CIAIAC

COMISIÓN DE
INVESTIGACIÓN
DE **A**CCIDENTES
E **I**NCIDENTES DE
AVIACIÓN **C**IVIL

Report IN-033/2016

Incident involving an Airbus A321-231, registration EC-MHS (operated by Vueling Airlines, S.A.) and an Airbus A320-214, registration G-EZTF (operated by Easyjet Airline Company LTD), in the vicinity of point ASTEK, intermediate approach fix for runway 07L at the Barcelona-El Prat Airport (Spain) on 7 August 2016

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COMISIÓN DE INVESTIGACIÓN DE ACCIDENTES E INCIDENTES DE AVIACIÓN CIVIL

NIPO Línea: 161-18- 097-1

NIPO Papel: 161-18- 094-5

Depósito legal: M-12266- 2018

Maquetación: David García Arcos

Impresión: Centro de Publicaciones

COMISIÓN DE INVESTIGACIÓN DE ACCIDENTES E INCIDENTES DE AVIACIÓN CIVIL

Tel.: +34 91 597 89 63
Fax: +34 91 463 55 35

E-mail: ciaiac@fomento.es
http://www.ciaiac.es

C/ Fruela, 6
28011 Madrid (España)

Notice

This report is a technical document that reflects the point of view of the Civil Aviation Accident and Incident Investigation Commission (CIAIAC) regarding the circumstances of the accident object of the investigation, and its probable causes and consequences.

In accordance with the provisions in Article 5.4.1 of Annex 13 of the International Civil Aviation Convention; and with articles 5.5 of Regulation (UE) n° 996/2010, of the European Parliament and the Council, of 20 October 2010; Article 15 of Law 21/2003 on Air Safety and articles 1, 4 and 21.2 of Regulation 389/1998, this investigation is exclusively of a technical nature, and its objective is the prevention of future civil aviation accidents and incidents by issuing, if necessary, safety recommendations to prevent from their reoccurrence. The investigation is not pointed to establish blame or liability whatsoever, and it's not prejudging the possible decision taken by the judicial authorities. Therefore, and according to above norms and regulations, the investigation was carried out using procedures not necessarily subject to the guarantees and rights usually used for the evidences in a judicial process.

Consequently, any use of this report for purposes other than that of preventing future accidents may lead to erroneous conclusions or interpretations.

This report was originally issued in Spanish. This English translation is provided for information purposes only.

Contents

ABBREVIATIONS vi

SYNOPSIS viii

1. FACTUAL INFORMATION 1

1.1. History of the flight 1
1.2. Injuries to persons 2
1.2.1. Aircraft EC-MHS, callsign VLG3001 2
1.2.2. Aircraft G-EZTF, callsign EZY18EP 3
1.3. Damage to aircraft 3
1.4. Other damage 3
1.5. Personnel information 3
1.5.1. Information on the crew of aircraft VLG3001 3
1.5.1.1. Captain 3
1.5.1.2. Copilot 4
1.5.2. Information on the crew of aircraft EZY18EP 4
1.5.2.1. Captain 4
1.5.2.2. Copilot 5
1.5.2.3. Training captain 6
1.5.3. Information on air traffic control personnel 6
1.5.3.1. Final approach executive controller 6
1.5.3.2. Final approach planning controller and QM 7
1.5.3.3. Executive controller in feeder Sector T3 7
1.5.3.4. Experience, aviation activity and training received 8
1.6. Aircraft information 8
1.6.1. General information on aircraft VLG3001 8
1.6.2. General information on aircraft EZY18EP 9
1.7. Meteorological information 9
1.8. Aids to navigation 10
1.8.1. General description 10
1.8.2. Description of traffic flow management 11
1.9. Communications 17
1.10. Aerodrome information 21
1.11. Flight recorders 22
1.11.1. Information from the quick access recorder (QAR) on VLG3001 22
1.11.2. Information from the quick access recorder on EZY18EP 23
1.12. Wreckage and impact information 24
1.13. Medical and pathological information 24
1.14. Fire 24
1.15. Survival aspects 24

1.16. Tests and research 24
1.16.1. Statement from the crew of VLG3001 24
1.16.2. Statement from the crew of EZY18EP 24
1.16.3. Statements from the air traffic controllers 25
1.16.3.1. Common points expressed by control personnel involving the incident 25
1.16.3.2. Statement from the executive controller on Final Approach 26
1.16.3.3. Statement from the planning controller and QM on Final Approach 27
1.16.3.4. Statement from executive controller in feeder Sector T3 28
1.16.3.5. Statement from executive controller in feeder Sector T4 28
1.16.3.6. Statement from planning controller in feeder Sector T4 28
1.16.3.7. Statement from the Duty Supervisor at the Barcelona ACC 28
1.16.4. Coordination of arrivals and departures between APP LECB and TWR LEBL 29
1.17. Organizational and management information 29
1.17.1. Barcelona ACC control room 29
1.17.2. Barcelona ACC airspace and Operations Manual 30
1.17.3. AMAN 32
1.17.4. Analysis conducted by the air traffic service provider (ENAIRE): 33
1.18. Additional information 34
1.18.1. Actions taken by ENAIRE and AESA 34
1.18.2. Initiatives carried out by the air navigation service provider 36
1.18.3. Language to be used in air-ground communication 36
1.19. Useful or effective investigation techniques 36

2. ANALYSIS 37

2.1. Description of scenario 37
2.2. Actions of air traffic control personnel during incident 37
2.2.1. Actions of Final Approach planning controller and QM 37
2.2.2. Actions of the executive controller in sector T3 38
2.2.3. Actions of the Final executive controller. 39
2.2.4. Evaluation of the coordination efforts 40
2.3. Considerations on the language used in land/air communications 41
2.4. Aspects involving airspace and procedures 42
2.5. Aspects involving training of air traffic control personnel 43
2.6. Operation with the AMAN tool 44
2.7. Actions taken by the air navigation service provider 45

3. CONCLUSIONS 46

3.1. Findings 46
3.2. Causes/Contributing factors 48

4. SAFETY RECOMMENDATIONS 49

5. APPENDICES 50

Abbreviations

°	Degrees
ACC	Area control center
ACSS	Aviation Communication & Surveillance Systems
AESA	National Aviation Safety Agency
AIP	Aeronautical Information Publication
AMAN	Tool for managing the approach sequence
AP1	Autopilot number 1
AP2	Autopilot number 2
APP	Approach control
APS/RAD-TCL	Approach control surveillance with radar and terminal control endorsements
ARR	Arrivals
ASTEK	Intermediate approach fix for runway 07L at the Barcelona Airport
ATC	Air traffic control
ATFCM	Air Traffic Flow and Capacity Management
ATM	Air Traffic Management
ATPL(A)	Airline transport pilot license (airplane)
ATS	Air Traffic Services
CAA	Civil Aviation Authority of the United Kingdom
CIAIAC	Civil Aviation Accident and Incident Investigation Commission
CRM	Crew resource management
DAF	Distance for delivery to Final
DEP	Departures
DFT	Final distance between aircraft
DME	Distance-measuring equipment
EAT	Expected approach time
EGKK	ICAO code for the London-Gatwick Airport
ELDT	Estimated landing time
ELR	East configuration at the Barcelona Airport
FD	Flight Director
FHA	Functional Hazard Assessment
FMP	Flow management position
ft	Feet
ft/min	Feet per minute
GCLP	ICAO code for the Gran Canaria Airport (Spain)
GNSS	Global navigation satellite system
GTA	Air Traffic Assessment
h	Hours
IAF RUBOT	RUBOT initial approach fix
IAF SLL	Sabadell initial approach fix
IAF VIBIM	VIBIM initial approach fix

IAF VLA	Villafranca initial approach fix
ICAO	International Civil Aviation Organization
IF	Intermediate Fix
IFR	Instrumental Flight Rules
ILS	Instrument landing system
IR(A)	Instrument rating (airplane)
km	Kilometer
kt	Knots
LEBL	ICAO code for the Barcelona Airport (Spain)
LECB	ICAO code for Barcelona FIC/ACC (Spain)
LoA	Letter of Agreement
LOC	Localizer
LPC	License proficiency check
LTD	Limited
m	Meter
METAR	Aviation routine weather report
N	North
NM	Nautical miles
OJTI	On-the-job Training Instructor
OPC	Operator proficiency check
P/N	Part Number
QAR	Quick access recorder
QM	Queue manager
RNAV	Area navigation
RWY	Runway
s	Seconds
S	South
SACTA	Automated air traffic control system
SCU	Sector Control Units
SERA	Standardised European Rules of the Air
S/N	Serial number
STAM	Short-Term ATFCM Measures
TAF	Terminal aerodrome forecast
TCA	Technical Flow Control
TCAS	Traffic collision avoidance system
TCAS RA	TCAS resolution advisory
TCAS TA	TCAS traffic advisory
TMA	Terminal control area
TONB	Takeoff Not Before
TRI	Type Rating Instructor
TRM	Team resource management
TWR	Aerodrome control tower
UTC	Universal Time Coordinated

Synopsis

Owner and Operator:	Vueling Airlines S.A	Easyjet Airline Company LTD
Aircraft:	Airbus A-321-231	Airbus A-320-214
Date and time of incident:	7 August 2016 at 9:17 UTC	
Site of incident:	Vicinity of point ASTEK, intermediate approach fix for runway 07L at the Barcelona-El Prat airport (Spain)	
Persons onboard:	7 crew + 197 passengers No injuries	7 crew + 168 passengers No injuries
Type of flight:	Commercial air transport – Scheduled – Domestic - Passenger	Commercial air transport – Scheduled – International - Passenger
Phase of flight:	Approach – Initial approach	Approach – Initial approach
Date of approval:	27 October 2017	

Summary of the event:

At around 09:17[1] on 7 August 2016, there was a loss of separation between an Airbus A-321-231, registration EC-MHS, and an A-320-214, registration G-EZTF, as they were at 5000 ft maneuvering toward the Localizer (LOC) course for RWY 07L at the Barcelona-El Prat Airport (LEBL). The first aircraft was inbound from the Gran Canaria Airport (GCLP) and maneuvering from the right of the LOC RWY 07L, which was in use at the time. The second aircraft had taken off from the London-Gatwick Airport (EGKK) and was maneuvering from the left of the Localizer. Both crews reacted to the instructions from the traffic collision avoidance system (TCAS) to resolve the conflict without further consequences to the aircraft or to the persons onboard.

