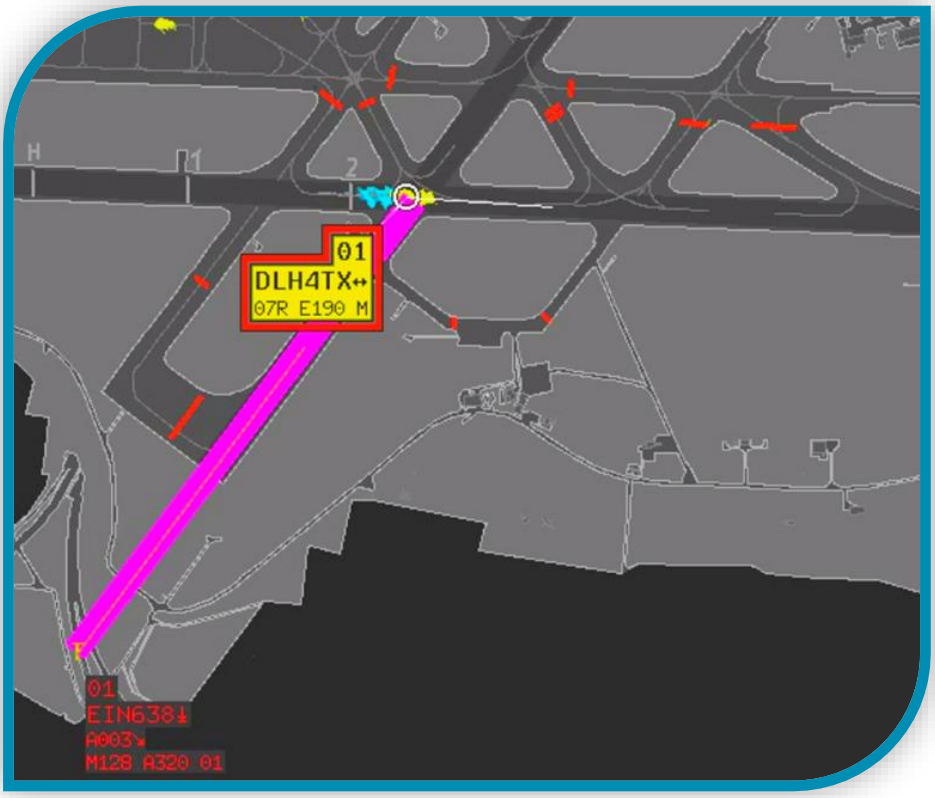
Federal Public Service
Mobility and Transport
Air Accident Investigation Unit

Air Accident Investigation Unit
(Belgium)
City Atrium
Rue du Progrès 56
1210 Brussels

Safety Investigation Report



SERIOUS INCIDENT
RUNWAY INCURSION
ON 5 OCTOBER 2016

EMBRAER ERJ-195 AND AIRBUS A320
AT EBBR

Ref.:
AAIU-2016-21

Issue date:
27 March 2017

Status:
Final

TABLE OF CONTENTS

TABLE OF CONTENTS **3**
FOREWORD **5**
SYMBOLS AND ABBREVIATIONS **6**
TERMINOLOGY USED IN THIS REPORT **8**
SYNOPSIS **9**
1 FACTUAL INFORMATION. **10**
1.1 HISTORY OF THE EVENT. 10
1.2 INJURIES TO PERSONS. 12
1.3 DAMAGE TO AIRCRAFT. 12
1.4 OTHER DAMAGE. 12
1.5 PERSONNEL INFORMATION 13
1.6 AIRCRAFT INFORMATION. 14
1.7 METEOROLOGICAL CONDITIONS. 16
1.8 AIDS TO NAVIGATION 18
1.9 COMMUNICATION. 20
1.10 AERODROME INFORMATION. 21
1.11 FLIGHT RECORDERS 24
1.12 WRECKAGE AND IMPACT INFORMATION. 24
1.13 MEDICAL AND PATHOLOGICAL INFORMATION. 24
1.14 FIRE. 25
1.15 SURVIVAL ASPECTS 25
1.16 TESTS AND RESEARCH. 25
1.17 ORGANISATION AND MANAGEMENT INFORMATION. 29
1.18 ADDITIONAL INFORMATION. 30
2 ANALYSIS. **37**
2.1 RUNWAY 37
2.2 SIMULTANEOUS INTERSECTING RUNWAYS OPERATIONS (SIRO) 37
2.3 HUMAN FACTORS 37
2.4 TRAFFIC CONTROL 39
2.5 TAXIWAY LAYOUT 39
2.6 EVENT CLASSIFICATION 43
3 CONCLUSIONS. **45**
3.1 FINDINGS 45
3.2 CAUSE 45
3.3 CONTRIBUTING FACTORS 45
4 SAFETY ACTIONS AND RECOMMENDATIONS. **46**
4.1 SAFETY ACTIONS BY AIR DOLOMITI 46
4.2 SAFETY ACTION BY BELGOCONTROL 47
4.3 SAFETY RECOMMENDATIONS BY AAIU(BE) 47
5 APPENDICES **50**
5.1 BELGOCONTROL – EBBR TWR MANUAL 50
5.2 AIR DOLOMITI SOPS 53
5.3 AIR DOLOMITI FDR DATA 55
5.4 AER LINGUS FDR DATA 58

FOREWORD

This report is a technical document that reflects the views of the investigation team on the circumstances that led to the incident.

In accordance with Annex 13 of the Convention on International Civil Aviation and EU Regulation 996/2010, it is not the purpose of aircraft accident investigation to apportion blame or liability. The sole objective of the investigation and the Final Report is the determination of the causes, and to define recommendations in order to prevent future accidents and incidents.

In particular, Article 17-3 of the EU regulation EU 996/2010 stipulates that the safety recommendations made in this report do not constitute any suspicion of guilt or responsibility in the accident.

The investigation was conducted by the AAIU(Be) with the support of the Italian ANSV, the Irish AAIU, the Airlines Air Dolomiti and Aer Lingus, Brussels Airport Company, Belgocontrol and the Belgian CAA.

Note:

About the time: For the purpose of this report, time will be indicated in UTC, unless otherwise specified.

SYMBOLS AND ABBREVIATIONS

’	Minute
A-SMGCS	Advanced-Surface Movement Guidance and Control System
AAIU(Be)	Air Accident Investigation Unit (Belgium)
ACI	Airport Council International
AIP	Aeronautical Information Publication
AMSL	Above mean sea level
ANSP	Air Navigation Service Provider
ANSV	Agenzia Nazionale per la Sicurezza del Volo (Italian aircraft accident investigation authority)
ARIWS	Autonomous runway incursion warning system
ATC	Air Traffic Control
ATCO	Air Traffic Controller
ATM	Air Traffic Management
ATPL	Air Traffic Pilot License
BCAA	Belgian Civil Aviation Authority
CAT	Category
CAVOK	Ceiling and Visibility OK
CVR	Cockpit Voice Recorder
E	East
EAPPRI	European Action Plan for the Prevention of Runway Incursions
EASA	European Aviation Safety Agency
EBBR	Brussels Airport
ECAC	European Civil Aviation Conference
ECAC ACC	ECAC’s expert group on aircraft accident and incident investigation
EDDM	Munich Airport
EMB	Embraer
ENAC	Ente Nazionale per l’Aviazione Civile (Italian Civil Aviation Authority)
ERJ	Embraer Regional Jet (marketing name)
EU	European Union
FDR	Flight Data Recorder
FH	Flight hour
FREQ	Frequency
ft	Foot (Feet)
GND	Ground
Hz	Hertz
IAA	Irish Aviation Authority
ICAO	International Civil Aviation Organisation
ILS	Instrument Landing System
IR	Intrument Rating
Kt	Knot(s)
LDG	Landing
LH	Left hand
m	Metre(s)
ME	Multi-Engine
METAR	Aviation routine weather report (in aeronautical meteorological code)
MHZ	MHz
N	North
NE	North-east

NOSIG	No significant change (used in trend-type landing forecasts)
OM	Operations Manual
PAPI	Precision approach path indicator
PSN	Position
QAR	Quick Access Recorder
QNH	Pressure setting to indicate elevation above mean sea level
RAT	Risk Analysis Tool
REL	Runway Entrance Lights
RI	Runway Incursion
RISC	Runway Incursion Severity Classification
RH	Right hand
RWSL	Runway Status Lights (RWSL)
RWY	Runway
SIRO	Simultaneous Intersecting Runways Operation.
SMR	Surface Movement Radar
SOP	Standard Operating Procedure
THL	Take-off Hold Lights
THR	Threshold
TKOF	Take-off
TWR	Aerodrome control tower or aerodrome control
TWY	Taxiway
UK CAA	Civil Aviation Authority United Kingdom
UTC	Universal Time Coordinated
VFR	Visual Flight Rules

TERMINOLOGY USED IN THIS REPORT

Safety factor: an event or condition that increases safety risk. In other words, it is something that, if it occurred in the future, would increase the likelihood of an occurrence, and/or the severity of the adverse consequences associated with an occurrence.

Contributing safety factor: a safety factor that, had it not occurred or existed at the time of an occurrence, then either:
(a) the occurrence would probably not have occurred; or
(b) the adverse consequences associated with the occurrence would probably not have occurred or have been as serious, or
(c) another contributing safety factor would probably not have occurred or existed.

Other safety factor: a safety factor identified during an occurrence investigation which did not meet the definition of contributing safety factor but was still considered to be important to communicate in an investigation report in the interests of improved transport safety.

Safety issue: a safety factor that
(a) can reasonably be regarded as having the potential to adversely affect the safety of future operations, and
(b) is a characteristic of an organisation or a system, rather than a characteristic of a specific individual, or characteristic of an operational environment at a specific point in time.

Safety action: the steps taken or proposed to be taken by a person, organisation or agency on its own initiative in response to a safety issue.

Safety recommendation: A proposal by the accident investigation authority in response to a safety issue and based on information derived from the investigation, made with the intention of preventing accidents or incidents. When AAIU(Be) issues a safety recommendation to a person, organization, agency or Regulatory Authority, the person, organization, agency or Regulatory Authority concerned must provide a written response within 90 days. That response must indicate whether the recommendation is accepted, or must state any reasons for not accepting part or all of the recommendation, and must detail any proposed safety action to bring the recommendation into effect.

Safety message: An awareness which brings to attention the existence of a safety factor and the lessons learned. AAIU(Be) can distribute a safety message to a community (of pilots, instructors, examiners, ATC officers), an organization or an industry sector for it to consider a safety factor and take action where it believes it appropriate. There is no requirement for a formal response to a safety message, although AAIU(Be) will publish any response it receives.

Federal Public Service
Mobility and Transport
Air Accident Investigation Unit

AAIU-2016-21

SYNOPSIS

Date and time:	Wednesday 05 October 2016 at 18:41 UTC
Aircraft:	a. Airbus A320-214, msn 1983 b. Embraer ERJ-195LR, msn 19000280
Location:	Intersection of Runway 07R and Runway 01, EBBR
Type of flights:	Commercial Aviation – Passenger
Phase:	a. Landing b. Take-off
Destination:	a. EBBR b. EDDM
Persons on board:	a. 2 pilots, 4 cabin crew, 156 passengers b. 2 pilots, 3 cabin crew, 62 passengers
Injuries:	None
Occurrence type:	Runway incursion (RI)

Abstract

An aircraft of Air Dolomiti, operated on behalf of Lufthansa (flight number: DLH4TX) from Brussels to Munich, was preparing for departure from Runway 07R. The crew received the instruction “line up and wait” from the Brussels Tower.
Another airplane, an A320 of Aer Lingus (flight number EIN638), was in final approach for landing on Runway 01. It was cleared for landing by the Brussels Tower.
Flight DLH4TX took off from Runway 07R without take-off clearance, conflicting with the landing Aer Lingus aircraft. Brussels Tower instructed the Aer Lingus to go around.

Cause

The incident was caused by the take-off without clearance of an aircraft instructed to “line up and wait” on Runway 07R while an aircraft was in final approach of Runway 01.

Contributing factors

- Not using a mnemonic and/or cross-check for the take-off clearance by the DLH4TX crew.
- Limited traffic information/situational awareness given when delivering ATC clearances.
- Inadequate doubt-clearing management in the cockpit.
- The unfamiliarity of the crew with the airport.
- Authorizing aircraft to line up on RWY 07R at a short distance from the intersection with RWY 01 without correlation with landing traffic on this latter.
- Intersection and status of RWY 01 not indicated on RWY 07R.
- The complex taxiway layout (junction connecting 6 taxiways right before C6, the oblique angled entry taxiway including a part of the taxiway centerline lights).

1 Factual information.

1.1 History of the event.

On 5 October 2016, an EMB195 aircraft of Air Dolomiti (Flight Number DLH4TX in this document), operated on behalf of Lufthansa from Brussels to Munich, was preparing for departure from Runway 07R.
DLH4TX was slightly late and the crew, during push-back, requested to depart from the C5 intersection of Runway 07R. The Ground controller responded by giving a taxi route leading to the C6 intersection. The crew did not understand immediately the taxi route received due to the rapid speaking tempo and the crew requested clarification. The crew reported that the ground frequency was quite busy.

The Captain was at the controls, while the First Officer was dealing with the communication. The first officer reported high work load during taxi operations due to the “unfriendly airport lay-out” and taking into account that it was night. Both captain and first officer were listening out the same radio frequency.
Upon reaching the C6 intersection, the airplane stopped before the stop bar that was lit. After switching to the Tower frequency, the crew received the instruction “line up and wait” for Runway 07R and the first officer read back the instruction correctly. The stop bar lights dimmed, allowing the airplane to proceed.

Another airplane, an A320 operated by Aer Lingus (Flight Number EIN638 in this document), was in final approach for landing on Runway 01. It was cleared to land by Brussels Tower after DLH4TX received the instruction for lining up on the crossing runway (07R).

The DLH4TX captain reported the taxiway centreline lights were not easy to follow from the intersection during line-up. When entering Runway 07R, the captain was uncertain of their position and asked the first officer if they were on the Runway. The crew looked to the left and right and reported no traffic in sight. During the line-up, the crew stated they had an optimum visual field of Runway 01 and again did not notice any landing light in sight.
Further, when aligned on Runway 07R, the captain asked the first officer whether they received the take-off clearance to which the first officer answered positively.

According to the Tower controller and the supervisor, the traffic at the moment of the incident was not dense. The Tower controller was managing the landings on the 01 as well as the take-offs on the Runway 07R.

Specifically for the line-ups from C6, the controller maintains eye contact with aircraft, because of the short reaction time necessary in case of incident. He stated his vision of the aircraft was good.

The crew of DLH4TX stated that they initiated the take-off run as soon as they were lined-up. They did not see EIN638 approaching, being concentrated on the take-off from Runway 07R in front of them.

The crew of EIN638 noticed DLH4TX starting to roll and was about to call ATC when the Tower controller, who had visual contact with both aircraft, promptly instructed EIN638 to go around. EIN638 responded immediately.

EIN638 eventually made an uneventful landing in EBBR.

After the event, the Tower controller was shocked and had to be replaced for the remainder of the shift.

The time line of the various actions have been reconstructed.

