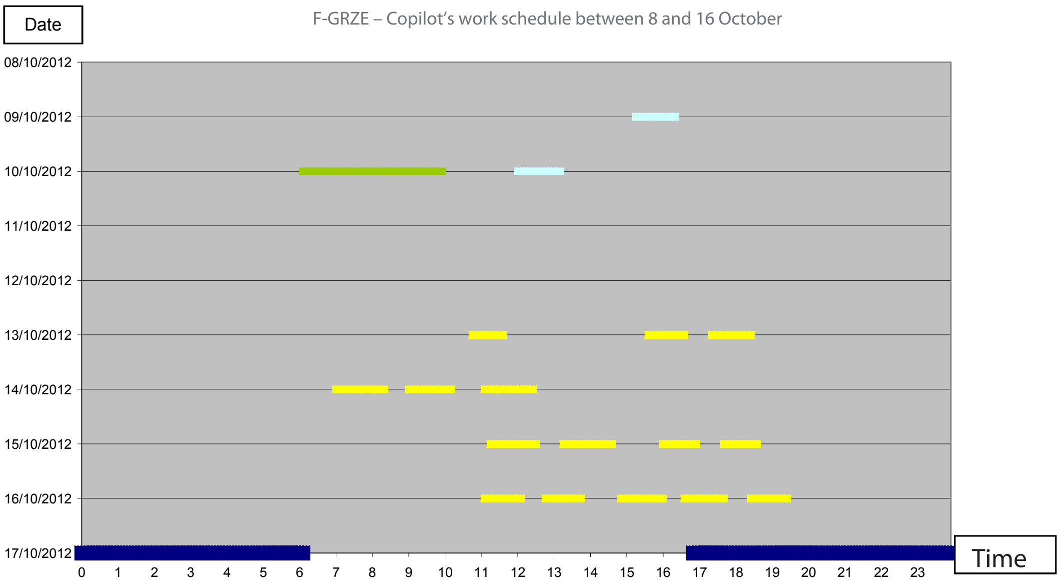
Appendix 10
ANS classes

Appendix 11
Embraer 145 ASR

Appendix 1

Captain's and copilot's schedules





UTC Time

In Yellow : legs performed

In Blue : ferry flights requested by airline

In green Other service time

Appendix 2

ILS instrument approach to RWY 25

28 JUL 11 — FRANCE

APPROCHE AUX INSTRUMENTS — **LORIENT** LANN BIHOUE

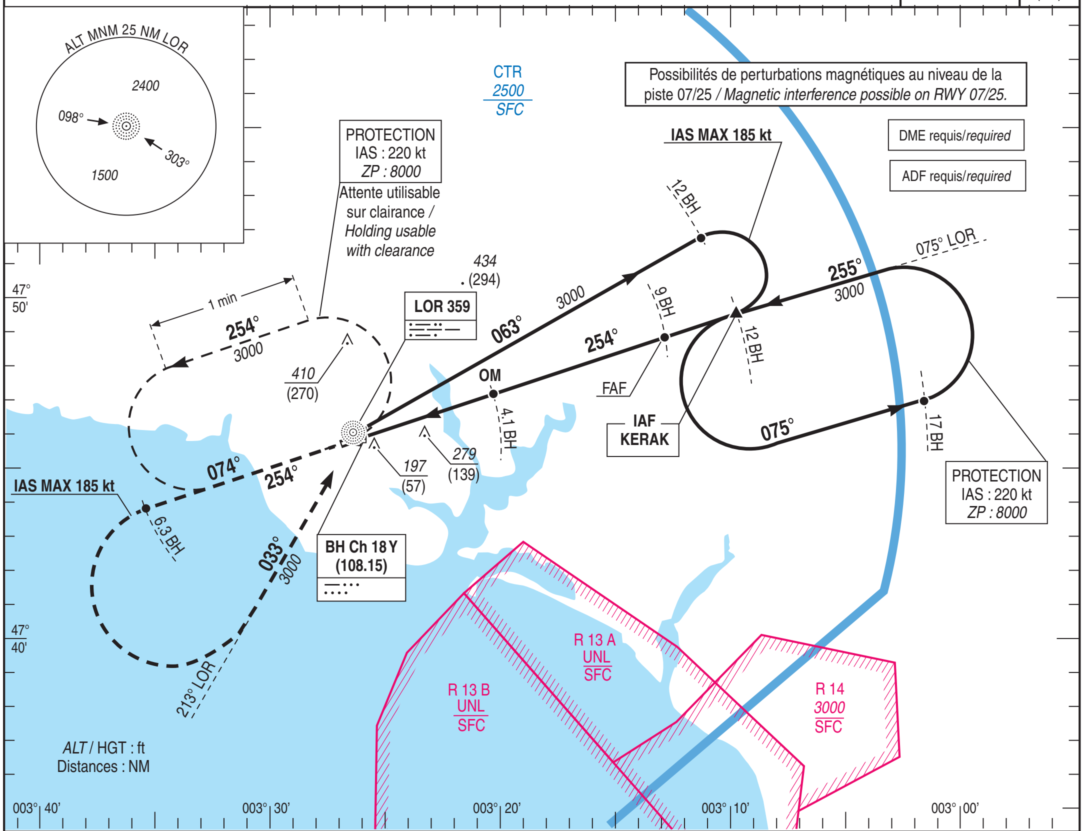
Instrument approach

CAT A B C D

ALT AD : 160, ***DTHR : 140 (5hPa)*** — ILS ou/*or* LOC RWY 25

ATIS : 129.125
APP : LORIENT Approche / *Approach* 123.0 122.1
TWR : LORIENT Tour / *Tower* 122.7 119.7(S)

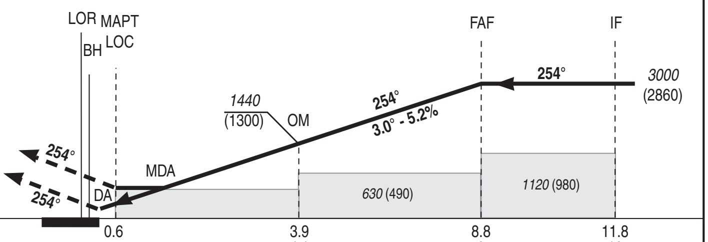
ILS	VAR
BH : 108.15	2°W
RDH : 57	(10)



TA : 5000

API : Monter **dans l'axe** vers ***3000*** (2860). A **6.3 BH** tourner à **gauche** pour intercepter et suivre le **QDR 213° (RM 033°)** vers **LOR**.
Monter à *1000* (860) avant d'accélérer en palier.