The investigation has identified the following circumstances in the incident: long duty period with heavy air traffic volume, no evaluation of traffic flow, unclear coordination criteria among air traffic controllers, deviations from the unit's operating procedures, and the use of imprecise instructions by the approach controller to resolve the lack of separation.

1 All times in this report are in coordinated universal time (UTC). To obtain local time, add two hours to UTC.

The cause of the incident is deemed to have been the incorrect coordination between the Queue Manager (QM) and the Sector T3 executive controller. The following factors have also been identified as contributing to the loss of separation between the aircraft:

- Prior to the event, no consideration was given to limiting arriving traffic.
- The Sector T3 executive controller did not follow AMAN[2] procedures.
- The Sector T3 executive controller did not follow the unit's operating procedures when he transferred the aircraft to the Final Sector.
- The Final executive controller provided insufficient information to the aircraft.
- Use of incomplete phraseology by Final executive controller with aircraft EZY18EP.
- Approach control personnel were subjected to a high workload for an extended period of time.
- The complexity of the airspace's structure.

Consequently, as concerns this report, this Commission deems it necessary to issue the following safety recommendation to the air navigation service provider:

REC 76/17. It is recommended that ENAIRE, as the air navigation service provider at both the approach unit and at the Barcelona Airport control tower, evaluate the need to provide targeted TRM training sessions, with a specific scope, in addition to those specified in the unit's Training Plan.

The scope of this recommendation shall consider those situations that require coordination between the APP LECB and TWR LEBL controllers.

REC 77/17. It is recommended that ENAIRE, as the air navigation service provider at both the approach unit and at the Barcelona Airport control tower, and as a result of the above recommendation, provide targeted TRM training sessions, with a specific scope, in addition to those specified in the unit's Training Plan.

The scope of this recommendation shall consider those situations that require coordination between the APP LECB and TWR LEBL controllers.

2 AMAN (Arrivals Manager) is a tool implemented in the SACTA system that generates a unique arrivals sequence at the airport and displays it to the controllers involved, primarily to those in the feeder sectors and the Final approach Sector.

1. FACTUAL INFORMATION

1.1. History of the flight

At around 09:17 on 7 August 2016, there was a loss of separation between an Airbus A-321-231, registration EC-MHS, and an A-320-214, registration G-EZTF, as they were at 5000 ft maneuvering toward the Localizer (LOC) course for RWY 07L at the Barcelona-El Prat Airport (LEBL). The first aircraft, with callsign VLG3001, was inbound from the Gran Canaria Airport (GCLP) and maneuvering from the right of the LOC RWY 07L, which was in use at the time. The second aircraft, with callsign EZY18EP, had taken off from the London-Gatwick Airport (EGKK) and was maneuvering from the left of the Localizer. Both crews reacted to the instructions from the Traffic Collision Avoidance System (TCAS) to resolve the conflict without further consequences to the aircraft or to the persons onboard.

Prior to the event, at 08:14, the airport's configuration had been changed from West (25R/25L), the preferred daytime configuration, to East (07L/07R) due the prevailing wind. At the time of the event, therefore, runway 07L was in use for landings and 07R for takeoffs.

In this configuration, the initial approach sectors that feed the Final approach are Sector T3, which includes Initial Approach Fixes (IAF) RUBOT and VIBIM, and Sector T4, with the SLL and VLA IAFs. Sector T3 handles traffic inbound from the South (S) of the airfield, and Sector T4 handles traffic approaching from the North (N).

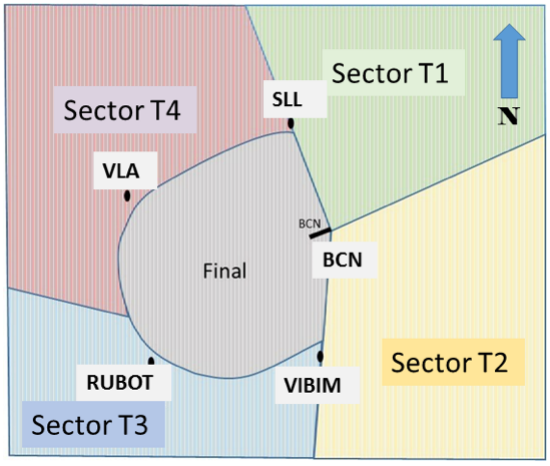


Figure 1. Locations of the sectors

Traffic flow in the two sectors, T3 and T4, is arranged by the Queue Manager (QM), a duty that is assigned to the Final approach planning controller. The QM has a tool called AMAN that specifies an arrival order for aircraft based on data collected from the aircraft's flight plans. The order established by the system can be modified by the QM in an effort to achieve a better traffic flow.

VLG3001 was inbound from the south of the airport, and thus contacted Sector T3, where the executive controller cleared it to wait over the RUBOT IAF at 09:00:58, since there were eight aircraft ahead of it in the approach sequence, including two with heavy wake turbulence. The controllers stated that the workload was high at that time.

EZY18EP was inbound from the north of the airport and contacted feeder Sector T4. Once at the SLL IAF, at 09:08:29, it was cleared to continue flying on heading 230° to start the approach. This clearance had been coordinated with the QM, meaning that despite having a sequence number higher than VLG3001, the aircraft began its approach.

The QM controller delayed altering its sequence number until 09:11:19, at which time the T3 controller instructed VLG3001, which was established at 5000 ft, to leave the RUBOT IAF to start its approach. Upon noticing the change in the radar label number, he asked if someone had changed the sequence. The controller reported hearing "no", so he once again instructed the aircraft to leave the RUBOT IAF heading north.

EZY18EP was transferred to the Final approach Sector, established at 5000 ft, and received vectors to intercept the Localizer. Then, at 09:14:59, the T3 executive controller transferred VLG3001 to the Final approach frequency.

The Final approach executive controller realized both EZY18EP and VLG3001 were flying on convergent headings at the same altitude of 5000 ft. After identifying the conflict, he instructed VLG3001 to turn to heading 330° and EZY18EP to descend to 3000 ft. He later instructed VLG3001 to turn to heading 260°. These actions were insufficient to provide the required separation and TCAS RA were triggered on both aircraft, which ended up closing to within 1.4 NM horizontally and 200 ft vertically.

Both aircraft continued flying and landed a few minutes later at the Barcelona-El Prat Airport.

1.2. Injuries to persons

1.2.1. Aircraft EC-MHS, callsign VLG3001

Injuries	Crew	Passengers	Total in aircraft	Other
Fatal				
Serious				
Minor				

Injuries	Crew	Passengers	Total in aircraft	Other
None	2 + 5	197	204	
TOTAL	**7**	**197**	**204**	

1.2.2. Aircraft G-EZTF, callsign EZY18EP

Injuries	Crew	Passengers	Total in aircraft	Other
Fatal				
Serious				
Minor				
None	3 + 4	168	175	
TOTAL	**7**	**168**	**175**	

1.3. Damage to aircraft

Neither aircraft was damaged.

1.4. Other damage

Not applicable.

1.5. Personnel information

1.5.1. Information on the crew of aircraft VLG3001

1.5.1.1. Captain

- Age: 46
- Nationality: Spanish
- License: Airline transport pilot license (ATPL (A))
- Licensing authority: Spain's National Aviation Safety Agency (AESA)
- Ratings:
  - » A320, valid until 30/04/2017
  - » IR (A) valid until 30/04/2017
- Medical certificate: class 1, valid until 21/10/2016

- Language Proficiency: level 5, valid until 11/01/2023
- Total flight hours: 9500 Flight hours on the type: 4200
- Duty hours:
  - » Last 30 days: 89:42
  - » Last 24 h: 7:03
  - » Rest time prior to flight: 15:08 h

1.5.1.2. Copilot

- Age: 49
- Nationality: Spanish
- License: Airline transport pilot license (ATPL(A))
- Licensing authority: Spain's National Aviation Safety Agency (AESA)
- Ratings:
  - » A320, valid until 30/06/2017
  - » IR (A) valid until 30/06/2017
- Medical certificate: class 1, valid until 27/10/2016
- Language Proficiency: level 5, valid until 10/11/2022
- Total flight hours: 14220
- Flight hours on the type: 7380
- Duty hours:
  - » Last 30 days: 51:43
  - » Last 24 h: 7:03
  - » Rest time prior to flight: 15:08 h

1.5.2. Information on the crew of aircraft EZY18EP

1.5.2.1. Captain

- Age: 44
- Nationality: British
- License: Airline transport pilot license (ATPL(A))

- Licensing authority: Civil Aviation Authority of the United Kingdom (CAA)
- Ratings:
  - » A320/IR, valid until 30/06/2017
  - » B737 300-900/IR valid until 31/12/2016
- Last CRM conducted on 24/06/2016
- Medical certificate: class 1, valid until 12/01/2017
- License proficiency check (LPC) valid until 31/12/2016
- Operator's proficiency check (OPC) valid until 31/12/2016
- Total flight hours: 13 400
- Flight hours on the type: 62
- Duty hours:
  - » Last 24 h: 05:25
  - » Rest time prior to flight: 7 days

1.5.2.2. Copilot

- Age: 26
- Nationality: British
- License: Airline transport pilot license (ATPL(A))
- Licensing authority: Civil Aviation Authority of the United Kingdom (CAA)
- Ratings:
  - » A320/IR, valid until 30/11/2016
- Last CRM conducted on 03/02/2015
- Medical certificate: class 1, valid until 05/12/2014
- License proficiency check (LPC) valid until 30/11/2016
- Operator's proficiency check (OPC) valid until 30/11/2016
- Total flight hours: 1540
- Flight hours on the type: 1380
- Duty hours:
  - » Last 24 h: 05:25
  - » Rest time prior to flight: 4 days

1.5.2.3. Training captain

- Age: 34
- Nationality: British
- License: Airline transport pilot license (ATPL(A))
- Licensing authority: Civil Aviation Authority of the United Kingdom (CAA)
- Ratings:
  - » A320/IR, valid until 31/03/2017
  - » Type rating instructor (TRI), valid until 28/02/2019
- Last CRM conducted on 03/02/2015
- Medical certificate: class 1, valid until 05/10/2016
- License proficiency check (LPC) valid until 31/032016
- Operator's proficiency check (OPC) valid until 31/03/2016
- Total flight hours: 7700
- Flight hours on the type: 7500
- Duty hours:
  - » Last 24 h: 05:25
  - » Rest time prior to flight: 12:55 hours

1.5.3. Information on air traffic control personnel

The operating sectors involved with aircraft approaching the Barcelona Airport in the East (ELR) configuration are the two feeder sectors (T3 and T4), two takeoff sectors (T1 and T2) and one Final approach Sector.