Time	DLH4TX	EIN638	ATC
18:39:26			Instruction for line-up and wait
18:39:30	Correct read-back.		
18:39:43	Starting taxi towards Runway 07R		
18:39:57	Taxiing		Instruction clearance for landing
18:40:02	Taxiing	Confirm clearance for landing	
18:40:39	Lined-up on RWY 07R (and still rolling)		
18:40:50	Apply TO power		
18:40:54			Activation of the proximity warning
18:40:58	On RWY07R/RWY01 intersection		
18:40:58			Instruction to go around
18:40:59		Apply GA thrust	
18:41:00		Confirm GA	
18:41:02	Leaves the intersection RWY07R/RWY01	Engine at 100% thrust	De-activation of the proximity warning
18:41:13		Above RWY07R /RWY01 intersection	

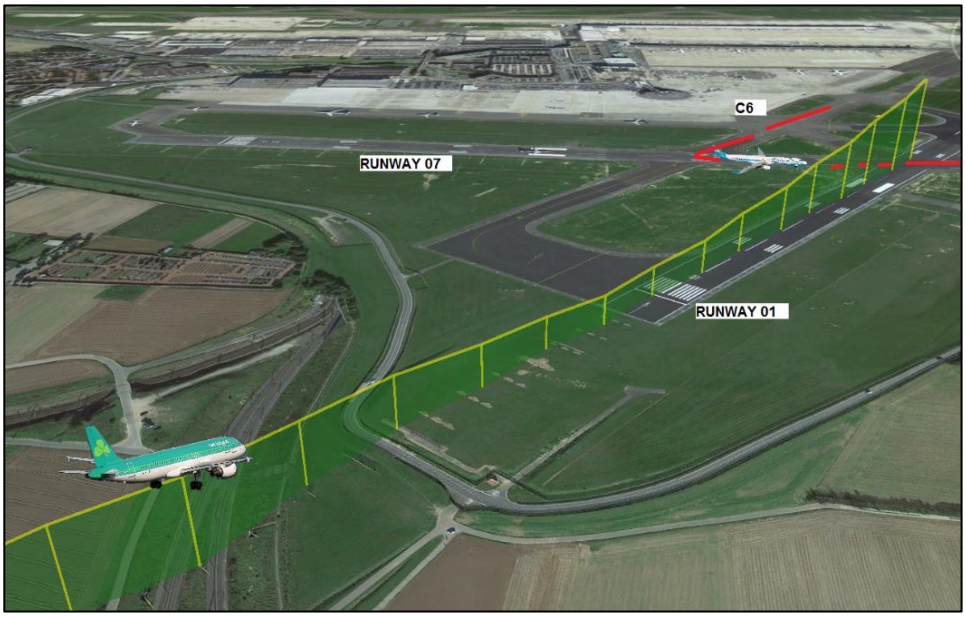


Figure 1: Situation sketch (airplane represented not in scale)

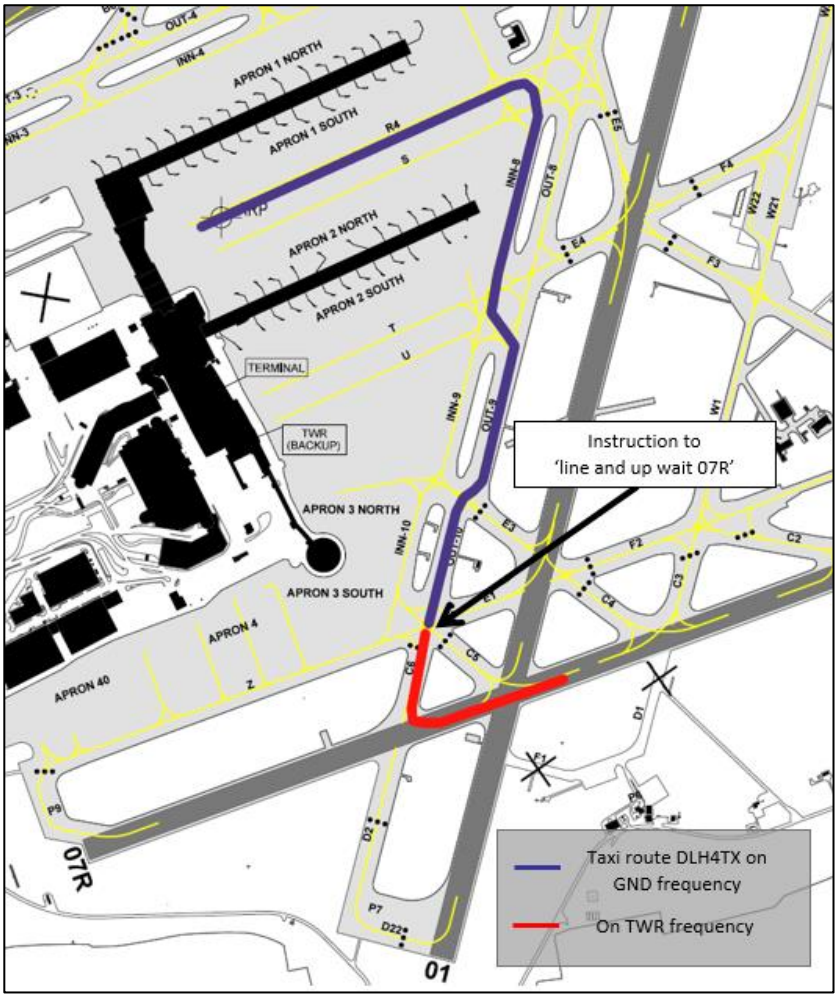


Figure 2 : route of DLH4TX at EBBR

1.2 Injuries to persons.

Injuries	Crew	Passenger	Others	Total
Fatal	0	0	0	0
Serious	0	0	0	0
Minor	0	0	0	0
None	11	218	0	229
Total	11	218	0	229

1.3 Damage to aircraft.

No damage to aircraft.

1.4 Other damage.

No other damage

1.5 Personnel information

1.5.1 EIN638

Captain
46 years, Irish nationality,
Holder of an ATPL licence, issued by the IAA in January 2014
Qualified on A319/A320/A321
Total experience: 10961:02 FH
Total experience on A320 family : 8960:22 FH
Total experience as a Captain: 5035:20 FH
Recent experience:
Last 12 months: 803: 57 FH
Last month: 40:49 FH

First Officer
31 years, Belgian nationality
Holder of a CPL licence, issued by the UK CAA in April 2014.
Total experience: 667:52 FH
Total experience on A320 family: 491:52 FH
Recent experience
Last 12 months:478:52 FH
Last month: 60:31 FH

1.5.2 DLH4TX

Captain
52, years, Italian nationality
Holder of a valid ATPL licence, issued by ENAC
Rating: EMB170 IR ME MP - Flight Instructor
Total experience: 14400 FH
Total experience on EMB: 4662 FH
Recent experience:
Last 12 months: 659.36 FH, Last 3 months: 170.59 FH, Last month: 79.49 FH
Last 24 hours flight time: 1.20 FH
Last 24 hours Duty time: 4.35 FH
The Captain was not very familiar with Brussels Airport, stating he only landed in Brussels Airport 6 or 7 times previously.

First Officer
45 years, Italian nationality
Holder of a valid ATPL licence, issued by ENAC.
Total experience: 8350 FH
Total experience on EMB: 4643 FH
Recent experience:
Last 12 months: 660.05 FH, Last 3 months: 146.56 FH, Last month: 40.80 FH
Last 24 hours flight time: 1.20 FH
Last 24 hours Duty time: 4.35 FH
The First Officer was not at all familiar with Brussels Airport; it was its 3rd time in Brussels and the previous occasion dated back 6 month ago.

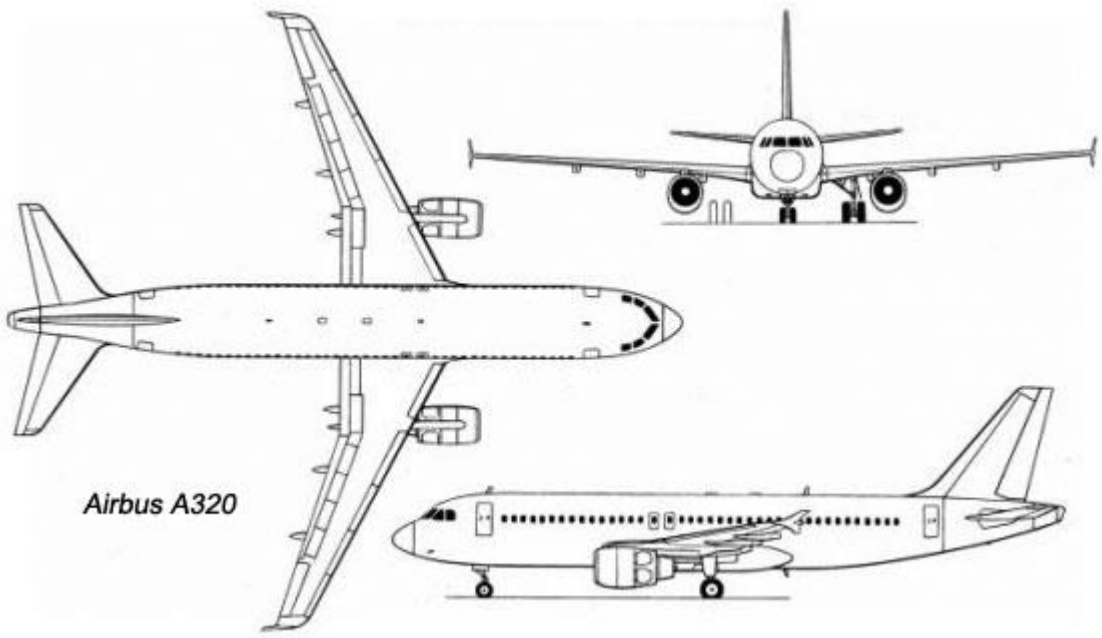
1.5.3 ATC controller

The ATCO concerned was duly qualified and experienced as an ATC TWR Controller. He had the duty shift from 13:00 UT to 20:00 UT. He has been working as a controller in the tower of Brussels for the last 8 years.

1.6 Aircraft information.

Airbus A320

The Aer Lingus aircraft is an Airbus A320-214, a medium-range, narrow-body commercial passenger twin-engine jet airliner manufactured by Airbus. The A320, first member of the A320 family including the A318/319/320/321, made its first flight in 1987. There are currently ca 7000 Airbus A320-family aircraft in service.



Airframe	
Manufacturer:	Airbus
Type:	A320-214
Serial Number:	1983
Built year:	2003
Capacity:	174 passengers

Embraer ERJ 195 LR

The Air Dolomiti aircraft is an Embraer ERJ195LR, a medium-range, narrow-body twin-engine airliner, produced by the Brazilian aerospace company Embraer. The ERJ 195 LR is a stretched version of the E-jet family, including the E170 / E175 / E190 and E195 models.

Airframe	
Manufacturer:	Embraer
Type:	ERJ 195 LR
Serial Number:	19000280
Built year:	2009
Capacity:	120 passengers

1.7 Meteorological conditions.

METAR

METAR EBBR 051820Z 06005KT CAVOK 09/04 Q1029 NOSIG=
METAR EBBR 051850Z 06005KT CAVOK 08/04 Q1029 NOSIG=

Wind:
Direction: 60 degrees
Speed: 5 knots

Wind speed observations at the time of the incident

Runway 25R	Tailwind measured in 10min (kt)	**6.1**
	Crosswind measured in 10min (kt)	**0.9**
	Tailwind measured in 2 min (kt)	**6.3**
	Crosswind measured in 2 min (kt)	**1.3**
	Maximum Tailwind Gust value (kt)	**8.5**
	Maximum Crosswind Gust value (kt)	**1.3**
Runway 25L	Tailwind measured in 10min (kt)	**4.8**
	Crosswind measured in 10min (kt)	**1.1**
	Tailwind measured in 2 min (kt)	**4.8**
	Crosswind measured in 2 min (kt)	**1.0**
	Maximum Tailwind Gust value (kt)	**6.6**
	Maximum Crosswind Gust value (kt)	**1.5**
Runway 19	Tailwind measured in 10min (kt)	**4.6**
	Crosswind measured in 10min (kt)	**4.2**
	Tailwind measured in 2 min (kt)	**4.9**
	Crosswind measured in 2 min (kt)	**4.1**
	Maximum Tailwind Gust value (kt)	**6.3**
	Maximum Crosswind Gust value (kt)	**5.8**

Meteorological forecast:

```
132
FABX53 EBBR 042108                J        +3222062433

DATE : 04/10/16

BELGOCONTROL - METEO MEETING FORECAST - EBBR - PART 1 OF 3
_____________________________________________________________

1. SYNOPSIS FOR THE PERIOD : 05/10/16 0000 Z - 05/10/16 2400 Z
---------------------------------------------------------------
 ALONG THE SOUTHERN FLANK OF A STRONG ANTICYCLONE CENTERED OVER
 SCANDINAVIA, ADVECTION OF SLIGHTLY UNSTABLE CONTINENTAL AIR IN AN
 ENE'LY FLOW BECMG COOLER (POLAR ORIGIN) FROM THE EVENING ONWARDS.
 DURING THE PERIOD, SOME REMNANTS OF THE DEPRESSION CENTERED OVER
 CENTRAL EUROPE WILL REACH THE E AND CENTER OF EBBU.

 WX: CLEAR TO PARTLY CLOUDY AND DRY.

2. TEMPERATURES :
   --------------
  GROUND : MIN.  +07 C  MAX.  +15 C
  AIR    : MIN.  +08 C  MAX.  +14 C

3. VISIBILITY :
---------------
  +10KM

4. PRECIPITATION :
------------------
  NIL

5. WIND :
--------
  SURFACE: 080 05KT MAX07
           BECMG 04/06Z 070 08KT MAX12
           BECMG 07/09Z 070 11KT MAX18
           TEMPO 10/15Z 080 13-14KT MAX23
           BECMG 16/18Z 060 08KT MAX12

     1000FT: 070-090 20-25KT

     2000FT: 090-100 25-30KT


6. WINTRY CONDITIONS :
----------------------
  NIL      WC 6

7. ADVERSE WEATHER :
--------------------
```

1.8 Aids to navigation

1.8.1 Ground movement

Brussels Airport is equipped with an Advanced Surface Movement Guidance and Control System (A-SMGCS) to monitor ground movements based on Surface Movement Radar (SMR) and multilateration. This system includes the functionality to give a warning to the ATC controller when a runway incursion occurs.

The alerting system activated when DLH4TX entered the Runway 01 protected area (90m from both sides of the runway axis); a blinking purple line appeared on the screen to visualize the conflicting flight paths (see fig.4).

Figure 3: DLH4TX Cleared for "line up and wait" on Runway 07R, from C6 intersection.

Figure 4: DLH4TX initiates the take-off; visualization of the conflict with EIN368 on ATC screen (time 18:40:54)

Figure 5: (time: 18:41:01) DLH4TX crosses Runway 01 with EIN638 in short final confirming the go-around

1.9 Communication.

The communication between the aircraft and tower occurs on the same frequency for landing aircraft on Runway 01 and aircraft taking off from Runway 07R. This procedure contributes to a higher situational awareness for all involved.