Missed approach : Climb straight ahead up to ***3000*** *(2860). At* ***6.3 BH*** *turn* ***left*** *to intercept and follow* ***QDR 213° (Mag track 033°)*** *to* ***LOR****. Climb at 1000 (860) prior to level acceleration.*



DTHR ← (NM)	0.6	3.9	8.8	11.8
DME BH ← (NM)	0.8	4.1	9	12

MNM AD : distances verticales en pieds, RVR et VIS en mètres./*Vertical distances in feet, RVR and VIS in metres.* — REF HGT : *ALT DTHR*

CAT	ILS (1)		OCH ILS	LOC OCH : 349		*MVL/Circling*	
	DA (H)	RVR	RVR	***MDA*** (H)	RVR	***MDA*** (H)	VIS
A	***390*** (250)	800	143	***490*** (350)	900	***710*** (570)	1500
B			153		900	***710*** (570)	1600
C			164		900	***810*** (670)	2400
D			178		900	***840*** (700)	3600

DME BH						
NM	**7**	**6**	**5**	**4**	**3**	**2**
ALT	***2360***	***2040***	***1720***	***1410***	***1090***	***780***
(HGT)	(2220)	(1900)	(1580)	(1270)	(950)	(640)

Observations/*Remarks* : (1) Minimums majorés / *(1) Increased minimums.*

	70 kt	85 kt	100 kt	115 kt	130 kt	160 kt	185 kt
OM - MAPT 3.3 NM	2 min 50	2 min 20	1 min 59	1 min 44	1 min 32	1 min 15	1 min 05
OM - DTHR 3.9 NM	3 min 21	2 min 45	2 min 21	2 min 02	1 min 48	1 min 28	1 min 16
VSP (ft/min)	370	450	530	610	685	845	975

DIRCAM

API	OCH	IDENT
X		X

AMDT 09/11 **CHG** : NIL (dernière modification le 30 JUN 11).

Appendix 3

Transcript of radio communications

Transmitting station	Receiving station	Time HHMMSS	communications
Approach	RA 446 DJ	18 57 01	Régionale DJ you are heading for an ILS on 25? The latest wind 170° 14 maximum 22 knots and err… the runway is wet with puddles
Approach	RA 446 DJ	19 00 57	And the latest wind 170 degrees 18 gusts 26
RA 446 DJ	Approach	19 01 07	Roger
BZ 937 QL	Approach	19 03 46	Lorient Brit Air QL
Approach	RA 446 DJ	18 03 51	DJ I'm listening
BZ 937 QL	Approach	19 03 53	Yes it's Brit Air QL here err… we are still Brest I'll call you back err… do you have the latest wind we're keen on runway 25 given the conditions
Approach	BZ 937 QL	19 03 51	QL it's not poss.. there's a err… no problem for the 25, the wind from 160, 17 gusts 26
BZ 937 QL	Approach	19 04 04	160, 17 to 26 roger. Hear you soon thanks
Approach	BZ 937 QL	19 04 07	Catch you later
RA 446 DJ	Approach	19 04 11	And the Régionale DJ established on final 25 and I confirm to the following colleague that the 25 is more comfortable given the wind
Approach	RA 446 DJ	19 04 19	Roger DJ call back passing 4 nautical miles
RA 446 DJ	Approach	19 04 21	We call back passing 4 nautical miles DJ
RA 446 DJ	Approach	19 04 25	Latest wind please
Approach	RA 446 DJ	19 04 27	Err… 160, 17 gusts 26
RA 446 DJ	Approach	19 03 28	Roger
Approach	RA 446 DJ	19 04 31	And for information a err… big squall on the field at the moment
RA 446 DJ	Approach	19 04 34	Yeah we see that that's why thanks
Approach	RA 446 DJ	19 04 36	Roger
Approach	RA 446 DJ	19 04 56	RA 446 DJ cleared landing runway 25 the wind 160, 17 gusts 26 call back runway cleared
RA 446 DJ	Approach	19 05 05	OK we err… cleared for landing 25 I call back when cleared DJ and in case of a go-around we climb 2000 on the extended centreline
Approach	RA 446 DJ	19 05 12	Affirmative
RA 446 DJ	Approach	19 07 36	And we land err… DJ err… we exit at the end
Approach	RA 446 DJ	19 07 40	DJ affirmative and you can now pass over to ground on 119.7 good night

RA 446 DJ	Approach	19 07 45	Yeah 19.7 and for the previous err… it's a bit slippery so err… with a crosswind it's not very err… easy
Approach	RA 446 DJ	19 07 49	Roger but we err… I will tell him thanks
RA 446 DJ	Approach	19 07 59	In fact err… there are some puddles that mean that the aeroplane sometimes starts aquaplaning
Approach	RA 446 DJ	19 08 04	You sometimes start aquaplaning is that right ?
RA 446 DJ	Approach	19 08 05	Yes with the crosswind yeah it's a bit hard to keep on the centreline yeah
Approach	RA 446 DJ	19 08 06	OK err I'll give him the info
RA 446 DJ	Approach	19 08 08	Thanks
Approach	RA 446 DJ	19 08 10	Thanks
RA 446 DJ	Approach	19 08 18	Yeah it's cleared DJ
Approach	RA 446 DJ	19 08 20	QL ground 119.7 good evening
RA 446 DJ	Approach	19 08 21	19.7
BZ 937 QL	Approach	19 10 21	Lorient Brit Air QL err good evening again on approach 70 on KERAK
Approach	BZ 937 QL	19 10 24	Brit Air QL Lorient Approach good evening again number one on approach, identified on radar, descend 70 on KERAK, the latest wind airport 160, 14 with gusts to 26 knots, the runway is wet with some puddles and so err… the Régionale that landed before you said that … the landing wasn't easy there was a bit of aquaplaning
BZ 937 QL	Approach	19 10 47	OK 70 KERAK and good evening again for the 25 that's ok, thanks for the info
Approach	BZ 937 QL	19 10 49	You're welcome
Approach	BZ 937 QL	19 11 56	And QL so, heavy showers on the airport, we have visibility falling to 2000 between 2 and 3000 metres and a the ceiling is still 800 feet on the other hand
BZ 937 QL	Approach	19 12 06	OK roger we're continuing… err… the 70 for the ILS
Approach	BZ 937 QL	19 12 11	Roger
Approach	BZ 937 QL	19 13 12	Brit Air QL continue 3000 feet QNH 1002 and I will call you back for the procedure
BZ 937 QL	Approach	19 13 19	3000, 1002 QL roger
BZ 937 QL	Approach	19 13 25	There's a mass of cloud associated with the storm that's passing over the airport, isn't there?
Approach	BZ 937 QL	19 13 32	The rain?
BZ 937 QL	Approach	19 13 34	Yes

Approach	BZ 937 QL	19 13 36	No no, in fact it's the front that's arriving over Brittany and it's going to last an hour like that in fact. For about an hour so err… it's really raining so … the runway we did an IP that makes… about 20 minutes or half an hour before the Régionale landed err… it was wet with puddles err it was raining and the DJ that landed err not even 5-10 minutes ago informed us that there was in fact aquaplaning on the runway […] given the wind in fact that was a crosswind he said more or less like you he really told us that it was a bit complicated
BZ 937 QL	Approach	19 14 13	Ok roger
Approach	BZ 937 QL	19 14 27	And so the latest wind 150, 17 gusts 25 with a CW of 18.6
BZ 937 QL	Approach	19 14 33	Roger
Approach	BZ 937 QL	19 14 40	Brit Air QL… you are cleared for ILS approach runway 25 and call back at 4 nautical miles
BZ 937 QL	Approach	19 14 47	Cleared approach ILS 25, will call back at 4 nautical miles, QL
BZ 937 QL	Approach	19 20 58	[…] QL
Approach	BZ 937 QL	19 21 00	Yes Brit Air QL cleared landing runway 25 the wind 160 degrees 14 gusts 24 call back when runway cleared
BZ 937 QL	Approach	19 21 08	Cleared landing 25, call back when runway cleared QL
Approach	BZ 937 QL	19 21 26	For info the CW (crosswind component) 24 knots
		19 21 27	[…]
BZ 937 QL	Approach	19 23 11	MAYDAY MAYDAY MAYDAY we have gone off the runway MAYDAY MAYDAY MAYDAY
Approach	BZ 937 QL	19 23 19	Roger
Approach	BZ 937 QL	19 23 41	Brit Air QL Lorient Approach ?
BZ 937 QL	Approach	19 23 46	Yes MAYDAY MAYDAY MAYDAY… I haven't got the thing anymore… MAYDAY MAYDAY MAYDAY we have gone off runway
Approach	BZ 937 QL	19 23 50	Roger Brit Air QL, we are sending you the rescue service, the fire service and the lighting is at maximum, you… are you on the green
BZ 937 QL	Approach	19 23 52	Yes we're on the green, evacuation, evacuation, we're evacuating
Approach	BZ 937 QL	19 24 06	Evacuate and I'll stay on a reachable frequency don't hesitate