Sector T3 handles aircraft inbound from the south, Sector T4 handles aircraft from the north, and sectors T1 and T2 handle aircraft transferred by LEBL TWR whose standard departures pass through them, as well as any aircraft executing a go around or missed approach.

Each sector has two controllers, an executive and a planning controller.

1.5.3.1. Final approach executive controller

- Age: 56

- Nationality: Spanish
- Licensing authority: Spain's National Aviation Safety Agency (AESA)
- Ratings:
  - » APS/RAD-TCL since 1988
  - » OJTI , until 13 November 2017
- Unit endorsement: APS/RAD-TCL LECB, valid until 6 October 2016
- Language proficiency:
  - » English level 4, valid until 22 November 2017
- Medical certificate: Class 3, valid until 28 September 2016

1.5.3.2. Final approach planning controller and QM

- Age: 50
- Nationality: Spanish
- Licensing authority: Spain's National Aviation Safety Agency (AESA)
- Ratings:
  - » APS/RAD-TCL since 1999
  - » Unit endorsement: APS/RAD-TCL LECB, valid until 4 December 2016
- Language proficiency:
  - » English level 5, valid until 13 February 2019
- Medical certificate: Class 3, valid until 5 May 2017

1.5.3.3. Executive controller in feeder Sector T3

- Age: 57
- Nationality: German
- Licensing authority: Spain's National Aviation Safety Agency (AESA)
- Ratings:
  - » APS/RAD-TCL since 1995
  - » OJTI, until 26 January 2018
  - » Evaluator until 30 July 2019

- Unit endorsement: APS/TCL LECB, valid until 26 January 2017
- Language proficiency:
  - » English level 5, valid until 23 January 2018
  - » Spanish level 4, valid until 26 January 2018
- Medical certificate: Class 3, valid until 9 May 2017

1.5.3.4. Experience, aviation activity and training received.

- The Final approach executive controller had been working as a controller at the unit since 1988. The day of the incident, 7 August, was his first day of work after two days off. He went on duty at 06:18, working as the executive and planning controller in the Final approach Sector for runway 25R. After a break, at 08:47 he went on duty as the Final approach executive controller for runway 07L. That same day he had a meeting scheduled with the Operational Safety Manager to evaluate another incident he had been involved in a few days earlier.
- The Final approach planning controller and QM started working at the unit in 1998 as a controller under instruction, and had been working as a controller at the unit ever since. He returned to work on 7 August after three days off. He went on duty at 04:47. Before going on duty as the Final approach controller, he had been the executive controller for this same sector when the airport's configuration was changed.
- The executive controller in Sector T3 started as a controller at the TWR LEBL in 1995, moving to Sector T3 three years later. On 7 August, he returned to work after having two days off. He went on duty at 05:26, standing watch as both the planning and executive controller for Sector T3, first in the West configuration and, following the change, in the East configuration.

In the months before the incident, the controllers took a refresher training course on TMA (Terminal Control Area) and another on non-preferred configurations, both in the simulator, lasting six hours. They also had training on TRM (Team Resource Management).

1.6. Aircraft information

1.6.1. General information on aircraft VLG3001

The Airbus A321-231 aircraft, registration EC-MHS and serial number 6740, is equipped with two IAE V2533-A5 engines (S/N V17864 and V17847). It had valid registration and airworthiness certificates.

The aircraft had 2663:53 flight hours. On the day of the incident, it underwent an A04 (daily) maintenance check, with 2660:52 flight hours on the aircraft.

The TCAS installed on the aircraft was an ACSS (Thales) T3CAS model, P/N 9005000-11203, with software 7.1.

1.6.2. General information on aircraft EZY18EP

The Airbus A320-214 aircraft, registration G-EZTF and serial number 3922, is equipped with two CFM56-5B4-3 engines (S/N 699394 and S/N 699395). It had valid registration and airworthiness certificates.

The aircraft had 25 060 flight hours and 12 259 cycles.

The last check of the aircraft prior to the incident had been on 21 July 2016, with 24861 flight hours and 12 171 cycles on the aircraft.

The TCAS installed on the aircraft was a Honeywell TPA-100B model, P/N 940-0351-001, with software version 7.1.

1.7. Meteorological information

METAR LEBL 070730Z 35003KT 280V060 9999 FEW015 24/17 Q1024 NOSIG=

METAR LEBL 070800Z 01004KT 290V080 9999 FEW020 26/18 Q1024 NOSIG=

METAR LEBL 070830Z 09009KT 9999 FEW020 26/19 Q1024 NOSIG=

METAR LEBL 070900Z 09009KT 060V120 9999 FEW020 26/19 Q1024 NOSIG=

METAR LEBL 070930Z 11009KT 080V140 9999 FEW020 26/19 Q1024 NOSIG=

The 05:00 TAF called for winds of 10 kt, predominantly from 100°, between 08:00 and 10:00.

LEBL 070500Z 0706/0806 30005KT 9999 FEW025 TX29/0712Z TN22/0806Z BECMG 0708/0710 10010KT TEMPO 0712/0716 1601QKT BECMG 0718/0721 VRBQ3KT BECMG 0800/0802 33007KT=

1.8. Aids to navigation

1.8.1. General description

At the time of the incident, the aids to navigation were working properly.

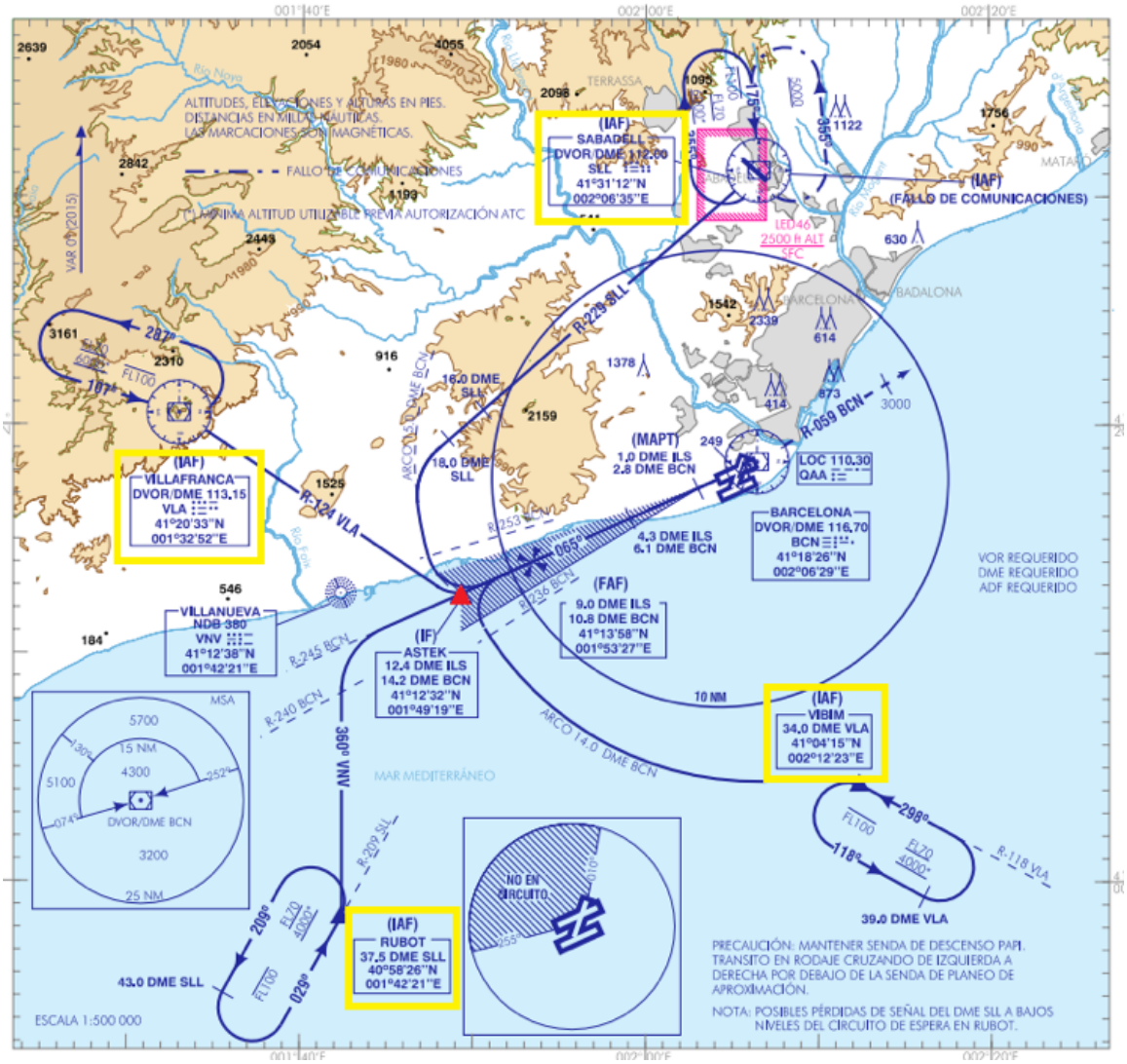


Figure 2. Approach chart for the LOC RWY 07L at LEBL

The approach control unit at the Barcelona-El Prat Airport has a flight data processing system called SACTA[3], and the sectors in which the aircraft were flying are under radar coverage.