Communication transcript

Time	Station	Communication
18:25:46	DLH4TX	4TX at 145 right request pushback
18:25:55	GND	4TX, Roger, When clear of the Scandinavian right hand behind, pushback is approved.
18:26:03	DLH4TX	Pushback approved when clear of the Scandinavian on the Right, 4TX
18:32:30	DLH4TX	It is 4TX, Ready for taxi
18:32:34	GND	For the 4TX, roger, opposite traffic is joining the stand 155, as soon as clear continue Romeo 4, Inner, Zulu, Holding point Runway 07R, QNH1029
18:32:48	DLH4TX	Romeo 4, Inner, Zulu to holding point 07 when clear of traffic in front, may we take C5 for departure ?
18:32:58	GND	You can expect C6. After Inner 8, continue Outer 9, C6, Holding point 07R.
18:33:06	DLH4TX	Romeo 4, Outer to C6, 4TX
18:34:16	DLH4TX	Dolomiti 4TX, taxi is confirmed Outer 9 to C6
18:34:21	GND	For the 4TX, first inner 8, then Outer 9 to C6
18:34:26	DLH4TX	Copied, first inner then outer to C6, 4TX
18:39:14	GND	4TX, Report ready on Tower 120.775
18:39:17	DLH4TX	We report ready on Tower 120.775, 4TX
18:39:21	DLH4TX	Brussels Tower, H4TX approaching Charlie 6, Ready for departure
18:39:26	TWR	H4TX Charlie 6, Line up and wait 07R
18:39:30	DLH4TX	Charlie 6, Line up and wait 07R, 4TX
18:39:57	TWR	Shamrock 638, Cleared to land. Runway 01 Wind 070 degrees, 6 kt
18:40:02	EIN638	Cleared to land 01, Shamrock 638
18:40:58	TWR	Shamrock 638, Go Around sir, Go Around
18:41:00	EIN637	Go Around Shamrock 638
18:41:03	TWR	Lufthansa 4TX ?
18:41:07	DLH4TX	Pard ?
18:41:09	TWR	Heu You were not cleared for Take-off, if I'm not mistaken, sir

1.10 Aerodrome information.

The Brussels airport is located at 6.5 Nautical Miles (12km) NE of the city of Brussels, on the coordinates 50°54'05''N 004°29'04''E. The elevation is 56m AMSL.

The airport has three bi-directional runways, all ICAO Code 4 (more than 1800 m in length).

The main characteristics of the runways are:

	01 / 19	**07 L / 25 R**	**07 R / 25 L**
Actual bearing	14.43° / 194.43°	65.38° / 245.38°	69.89° / 249.89°
Available distance for take-off	2987m	3638m	2891m / 3211m
Width	50m	45m	45m
Slope	- 0.78% / + 0.78%	- 0.21% / + 0.21%	-0.15% / +0.15%

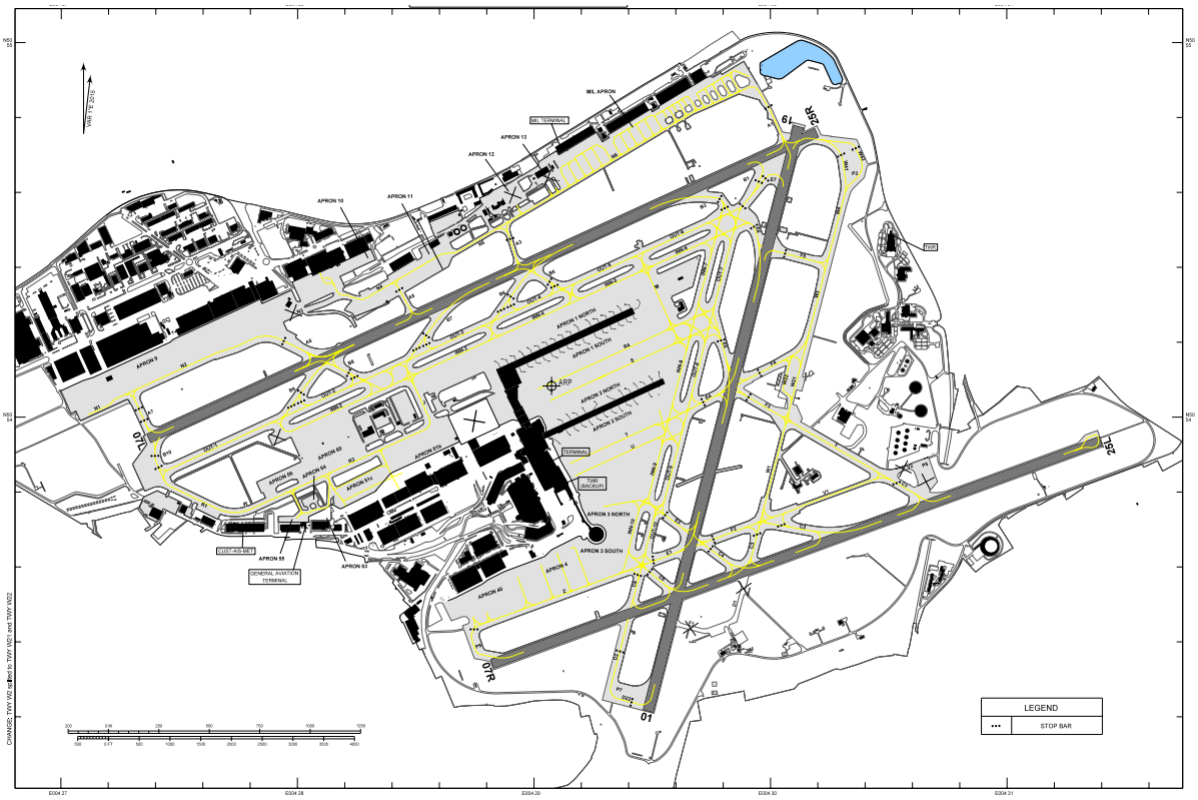


Figure 6: Brussels Airport

Runway 01 was in use for landings and Runway 07R was in use for take-offs since 04 October 04:43 UTC until 07 October 23:27 UTC. On the day of the incident, the selection of the Runway Configuration was based on the prevailing meteorological conditions (exceedance of max. tail wind limits for RWY 25R).

As the forecast indicated that Runway 25R was not going to be used for a while, the opportunity was taken to perform short-term planned works on that runway. The works were completed by 09.30UTC.

Brussels airport Runway-in-use wind criteria:

	RWY 01	RWY 07 L/R	RWY 19 (TKOF and LDG)
Tailwind MAX	0 - 3 kts (incl)	0 - 3 kts (incl)	0 - 3 kts (incl)
Crosswind MAX	20 kts	20 kts	20 kts

Note: (incl) means that the wind component threshold is exceeded when the component exceeds 3 KT.

	Rwy 25L/R	RWY 19 (TKOF only)
Tailwind MAX	7 kts	7kts
Crosswind MAX	20 kts	20 kts

Radio navigation and landing aids:

Runway 01	ILS CAT I		RNAV (GNSS)
Runway 19	ILS CAT I		
Runway 25L	ILS CAT III	VOR	RNAV (GNSS)
Runway 07R	no ILS	VOR	
Runway 25R	ILS CAT III		RNAV (GNSS)
Runway 07L	no ILS	VOR	

AIP. EBBR AD 2.13 Declared distances

In order to reduce the taxi procedure, ATC may, with a visibility of 2 KM or more and subject to pilot's acceptance, authorize take-off from one of the intersections below. Pilots unable to accept should advise ATC duly in advance.

To expedite departing traffic when RWY 01 is in use, departure on RWY 07R from position “H”, line-up position 1 or line-up position 2 will be assigned by ATC.

	Position	Take-off distance available (m)
Runway 07R	C6 intersection	2405
	C5 intersection	2148
	C4 intersection	1792
	Line-up PSN 1	2624
	Line-up PSN 2	2341
	Line-up PSN H	2891

Line-up position signs at RWY 07R:

- Sign “PSN 1": (line-up position 1) on the left beyond the PAPI at 461.4 M from THR 07R
- Sign “PSN 2": (line-up position 2) on the left at 743.7 M from THR 07R (BTN TWY C6 and C5)
- Sign “PSN H”: (line-up position heavy) on the left at 194 m from THR 07R

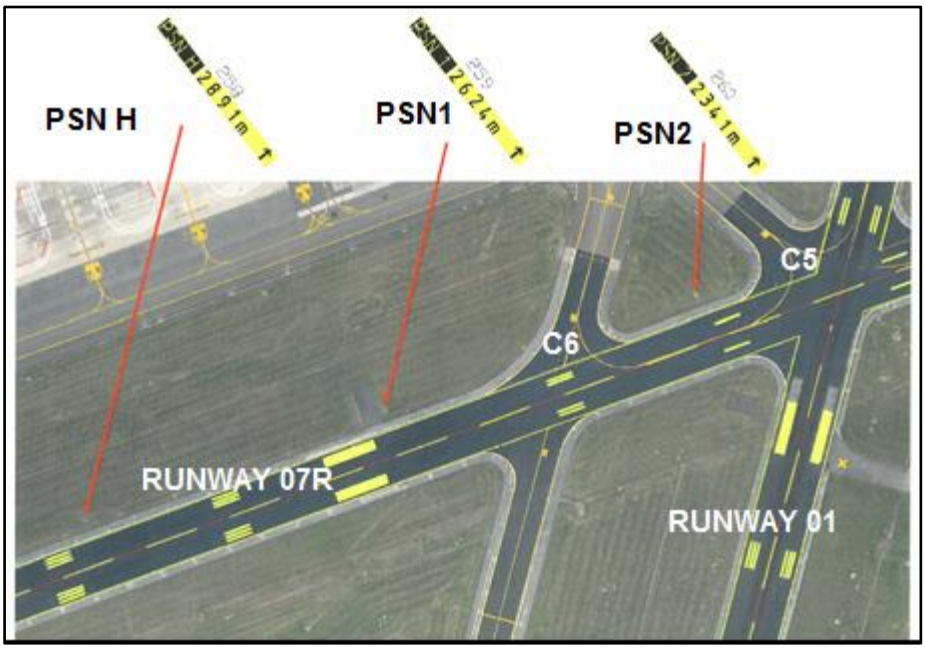


Figure 7: Location of Positions

- TWY C6 is used for facilitating the intersection departure on Runway 07R.

  The distance between the centreline of RWY 07R at Line up Position 2 against the axis of RWY 01/19 is 93,74m. As above stated, Runway 01 has been equipped with a CAT I Instrument Landing System (ILS). This means that the minimum distance from the runway centre line to a hold position is 90 m.

- The distance between the intersections of Taxiway C6 axis with the Runway 07R axis against the Runway 01/19 axis is more than 125m. The distance between this point and the location of Line Up position 2 looking into the RWY axis is 64m. The location of intersection TWY C6 with RWY07R lies physically in-between Line up Positions 2 and 1.

- 3 departure positions have been defined on Runway 07R for noise abatement and operational capacity reasons. All three signs are accompanied by a “Take off run available” (TORA) sign indicating the declared distances.
  - Sign “PSN H” (line-up position heavy) on the left at 194 m from THR 07R
  - Sign “PSN 1" (line-up position 1) on the left beyond the PAPI at 461.4 m from THR 07R
  - Sign “PSN 2" (line-up position 2) on the left at 743.7 m from THR 07R (BTN TWY C6 and C5)

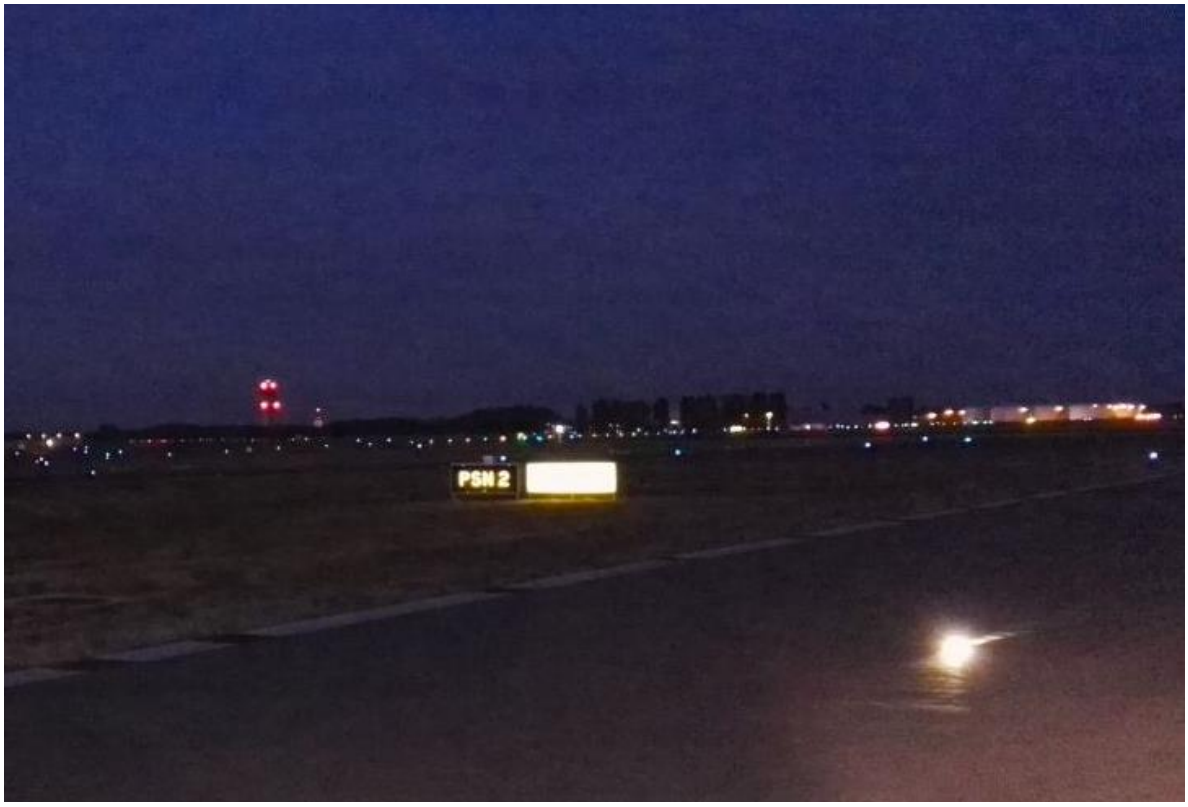


Figure 8: PSN2 sign, at night

1.11 Flight recorders.

Both aircraft are equipped with flight data recorders (FDR) and cockpit voice recorders (CVR), as required.

However, since no accident occurred, the FDR's were not read-out. The Quick Access Recorders (QAR) (or equivalent) were used since they contained the information required for the investigation. The data are in appendix.

The cockpit voice recorder (CVR) preserves only the last two hours of the sounds in the cockpit, including the conversation of the pilots. The recording was not available anymore when the incident was reported.

1.12 Wreckage and impact information.

Not Applicable

1.13 Medical and pathological information.

Not Applicable

1.14 Fire.

Not Applicable

1.15 Survival aspects.

Not Applicable

1.16 Tests and research.

1.16.1 Similar events (Take-off without ATC Clearance) resulting in accidents or serious incidents.

The following events were found in Skybrary

B463 / PA38 Birmingham UK, 1999 On 28 April 1999, a BAe 146-300 being operated by Irish Airline Aer Lingus on a scheduled passenger flight from Birmingham to Dublin began its take off from Runway 33 in normal daylight visibility without ATC clearance just prior to the touchdown of a PA38 on the intersecting cross wind Runway 06. Collision was very narrowly avoided after the Controller intervened and the BAe 146 rejected its take off but was unable to stop before the intersection where the now stationary PA38 was positioned off the Runway 33 centreline. As the BAe 146 stopped, the aircraft commander transmitted "did we hit him" to which a negative reply was given by the Controller.

B738, Eindhoven Netherlands, 2012 Incident: On 11 October 2012, the crew of a Ryanair Boeing 737-800 did not change frequency to TWR when instructed to do so by GND whilst already backtracking the departure runway and then made a 180° turn and took off without clearance still on GND frequency. Whilst no actual loss of ground or airborne safety resulted, the Investigation found that when the Captain had queried the receipt of a take off clearance with the First Officer, he had received and accepted a hesitant confirmation. Crew non-compliance with related AIP ground manoeuvring restrictions replicated in their airport briefing was also noted.