Appendix 4

Relevant deviations in ATC reports from 27 to 30 September 2011

- Deviation n°1**:** *Main runway. The clearance areas associated with landing funnel 07 and takeoff funnel 25 are impinged on to the west of the runway by the service road. Radio contact is not made mandatory, there are no traffic lights, just a sign marked "Danger! No parking, stopping subject to ATC authorisation" is installed.*

- Deviation n°3**:** *presence of systems used by both military and civil aviation, consisting of non frangible obstacles on the side strips (deck landing optics, stop strands, beacons and localizer premises) and presence of other obstacles or deterioration on the side strip (stones, bushes, protruding electric blocks… behind the Localizer antennae, presence of a part of the service road).*

- Deviation n°7**:** *presence of numerous rubber marks that mask the daytime markings and appear to alter the* functional skid resistance *characteristics when the runway is wet.*

- Deviation n°13**:** *in general, the daytime markings are in very bad condition and do not guarantee any contrast given that the runway surface is made of concrete. Numerous yellow marks are predominant even though white should predominate.*

- Deviation n°14: *there are no side markings on the main runway used for precision approaches.*

- Deviation n°15: *The markings on the 4 thresholds, displaced or not, are not in accordance with the regulations:*

  - They start 8 m from the thresholds instead of 6 m which also displaces the runway identification markings and the position runway centreline markings;
  - The width of the markings on displaced threshold 25 was 0.45 m instead of 0.30 m;
  - The width of the markings on the main runway was 0.90 m instead of 0.45 m.

- Deviation n°16: *The markings for the touchdown zone on the main runway only measure 1.70 meters wide (instead of 3 m minimum).*

- Deviation n°24: *The approach lighting for runway 25 is in accordance with a NATO type configuration (106 lights) and does not correspond with the ICAO type lighting (120 lights).*

Appendix 5

Daytime markings of runway 25 (14 November 2012)

-**Markings on the threshold of runway 25**

Wheel marks on touchdown zones 150 m from threshold 25

- **<u>Aim point marks and markings for the runway centreline</u>**

- **<u>Wheel marks on touchdown zones 600 m from threshold and runway centreline</u>**

Appendix 6

Functional skid resistance measurements on 14 and 15 November 2012

A colour code is used to describe the various runway areas that have measurements that are lower than that in the maintenance plan (in yellow) and below the minimum acceptable level (in red).

	14/11/2012 Left side				07	15/12/2012 Right side
	10 m centreline	6 m centreline	3-5 m centreline	3 m centreline		3-5 m centreline
	µF	µF	µF	µF		µF
2300-2400	0,54	0,46		0,41	Runway 25 / 07	0,40
2200-2300	0,52	0,51		0,50		0,39
2100-2200	0,50	0,47	0,56	0,49		0,47
2000-2100	0,49	0,53	0,60	0,55		0,50
1900-2000	0,52	0,58	0,63	0,57		0,50
1800-1900	0,46	0,52	0,59	0,53		0,49
1700-1800	0,42	0,51	0,58	0,53		0,56
1600-1700	0,45	0,50	0,56	0,52		0,58
1500-1600	0,49	0,54	0,57	0,52		0,55
1400-1500	0,50	0,54	0,57	0,53		0,56
1300-1400	0,49	0,53	0,57	0,52		0,56
1200-1300	0,48	0,53	0,54	0,51		0,57
1100-1200	0,54	0,57	0,59	0,58		0,58
1000-1100	0,58	0,60	0,60	0,59		0,58
900-1000	0,55	0,60	0,59	0,59		0,58
800-900	0,57	0,59	0,55	0,55		0,60
700-800	0,57	0,60	0,56	0,54		0,58
600-700	0,56	0,60	0,55	0,54		0,55
500-600	0,48	0,60	0,54	0,55		0,55
400-500	0,55	0,53	0,51	0,49		0,56
300-400			0,40			0,58
200-300			0,44			0,54
100-200			0,42			
0-100					25	

Tests made at 65 Km/h

Dark green	Values that are above those in the maintenance plan **µF > 0,39**
Light green	Values that could be below the minimum acceptable level and of that in the maintenance plan, taking into account the uncertainty in the measurements (**µF - 0,09 <or= 0,39**)
Yellow	Values between the minimum acceptable level and that in the maintenance plan **0,31 < µF <or= 0,39**
Red	Values below the minimum acceptable level **µF <or= 0,31**
Grey	Section not measured

Colour coding of skid resistance for tests performed at 65 km/h

Measurement uncertainties of functional skid resistance of runways are determined experimentally. Thus, the values of the extended U uncertainty for the measurement of functional skid resistance using the IMAG are[41]:)

- ❒ U = 0.1 at 95 km/h
- ❒ U = 0.09 at 65 km/h

	Left side 10 m centreline μF	Left side 6 m centreline μF	Left side 3-5 m centreline μF	Left side 3 m centreline μF	Right side 3-5 m centreline μF
2300-2400	0,39	0,38		0,30	
2200-2300	0,36	0,32		0,34	0,24
2100-2200	0,35	0,28		0,31	0,28
2000-2100	0,32	0,33		0,39	0,28
1900-2000	0,37	0,42	0,43	0,43	0,29
1800-1900	0,30	0,35	0,38	0,36	0,29
1700-1800	0,25	0,32	0,35	0,35	0,37
1600-1700	0,26	0,33	0,35	0,34	0,39
1500-1600	0,31	0,35	0,37	0,37	0,35
1400-1500	0,34	0,37	0,36	0,36	0,36
1300-1400	0,31	0,35	0,38	0,38	0,36
1200-1300	0,28	0,34	0,35	0,35	0,38
1100-1200	0,37	0,39	0,41	0,44	0,39
1000-1100	0,42	0,40	0,42	0,42	0,36
900-1000	0,39	0,43	0,42	0,43	0,39
800-900	0,37	0,39	0,36	0,38	0,41
700-800	0,43	0,39	0,38	0,39	0,38
600-700	0,45	0,39	0,36	0,40	0,32
500-600			0,33		0,31
400-500			0,29		0,35
300-400			0,19		
200-300			0,24		
100-200			0,29		
0-100					

Le ft si de

25

Tests made at 95 Km/h

Dark green	Values that are above those in the maintenance plan **μF > 0,27**
Light green	Values that could be below the minimum acceptable level and of that in the maintenance plan, taking into account the uncertainty in the measurements (**μF - 0,1 <or= 0,27**)
Yellow	Values between the minimum acceptable level and that in the maintenance plan **0,19 < μF <or= 0,27**
Red	Values below the minimum acceptable level **μF <or= 0,19**
Grey	Section not measured

Colour coding of skid resistance for tests performed at 95 km/h

[41] Number defining the imprecision around the result of the measurement that corresponds to a confidence level of 95%. This means that the true skid resistance value is between [μF-U, μF+U] with a risk of error of less than 5%. Taking into account this uncertainty to use as a reference for decision-making in case of corrective action is the responsibility of the aerodrome operator.