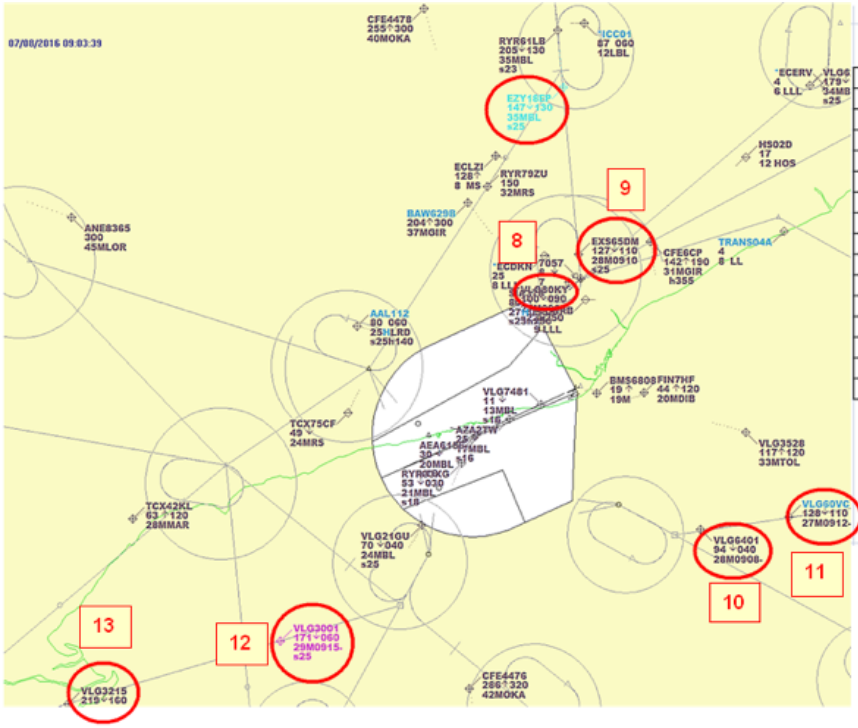
3 The Automated Air Traffic Control System (SACTA) is used to manage air traffic. It does so by integrating the systems and sub-systems of every en-route and approach control center in Spain, which allows it to process and coordinate the data they generate.

Figure 2 shows the approach chart for the LOC RWY 07L at LEBL, and the locations of the initial approach fixed (boxed in yellow), as described in point 1.1 and Figure 1.

Inbound traffic on the intermediate fix (IF) ASTEK is sequenced with aid from a tool that handles sequencing for arriving traffic called AMAN, which is part of the SACTA system.

1.8.2. Description of traffic flow management

The data from the air traffic control system were used to compile the sequence shown below. Initially, the controller who was handling the arrivals queue (QM) had set up a sequence in which VLG6401 was ahead of EXS65DM. At 09:03:39, the sequence was modified, leaving it as shown below in Figure 3:



	HORA		
	9:00:46	9:02:01	9:03:39
1	AFL2638	VLG7481	VLG7481
2	VLG7481	AZA2TW	AZA2TW
3	AZA2TW	AEA6156	AEA6156
4	AEA6156	RYR33XG	RYR33XG
5	RYR33XG	VLG21GU	VLG21GU
6	VLG21GU	AAL112	AAL112
7	AAL112	SIA378	SIA378
8	SIA378	VLG80KY	VLG80KY
9	VLG80KY	VLG6401	EXS65DM
10	VLG6401	EXS65DM	VLG6401
11	EXS65DM	VLG60VC	VLG60VC
12	VLG60VC	VLG3001	VLG3001
13	VLG3001	VLG3215	VLG3215
14	VLG3215		
15			
16			
	SECUENCIA INICIAL	ATERRIZAJE Nº1	REORDENACIÓN SECUENCIA

Figure 3. Sequence at 09:03:39

Before that time, the AMAN tool had not assigned a sequence number to EZY18EP, RYR61LB or VLG6247, all of them inbound from the north.

It should also be noted that the two aircraft preceding VLG80KY had a heavy wake turbulence, meaning the executive controller on Final had to establish a greater distance between them (4 NM) and with respect to VLG80KY (5 NM). Moreover, the separation between SIA378, VLG80KY and EXS65DM when they reached the SLL IAF was below 5 NM. VLG80KY was initially cleared to proceed on heading 250°

to separate from the preceding aircraft in the sequence (SIA378, a heavy wake turbulence aircraft). As for EXS65DM, it initially entered a holding pattern at the SLL IAF, but was quickly instructed to exit the pattern on heading 250°.

At 09:07:28, an arrival order was assigned to VLG6247, which was sequenced in with two aircraft from the north (numbers 5 and 6), four aircraft from the south (7, 8, 9 and 10) and three more from the north (11, 12 and 13). These last three reached the SLL IAF separated by under 5 NM. Figure 4 shows the position of the aircraft when the sequence was established.

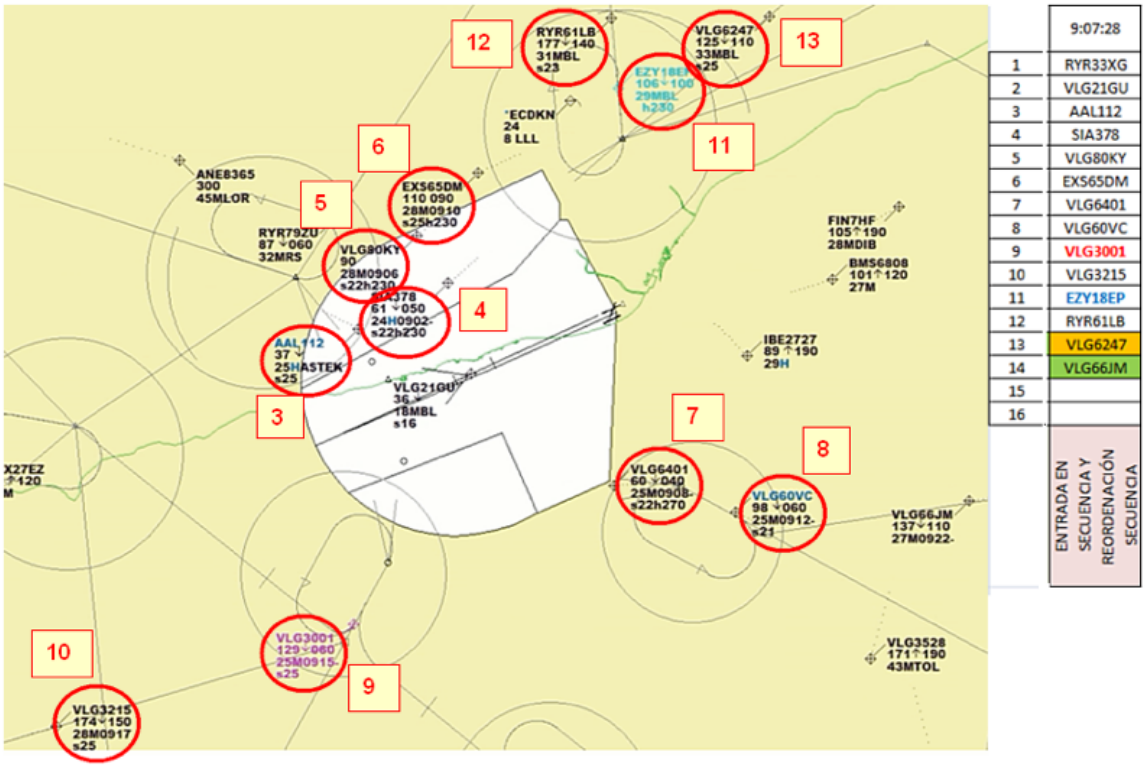


Figure 4. Sequences at 09:07:28

VLG6401, inbound from the south (in radio contact with T3) and number 7 in the sequence, had left IAF VIBIM. On the other hand VLG80KY and EXS65DM were inbound from the north (in radio contact with T4) and numbers 5 and 6 in the sequence, respectively. EZY18EP was reaching the SLL IAF and VLG3001 was reaching the RUBOT IAF.

At 09:08:36, VLG3001 was holding at the RUBOT IAF, while EZY18EP was leaving the SLL IAF. The sequence from the AMAN tool was still in effect.

At 09:11:19 (Figure 5), the QM approved a change to the established sequence, moving EZY18EP ahead of VLG3001 and VLG3215.

VLG3001 was still holding at the RUBOT IAF. EZY18EP, RYR61LB and VLG6247, inbound from the north, had left the SLL IAF on headings 230°, 240° and 250°, respectively.

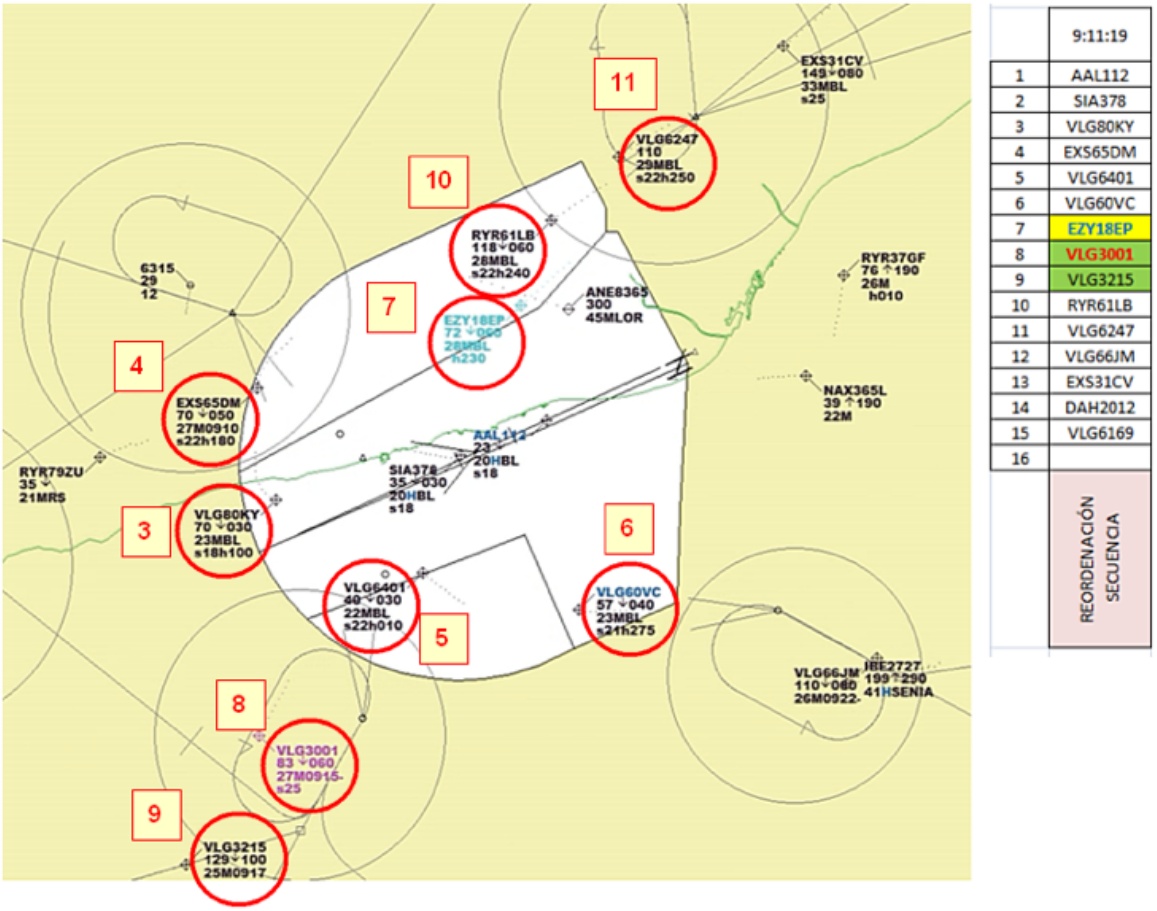


Figure 5. Sequence at 09:11:19

Figure 6, below, shows the traffic situation at 09:11:59, when Sector T3 instructed VLG3001 to proceed to the RUBOT IAF and leave it heading north. It also shows that VLG6401 was being vectored to intercept the Localizer ahead of VLG80KY and EXS65DM, despite being behind them in the established sequence.