B744 / MD90, Chitose Japan, 2008 Serious incident: On 16 February 2008, during daylight and in poor visibility, a Boeing 747-400, operated by Japan Airlines, was holding on a taxiway next to Runway 01R of New Chitose Airport, Japan. A Douglas MD-90-30 operated by the same airline landed on the same runway and was still on the runway when the B747 was cleared to line up and wait. Shortly after lineup the B747 began its takeoff roll without receiving such clearance and subsequently was instructed to abort the takeoff. The crew of the B747 successfully rejected the takeoff.

AT43/A346, Zurich Switzerland, 2010 Serious Incident: On 18 June 2010, an ATR 42 began a daylight take off on Runway 28 at Zurich without ATC clearance at the same time as an A340 began take off from intersecting Runway 16 with an ATC clearance. ATC were unaware of this until alerted to the situation by the crew of another aircraft which was waiting to take off from Runway 28, after which the ATR 42 was immediately instructed to stop and did so prior to the runway intersection whilst the A340 continued departure on Runway 16.

B190 / BE9L, Quincy IL USA, 1996 Accident: On 19 October 1996, a Beech 1900 landing at an uncontrolled airport in Quincy, Illinois, USA, , collided with a Beech 90 King Air on take-off roll on an intersecting runway.

1.16.2 Similar incidents in EBBR (2012-2016)

The database on aviation occurrences (ECCAIRS) was interrogated on similar events that occurred in the past in EBBR. A total of 6 similar events were found for the last 5 years.

	Take-off without clearance	Number of movements per year in EBBR
2012	3	223431
2013	1	216677
2014	0	231528
2015	1	239349
2016	2	205886 (up to November)

Runway used TO / Ldg	Event
25 R	Take-off without ATC clearance (2012)
07 R / 07L	Aircraft lined up on R07R mistook (call sign confusion) clearance of landing traffic on R07L and took off without clearance. (2012)
25R / 25 L	Aircraft receives clearance for line up and wait on 25 R and starts TO roll. ATC unable to stop the aircraft because of another radio call blocking the frequency. (2012)
19 / 25L	Aircraft lined up on R 19, started rolling without clearance while another aircraft in short final on R 25L. ATC instructed the aircraft to stop, which was acknowledged (2013)
07 L-R / 01	2 Aircraft lined up, one on R07L, another on R07R (at holding position 1). Aircraft on R07L started take off roll without clearance, ATC instructed aircraft to stop, which was acknowledged. (2015)
25 R	An aircraft received the instruction to line-up and wait on Runway 25R. The aircraft took off without having received the clearance. (2016)

1.16.3 Classification of the event.

According to Annex 13
The Air Accident Investigation Unit (Belgium) has determined that this event is to be considered as a "Serious Incident", based on the ICAO Annex 13 definition:

Serious incident definition:

Means an incident involving circumstances indicating that there was a high probability of an accident and is associated with the operation of an aircraft (…). A list of examples of serious incidents is set out in the Annex.

The incidents listed in the above-mentioned Annex are typical examples of incidents that are likely to be serious incidents. The list is not exhaustive and only serves as guidance with respect to the definition of 'serious incident':

- a near collision requiring an avoidance manoeuvre to avoid a collision or an unsafe situation or when an avoidance action would have been appropriate,
- take-offs from a closed or engaged runway, from a taxiway,
- runway incursions classified with severity A according to the Manual on the Prevention of Runway Incursions (ICAO Doc 9870) which contains information on the severity classifications.

According to "RISC".
The runway incursion severity referred to in Annex 13 is to be assessed using ICAO doc 9870. ICAO has developed a computer program (the Runway Incursion Severity Risk Calculator) as a tool intended to enable a consistent assessment of the severity of runway incursion events.

For the purpose of global harmonisation and effective data sharing, the runway incursion severity classification has been divided into 5 categories A to E.

Table 6-1. Severity classification scheme

Severity classification	Description*
A	A serious incident in which a collision is narrowly avoided.
B	An incident in which separation decreases and there is significant potential for collision, which may result in a time-critical corrective/evasive response to avoid a collision.
C	An incident characterized by ample time and/or distance to avoid a collision.
D	An incident that meets the definition of runway incursion such as the incorrect presence of a single vehicle, person or aircraft on the protected area of a surface designated for the landing and take-off of aircraft but with no immediate safety consequences.
E	Insufficient information or inconclusive or conflicting evidence precludes a severity assessment.

* Refer to Annex 13 for the definition of "incident".

Air Dolomiti used RISC to determine the severity of this event, and the outcome was:

Severity Level	S3 - Medium
Probability Level	P2 - Low / Possible under certain circumstances
Risk Level	C – Acceptable. Long term improvement desired

Air Dolomiti assessed also other runway incursion events, similar to the events that occurred in Brussels (see 1.16.2. here above) and the related computed severity was determined as “D” or “E”.

According to “RAT”

Eurocontrol has developed a series of safety tools to help ANSPs implementing operational safety improvements, conduct safety assessments and collect, assess and analyze ATM safety data in the context of their Safety Management Systems (SMS). One of them is the RAT – Risk Analysis Tool, a computer-based tool providing enhanced severity and risk assessment methodology for reported ATM incidents.

The RAT applies the following classification scheme ranking from A (most critical) to E;

Category code	Category	Definition
A	Serious incident	An incident involving circumstances indicating that an accident nearly occurred
B	Major incident	An incident associated with the operation of an aircraft, in which the safety of the aircraft may have been compromised, having led to a near collision between an aircraft, with ground or obstacles (i.e. safety margins were not respected, in this case, not as a result of an ATC instruction)
C	Significant incident	An incident involving circumstances indicating that an accident, a serious or major incident could have occurred, if the risk had not been managed within safety margins, or if another aircraft had been in the vicinity
D	Not Determined	Insufficient information was available to determine the severity, or inconclusive or conflicting evidence precluded such determination (RF<70%)
E	No Safety effect	An incident which has no safety effect.

This incident was analysed by a panel of CAA and ANSP representatives of various countries during a workshop at Eurocontrol on 20th of October 2016 to test the future ERCS (European Common Risk Classification Scheme) against the RAT Methodology.

The results indicate an overall risk severity C; (significant incident).

1.17 Organisation and Management Information.

1.17.1. Air Dolomiti

The Air Dolomiti Operations Manual defines the procedure to follow for radio communication in general and during taxi. Although not totally clear, this procedure requires to ask ATC for confirmation in case of any doubt arising regarding clearances received.

8.3.1.2. Radio communications

The minimum communication equipment for operations under IFR consists of two independent radio communication systems, plus one SSR transponder.

Normally both pilots shall guard the ATC channels and inform each other if this guard is temporarily interrupted.

Communications are normally handled by PNF, using standard English phraseology, as prescribed by ICAO DOC 4444 and Annex 10 "Aeronautical Telecommunications", reported also in the COM section of the General Part of the on-board Route Manual.

Every ATC clearance must be thoroughly understood and read back asking clarification, if it is the case, to assure understanding; the clearance must be confirmed between the pilots in case of operations in areas of high terrain and when change of heading, flight level, frequency and route/waypoint or instruction of holding short of a runway are issued.

8.3.2.2. Taxi

An Air Dolomiti airplane shall only be taxied on movement area by an appropriately qualified pilot.

Taxiing from the parking position or after push-back must not be commenced unless the hand signal from ground personnel has been received.

Each flight crew member should have the necessary aerodrome layout charts available.

The pilot taxiing the aircraft should concentrate on steering the airplane, while the pilot monitoring should concentrate on navigation referring to taxi charts and asking for directions or progressive taxi instructions when in doubt of taxi route.

All taxi clearances should be heard and should be understood by each flight crew member. Both crew members shall monitor clearances given to other aircrafts. All taxi clearances should be cross-checked against the aerodrome chart and aerodrome surface markings, signs, and lights.

The pilot taxiing the aircraft should announce in advance his/her intentions to the pilot monitoring.

Any action which may disturb the flight crew from the taxi activity should be avoided or done with the parking brake set (e.g. announcements by public address).

In conditions of limited visibility crew members shall concentrate in clearing the area around the airplane and in complying with ATC taxi clearance, delaying or suspending checklist while the aircraft is moving.

1.17.2. Air Traffic Control

When the incident occurred, the EBBR tower was manned by 6 controllers:

- 1 for the Delivery
- 1 for the Ground frequency
- 2 for the Tower (Air) frequency
- 1 Supervisor
- 1 reserve.

1.18 Additional information.

1.18.1 Human Factors.

There are a lot of publications made regarding the human factors aspects in aviation further the investigation on the 1977 accident in Tenerife, where 2 B747 aircraft collided on the ground. This accident was caused, among others, by the initiation of a take-off without authorization by one of the two aircraft.

In the last years, a lot of efforts were made to improve the design of aviation systems to control and mitigate human error.

In the field of communication between pilots and ATC, the following actions were noted;

- The use of the English language.
- The use of standardized phraseology
- The use of read-back (repetition of the instruction given).
- …

Nevertheless, these actions, however effective they are, do not provide a 100% certitude that errors will not occur.

A series of initiatives were taken in order to further learn from human errors, such as:

- The reporting of occurrences (such as the non-punitive 40 years-old Aviation Safety Reporting System – ASRS in the USA with a database of nearly 200000 occurrences, the publication of monthly bulletins, analysis reports, etc..)
- The UK Confidential Reporting Programme for Aviation and Maritime (CHIRP)
- The European Regulation – (EU) N°376/2014 on the Mandatory and Voluntary reporting, analysis and follow up of occurrences in civil aviation.

<u>Existing studies/publications on human performance</u>

From *Aviation Psychology, Human Factors, and the Design of Aviation Systems,* Monica Martinussen, David R. Hunter (2009)

This book provides an overview of the role of psychology in the field of aviation. It addresses amongst other the contribution of psychology and psychological characteristics of pilots in the design of aviation systems.

To illustrate the human limitations, Chapter 3.7 ‘Interacting with the system’ describes the short-term memory and the psychological phenomena that influence the recall of information.
It defines the short-term memory as the term applied to human memory for information presented and retained for a fairly short time span – typically, on the order of a few seconds to a very few minutes. Research has demonstrated that the short-term memory capacity of humans is around seven digits. A study of Miller in 1956 refers this as the “magic number 7, plus or minus 2”. As the number of digits to be recalled exceeds this number, the rate of errors increases rapidly. For this reason, well-designed systems avoid requiring humans to hold more than seven digits (or other bits of information, such as words) in their short-term memory.

More in relation to this incident, there are two other psychological phenomena that influence the recall of information; the “serial position effect” and “confirmation bias”.

When humans learn a list of words or other information, it has been found that they tend to recall the first and last items better than those that appeared in the middle. This is called serial position effect.

But, it is not just the position of information that affects the pilot’s recall. The predisposition of the pilot to receive information also comes into play. Psychological research has shown that humans tend to look for information that confirms or supports their pre-existing beliefs or views of the world. This tendency is called confirmation bias.

Briefing Note Airbus

Airbus has published a ‘Flight Operations Briefing Note (Rev 03 – Sept. 2004) on Effective Pilot/Controller Communications. This note provides an overview of various factors that may affect pilot/controller communications and how these communications can be enhanced. Amongst others, the following factors are described:

- Building Situational Awareness
  Flight crew and controller may prevent misunderstandings by providing each other with timely information, for better anticipation.
  At all times, pilots should build and update a mental picture of the other traffic in the vicinity of their intended flight or ground path.

- Perceiving What Was Expected or Wanted (not what was actually said)
  This involves perceiving what was expected or wanted and not what was actually said. The bias of expectation can lead to:
  - Transposing the numbers contained in a clearance (e.g., an altitude or FL) to what was expected, based on experience or routine; or,
  - Shifting a clearance or instruction from one parameter to another (e.g., perceiving a clearance to maintain a 280-degree heading as a clearance to climb / descend and maintain FL 280).

- Failure to Request Clarification (when in doubt)
  Reluctance to seek confirmation or clarification may cause pilots to either :
  - Accept an inadequate instruction (over-reliance on ATC); or,
  - Define by themselves the most probable interpretation.

  Failing to request clarification may cause flight crew to believe erroneously that they have received the expected clearance (e.g., clearance to cross an active runway).

- Effective Listening – Filtering Communications
  Effective communication requires active and intensive listening by all parties involved, concentrating on each part and word in order to fully understand the whole message.
  Because of other flight deck duties, pilots tend to filter communications, listening primarily to communications that begin by their aircraft call-sign and not hearing other communications.

To maintain situational awareness, this filtering / selection process should be adapted, according to the flight phase, for more effective listening, e.g., whenever occupying an active runway (e.g., while back-tracking or holding into position / being lined up and ready for take-off) or when conducting a final approach to an assigned runway, pilot's should listen and give attention to all communications related to this runway (…).

1.18.2 Runway incursion hazard prevention.

Runway incursions are recognised as a potential safety hazards.

- ICAO has published Doc 9870 – Manual on the Prevention of Runway Incursions (first edition 2007)
- Eurocontrol, with the support of the major aviation stakeholders has issued the European Action Plan for the Prevention of Runway Incursions (EAPPRI – Edition 2.0).
- The Airports Council International (ACI) developed a Runway Safety Handbook (first edition 2014).
- ICAO Annex 14, Volume 1, Seventh Edition published on 10 November 2016, the possibility to use of an Autonomous Runway Incursion Warning System (ARIWS) is introduced.

a. <u>ICAO Doc 9870.</u>

Runway incursion definition:

Any occurrence at and aerodrome involving the incorrect presence of an aircraft, vehicle or person on the protected area of a surface designated for the landing and take-off of aircraft.

According to Doc 9870, this serious incident can be categorized as a runway incursion due to a breakdown in communication involving the pilot misunderstanding the controller's instructions.

Doc 9870 further analyses the aerodrome configuration with respect to potential risk of collision or runway incursion by defining hot spots.

Hot Spot definition:

A location on an aerodrome movement area with a history or potential risk of collision or runway incursion and where heightened attention by pilots/drivers is necessary.

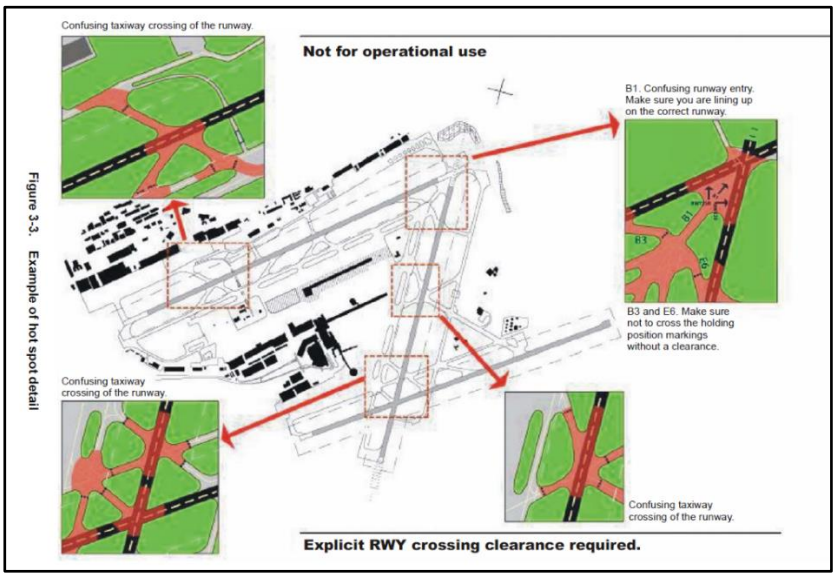


Figure 9: ICAO Doc 9870 extract

Brussels airport is taken as an example, and the C6 intersection is identified as a hot spot.