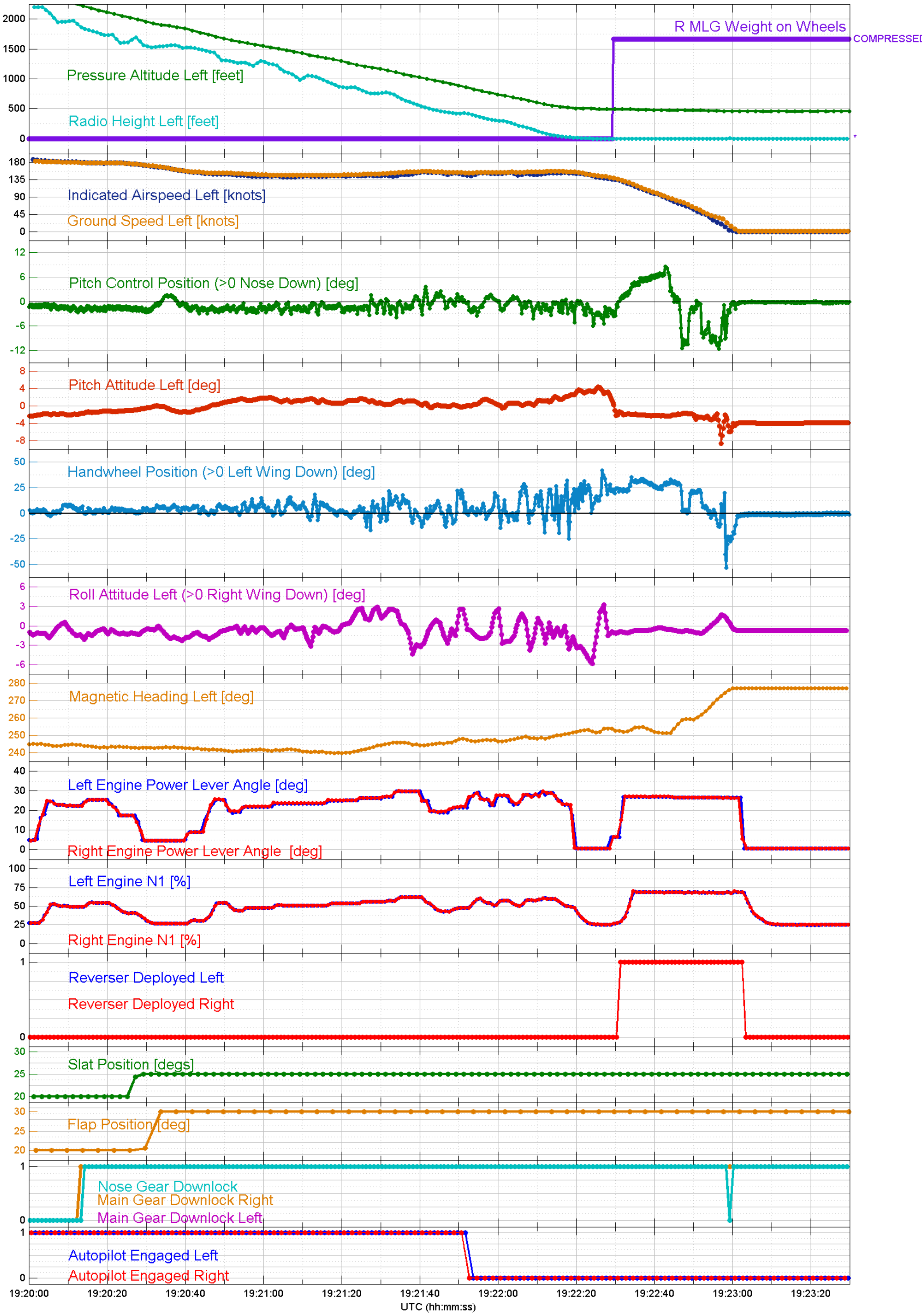
Appendix 7

Detailed history of flight based on FDR parameters

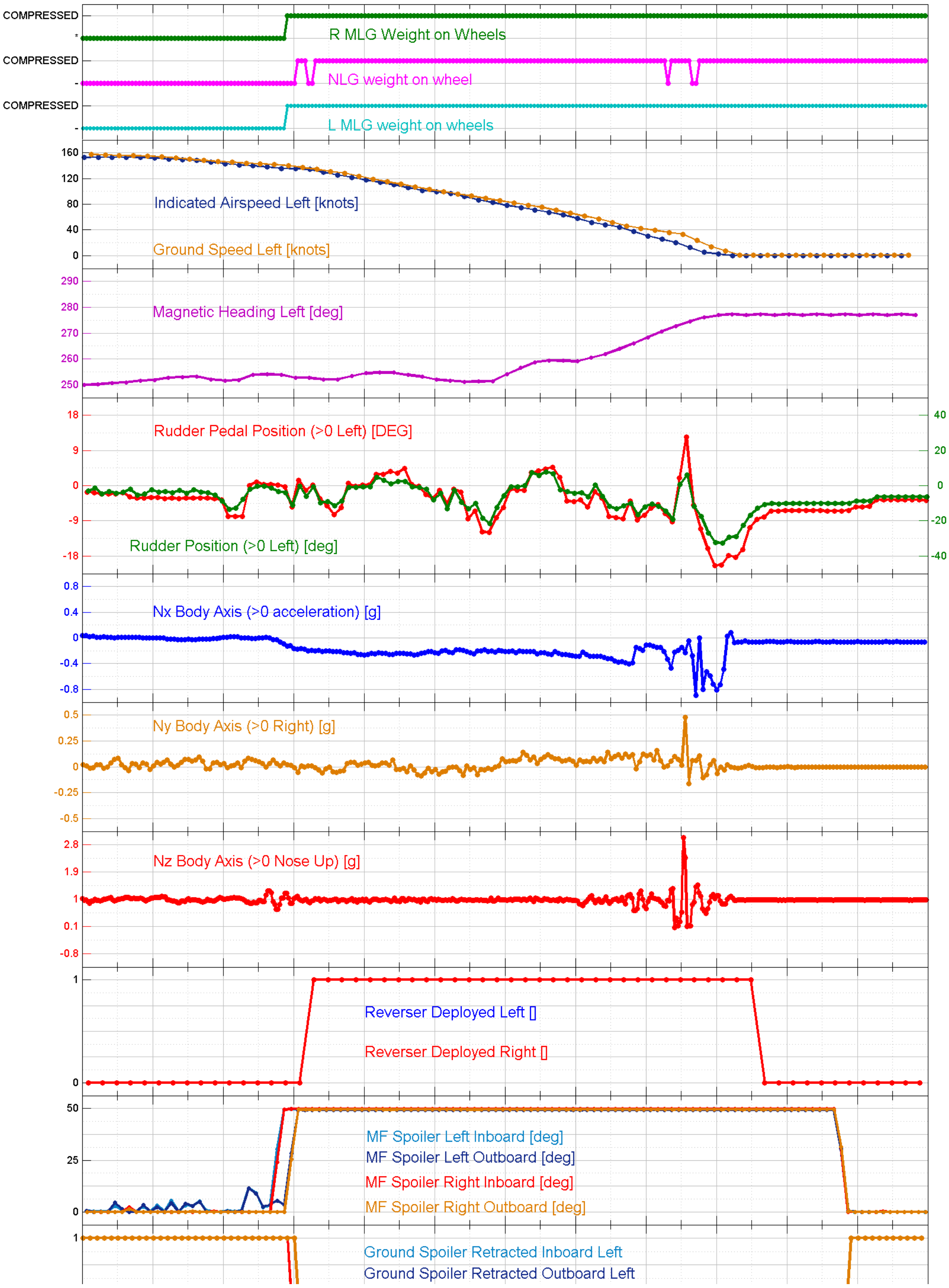
Orly-Lorient event flight Landing weight = 28.5 t The position of the centre of gravity was not recorded.			
UTC time	**Altitude QNH (ft)** **RA (ft)**	**FDR parameters**	**Comments**
19h19min32	2610	The speed selected went to 180 kt.	
19h20min14	1870	The speed stabilised at about 180 kt. The landing gear was locked down. The vertical FMA mode engaged was GS. The lateral FMA mode engaged was APP.	
19h20min20	1760	The speed selected went to 140 kt.	
19h20min24		The speed is starting to drop.	
19h20min27		The position of the slats changed from 20 to 25°.	
19h20min33		The position of the flaps changed from 20° to 30°.	
19h21min10	1070	The speed stabilised at about 144 kt. The N1s were stable at about 51%.	
19h21min17		The N1s go from 51% to 53.8%.	
19h21min25		The N1s changed from 53.8% to 55.9%. The speed was 145 kt.	
19h21min30 ->19h21min35		The N1s increased to 61.7%.	
19h21min33 ->19h21min41		The speed increased from 143 kt to155 kt.	
19h21min41 >19h21min47		The N1s go from 61.7% to 42.9% The speed varies between 155 kt and 149 kt.	
19h21min47 ->19h21min55		The N1s increased from 42.9% to 60.4% The speed varied between 149 kt and 152 kt	
19h21min52	430	**The AP disengaged.** IAS = 147 kt GS = 153 kt	Distance to threshold 25 = +1,730 m.
19h21min53 ->19h22min13		The speed varied between 147 kt and 153 kt.	
19h22min00	400	IAS = 151 kt. GS = 154 kt	Distance to threshold 25=+1,140 m.
19h22min06 ->19h22min20		The column position varied between neutral and 5.2°nose-up (half-stop) The angle of attack increased from 0.1° to 3.3°.	
19h22min04 ->19h22min14		The column was positioned between 1/3 de the stop right and 1/3 of the left stop.	