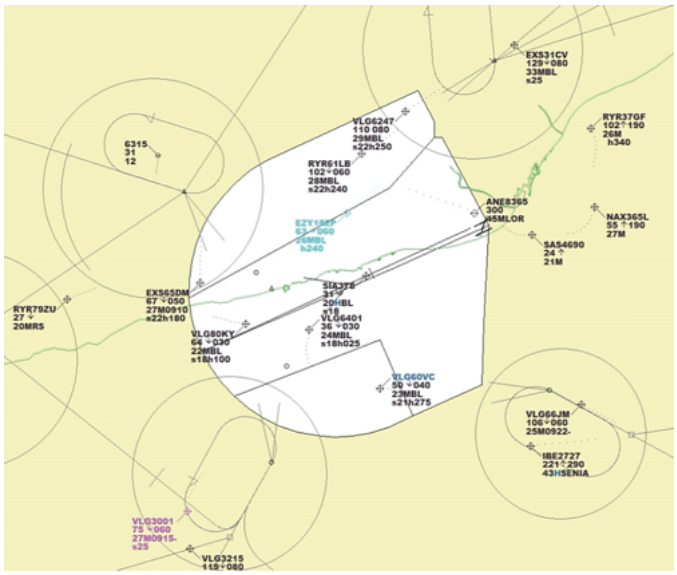


Figure 6. Sequence at 09:11:59

At 09:13:12, Figure 7, the QM made another sequence change, putting RYR61LB and VLG6247, which were inbound from the north, ahead of VLG3001. As a result, the sequence in place meant that after the three aircraft that were at the Localizer (marked with positions 2, 3 and 4 in Figure 7), there was one aircraft (VLG60VC, position 5) inbound from the south, three more (EZY18EP, RYR61LB and VLG6247, in positions 6, 7 and 8, respectively) from the north, followed by VLG3001 (in position 9) from the south.

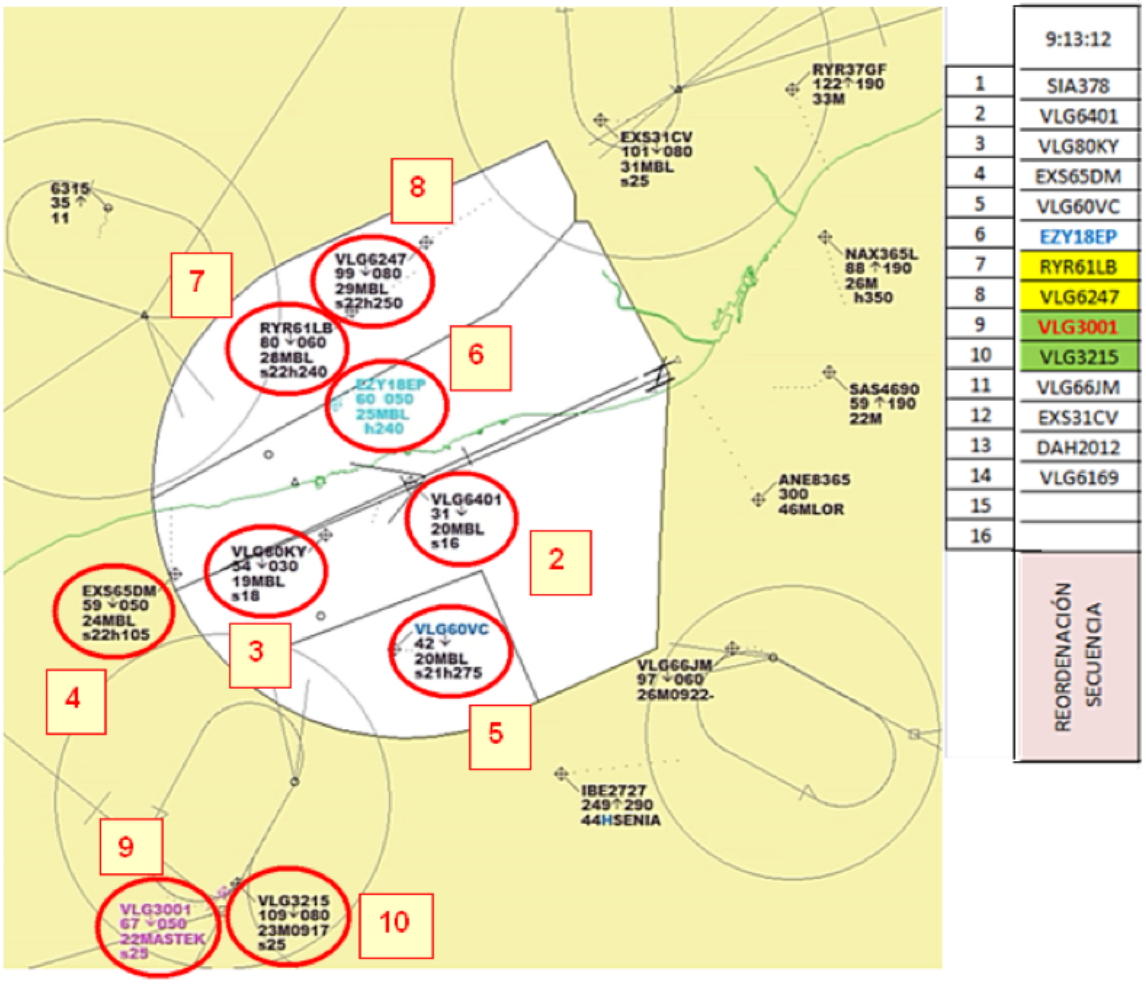


Figure 7. Sequence at 09:13:12

At 09:14:59, Figure 8, when the T3 controller transferred VLG3001 to the Final approach frequency, the aircraft was in the vicinity of IAF RUBOT holding at 5000 ft. There were three aircraft at the Localizer and another four ahead in the sequence that had not intercepted the Localizer yet.

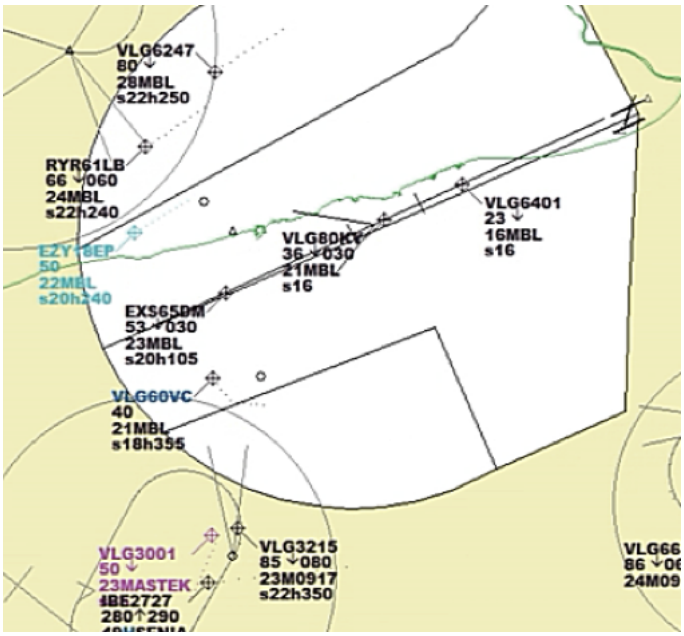


Figure 8. Sequence at 09:14:59

By 09:17:09, EZY18EP had started its descent from 5000 ft and was at 4900 ft. VLG3001 was still at 5000 ft and separated horizontally from it by 1.5 NM, Figure 9.

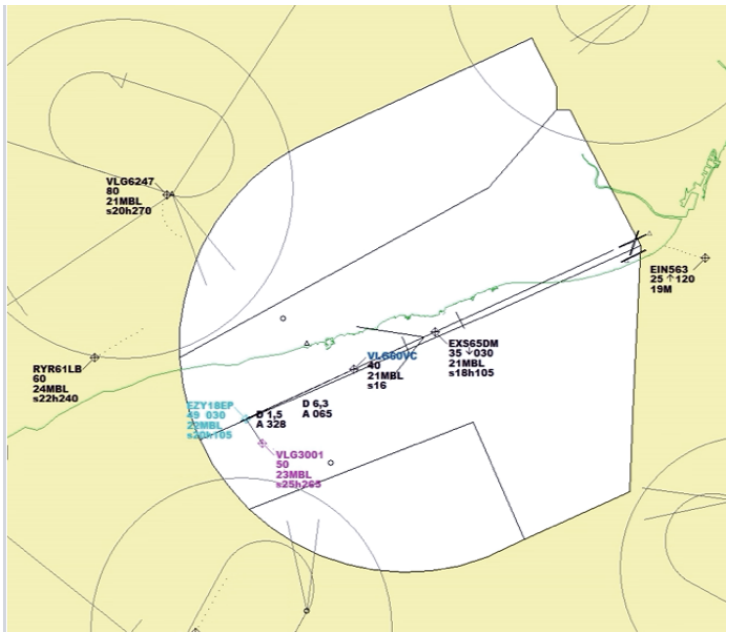


Figure 9. Closest point of approach

Figure 10 shows that the shortest horizontal distance between the aircraft was 1.4 NM. The radar data show that VLG3001 was turning left. The vertical distance between the aircraft at that point was 200 ft, since VLG3001 had climbed to 5100 ft.