The Chapter 4 of Doc 9870 defines recommendations for the prevention of runway incursions, including, among others;

- (4.4.2.) Pilots should not accept an ATC clearance that would require them to enter or cross a runway from an obliquely angled taxiway.
- (4.4.4.) Pilots should turn on landing lights when take-off or landing clearance is received and when on approach.
- (4.4.6.) If there is any doubt when receiving a clearance or instruction, clarification should be immediately requested from ATC before the clearance or instruction is enacted.
- (4.5.16.) When using multiple or intersection departures, oblique or angled taxiways that limit the ability of the flight crew to see the landing runway threshold or final approach area should not be used.
- (app. B – 6.6.) Listen on the frequency. The pilot should listen on the frequency at all times and try to visualize the other traffic in the vicinity. The pilot should know what runways will be encountered between the aircraft's current location and final destination. Particular attention should be paid to all clearances and instructions issued to traffic involving those runways.
- (app. B – 7.4.) Both the pilot flying and the pilot not flying should monitor the frequency and agree upon acceptance of a clearance to taxi, take-off or land on a runway. Any misunderstanding or disagreement should be resolved immediately by contacting ATC for clarification.

Moreover, in attachment A of Annex 14 it is stated that the centre line of an entrance taxiway should be perpendicular to the runway centre line, where possible. This design principle provides pilots with an unobstructed view of the entire runway, in both directions, to confirm that the runway and approach are clear of conflicting traffic before proceeding towards the runway. Where the taxiway angle is such that a clear unobstructed view, in both directions, is not possible, consideration should be given to providing a perpendicular portion of the taxiway immediately adjacent to the runway to allow for a full visual scan by the pilots prior to entering or crossing a runway.

b. EAPPRI.

The document features a series of recommendations and guidelines, including among others:

- (1.4.8.) Pilots are advised to switch on forward facing lights when in receipt of a take-off clearance and show forward facing lights on the approach.
- (1.4.13) If there is any doubt when receiving a clearance or instruction, clarification should be requested immediately from Air Traffic Control.
- (app.A) speech transmitting techniques should be such that the highest possible intelligibility is incorporated in each transmission. Fulfilment of this aim requires that flight crew and ground personnel should:
  - Enunciate each word clearly and distinctly
  - Maintain an even rate of speech. When a message is transmitted to an aircraft and its content need to be recorded the speaking rate should be at a slower rate to allow for the writing process.
- (app.D) Pilots should turn on aircraft forward facing lights when in receipt of a take-off clearance. (…)
- (app D) When cleared to line up and/or when crossing any runway, position the aircraft at a right angle with the runway where possible, in order to better observe the other traffic, both arriving and departing.
- (app K) Flight crew need an unobstructed view of the runway, in both directions, to confirm that the runway and approach is clear of conflicting traffic before proceeding to enter or line up. To achieve this clear view, runway entrances should be at right angles to a runway.

c. ACI Runway Safety Handbook

This handbook provides guidance material for the development of a runway safety programme for all aerodrome (large or small) as well as ways to tailor, improve and expand existing programmes. The chapter Planning and Design explains how to prevent or mitigate infrastructural hazards of runway incursion, excursion and confusion.
Some guidelines;

- Naming of the taxiways begins on one side of the aerodrome and carries on to the other extremity (e.g. from east to west or from north to south);
- A taxiway crossing a runway should be named differently on the two sides of the runway.
- ACI recommends that a taxiway accessing a runway should be identified by a code consisting of a letter followed by a figure (e.g. A1, A2, A3 ... A12), beginning with 1 but not 0, from the extremity of the runway and continuing without missing a number. As far as practicable, this type of identification is not used for other, less critical parts of the aerodrome: only one letter is used.

d. ICAO Annex 14, seventh edition – July 2016 - Autonomous runway incursion warning system (ARIWS)

ICAO Annex 14 introduces ARIWS and defines it as a system which provides autonomous detection of a potential incursion or of the occupancy of an active runway and a direct warning to a flight crew or a vehicle operator.

The operation of an ARIWS is based upon an independent surveillance system (primary radar, multilateration, specialized cameras, dedicated radar, etc.) which monitors the actual situation on a runway and automatically returns this information to warning lights at the runway (take-off) thresholds and entrances. When an aircraft is departing from a runway (rolling) or arriving at a runway (short final), red warning lights at the entrances will illuminate, indicating that it is unsafe to enter or cross the runway. When an aircraft is aligned on the runway for take-off and another aircraft or vehicle enters or crosses the runway, red warning lights will illuminate at the threshold area, indicating that it is unsafe to start the take-off roll.

Paragraph *5.3.30 Runway status lights* is added to Chapter 5 of ICAO Annex 14. It describes the conditions which must be met when Runway status lights (RWSL) are installed. They are a type of autonomous ARIWS and consist of two basic visual components:

- Runway Entrance Lights (RELs), which warns pilots and vehicle drivers it is unsafe to enter or cross a runway
- Take-off Hold Lights (THLs), which warns it is unsafe to take-off

A third component of this system, currently not described in Annex 14, are Runway Intersection Lights (RILs), which warns when it is unsafe to enter or cross an intersecting runway.

The general characteristics and a further description of ARIWS can be found in paragraph 9.12 and *Attachment A, Section 21* of ICAO Annex 14.

Figure 10 : The different components of Runway Status Lights (picture from Eurocontrol)

1.18.3 Variable message signs

Next to fixed message signs, presenting only one continuous message, ICAO Annex 14 also offers the possibility to place Variable message signs, capable of presenting several predetermined messages or no message, as applicable. It shall show a blank face when not in use.

Annex 14 Chapter 5.4 *Signs* of Annex 14 contains the following recommendation:

> 5.4.1.2 **Recommendation.—** A variable message sign should be provided where:
>
> a) the instruction or information displayed on the sign is relevant only during a certain period of time; and/or
>
> b) there is a need for variable predetermined information to be displayed on the sign to meet the requirements of 9.8.1.

Chapter 9.8.1 states that a surface movement guidance and control system (SMGCS) shall be provided at an aerodrome.

More guidance on variable message signs is contained in the ICAO *Aerodrome Design Manual (Doc 9157), Part 4*

2 Analysis.

2.1 Runway

In function of the wind direction and speed, the use of Runway 07R for take-off and Runway 01 for landing was within the airport crosswind prescribed limitations and was also within the operational limitation of both aircraft.

The meteorological forecast for the day indicated that the tailwind maximum values (mean and peak (wind gusts)) for Runways 25R/L were to be exceeded throughout the day. The configuration Runway 07R for take-off and Runway 01 for landing was therefore selected. At 18:41 UTC, the tailwind gust value measured on Runway 25R (8.5 kt) exceeded the limit value published in the AIP (7kt).

2.2 Simultaneous Intersecting Runways Operations (SIRO)

Runways 01 and 07R of Brussels Airport are intersecting. Many other airports have intersecting runways, often as a consequence of expansion but also to provide a take-off option with minimal crosswind where wind direction is variable. Although the use of both runways simultaneously may serve to increase traffic efficiency, shorter approach tracks and taxi routes for example, there are inherent risks associated with simultaneous operation of intersecting runways; strict procedures must be in place to prevent a runway incursion.

The simultaneous use of parallel runways also holds risks and needs strict procedures. For this reason and the fact that the runways selection also depends on the prevailing wind direction and speed, the choice of using intersecting above parallel runways is not further analyzed in this report, only the associated safety issues of intersecting runways are further considered.

2.3 Human Factors

The DLH4TX crew received an instruction from ATC, read it back correctly, but eventually did not follow it.

We can compare this phenomenon with other human failures, such as passing a red light when driving the car without realizing. The frequency of this kind of human failure has been estimated for the rail sector (Buizingen railway accident report), specifically for the violation of red signals by train drivers. This estimation shows a failure rate of 10^{-5} for adequately selected and trained personnel.

This figure is of the same magnitude as the rate of take-offs initiated without clearance at EBBR (2 events for 230000 registered movements per year).

The parameters influencing this human failure rate is, among others;

- Fatigue,
- Routine work
- Distraction

In the case of this incident, the extra attention required from the crew caused by a unfamiliar airport, the reported complexity of the taxiway route (including a part of the taxiway centerline lights),and time pressure (the flight was late) adding to some difficulties to understand the ground controller may have caused an elevated stress level for the crew during taxi. This could have reduced their attention to standard and expected instructions/clearances such as 'line up and wait' (so-called 'selective attention').

From the literature on human factors, we can deduct that this kind of lapse is also related to the phenomenon of "expectation" in which the reception of a message is biased by the anticipation of actions to perform. In this case, the message received by ATC – stored in the short term memory of the crew – faded rapidly and the crew remained with the thought that they have got take-off clearance because they were cleared to get on the runway for the purpose of taking off. This determination can also be influenced by another phenomenon – the serial position effect, in which the human tends to recall the first and last words in a sentence and the instruction the crew received was "Line up and wait Runway 07R", with the "wait" instruction sitting in the middle.

Also, GND gave instruction – '4TX, Report ready on Tower 120.775' and the crew reported to the TWR – 'Brussels Tower, H4TX approaching Charlie 6, Ready for departure'.
Requesting to report READY might give to the crew the perception that it is expected to perform the take off as soon as possible. The instruction to WAIT after the line-up was probably not expected by the crew and although it was correctly read back it just didn't reach the crew's mind."
These contributing elements were identified in the study conducted prior to the publication of the ICAO Doc 9870 Runway Incursion Prevention Manual and the European Action Plan for the Prevention of Runway Incursions (EAPPRI – Edition 2.0) published by Eurocontrol. Among other recommendations, the documents support the use of a mnemonic in relation with the reception of the take-off clearance (switching on landing lights) and a procedure to apply in case of doubt regarding ATC instructions received.

Air Dolomiti was using the "landing light" procedure on its former fleet of aircraft, but discontinued it after the renewal of the fleet with Embraer 195. Air Dolomiti wanted to streamline its procedures and stick to the aircraft manufacturer's instructions, which did not include the "landing light" procedure.

The text in chapter *8.3.1.2. Communications* of the Air Dolomiti Operations Manual requires that all ATC clearances must be thoroughly understood and in case of doubt clarification must be requested to ATC. The text requires further that clearances must be confirmed between the pilots, but does not clearly express that clearances needs to be heard by each flight crew member.

The text in chapter *8.3.2.2. Taxi* is more clear as it states that all taxi clearances needs to be heard and understood by each flight crew member. However this chapter does not express what to do in case of disagreement.

In this incident, the captain did not recall having heard a take-off clearance and asked for confirmation by the First Officer whether they had received the clearance. The captain was satisfied by the positive answer of the First Officer. The instructions of the Operations Manual are unclear, as both texts do not state clearly that if a clearance is not confirmed having been understood by both crew members, confirmation must be requested to ATC.

Regarding the ATC instruction “Line up and wait Runway 07R”, owing to the human factors identified above, should this instruction have been supplemented by additional information, such as a location, a warning for incoming traffic, it would have increased the situational awareness of the crew and increased the probability that the instruction would have been retained.

2.4 Traffic control

The ATC controller (TWR) gave the instruction to line up and wait to DLH4TX, effectively giving it the clearance to enter Runway 07R, to line up the aircraft with the runway centerline and to stop as soon as the line-up was achieved.

It took only 5 seconds for DLH4TX to reach the intersection of the 2 runways from the moment it started to accelerate for the take-off run. It was impossible for the Tower ATCO to react fast enough in order to stop the departing aircraft before it reached the runway intersection. However in this case, there was just enough time to instruct EIN638 to go-around because this aircraft was still at a sufficient distance from the runway intersection.

2.5 Taxiway layout

Because the crew reported to have had some difficulties with the assigned taxi-route, which is confirmed by the communication transcript (see 1.9), the taxi-route and layout is hereunder briefly analyzed.

The reported complexity may be the result of :

- An actual complex taxiway lay-out,
- The crew not being familiar with the airport lay-out,
- The environmental conditions.
- The combination of the above-mentioned elements.

With respect to the environmental conditions, the event occurred at night. Arriving at the C6 intersection from the Outer 10 taxiway, the aircraft faces 5 possible exits (E1, C5, C6, Taxiway Z, Inner / Apron 3 South). The pictures on page 40 show the apparent complex situation.

The assigned taxi-route was Romeo 4, Inner 8, continue Outer 9, C6, Holding point 07R.