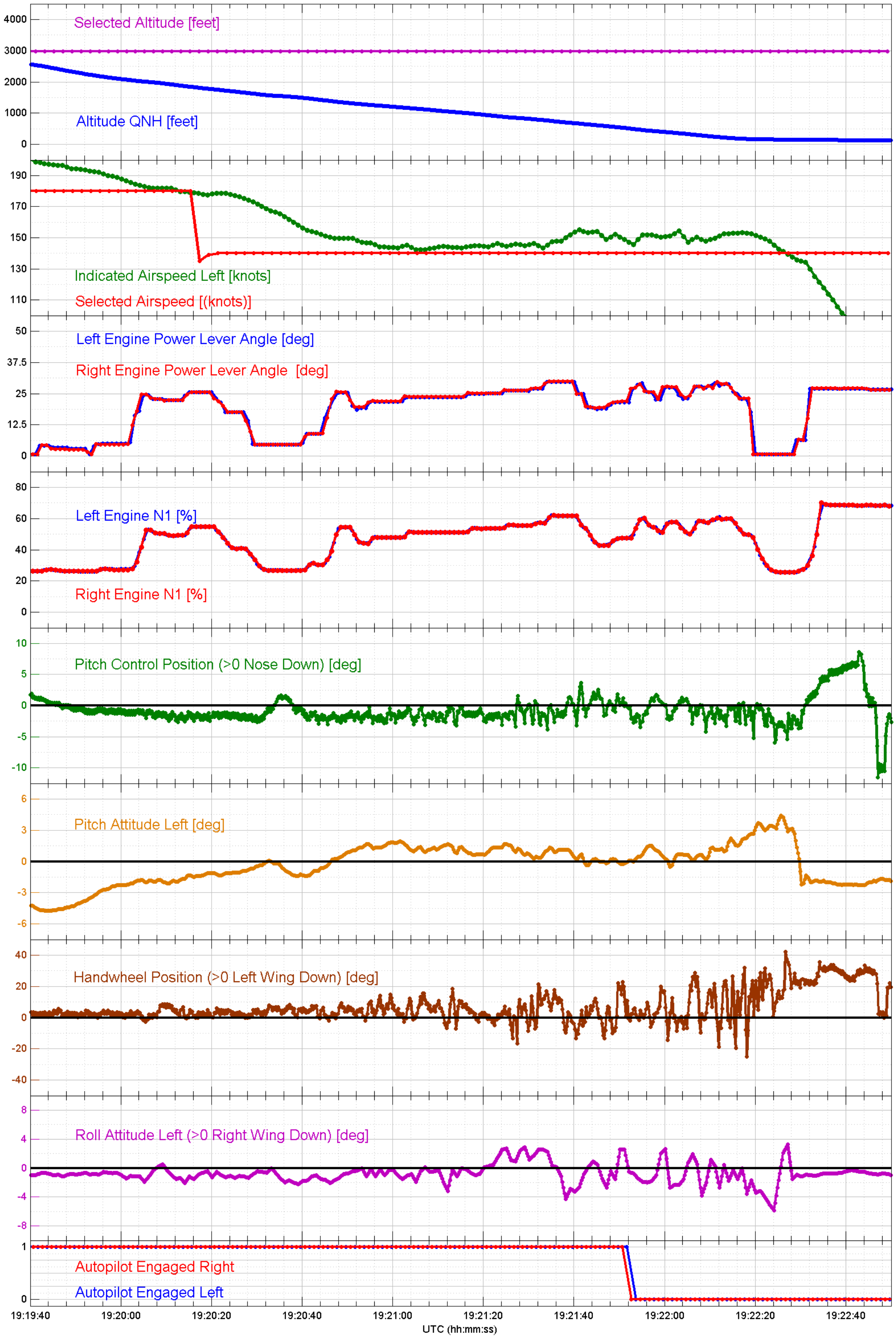
19h22min14	56	**Passage over threshold 25** IAS = 153 kt GS = 157 kt The angle of attack was 1.8° The roll was 1.8° left.	Tailwind 4 kt.
19h22min14 ->19h22min19		The column position varied between the half-stop left and 1/3 of the stop right	
19h22min19	17	The thrust levers were positioned on IDLE. IAS = 153 kt.	Distance to threshold 25 = -330 m.
19h22min20 ->19h22min29		The column was positioned : - between neutral and the pitch-up half-stop. - between neutral and 2/3 de the stop left. The angle of attack increased from 3.3° to 4.4° before dropping to about 0°. The roll varied between 5.8° left and 3.2° right.	Range of lateral column variations = [-70° ; +70°] Range of longitudinal column variations = [-13° ; +11°].
19h22min20		The N1 started to drop.	
19h22min24		The N1 stabilised at about 26%. The magnetic heading stabilised at about 253°.	
19h22min24 ->19h22min47		The column was positioned left.	
19h22min25		The rudder was positioned right 2 s.	Range of rudder variations = [-23,6° ; +24,6°].
19h22min29		MLG touchdown The rudder was positioned right (1 point). The magnetic heading was 253°. The column was positioned 23° left. The roll was 0.9° left. IAS = 136 kt GS = 140 kt Nz=1.19 g Ny=0.02 g The Nx started to drop The inner spoilers were positioned at 49°.	Distance to threshold 25 = - 1,130 m.
19h22min30		Nose gear touchdown. Nz= 1.09 g Ny = - 0.05 g The outer spoilers were positioned at 49°. The Ground spoilers were deployed.	
19h22min31		The nose gear was no longer. compressed (0.5s). The thrust reversers were deployed. The N1s started to increase.	