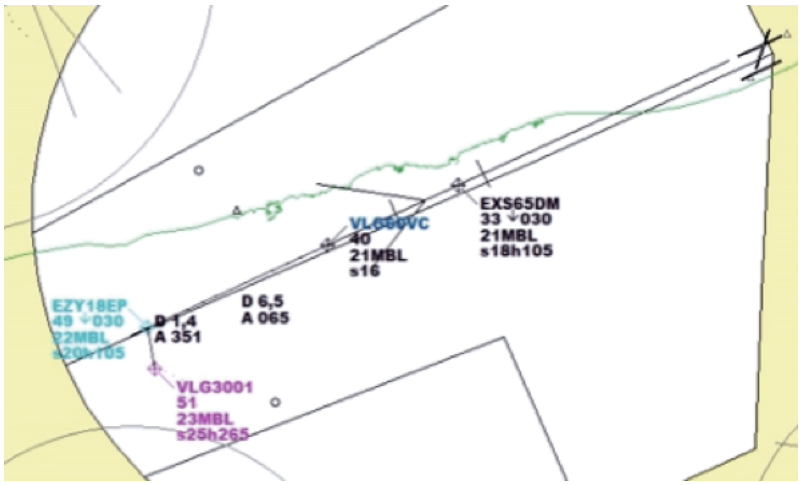


Figure 10. Closest point of approach

1.9. Communications

Investigators had access to the communications between the air navigation services and the aircraft during the event on the final approach and control sector frequencies, but not to the communications between the controllers in the Sector Control Units (SCU), since even though the physical communication lines were available and allow recording, these lines were not used. This is because the proximity between the SCUs allowed the controllers to communicate face to face for faster coordination.

The most significant communications between VLG3001, EZY18EP, Sector T3 and Final are transcribed below:

- Communications with approach Sector T3:

TIME	STATION	ORIGINAL TEXT	TRANSLATE TEXT
9:00:58	T3	Vueling three zero zero one hold over RUBOT.	
9:01:03	VLG3001	Holding over RUBOT, Vueling three zero zero one.	
9:01:47	VLG3001	Vueling three zero zero one reaching to minimum clean.	
9:07:35	T3	Vueling tres mil uno mantenga nivel nueve cero al alcanzar.	Vueling three thousand one maintain flight nine zero upon reaching.

TIME	STATION	ORIGINAL TEXT	TRANSLATE TEXT
9:07:40	VLG3001	(…) nueve cero al alcanzar, Vueling… tres mil uno.	(...) nine zero upon reaching, Vueling three thousand one.
9:08:50	T3	Vueling tres mil uno entre en la, en la espera de RUBOT.	Vueling three thousand one hold at RUBOT.
9:08:54	VLG3001	Entrando ya en la espera de RUBOT, Vueling tres mil uno.	Holding at RUBOT now, Vueling three thousand one.
9:09:00	T3	Vueling tres mil uno baja a nivel ocho cero.	Vueling three thousand one descend to level eight zero.
9:09:03	VLG3001	Bajamos para ocho cero, Vueling tres mil uno.	Descending to eight zero, Vueling three thousand one.
	T3	Vueling three… Vueling tres mil uno baje a seis mil pies, mil veinticuatro.	Vueling three... Vueling three thousand one descend to six thousand feet, one thousand twenty-four.
9:11:11	VLG3001	Mil veinticuatro y tres… seis mil pies, Vueling tres mil uno.	One thousand twenty-four and three... six thousand feet, Vueling three thousand one.
9:11:30	T3	Vueling tres mil uno continúe virando directo a RUBOT y abandone RUBOT en rumbo… negativo, mantenga, mantenga eh… la autorización anterior y continúe en la espera.	Vueling three thousand one continue turning direct to RUBOT and leave RUBOT on course... negative, maintain, maintain, uh... the previous clearance and continue holding.
9:11:43	VLG3001	Continuamos en la espera y descendemos para seis mil pies sobre mil veinticuatro, Vueling (Ininteligible) uno.	Continuing to hold and descending to six thousand feet at one thousand twenty-four, Vueling (garbled) one.
9:11:59	T3	Vueling tres cero cero uno ahora sí, proceda a RUBOT, y después de RUBOT a rumbo Norte.	Vueling three thousand one proceed now to RUBOT and after RUBOT turn north.
9:12:03	VLG3001	RUBOT, y después de RUBOT rumbo Norte, Vueling tres mil uno.	RUBOT, and after RUBOT heading north, Vueling three thousand one.
9:12:07	T3	Vueling tres mil uno baje a cinco mil pies.	Vueling three thousand one descend to five thousand feet.
9:12:11	VLG3001	Cinco mil pies, Vueling tres mil uno.	Five thousand feet, Vueling three thousand one.
9:12:45	T3	Vueling tres mil uno proceda a ASTEK.	Vueling three thousand one proceed to ASTEK.
9:12:48	VLG3001	Directos a ASTEK, Vueling tres mil uno.	Direct to ASTEK, Vueling three thousand one.
9:14:22	T3	Vueling tres mil uno enmienda autorización proceda en rumbo Norte.	Vueling three thousand one amended clearance, proceed heading north.

TIME	STATION	ORIGINAL TEXT	TRANSLATE TEXT
9:14:27	VLG3001	Rumbo Norte, Vueling tres mil uno.	Heading north, Vueling three thousand one.
9:14:59	T3	Vueling tres mil uno, Final diecinueve uno hasta luego.	Vueling three thousand one, final nineteen one, good bye.
9:15:02	VLG3001	Diecinueve uno, Vueling tres mil uno.	Nineteen one, Vueling three thousand one.

- Communications with the Final approach Sector :

TIME	STATION	ORIGINAL TEXT	TRANSLATE TEXT
9:12:53	EZY18EP	Hello, Easy one eight echo papa, six thousand feet heading two four zero degrees.	
9:12:57	F	Easy one eight echo papa buenos días radar contact, descend five thousand feet.	
9:13:03	EZY18EP	Descend five thousand feet, Easy one eight echo papa.	
9:15:00	F	Easy one eight echo papa, proceed now on heading two zero zero.	
9:15:03	EZY18EP	Left heading two zero zero, Easy one eight echo papa.	
9:15:43	F	Easy one eight echo papa, turn left on heading one zero zero.	
9:15:48	EZY18EP	Left heading one zero zero degrees, Easy one eight echo papa.	
9:15:53	F	Vueling tres mil uno, ¿Barcelona?	Vueling three thousand one, Barcelona.
9:15:55	VLG3001	Buenos días Vueling tres mil uno, estamos en frecuencia.	Good morning Vueling three thousand one, on the frequency.
9:15:58	F	Vueling tres mil uno buenos días, está en contacto cinco mil pies… proceda ahora en rumbo tres tres cero.	Vueling three thousand one good morning, contact five thousand feet... proceed on heading three three zero.
9:16:08	VLG3001	De rumbo Norte a rumbo tres tres cero, Vueling tres mil uno.	From heading north to heading three three zero, Vueling three thousand one.
9:16:12	EZY18EP	One eight echo papa, could we intercept the Localizer?	

TIME	STATION	ORIGINAL TEXT	TRANSLATE TEXT
9:16:16	F	Easy one eight echo papa, affirm, intercept Localizer and cleared for ILS Zulu runway zero seven left.	
9:16:23	EZY18EP	Zulu zero seven left, Easy one eight echo papa.	
9:16:25	F	Easy one eight echo papa, leave now five thousand feet for three thousand feet, please.	
9:16:30	EZY18EP	Say again, one eight echo papa?	
9:16:33	F	Easy one eight echo papa, leave five thousand feet for three thousand feet.	
9:16:38	EZY18EP	Descending three thousand, one eight echo papa.	
9:16:41	F	Vueling tres mil uno, continúe virando a rumbo dos seis cero.	Vueling three thousand one, continue turning heading two six zero.
9:16:44	VLG3001	Dos seis cero rumbo… para Vueling tres mil uno.	Two six zero heading... for Vueling three thousand one.
9:17:07	F	Easy one eight echo papa I confirm, leave five thousand feet for three thousand feet.	
9:17:13	VLG3001	Vueling tres mil uno re… R/A.	
9:17:16	F	Vueling tres mil uno recibido.	
9:17:21	EZY18EP	One eight echo papa now clear of conflict, and descending three thousand feet, roger.	
9:17:27	F	Easy one eight echo papa … roger, complete ILS Zulu runway zero seven left.	
9:17:32	EZY18EP	Descending ILS Zulu, and that was a TCAS R/A for your information, Easy one eight echo papa.	
9:17:38	F	Vueling tres mil uno cuando le sea posible vire por la derecha rumbo cero nueve cero.	Vueling three thousand one when possible turn right heading zero nine zero.
9:17:43	VLG3001	Sí por la derecha rumbo cero nueve cero y resume… TCAS, Vueling tres mil uno …	Turn right heading zero nine zero and resume... TCAS, Vueling three thousand one …

TIME	STATION	ORIGINAL TEXT	TRANSLATE TEXT
		CONTROLLER RELIEF	
		Maniobra de aproximación frustrada.	Missed approach maneuver.

The communication between the crew members and the controllers is a factor related to safety in flight. The evidences show that the communications recorded in the radio frequency of final approach sector were made alternatively in the mother languages of the operators, i.e., Spanish for Vueling and English for EasyJet. These communications were legible and independent.

The scenario shows that both aircraft were cleared to 5000 ft. At first the aircraft VLG3001 did not hear that the EZY18EP was cleared to 5000 ft, because when the instruction of the Final controller occurred at 9:12:57, the first one was waiting at RUBOT, in frequency with the Sector T3.

Also, it is observed how the Final controller tries to separate both traffics, modifying the course of the VLG3001 to 330° and clearing the EZY18EP to the localizer.

1.10. Aerodrome information

The Barcelona-El Prat Airport (ICAO code LEBL) is located some 10 km southwest of the city of Barcelona.

It is at an elevation of 4 m and it has two parallel runways (25R/07L and 25L/07R) and one cross runway in a 02/20 orientation. The dimensions of the runways in meters are:

- 25R/07L - 3352X60
- 25L/07R - 2660X60
- 02/20 - 2528X45

The preferred configuration between 07:00 and 23:00 (local time) is West with parallel runways, in which runway 25R is used for landings and 25L for takeoffs. The non-preferred configuration, which was being used at the time of the incident, is East with parallel runways, in which 07L is used for landings and 07R for takeoffs.