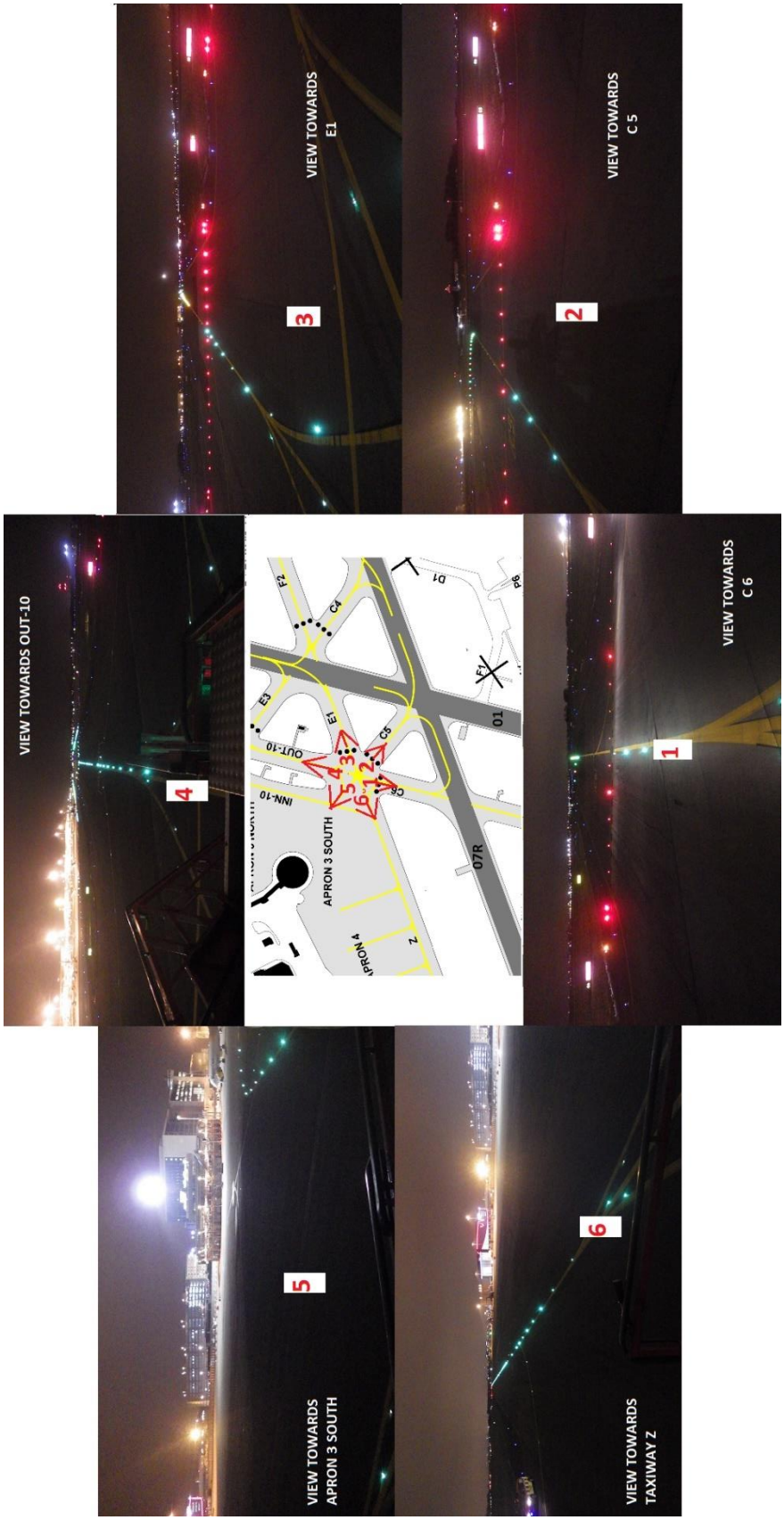


Figure 11 : C6 intersection at night

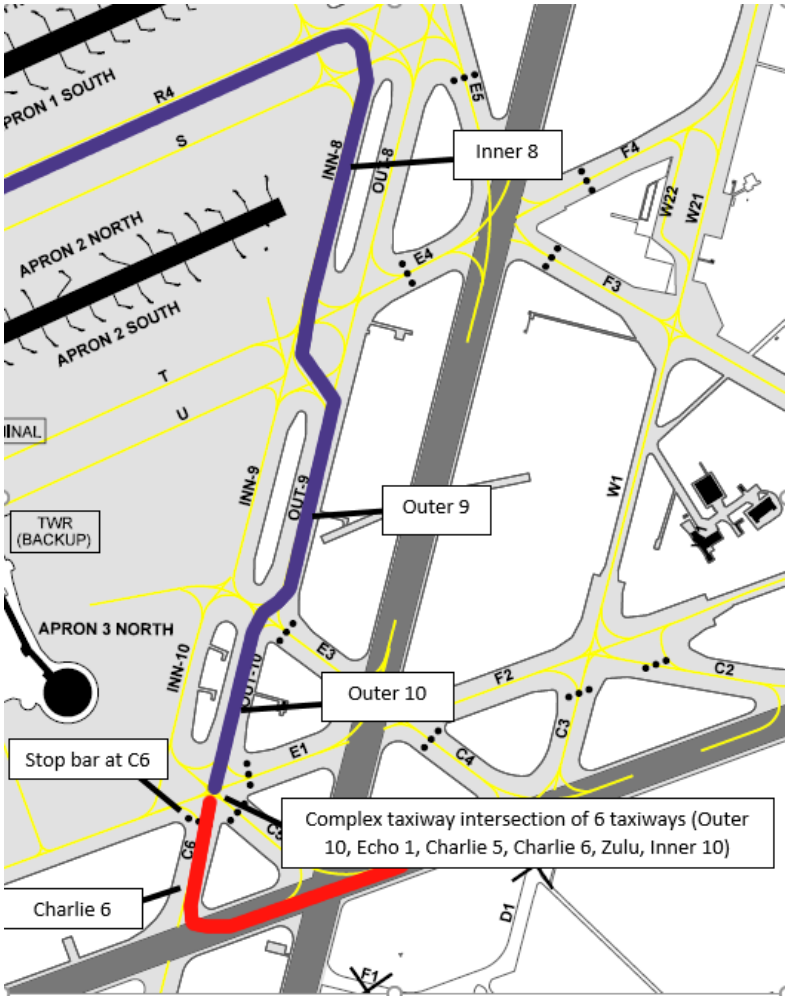


Figure 12: Taxi route

Aircraft coming from Romeo 4 are instructed to initially taxi via Inner for 3 reasons;

- As much as possible, taxi traffic from north to south occurs via Inner, opposite traffic via Outer;
- To avoid a possible confusion between taxiway E5 and Outer 8, to prevent potential runway incursions;
- To avoid a possible obstruction of the traffic on RWY01 when landing traffic on RWY01 has to hold on E5, waiting for opposite traffic turning on Outer 8.

However, the use of C6 via Inner might cause a possible flow obstruction. Aircraft waiting in line on the Inner for taking off on RWY07R via C6 might block the way for aircraft in need of a longer take-off distance (position H and 1 via taxiway Zulu). Therefore, aircraft taxiing to C6, once passed Outer 8, are directed to the Outer to free the taxi route to Zulu.

In the ACI Runway Safety Handbook there is a chapter on taxiway naming convention. It is suggested to develop a simple and logical method for designating taxiways. Amongst others, the following guidelines are listed:

- Naming of the taxiways begins on one side of the aerodrome and carries on to the other extremity
- A taxiway crossing a runway should be named differently on the two sides of the runway
- ACI recommends that a taxiway accessing a runway should be identified by a code consisting of a letter followed by a figure. As far as practicable, this type of identification is not used for other, less critical parts of the aerodrome: only one letter is used. The goal of this practice is to warn a pilot or a vehicle driver of proximity with a runway

Keeping the basic principle of 'keep it simple' in mind and taking the above guidelines into account, the addition of a number to the taxiways 'Inner' and 'Outer' is not needed as they don't have access to a runway. It makes the situation more complex than needed.

Moreover in chapter N of the EASA Certificate Specifications for Aerodrome Design (CS-ADR_DSN), it is written that the use of 'Inner' and 'Outer' should be avoided wherever possible for the designation of taxiways.

Just before entering taxiway C6, there is a complex intersection[1] of 6 taxiways (in 3 directions). 3 taxiways (E1, C5, C6) give entrance to a runway and are equipped with holding point markings, signs and stop bars. Both C5 and C6 provide entrance to Runway 07 at that point.

Taxiway C6 makes an oblique angle with Runway 07R. As this taxiway is parallel with active Runway 01, it is reported by other pilots that it provides a good wide angle to monitor the arriving traffic on the latter. On the other hand, aircraft have to make a turn of 120° when they line up in the direction of 07R.
One of the guidelines for aerodrome design in ICAO Annex 14 Attachment A and EAPPRI (and also in the ACI Runway Safety Handbook) is that runway entrances should be at right angles to a runway. This is because flight crew need an unobstructed view of the runway, in both directions, to confirm that the runway and approach is clear of conflicting traffic before proceeding to enter or line up.

Flight crew is also encouraged to position the aircraft at a right angle with the runway where possible, in order to better observe the other traffic, both arriving and departing. Although the line-up itself did not cause a runway incursion on Runway 01, the not-standard entry on Runway 07R caused additional confusion in the cockpit as the taxi centerline lights where not easy to follow.

ICAO Annex 14 leaves the option to provide only a perpendicular portion of the taxiway immediately adjacent to the runway to allow for a full visual scan by the pilots prior to entering or crossing a runway.

[1] Complex intersection: generally involves three or more crossing pavements, such as three taxiways, two runways and a taxiway, or two taxiways and a runway

2.6 Event classification

From its beginning, aviation did evolve on the base of the lessons learned from accidents. However quite effective, this system is fundamentally reactive and different approaches were made to adopt a more pro-active system.

One of the current cornerstone of aviation safety lies in the reporting of incidents, their analysis and the drawing of lessons in order to continuously improve safety without having to wait for an accident to occur. The latest European regulation on this matter is Regulation (EU) 376/2014 of the European Parliament and of the Council of 3 April 2014 on the reporting, analysis and follow-up of occurrences in civil aviation.

Each occurrence in aviation is to be reported, logged, classified, analyzed as part of individual (Operator's, Airport's, Traffic Control's,…) Safety Management System. Owing to the high number of occurrences, automated system were designed to provide a rational, neutral and repetitive analysis outcome. Organizations like ICAO and Eurocontrol have designed such systems (the Risk Analysis Tool (RAT), Runway Incursion Severity Classification (RISC) and the latest European system is being designed - European Risk Classification Scheme (ERCS).

The differences between these classification systems (5 severity categories, ranking from A (most critical) to E and the Annex 13 on Accident Investigation definition of "serious incident" (associated to a category "A" severity) can produce some conflicting situation in the grading attributed to an event. In this case, RAT and RISC evaluate the severity as Category C, while the Annex 13 evaluation concludes that this event is a serious incident (which by definition would be categorized "A" in both RAT and RISC systems).

The definition of a "Serious Incident", in accordance with ICAO Annex 13, considers the possibility that the incident might have resulted in an accident if the circumstances had been slightly different and that chance (providence) played a role in determining the actual outcome of the event. The RAT and RISC-methods, on the other hand, are more aimed at strictly focusing on the actual circumstances.

The determination by AAIU(Be) of the classification of "serious incident" was made on the base of the ICAO Annex 13 definition and the guidelines given during the workshop on the treatment of incident organized by the ECAC ACC in Roskilde, May 2012, considering the answers to the following questions:

- Why did this incident not turn into an accident?
- Were there in place safety nets/positive factors (eg equipment, procedures) that prevented an accident from occurring?
- Were there safety nets/positive factors that reduced the incident's seriousness?
- Or was the outcome of this occurrence merely a matter of circumstance (including chance or providence?)

Considering the following;

- The DLH4TX crew started the take-off run unaware of the landing traffic.
- The time when the take-off run was initiated was random.
- The relative bearing between the flight path of both aircraft (120° for DLH4TX) makes that the detection of the incoming EIN638 aircraft by DLH4TX would have been difficult when aligned on Runway 07R.
- The time DLH4TX took to reach the intersection, from the brake release is 8 seconds, too short for the ATC controller to initiate an action for that aircraft (such as instructing to interrupt the take-off).
- For an aircraft initiating a go-around, such as the EIN638, there is a time delay between the moment the crew advances the engine throttle and the moment the aircraft responses. During the 4 seconds to reach max power, the aircraft descended 52 ft. The lowest elevation reached is 68 ft above ground level.

The fact that DLH4TX did not start the take-off run 10-15 seconds later is just a matter of circumstances (chance). Would that have been the case, then the outcome was the exposure of EIN638 to the DLH4TX's jet blast or a collision between the 2 aircraft.

The effectiveness of the remaining barriers in that case would have been strongly reduced. The awareness of the EIN638 crew would lead to the initiation of a refused landing / go-around action, but the inertia of the aircraft would have delayed the effectiveness of their action. The action of the traffic controller could not avoid the DLH4TX to start the take-off and the instruction for go-around, owing to the inertia of the EIN638 aircraft might have not been sufficiently efficient.

The difference in the severity classification between an incident class "A" (serious incident) and class "C" (significant incident) is not a pure administrative matter, but triggers also a different response by the concerned stakeholders; a class "C" would be considered as a routine event with minimal investment in investigation, while a class "A" would be scrutinised in detail.

3 Conclusions.

3.1 Findings

- The flight crew of both aircraft involved were duly licensed and qualified in accordance with applicable Regulation.
- The TWR controller involved was duly qualified.
- The flight crew of both aircraft held valid medical certificates and were medically fit to operate the flight.
- The flight crew of DLH4TX was adequately rested and reported to be not fatigued. Their flight and duty times were in compliance with the applicable regulation and Air Dolomiti requirements.
- The crew of DLH4TX was not very familiar with Brussels airport and reported difficulties to navigate on ground.
- Runway 07R was used for take-offs and Runway 01 was used for landings.
- The crew of DLH4TX were instructed by ATC to line up and wait on Runway 07R from the C6 intersection.
- The crew of DLH4TX, although not certain of having received the take-off clearance, did not request confirmation to ATC, as required by the operator's procedure.
- The Air Dolomiti's Operations Manual on clearing doubts with ATC is unclear.
- The crew of DLH4TX initiated a take-off run without clearance and without noticing the landing EIN638 aircraft.
- EIN638 was cleared to land on Runway 01.
- ATC instructed EIN638 to go-around upon DLH4TX reaching the intersection between RWY07R and RWY01.
- EIN638 responded immediately to the go-around instruction received.
- Visual meteorological conditions prevailed on departure and weather was not a factor in the event.

3.2 Cause

The incident was caused by the take-off without clearance of an aircraft instructed to "line up and wait" on Runway 07R while an aircraft was in final approach of Runway 01.

3.3 Contributing factors

- Not using a mnemonic and/or cross-check for the take-off clearance by the DLH4TX crew.
- Limited traffic information/situational awareness given when delivering ATC clearances.
- Inadequate doubt-clearing management in the cockpit.
- The unfamiliarity of the crew with the airport.
- Authorizing aircraft to line up on RWY 07R at a short distance from the intersection with RWY 01 without correlation with landing traffic on this latter.
- Intersection and status of RWY 01 not indicated on RWY 07R.
- The complex taxiway layout (junction connecting 6 taxiways right before C6, the oblique angled entry taxiway including a part of the taxiway centerline lights).

4 Safety actions and recommendations.

4.1 Safety actions by Air Dolomiti

Further to the application of the operator's internal Safety Management policy, Air Dolomiti safety department determined the following internal recommendations:

4.1.1 Improvement of the Operations Manual

Modification of the text in OM A 8.3.1.2. as follows:
"Every ATC clearance must be thoroughly understood and read back asking clarification to the ATC unit, if it is the case, to assure understanding.

AAIU(Be) considers that the proposed improvement of the Operations Manual does not completely address the applicable safety issue, therefore AAIU(Be) issues Safety Recommendation SR BE-2016-0018 (see 4.3. hereunder).

4.1.2 Enforcement of existing procedures

On ground, the pilot conducting the taxi, should continuously express his/her intention in relation to the ground route to be followed.

AAIU(Be) supports the safety action.

4.1.3 Use of the landing lights as a mnemonic for the take-off clearance.

To insert in SOPs the procedure that the nose landing light is switched on only when the take-off clearance has been received.

AAIU(Be) supports the safety action.

4.1.4 Doubt management

It is recommended that both Simulator training scenarios and ground recurrent training for 2017 include in the CRM section exercises on how to properly clear a doubt related to operational procedures (ATC clearances, performance computation, environmental information, etc, …).

AAIU(Be) supports the safety action.

4.1.5 Safety promotion

It is recommended to insert the results of the internal investigation in the next safety bulletin (distributed to flight crew within Air Dolomiti) and to use this event as a case study during the SMS recurrent training for 2017.

AAIU(Be) supports the safety action.

4.2 Safety action by Belgocontrol

4.2.1 Improvement of situational awareness/ traffic information to flight crew

Belgocontrol published an internal note (N2Ops-2016/0194-v1) following the incident:

> When an aircraft is authorized to LINE UP AND WAIT during 'crossing RWY operations', inform it of the closest traffic
> that is cleared to land on the crossing RWY.
> "Line up and wait RWY 19, landing traffic RWY 25L" or
> "Line up and wait RWY 07R, landing traffic RWY 01"
>
> Same procedure when a pilot reports ready for departure on TWR frequency at position H -1 or 2 on RWY 07R: " Hold position, landing traffic RWY 01".
>
> Be aware that various airport factors may affect pilot situational awareness, distract the crew, or lead to crew confusion: crossing RWYs, complex and confusing intersections, etc …

Every ATCO working in EBBR TWR before starting duty will have to acknowledge reception and knowledge of the note by signing the attendance list. This will be integrated in the EBBR TWR manual to be used for future ATCO's as well.

AAIU(Be) supports the safety action.

4.3 Safety Recommendations by AAIU(Be)

4.3.1 Safety Issue: Doubt-clearing mismanagement in the cockpit.

Currently, it is not stated in Air Dolomiti's Operations Manual how to clear doubt and which crewmember should confirm the take-off clearance. Therefore:

> **Safety Recommendation N° BE 2016-0018**
>
> It is recommended that Air Dolomiti revises the text in Operations Manual A 8.3.1.2. to have the following sentence added;
>
> "Take-off clearance must be heard by each crew member and confirmed between the crew members. If confirmation is not achieved, clarification must be requested to ATC."

4.3.2 **Safety issue:** Authorizing aircraft to line up on RWY 07R at a short distance from RWY 01 without correlation with landing traffic on this latter.

Although the use of both runways simultaneously may serve to increase flight capacity, there are significant inherent risks associated with it; therefore strict measures and procedures must be in place to prevent a runway incursion.

The investigation learned that improvements can be made to both increase the situational awareness of the flight crew and mitigate the probability of critical runway incursions.