19h22min31.5		Nose gear touchdown. IAS = 134 kt GS = 134 kt	
19h22min32		The column was positioned nose down.	
19h22min35		The Nx stabilised at about -0.24 g.	
19h22min37		The N1 stabilised at about 68% (max REV).	
19h22min39 ->19h22min45		The rudder was positioned right (max reached = 12°).	
19h22min43 ->19h22min45		The Nx stabilised at about -0.2 g.	
19h22min47		The magnetic heading started to increase. The Nx started to drop	The deceleration increased
19h22min49		Passage over threshold 07 GS = 66 kt.	
19h22min53		The Nx reached a minimum of -0.41 g before increasing.	
19h22min54 ->19h22min56		The Nx varied between -0.11 g and -0.19 g.	
19h22min57		The rudder was positioned 12 ° left (1 point). Nz peak at 3 g Ny peak at 0.48 g.	
19h22min58		Pic de Nx at -0.89 g.	
19h22min58 ->19h23min02		The rudder was positioned right between 9° and 20°.	
19h23min01		The magnetic heading stabilised at about 277°.	
19h23min02		The aeroplane came to a stop.	
19h23min03		The thrust reversers were retracted..	
19h23min09		The Ground spoilers were retracted.	



R MLG Weight on Wheels
COMPRESSED
Pressure Altitude Left [feet]
Radio Height Left [feet]
Indicated Airspeed Left [knots]
Ground Speed Left [knots]
Pitch Control Position (>0 Nose Down) [deg]
Pitch Attitude Left [deg]
Handwheel Position (>0 Left Wing Down) [deg]
Roll Attitude Left (>0 Right Wing Down) [deg]
Magnetic Heading Left [deg]
Left Engine Power Lever Angle [deg]
Right Engine Power Lever Angle [deg]
Left Engine N1 [%]
Right Engine N1 [%]
Reverser Deployed Left
Reverser Deployed Right
Slat Position [degs]
Flap Position [deg]
Nose Gear Downlock
Main Gear Downlock Right
Main Gear Downlock Left
Autopilot Engaged Left
Autopilot Engaged Right
19:20:00
19:20:20
19:20:40
19:21:00
19:21:20
19:21:40
19:22:00
19:22:20
19:22:40
19:23:00
19:23:20
UTC (hh:mm:ss)

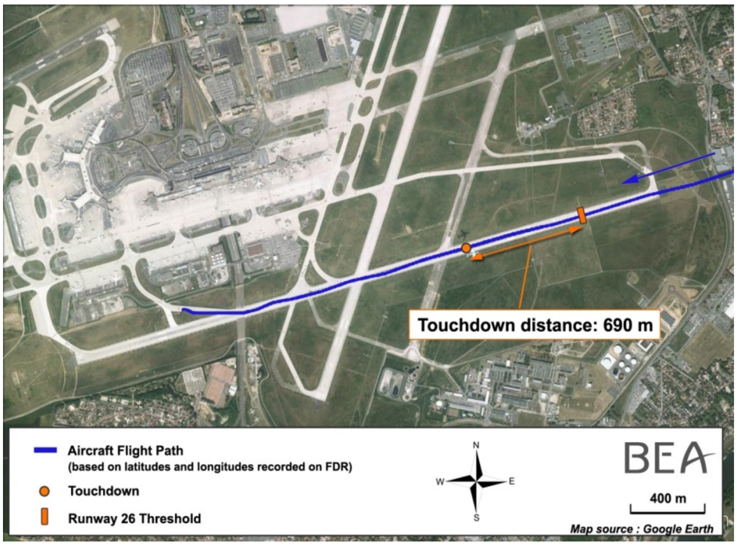

COMPRESSED
R MLG Weight on Wheels
COMPRESSED
NLG weight on wheel
COMPRESSED
L MLG weight on wheels
160
120
80
40
0
Indicated Airspeed Left [knots]
Ground Speed Left [knots]
290
280
270
260
250
Magnetic Heading Left [deg]
18
9
0
-9
-18
Rudder Pedal Position (>0 Left) [DEG]
Rudder Position (>0 Left) [deg]
40
20
0
-20
-40
0.8
0.4
0
-0.4
-0.8
Nx Body Axis (>0 acceleration) [g]
0.5
0.25
0
-0.25
-0.5
Ny Body Axis (>0 Right) [g]
2.8
1.9
1
0.1
-0.8
Nz Body Axis (>0 Nose Up) [g]
1
0
Reverser Deployed Left []
Reverser Deployed Right []
50
25
0
MF Spoiler Left Inboard [deg]
MF Spoiler Left Outboard [deg]
MF Spoiler Right Inboard [deg]
MF Spoiler Right Outboard [deg]
1
Ground Spoiler Retracted Inboard Left
Ground Spoiler Retracted Outboard Left

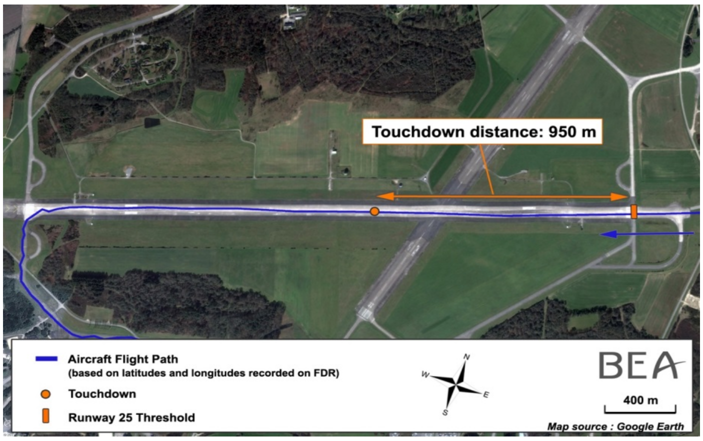
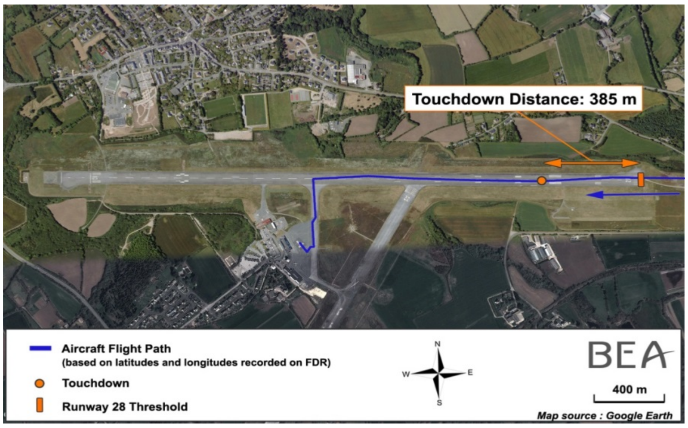