In both configurations, aircraft take off from the shorter runway, which is why takeoffs are allowed from the preferred runway for landings (25R/07L) for aircraft that need a longer runway length to take off. Such a situation requires filing a justification with the airport's Operations Office as soon as possible.

The change in configuration due to a change in wind direction is laid out in the AIP, which indicates that ATC shall keep the preferred configurations in situations with up a 10-kt tailwind and/or 20-kt crosswind, including gusts.

Figure 10. Barcelona-El Prat Airport

Figure 10 shows the airport's configuration during the accident.

1.11. Flight recorders

1.11.1. Information from the quick access recorder (QAR) on VLG3001

The QAR readings, when synchronized with the communications presented in Section 1.9, revealed the following events:

VLG. a) At 09:16:07, with the autopilot engaged, the heading selector was changed following a communication with the crew instructing them to turn to heading 330°. No other inputs to the controls were recorded at that time.

VLG. b) At 09:16:34, a TCAS traffic advisory (TA) was received that lasted until 09:17:01. The crew did not provide any inputs to the flight controls and the aircraft continued turning to its selected heading.

VLG. c) The aircraft maintained an altitude of 5000 ft, from which it was transferred by Sector 3 to Final.

VLG. d) At 09:16:42, the crew again provided an input to the heading selector after receiving a new instruction from the Final controller to continue turning to 260°. The aircraft, whose autopilot was engaged, started turning after four seconds.

VLG. e) At 09:17:02, a TCAS climb resolution advisory (RA) was received. At the time, the aircraft was turning through course 300° at a bank angle of 25°. One second later, the crew disengaged the autopilot (AP1) and the climb rate was increased to 1454 ft/min (value reached at 09:17:11). At the same time, the aircraft started to reduce its bank angle.

VLG. f) At 09:17:13, the TCAS climb RA was replaced by a "do not descend" RA. The descent rate began dropping, eventually reaching zero.

VLG. g) At 09:17:18, the TCAS conflict cleared and at 09:17:25, AP1 was again engaged. The aircraft's bank angle increased once more.

VLG. h) The QAR data did not record any communications between the crew and the Final approach Sector in the time period between 09:14:59 and 09:15:53.

1.11.2. Information from the quick access recorder on EZY18EP

In a similar fashion, the synchronization of the data from this aircraft's QAR with the communications contained in Section 1.9 yields the following timeline:

EZY. a) Cleared by the Final controller to the LOC RWY 07L, at 09:16:16, the aircraft continued turning left, maintaining an altimeter altitude of 4700 ft.

EZY. b) While executing the turn, at 09:16:25, the crew are instructed by the Final controller to leave 5000 ft, an instruction that is repeated at 09:17:07.

EZY. c) During the time period indicated above (from 09:16:25 and 09:17:07):

1) A TCAS TA was received at 09:16:34.
2) The aircraft leveled off at 09:16:53, still at a 5° nose-down attitude.
3) A TCAS descend RA was received at 09:17:01.
4) At 09:17:05, the crew disengaged the autopilot (AP1 and AP2) and the flight directors (FD1 and FD2), accelerating the aircraft's descent rate.

1.12. Wreckage and impact information

The aircraft involved in the incident were not damaged.

1.13. Medical and pathological information

There are no indications that physiological factors affected the actions of the members of the flight crew or that they were incapacitated in any way.

1.14. Fire

There was no fire.

1.15. Survival aspects

Both aircraft landed normally.

1.16. Tests and research

1.16.1. Statement from the crew of VLG3001

The crew stated that while established at 5000 ft on heading North, they were instructed to turn left to heading 330°. They were in visual contact with the preceding aircraft and were again instructed to turn left to heading 260° to increase horizontal separation with respect to EZY18EP, which was turning to position itself on final approach to runway 07L. They received a TCAS TA and, some thirty seconds later, a RA with a climb instruction, followed by another RA with a level off instruction.

Once the TCAS indicated clear of conflict, they were again vectored into the sequence for the final approach.

1.16.2. Statement from the crew of EZY18EP

The crew stated that as they were capturing the Localizer signal, the controller cleared them to descend to 3000 ft and continue descending with the ILS glide slope. They received a TCAS TA due to another aircraft located at the same altitude, 3 NM to their right. Almost immediately they received a TCAS descend RA, followed by a level off RA.

They informed ATC and once the TCAS reported clear of conflict, they continued the approach and landed normally.

1.16.3. Statements from the air traffic controllers

1.16.3.1. Common points expressed by control personnel involving the incident

The controllers and supervisor who were on duty at the posts involved in the air traffic incident were interviewed.

They all stated they did not feel fatigued at the time of the incident. They also agreed that the workload was high, due to the amount of inbound traffic and to the adjustments that had been required by the runway change that had taken place practically one hour earlier.

In order to manage the traffic, they had to direct aircraft to holding patterns before they could clear them to the relevant IAFs for the feeder sectors, a situation to be minimized due to its negative impact on flight time.

In addition to the problems described above, there were other difficulties, grouped into the categories below:

a) Those pertaining to the configuration of the airspace proper.

b) Those pertaining to variable factors, some present in the event and some not, that affect operability.

The difficulties in the first group include the following:

- The configuration of the approach to runway 07L, since the four initial approach fixes are located at varying distances between one another and the Localizer.
- The procedure does not ensure vertical separation when the Localizer is captured, since the descent is cleared from two IAFs at 4000 ft and from the other two at 5000 ft, it could being in evolution at the time of the capture of the Localizer.
- The arrangement of the four IAFs results in some aircraft flying outbound from the Localizer course and others inbound, which causes differences in speeds between aircraft on approach.

The second group includes the following:

- The non-preferred ELR configuration at the airport (landings on runway 07L and takeoffs from runway 07R), in which the controllers rotate frequently through the posts, even if this is simulated during training.
- The existing wind conditions, due to their influence on flight speed and on the wakes of the aircraft.

- The performance of each aircraft type, which can vary even depending on the airline in question.
- Unexpected alterations due to emergency declarations, go-arounds, etc.
- Inflexibility in the runway configuration change requirements, which are based on specified crosswind and/or tailwind components, which prevents managing the traffic flow beforehand[4].

Other aspects expressed in the statements involve the support measures for managing traffic. This group includes the following considerations:

- The implementation of the AMAN tool was useful. Before it was put into service, controllers received the approved training. They stated that the workload of the QM, who also performs the duties of the planning controller, is very high.
- They all stated that they received simulator training on non-preferred configurations, including ELR, and refresher TMA training. They thought the simulator training was adequate, but warned that the simulator is significantly different from actual operations. Specifically, they stated that the winds simulated are not realistic, and neither is the behavior of the aircraft, whose performance varies depending on the airline.
- They also noted that all of the changes made by the QM into the AMAN sequence have to be coordinated. When questioned as to how this should be done, however, their answers were not uniform.
- They stated that in certain specific circumstances, and depending on the traffic, controllers in the feeder sectors can readjust the sequences for their traffic in AMAN, since the tool allows changes to be made from any control position associated with the TMA.
- As concerns the coordination between APP LECB and TWR LEBL, it is hampered by the complexity of coordinating the shifts between all the controllers at both units, which makes fluid training impossible.

1.16.3.2. Statement from the executive controller on Final Approach

The influx of traffic forced him to instruct aircraft to intercept the Localizer increasingly further away from the airport, though he did not feel overwhelmed by the situation at any point.

4 See CIAIAC report IN-012/2016 in reference to the regulatory initiative to adapt Article 4.5.4.3.3 of Spain's Air Traffic Regulations, on selecting the runway in use, to the contents of the ICAO recommendations provided in Article 7.2.6 of Document 4444, Air Traffic Management, intended to enhance the operability of airports.

Some aircraft were transferred to his frequency on headings different from those specified in the standard operating procedures. As concerns VLG3001, it was transferred to him at 5000 ft heading north. He realized he would be unable to add it to the sequence, so he initially instructed it to turn to heading 330°, thinking this would be an adequate heading. Three times he instructed EZY18EP to descend to 3000 ft. Upon realizing that the separation was insufficient, he instructed VLG3001 to turn to heading 265°. The controller stated that the aircraft did not turn as fast as required, even though the crew should have realized that the turn was meant to resolve a compromising situation.

He added that he was relieved from his post after the incident but that after taking a break, he resumed his duties, this time on a sector with a lower workload, something that, in hindsight, he did not think appropriate.

1.16.3.3. Statement from the planning controller and QM on Final Approach

The controller stated that situations in which the sequence had to be changed at the last moment were constantly occurring.

Before the incident they had to merge VLG6401, which was inbound from the south (Sector T3), into the sequence, which resulted in added pressure. Given the situation at the time, he decided to prioritize traffic coming in from the north (Sector T4) because the workload arising from the traffic was higher (as is almost always the case), and thus reduce the average delay. He did not recall hearing the executive controller in Sector T3 ask (out loud) for a change to the sequence.

He noticed that the south controller removed VLG3001 from the holding pattern, in clear conflict with traffic inbound from the north. He asked the Sector T3 executive controller to turn the aircraft, but the latter told him that he had already transferred it, and so he informed the executive controller on Final. He stated that the frequency was saturated and that the executive on Final gave the turn instruction as soon as possible.

The controller in question also admitted feeling overloaded, and stated that he was going to request the supervisor's presence when the incident took place.

The controller added that after the incident, when the executive controller on final requested to be relieved, he took over that position, which he had already occupied in the previous rotation, meaning he stood watch as Final executive controller for a long, continuous time, which is very stressful given the high workload.

1.16.3.4. Statement from executive controller in feeder Sector T3

He stated that to offload the sequence from Sabadell (SLL IAF), traffic was routed through BL38-VIBIM-T3. The planning controller on Final (QM) established the sequence for delivering four aircraft, two waiting at the VIBIM IAF and two waiting at the RUBOT IAF, ahead of EZY18EP, which was inbound from the north. He sent the traffic from VIBIM on heading 270° and transferred them to the Final sequence. The Final controller took advantage of a gap to turn VLG6401, which shortened its sequence, so he took out VLG3001, heading north. At that point he noticed a change in the sequence numbers on the AMAN tool, so he instructed it to hold once more at the RUBOT IAF.

He asked out loud from his post if anyone had changed the order in AMAN, and heard "no". He did not recall who answered, though he thought that the QM controller was coordinating with Sector T4. As a result, he thought the specified sequence was still in effect (since no coordination to the contrary had taken place). He again took VLG3001 from its hold and placed it behind the preceding traffic, thinking that it was ahead of EZY18EP, since no coordination had taken place. He thought the traffic coming in from the north would be kept on the outbound localizer course, meaning they would not be in conflict with VLG3001.