Recommendation to mitigate the risk of (time-)critical runway incursions:

Currently, the moment to give the instruction 'line-up and wait' is not defined. The aircraft receives the instruction to line-up on Runway 07R and the controller waits until the landing traffic has cleared the intersection with Runway 01 to give the clearance for take-off.

The instruction for line-up may be given when a landing aircraft has passed a defined distance from the RWY01 threshold so that the time required for the aircraft to enter Runway 07R, to start a non-authorized take-off and reach the intersection with Runway 01 will in any case be longer than the time for the closest landing aircraft to reach the intersection.

In the case of the rolling aircraft on RWY07 immediately starts its take-off, this procedure will provide additional time to assess that the next landing aircraft either still may continue its approach or has to make a go-around. Therefore and in analogy of the existing instructions in the Belgocontrol EBBR TWR Manual Chapter 3.3.2.4.:

Safety Recommendation BE-2016-0019:

It is recommended that Belgocontrol makes a substantiated study on a procedure which defines a time frame (in function of distance to the RWY01 threshold of the landing traffic) wherein the instruction to "line-up and wait" via C6 should be given to reduce the risk of collision between aircraft in the event of an aircraft taking off from C6 without having received the clearance.
This study should also take into account the possible replacement of taxiway C6 by a right angled entrance taxiway and the replacement of the current stop bar by a CAT I stop bar (90 m from runway centreline) as these both factors would definitely reduce the time needed to line-up on runway 07R.

Recommendation to increase the situational awareness of the flight crew

Although the situational awareness of the flight crew will already be improved by the auditory aid of providing traffic information (see safety action by Belgocontrol under 4.2.1), neither the intersection with Runway 01/19 nor the status of Runway 01/19 is visually indicated when standing on Runway 07R. ICAO foresees some means (as part of the SMGCS) that can be used to increase the situational awareness, next to the mandatory standards. Such means could be:

- Variable message signs on both sides of the runway.
- Runway guard lights
- Stop bar
- Autonomous runway incursion warning system (ARIWS)

Therefore:

Safety Recommendation BE-2016-0020:

It is recommended that Brussels Airport Company performs a study aimed to improve the indications on Runway 07R of both the presence and the status of Runway 01-19 in the vicinity of their intersection.

4.3.3 Safety Issue: The complex taxiway layout

From the declaration of the flight crew, it appeared that the rather complex taxi-layout (inner, outer, the junction connecting 6 taxiways right before C6, the oblique angled entry to RWY07R) played a contributing factor in the incident.
It increased the workload/stress causing a degradation in situational awareness and alertness to the given instructions of the TWR.

From the analysis, it appeared that improvements are possible, amongst others:

- Adding “No entry” markings and signs on C5 at the side of its intersection with ‘Outer’ and ‘Zulu’.
- Visibility of the taxiway centerline lights running from C6 to RWY 07R.
- The introduction of an entrance taxiway to Runway 07R, adjacent to the current taxiway ‘Inner’ and ending with a perpendicular portion immediately adjacent to the runway. This taxiway than can be used for lining up instead of the current C6. This also avoids the need to go via the (current) complex intersection.
- The reduction in number of direction/taxiway name changes when taxiing from the terminal to the runway-holding position(s) of Runway 07R.
- The renaming of the taxiways ‘Inner’ and ‘Outer by the use of single letters.

Therefore:

Safety Recommendation BE-2016-0022:

It is recommended that Brussels Airport Company makes a study aimed to reduce the complexity of the taxi route to the current line-up position 2.

5 Appendices

5.1 Belgocontrol – EBBR TWR Manual

1.3.2.2 Air controller

(24 JUL 2014)

Air controller tasks:

- Sign presence list
- Check new N2ATS, NOTAM, MEMO, WIGU, HR publications, AIP amendments, v-V-MATS amendments
- Handle all traffic within his/her area of responsibility.
- use standard phraseology in all Radio and Telephone communications
- instruct departing aircraft in sequence to line up RWY and wait in respect of landing aircraft.
- coordinate when necessary with approach or the GROUND control.
- ensure that the departing aircraft is lined up on the correct runway
- advise a lining-up aircraft of any essential traffic on the same runway.
- give take-off CLR to aircraft in respect of preceding departures and previous arrivals.
- advise ARO in case of diversion or when a VFR requests the opening or closure of his flight plan. Remark: during the night period (1900-0700 LT) ARO cannot always be reached via the VCS-b.

ARO can be reached via the regular telephone line 2540.

- instruct the departing aircraft to contact DEP frequency when clear of traffic and is observed to adhere to the departure instructions.
- give traffic info about traffic crossing the RWY taxiing or on tow to improve situational awareness
- give QNH's change on traffic in contact.
- give info on wind shear and other relevant meteo information to involved traffic
- ensure that the sensitive area is vacated before aircraft on final has passed 2 NM from touchdown (in LVPP)
- make the necessary coordination for traffic leaving the CTR
- give instructions to VFR requesting to cross the CTR (published VFR routes, CLR limit, RWYS in use, altitude, QNH, necessary coordination)
- issue info on essential local traffic
- advise APP or/and involved adjacent unit when uncontrolled flights (blips) are seen on the radar
- give information concerning aircraft that constitute essential local traffic to aircraft under the control of APP
- authorize RWY inspection and provide the results to the supervisor
- report to supervisor RWY Surface Friction Assessments results.
- give traffic information on preceding landing or departing traffic if necessary
- authorize crossing of the RWY by aircraft or vehicles
- issue the landing CLR when landing RWY is clear.
- give initial TWY instructions: "cross RWY…"to aircraft leaving the RWY after landing and transfer the aircraft on the correct frequency
- when appropriate issue a go-around instruction and update this information in the E-E by using the G/O function.
- provide the prescribed separation in the CTR
- advise APP in case of special VFR request
- keep the AMS and the E-E up- to -date

- manage the lighting panel
- take the appropriate actions in case of emergency
- report to the supervisor any incident or occurrence
- report to the supervisor any equipment failure
- report to the supervisor the missed approaches and any unusual occurrences
- additional tasks concerning E-E:
    - be responsible for the settings of the E-E CWP.
    - Manage his personal queue.
    - Instruct local flights to reset 7000 before they leave the frequency, if required.
    - Report all technical incidents to the Supervisor, even if at that moment considered as a detail ,in order to allow DGE to have as much as possible data available and ASAP switch to another CWP ,if necessary by re-sectoring the Eurocat system.
- make a correct and complete hand-over

3.3.2.4 Departure on 07R/07L

(13 DEC 2012)

For traffic departing from the N sector, GND N issues taxi clearance via INNER 8 (clearance limit + point of transfer); for any other routing coordination is required. GND S then guides the aircraft to C6 or to Z

Traffic departing from S sector is guided by GND S to C6 or toZ .

TWR 1 gives line-up on RWY 07R via C6.

GND S gives line-up on 07R via Z, for position 1 and for position H.

TWR 2 shall assist TWR 1 in coordinating the departure sequence to APP. (If not clearly indicated on the AMS.)

TWR 1 gives line-up on RWY 07L

In general: departing traffic will not be transferred before starting the turn when there is landing traffic on RWY 01 within 4 NM from touchdown.

No aircraft will be cleared for take-off from RWY 07R once an arrival is within 2NM of the RWY 01 threshold.
This will provide additional time to assess the departure roll (prior 2NM) and/or to issue a go-around instruction if required.
In addition to this:

- Be careful when using complex and confusing intersections (intersection TWY C6 is close to C5, E1 and RWY 01)
- Never use the phrase 'cleared for immediate takeoff' when the traffic is still on a TWY (C6 , TWY Z):
- When using the word 'immediately' include the reason for this action. Make sure you give the pilot(s) all the appropriate traffic information.
- Warn the crew of an arriving aircraft on (short) final RWY01 about jet blast, when a departing jet is still rolling on the crossing RWY 07R.

As a common rule it is NOT allowed to take off from RWY 07L if an approaching aircraft is within 4NM distance of the threshold of RWY 01 until it has completed its landing manoeuvre.

The purpose of this procedure is to prevent an aircraft that is abandoning an approach, from crossing the flight path of an aircraft taking off from the 'crossing' RWY (risk of wake turbulence)

5.2 Air Dolomiti SOPs

SOP STANDARD OPERATING PROCEDURES Flight Ops Dept.	NORMAL PROCEDURES	Chapter 3 Rev. 1	Section 9	Page 1

3.9 BEFORE TAKEOFF

Before a take off clearance is accepted, ensure that the minimum engine warm-up time (time from engine start to application of significant power/take off power) of 2 minutes is observed.

The Before Takeoff Procedures and checklist must be performed when cleared to line up on the runway. Use all available information such as heading and FMS course indication (PFD), lateral profile (MFD), departure runway (MCDU) and RAAS broadcast to ensure the airplane is on the assigned runway for takeoff. Check PFD's and MCDU's and verify that no advisory messages or scratchpad messages are displayed.

CM1 takes control of his own EFB. Cleared SID must be displayed on both EFBs.

CHALLENGE	ACTION	PERFORMED BY
"BEFORE TAKE OFF CHECKLIST"	CALL	CM1
Cabin Crew	ADVISE	CM2

Broadcast on PA "CABIN CREW PREPARE FOR TAKEOFF"

CM1 turns off taxi lights and turns on landing lights

CM2 turns on the strobe lights.

Fuel Quantity ..... **CHECK**..... **CM1 CM2**

Check fuel on board equal to or greater than Minimum for flight (PLNTOF on OFP + 200kg MAP fuel). Use of Contingency Fuel on the ground is not allowed.

Brake Temperature ..... **CHECK**..... **CM1 CM2**

Brake temperature indication must be in the green range for takeoff.

After checking brakes temperature the CM2 should select MAP on MFD.

EICAS ..... **CHECK**..... **CM1 CM2**

Check:

- No EICAS warning , caution or advisory messages displayed unless in accordance with MEL. Status messages related to a given airplane configuration resulted by crew action should be displayed.
- Thrust rate mode (TO-1, TO-2 or TO-3).
- ATTCS as applicable.
- FLEX TEMP (__°C) as applicable.

AirDolomiti

Transponder..... TA/RA..... CM2

BEFORE TAKE OFF		
CHALLENGE	ACTION	ANSWERED BY
BRAKES TEMPERATURE.....	CKD	1 - 2
EICAS.....	CKD	1 - 2
FUEL QUANTITY.....	CKD	1 - 2
TRANSPONDER.....	TA / RA	2

3.9.1 TAKEOFF TECHNIQUE

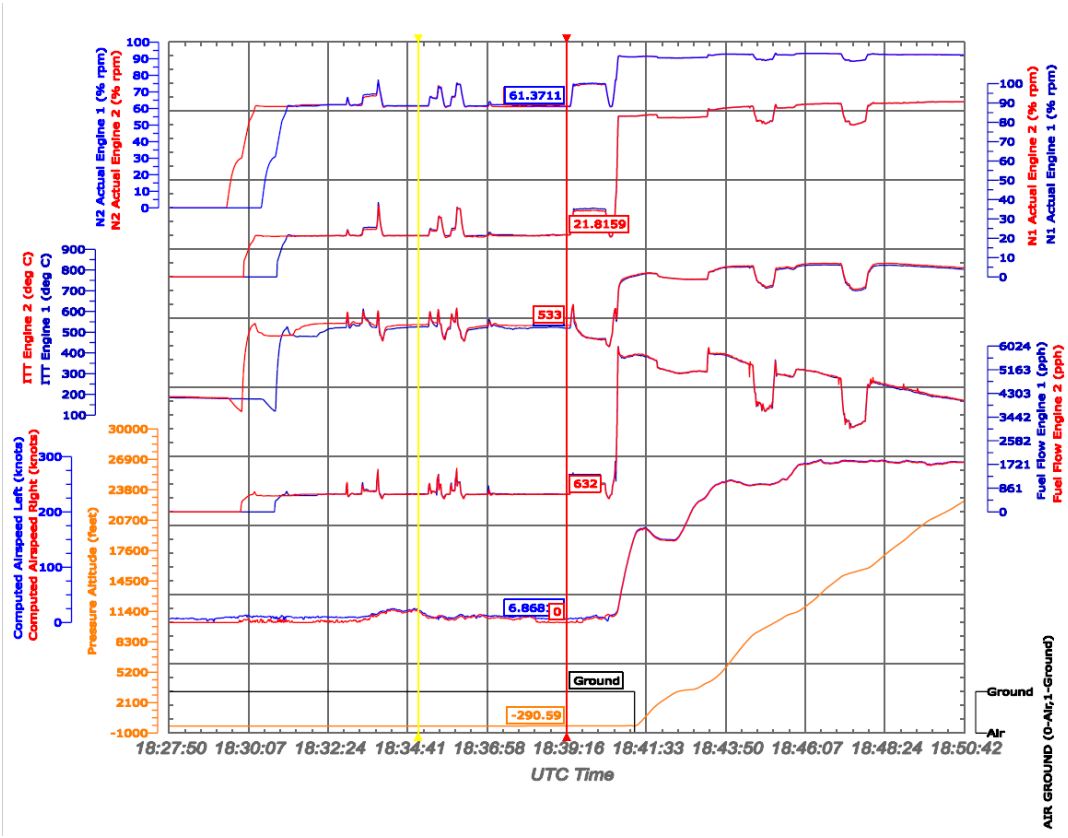
When the aircraft is lined up on the runway, checklist completed and clearance received, CM2 announces: "READY AND CLEARED FOR TAKEOFF"

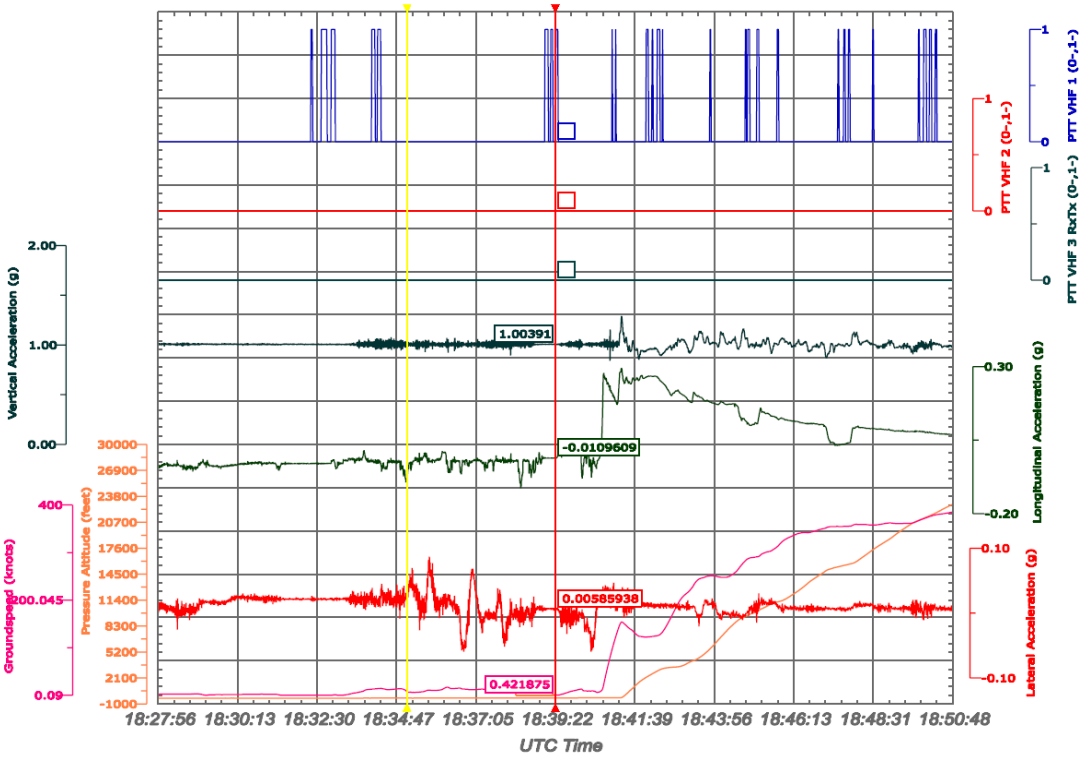
If CM2 is PF, the Captain will give him control, announcing : " YOU HAVE CONTROL".