Selected Altitude [feet]
Altitude QNH [feet]
Indicated Airspeed Left [knots]
Selected Airspeed [(knots)]
Left Engine Power Lever Angle [deg]
Right Engine Power Lever Angle [deg]
Left Engine N1 [%]
Right Engine N1 [%]
Pitch Control Position (>0 Nose Down) [deg]
Pitch Attitude Left [deg]
Handwheel Position (>0 Left Wing Down) [deg]
Roll Attitude Left (>0 Right Wing Down) [deg]
Autopilot Engaged Right
Autopilot Engaged Left
19:19:40
19:20:00
19:20:20
19:20:40
19:21:00
19:21:20
19:21:40
19:22:00
19:22:20
19:22:40
UTC (hh:mm:ss)

Appendix 8

Comparison of touchdown zones

External environment	Runway for landing	Aeroplane configuration	Ground speed on touchdown	Distance of touchdown in relation to runway threshold
Flight N (PF=Captain)				
Night Visibility = 1800m Wind on passage over threshold = 150°/25 kt	Lorient Lann Bihoué runway 25	**Flaps 30°**	140 kt	**1,130 m**
VOL N-1 (PF=CDB)				
Daytime Visibility > 10km Wind on passage over threshold = 170°/5 kt	Paris Orly runway 26	**Flaps 45°**	121 kt	**690 m**

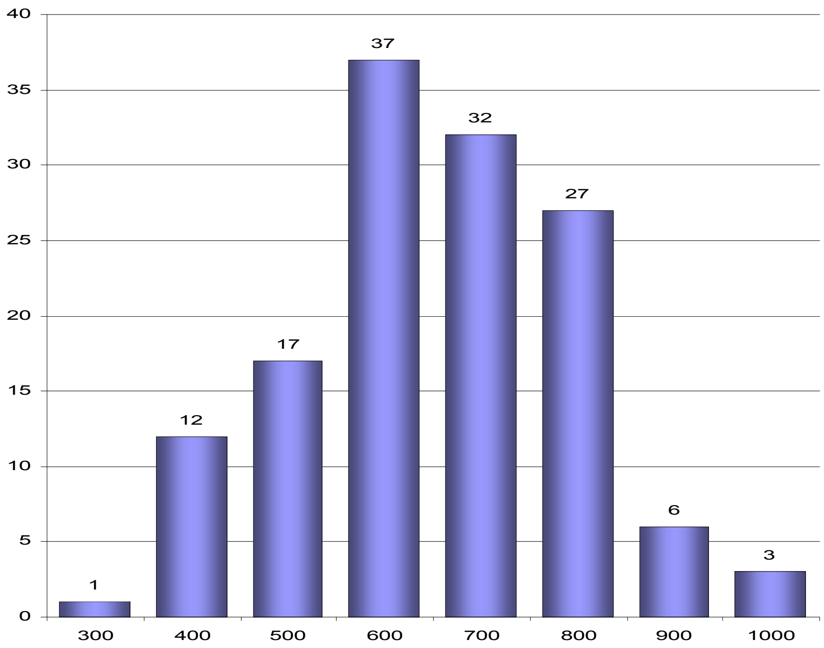


<table>
<tr><td colspan="5">FLIGHT N-2 (PF=Copilot)</td></tr>
<tr><td>Daytime
Visibility > 10 km
Wind on passage over threshold =150°/18 kt</td><td>Lorient Lann Bihoué runway 25</td><td>Flaps 45°</td><td>123 kt</td><td>950 m</td></tr>
<tr><td colspan="5">
</td></tr>
<tr><td colspan="5">FLIGHT N-4 (PF=Copilot)</td></tr>
<tr><td>Daytime
Visibility > 10 km
Wind on passage over threshold =200°/4kt</td><td>Quimper runway 28</td><td>Flaps 45°</td><td>128 kt</td><td>385 m</td></tr>
<tr><td colspan="5">
</td></tr>
</table>

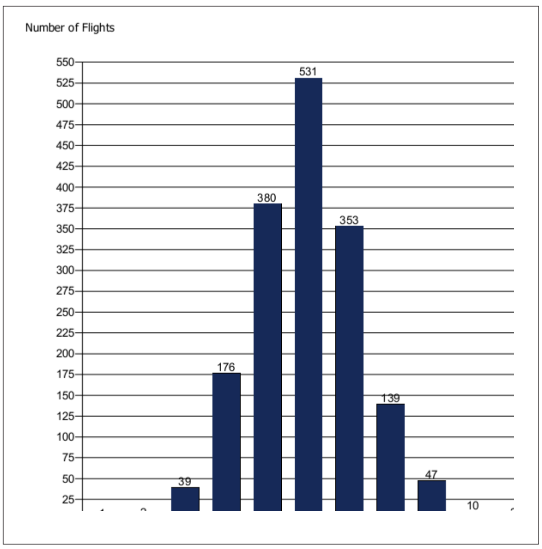
Appendix 9

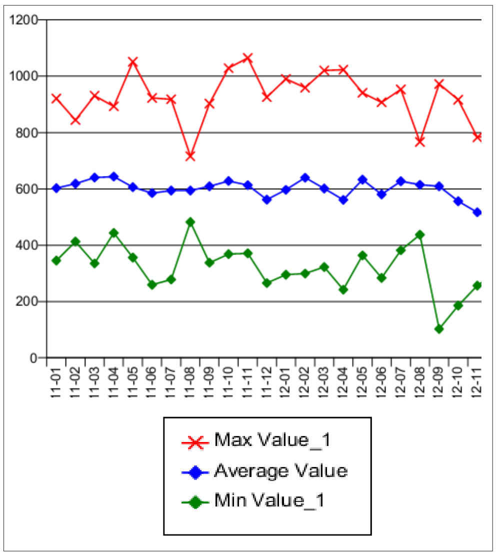
Brit Air Statistics

- Long landings in CRJ-1000 from May 2011 to December 2011 (Lyon Saint-Exupéry) runway 36 L (LDA: 4000 m)



- Number of CRJ-700 long landings compared to the total number of CRJ-700 landings on runway 25 at Lorient Lann Bihoué from January 2011 to December 2012.





Appendix 10

ANS Classes (Source : BRIT AIR)

	Classe 1	Classe 2	Classe 3
LOC	Entre 1000 et 200 ft **1.1 dots** pendant plus de 3 s	Entre 1000 et 200 ft **1.5 dots** pendant plus de 3 s	Entre 1000 et 200 ft **2 dots** pendant plus de 3 s
GLIDE	Entre 1000 et 200 ft **1.1 dots** pendant plus de 3 s	Entre 1000 et 200 ft **1.5 dots** pendant plus de 3 s	Entre 1000 et 200 ft **2 dots** pendant plus de 3 s
TRAIN	Sortie < à **900 ft**	Sortie < à **500 ft**	Sortie < à **300 ft**
VOLETS	Sortie 45 ° < **900 ft**	Sortie 45 ° < **250 ft**	Sortie 45 ° < **100 ft**
VITESSE	Entre 900 et 10 ft CR7/CRK Vitesse > **VAPP +20** Pendant plus de 3 s CR1 Vitesse > **160 kts** Pendant plus de 3 s	Entre 900 et 10 ft CR7/CRK Vitesse > **VAPP +30** Pendant plus de 3 s CR1 Vitesse > **170 kts** Pendant plus de 3 s	Entre 900 et 10 ft CR7/CRK Vitesse > **VAPP +40** Pendant plus de 3 s CR1 Vitesse > **180 kts** Pendant plus de 3 s
POUSSÉE	Entre 1000 ft et 10 ft **N1 < 35 %** pendant plus de **20 s**	Entre 1000 ft et 10 ft **N1 < 35 %** pendant plus de **40 s**	-

Appendix 11

Embraer 145 ASR

REGIONAL
COMPAGNIE AÉRIENNE EUROPÉENNE

ASR
Air Safety Report

Sécurité des Vols
Réf.: 952/ER4/12

Evénement en exploitation

- CFIT
- Perte de Contrôle en Vol
- Collision VOL
- Collision SOL
- Dommage VOL
- Dommage SOL
- Sortie (ou Risque) piste/TWY
- AUTRES PRECURSEURS
- AUTRE EVENEMENT

Type d'avion	Immat	Date	Heure	N°vol ATC
ER4	F-GRGC	16/10/2012	1910	RA446DJ

N° d'ATLB	Départ (initial/reel)	Dest. (initiale/reelle)	N°vol commercial
0806236	LYS	LRT	AF5446

Lieu/Position	Niv. grav.	Parking	Masse	Phase de vol
	2		16T	Atterrissage

Type d'App.	IMC/VMC	Piste	Etat piste
ILS	VMC	25	Wet / Mouillée

IAS/MACH	SAT/TAT	Alti./Haut.
100	13	QNH

MTO Terrain

Visi: 10000	
Vent: 190/22	QNH: 1002
Plafond: BKN 800	T°(SAT): 13
Lum. Nuit	

Temps sign. Pluie

Config. Utilisée	AP	FD	ATS	Train	Volets	Aérofr.	Stab Trim	PRNAV	BRNAV	RVSM
	Non	Oui	Non	Oui	22	Rentrés		Oui	Oui	Oui

DESCRIPTION : Pour les événements **"ASR"** ayant eu lieu à l'étranger, merci de rédiger en **ANGLAIS**.

En approche ILS RWY 25 à LRT, la tour nous annonce un grain sur le terrain et un vent en finale du 190 pour 22Kt. Le plafond est de 800FT reporté à l'ATIS. Une pluie modérée nous oblige à mettre les essuie-glaces vers 700FT obtenant ainsi le visuel de la piste. Aucun cisaillement de vent n'est à reporter. Après l'atterrissage, vu la quantité d'eau sur la piste, le CDB PF applique pleines reverses par sécurité et vers la fin du premier tiers de la piste, l'avion entre en aquaplaning aux environ de 100KT faisant une embardée à droite que le CDB corrige doucement, l'avion revenant au centre de la piste s'arrête rapidement.
Il semble que des flaques d'eau apparaissent sur la piste 25 lorsqu'il pleut, ceci a déjà été constaté.

En dégageant la piste, nous rendons compte à la tour de l'état de la piste glissante et que nous sommes entrés en aquaplaning, pour le reporter à l'avion Britair que nous avions entendu en fréquence quelques minutes au paravant, demandant la piste 25, comme nous plutôt que la 07 mentionnée sur l'ATIS, vu le plafond assez bas pour effectuer une percée locator et le vent passant un peu plus ouest.

URGENCE	ALARME	SITUATION

CONSEQUENCE EXPLOITATION
sans conséquence

Type d'avion	Immat	Date	Heure	N°vol ATC
ER4	F-GRGC	16/10/2012		RA446DJ

N° d'ATLB	Départ (initial/reel)	Dest. (initiale/reelle)	N°vol commercial
NIL	LYS	LRT	AF5446

Lieu/Position	Niv. grav.	Parking	Masse	Phase de vol
CF ASR CDB SUR LE SUJET	2			Atterrissage

Type d'App.	IMC/VMC	Piste	Etat piste	MTO Terrain	
				Vent:	Visi:
					QNH:
IAS/MACH	**SAT/TAT**	**Alti./Haut.**		Plafond:	T°(SAT):
				Lum.	

Temps sign.

Config. Utilisée	AP	FD	ATS	Train	Volets	Aérofr.	Stab Trim	PRNAV	BRNAV	RVSM

DESCRIPTION : Pour les événements **"ASR"** ayant eu lieu à l'étranger, merci de rédiger en **ANGLAIS**.

ASR rédigé en complément de celui du CDB, concernant un risque de sortie de piste, en conditions météo dégradées (pluie modérée, piste & ILS25 à LRT, Vw travers 20kt, et Vw effectif de 09 Kt de face, "flaque d'eau" sur la piste (WET à l'ATIS), masse au LDW de 16T, F22, visi >10km et B800'). CDB PF.
Après une approche bien stabilisée, et un touché des roues aux plots, les reverses sont deployées FUll POWER immédiatement, et le freinage des roues activé. Vers 100 Kt, perte de contrôle temporaire avec glissade/dérapage à droite de l'axe (nez à gauche et arrière de l'avion vers la droite de l'axe). Les freins sont relâchés et l'avion revient peu après dans l'axe, et le freinage reprend, et la vitesse de l'avion est contrôlée en deuxième partie de piste. Dégagement au bout et on signale à la TWR (je ne me souviens pas des termes exacts employés), que le suivant (DB) doit être prévenu que la piste est glissante (N'aurais-je pas utilisé un terme trop vague, ou trop imprécis, pour la transmission des infos au suivant?!)...
Nous apprendrons peu après que le vol DB qui nous suivait est sorti de piste (bout de bande 25).
r
J'aimerais mentionner plusieurs choses à propos de ces problèmes récurrant des CONDITIONS et de l'ETAT de piste, de façon générale sur beaucoup d'aéroports que nous fréquentons, notamment Lorient.

1) En effet, les contrôleurs nous signalent souvent des "flaques d'eau", ou, une piste inondée (?), ou "très mouillée (!)". Il est rare d'avoir connaissance de la contamination réelle des pistes, par absence de mesure. Nous ne pouvons nous fier qu'à des termes connus et définis dans notre documentation, afin de prendre une décision, fiable. Cela est souvent de même avec les problèmes de glissance ("ça glisse un peu", "le freinage n'est pas top", "y'a un peu de neige sur les piste" etc....).
Nous ne pouvons nous permettre d'attendre de "voir sur place" pour décider, c'est trop tard !

2) Sur certains terrains, comme celui de LRT, la piste est en mauvais état, et présente des ornières effectivement propices à la présence de flaques d'eau, même longtemps après la précipitation. Nous devons nous interroger sur les 5 sorties de piste en 5 ans sur ce terrain...
Nous n'avons aucune information dans notre documentation sur la capacité d'un avion à se poser sur des flaques d'eau, même ponctuelles....
Nous nous sentons désarmés face à ce type de problème...

3)Comment se serait comporté notre avion, avec 3 tonnes de plus, 20 kt d'IAS de plus, et des pneus dont les sculptures sont effacées, (en restant dans les tolérances)...?
Les conditions ou ambiants n'étaient certes pas très favorables, mais nous étions loin des limitations.

URGENCE	ALARME	SITUATION

CONSEQUENCE EXPLOITATION

sans conséquence

Bureau d'Enquêtes et d'Analyses
pour la sécurité de l'aviation civile

200 rue de Paris
Zone Sud - Bâtiment 153
Aéroport du Bourget
93352 Le Bourget Cedex - France
T : +33 1 49 92 72 00 - F : +33 1 49 92 72 03
www.bea.aero

Liberté • Égalité • Fraternité
RÉPUBLIQUE FRANÇAISE