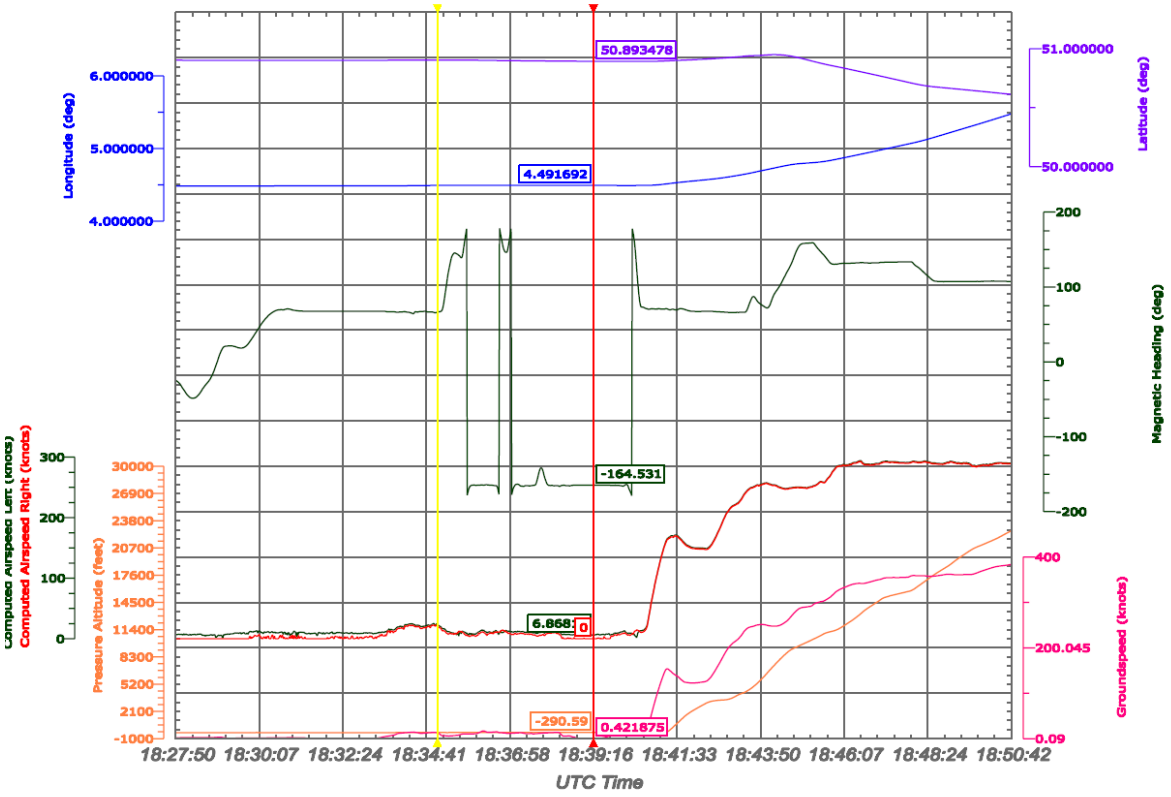
Equal power settings should be verified before releasing the brakes, especially on slippery runways. The AT system will engage automatically when both throttles have been advanced beyond 50° TLA.

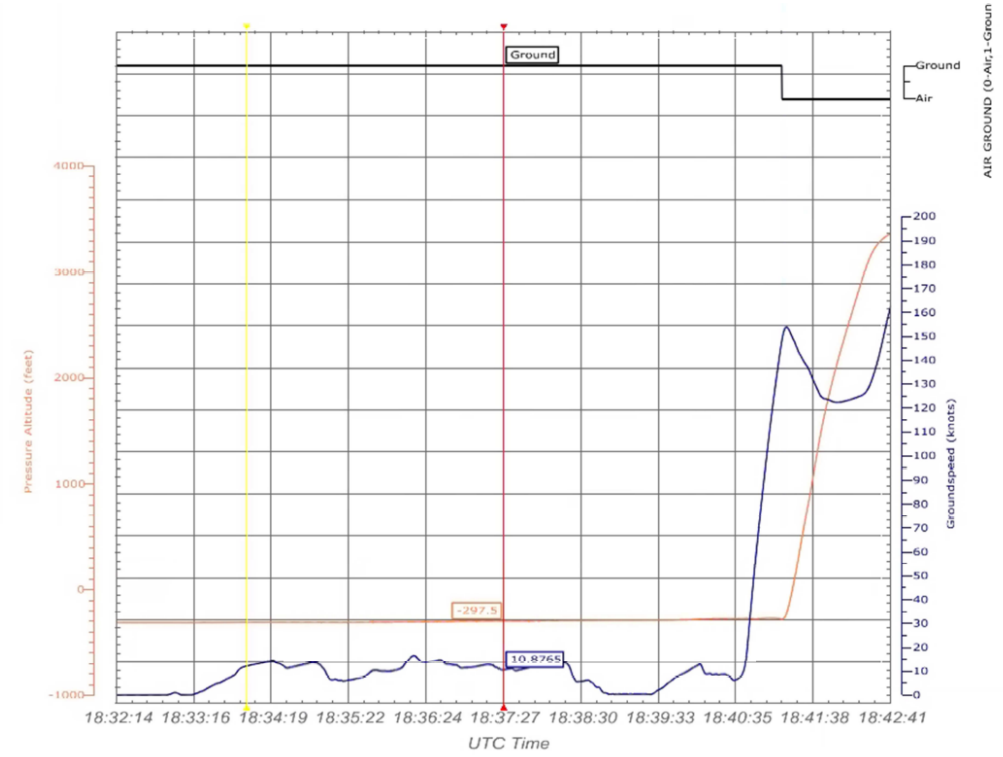
Thrust Levers shall be advanced initially to 40% N1, and, only after engines have stabilized on this datum, TLs can be advanced further, in accordance with the selected takeoff technique.

5.3 Air Dolomiti FDR data

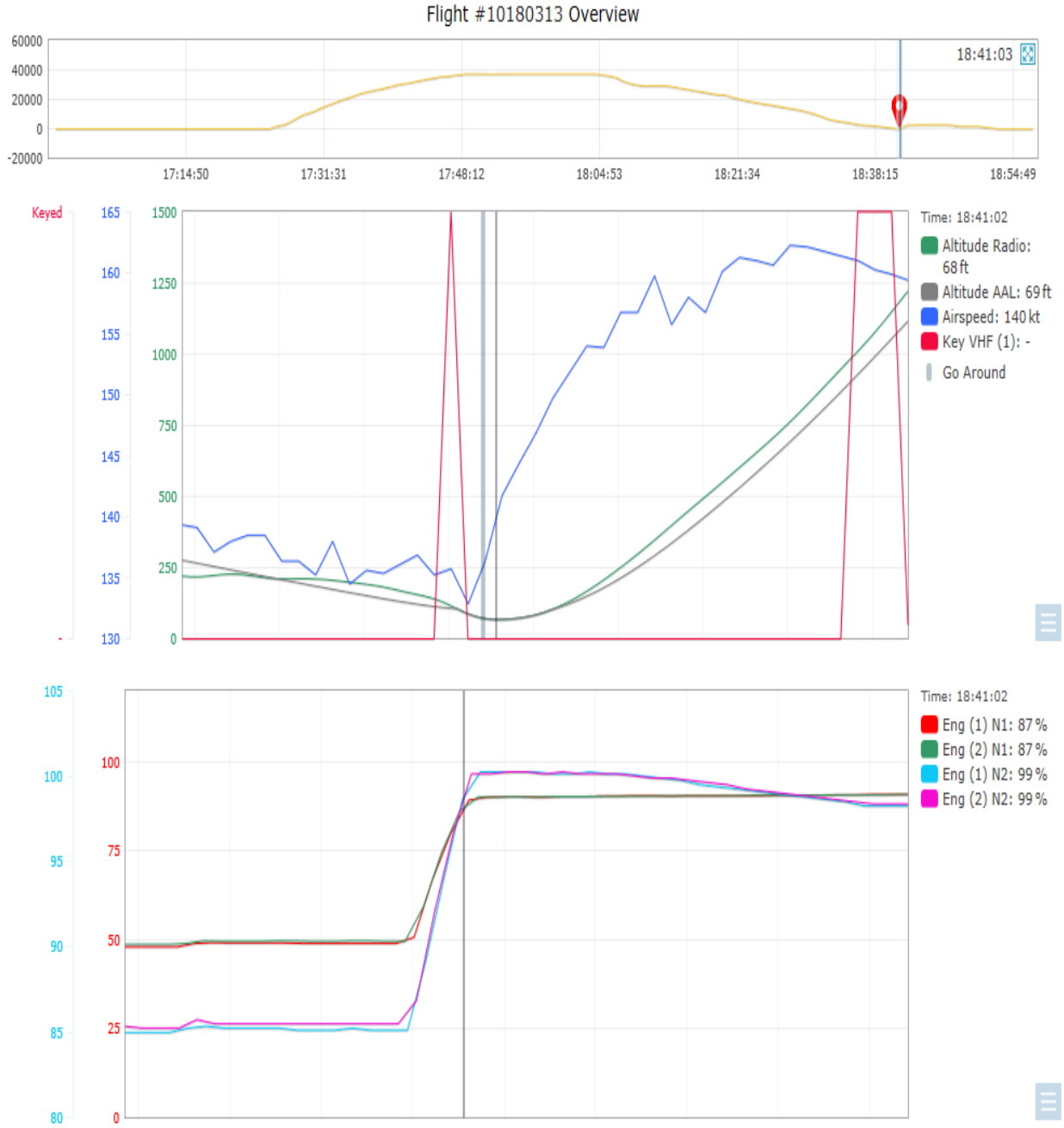


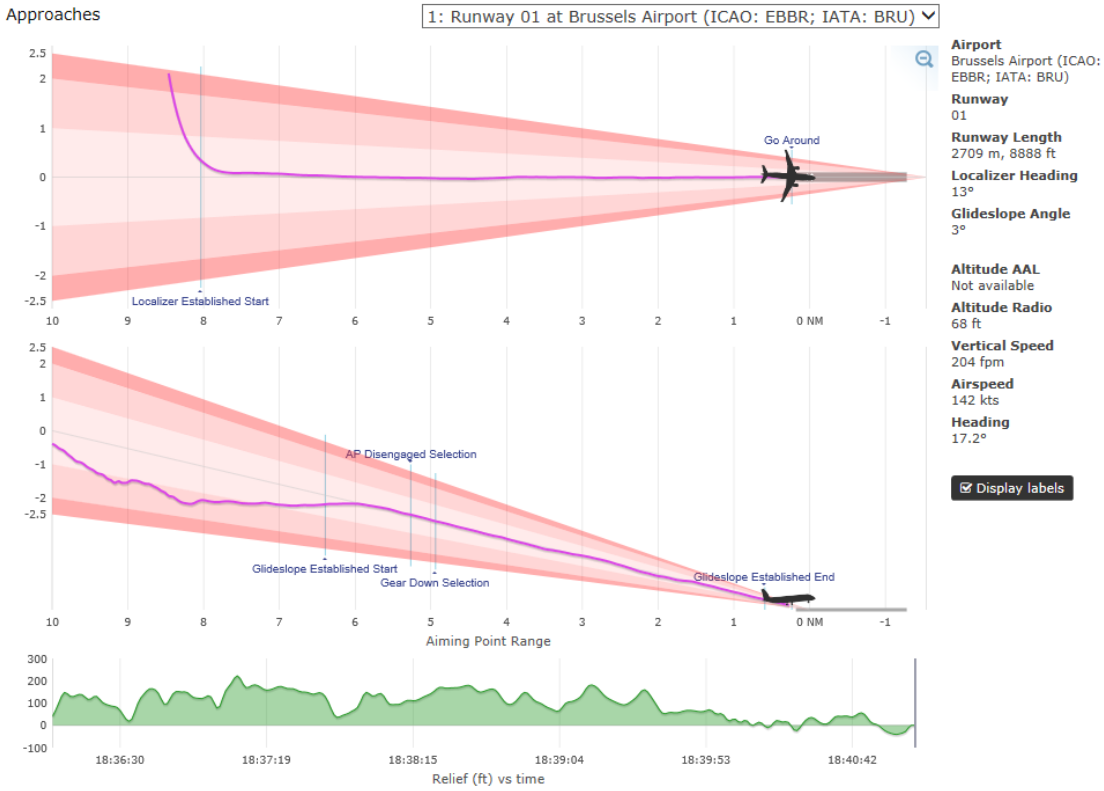

Vertical Acceleration (g)
2.00
1.00
0.00
1.00391
-0.0109609
0.00585938
0.421875
Groundspeed (knots)
400
200.045
0.09
Pressure Altitude (feet)
30000
26900
23800
20700
17600
14500
11400
8300
5200
2100
-1000
PTT VHF 2 (0-,1-)
PTT VHF 3 RxTx (0-,1-)
PTT VHF 1 (0-,1-)
Longitudinal Acceleration (g)
0.30
-0.20
Lateral Acceleration (g)
0.10
-0.10
18:27:56 18:30:13 18:32:30 18:34:47 18:37:05 18:39:22 18:41:39 18:43:56 18:46:13 18:48:31 18:50:48
UTC Time


Longitude (deg)
6.000000
5.000000
4.000000
50.893478
4.491692
51.000000
50.000000
Latitude (deg)
200
100
0
-100
-200
Magnetic Heading (deg)
Computed Airspeed Left (knots)
Computed Airspeed Right (knots)
300
200
100
0
Pressure Altitude (feet)
30000
26900
23800
20700
17600
14500
11400
8300
5200
2100
-1000
-164.531
6.868
0
-290.59
0.421875
400
200.045
0.09
Groundspeed (knots)
18:27:50 18:30:07 18:32:24 18:34:41 18:36:58 18:39:16 18:41:33 18:43:50 18:46:07 18:48:24 18:50:42
UTC Time


Ground
Ground
Air
AIR GROUND (0-Air,1-Groun
Pressure Altitude (feet)
4000
3000
2000
1000
0
-1000
-297.5
10.8765
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
Groundspeed (knots)
18:32:14 18:33:16 18:34:19 18:35:22 18:36:24 18:37:27 18:38:30 18:39:33 18:40:35 18:41:38 18:42:41
UTC Time

5.4 Aer Lingus FDR data




Approaches
1: Runway 01 at Brussels Airport (ICAO: EBBR; IATA: BRU)
Go Around
Localizer Established Start
AP Disengaged Selection
Glideslope Established Start
Gear Down Selection
Glideslope Established End
Aiming Point Range
Relief (ft) vs time
Airport
Brussels Airport (ICAO: EBBR; IATA: BRU)
Runway
01
Runway Length
2709 m, 8888 ft
Localizer Heading
13°
Glideslope Angle
3°
Altitude AAL
Not available
Altitude Radio
68 ft
Vertical Speed
204 fpm
Airspeed
142 kts
Heading
17.2°
Display labels

THIS PAGE IS INTENTIONALLY LEFT BLANK

Air Accident Investigation Unit - (Belgium)
City Atrium
Rue du Progrès 56
1210 Brussels

Phone: +32 2 277 44 33
Fax: +32 2 277 42 60

air-acc-investigation@mobilit.fgov.be
www.mobilit.belgium.be