1.16.3.5. Statement from executive controller in feeder Sector T4

The executive controller in Sector T4 stated that he followed the QM's instructions at all times and sequenced on agreed headings. At one point he saw two conflicting aircraft at the same altitude, which he reported to the controller on Final.

1.16.3.6. Statement from planning controller in feeder Sector T4

In his statement, he noted that at about 09:10, three aircraft came in from the SLL IAF, spaced within 5 NM. They were cleared to fly outbound from the IAF, after coordinating with the QM, since they were successive in the sequence. He decided to hold a fourth aircraft that was 10 NM behind. A few minutes later, he noticed they were not successive in the sequence, so he asked the QM to confirm if the numbers had been changed, with the QM replying he had not changed the order. When he saw an aircraft coming in from Sector T3 he realized they would not all fit in, so he gave an amended clearance to the third aircraft, which is the only one he had on the frequency.

1.16.3.7. Statement from the Duty Supervisor at the Barcelona ACC

The supervisor stated that arrivals were set to 38, a capacity that is highly questionable because with the number of heavy aircraft due to land in Barcelona, in addition to

the aircraft that requested the non-preferred runway to take off (both situations requiring increased separation between arrivals), it was impossible for that many aircraft to land per hour. This required instructing many aircraft to hold, a circumstance that increased the workload and hampered operations.

1.16.4. Coordination of arrivals and departures between APP LECB and TWR LEBL

The information reviewed shows that for the period between 08:40 and 09:40, three heavy wake turbulence aircraft arrived at LEBL, with two such aircraft taking off from 07L. Specifically, prior to the loss of separation, the APP LECB unit had to coordinate the following takeoffs with the TWR LEBL:

- Request from the TWR LEBL, minutes before the incident, for a high tail assembly aircraft to cross runway 07L, which required leaving a distance of 6 NM between two arrivals.
- Request from the TWR LEBL to leave two 8-NM gaps so two aircraft could take off from runway 07L.

These steps were taken while observing a 38-operation rate for arrivals at LEBL.

A review of the recorded data shows that a proper analysis of the traffic present would have yielded a rate of 36 operations per hour, but the list of arrivals (ARR) and departures (DEP) was not checked before settling on the 38 rate. As a result, the operational rate was in excess of requirements.

1.17. Organizational and management information

1.17.1. Barcelona ACC control room

The control room was visited during the investigation to inspect the posts occupied by the controllers on the day of the accident. It was noted that the approach posts are next to one another, with the Final approach post being between the T3 and T4 feeder sectors. It was also noted that, as a general rule, the planning controller is seated to the right of the executive controller. The posts in which the controllers were seated on the day of the incident are shown in Figure 11.

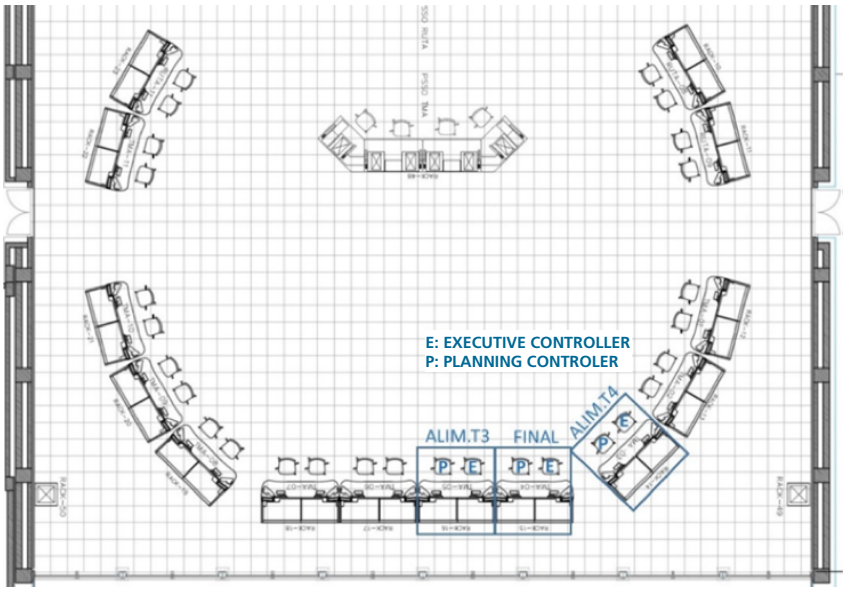


Figure 11. Posts occupied by the controllers on the day of the incident

Controllers can coordinate over the telephone (hotline) with the other SCU manned in the station. In this case, since the posts are located next to one another, controllers usually coordinate face to face, which is more immediate and requires fewer communications. In some cases, they coordinate from their posts, and in other cases the planning controllers leave their chairs and walk to the relevant post.

The investigators also verified that the ergonomic aspects of the control room did not limit the controllers' actions in their posts during the incident.

1.17.2. Barcelona ACC airspace and Operations Manual

In the ELR configuration (landings on runway 07L and takeoffs from runway 07R), aircraft can be inbound from four IAFs, two located north of the airport and controlled by Sector T4, and two south of the airport and controlled by Sector T3.

These sectors feed traffic to the Final Sector, to which aircraft are transferred from said IAFs so they can fly the approach procedure and be transferred to the control tower (TWR LEBL) to complete the landing.

Point 11.3.2.6 of the Operations Manual at the unit describes how the feeders must deliver aircraft to the Final Sector in terms of both their headings and altitudes for the various configurations. Specifically, for the ELR configuration:

- An aircraft from the RUBOT IAF must be instructed to leave it on a heading between 010° and 350° and cleared to descend to 4000 ft.

- An aircraft from the VIBIM IAF must be instructed to leave it on a heading between 280 and 260° and cleared to descend to 4000 ft.
- An aircraft from the SLL IAF must be instructed to leave it on a heading between 230° and 240° and cleared to descend to 5000 ft.
- An aircraft from the VLA IAF must be instructed to leave it on a heading between 140° and 160° and cleared to descend to 5000 ft.

The procedure states that if a sequence cannot be coordinated with Final Approach with the indicated headings, the traffic must be cleared to enter a holding pattern.

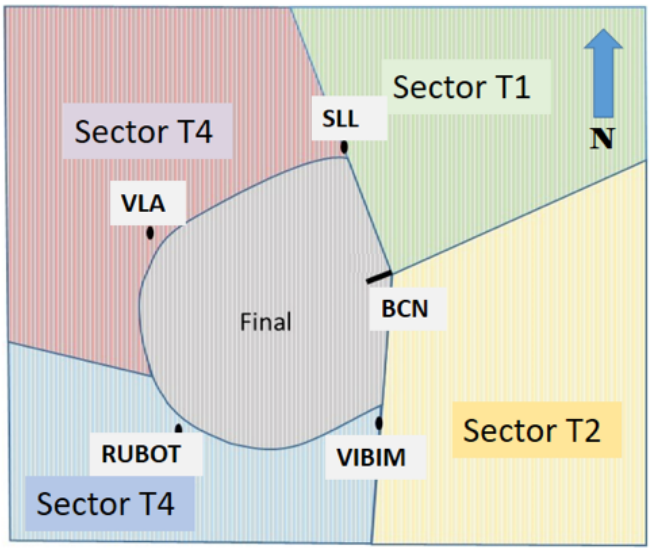


Figure 12. Approach sector for Barcelona ACC in ELR configuration

Point 11.3.2.6.3 indicates that the AMAN sequence specifies the preceding aircraft to follow, meaning that the sequencing shall always be with respect to the preceding aircraft, whether it is from the same feeder or not. The feeder sectors are responsible for delivering the traffic to the Final Sector as per the sequencing plan specified by the QM.

The following definitions are provided for calculating the traffic hand-off distance:

- DFT[5]: Hand-off distance between FINAL to TWR LEBL, measured at the threshold without HIRO and measured at 4DME with HIRO[6].
- DAF[7]: Hand-off distance from feeder to Final, based on the formula DAF=DFT+2NM between consecutive aircraft.

5 DFT: Final distance between aircraft.

6 Term used for operations at busy airports involving the optimized separation of aircraft on final approach to minimize runway occupancy time for both arriving and departing aircraft, and thus increase runway capacity.

7 DAF: Distance for delivery to Final.

By way of example, for typical configurations:

DAF	WITHOUT wake separation DFT+2NM	WITH wake separation (H, M, L)	A380 (J)
WRL/ELR (HIROS)	5	8	10
WRL/ELR (NO HIROS)	6	8	10
	Rounded up from 5.5		
ENR	8	8	Not allowed
	Rounded up from 7.5		

As the figure shows, the IAFs are not located symmetrically around the Localizer, with the distance from SLL to the Localizer intercept point being higher than that from the RUBOT IAF. The headings on which the aircraft are delivered means some aircraft are outbound, some are inbound and yet others are on headings that are practically perpendicular to the Localizer. Moreover, aircraft from the south must be cleared to descend to 4000 ft, while those from the north must be cleared to descend to 5000 ft. This means that aircraft do not have to be established and may be transitioning when they are transferred to the Final approach Sector.

1.17.3. AMAN

AMAN (Arrivals Manager) is a tool implemented in the SACTA system that generates a unique arrivals sequence at the airport and displays it to the controllers involved, primarily to those in the feeder sectors and the Final approach Sector.

The system automatically assigns an arrival order to an aircraft when its flight plan is active in SACTA and it is within a certain time horizon, which in the case of LEBL is 90 minutes to ELDT (Estimated Landing Time). The sequence can vary automatically depending on a series of criteria until an aircraft reaches its "freezing horizon", at which point its sequence number will not be changed automatically, though it may be changed manually. This parameter is adjustable. In the case of LEBL, the "freezing horizon" is 25 minutes prior to ELDT.

For the automatically established sequence to be valid, the Queue Manager (QM) must manually validate the sequence that is automatically assigned by the system and make changes to it as required to adapt it to the actual traffic situation, even after an aircraft is past its freezing horizon. This task can only be performed by the QM.

At the Barcelona ACC, the tasks of the QM are carried out by the planning controller in the Final approach Sector.

The information on the sequence and any changes are displayed to the remaining controllers on the basic flight labels, such that the sequence number is the same color as the label if it has not been assigned manually (the QM has not validated the sequence), and yellow if it has been assigned and validated manually (see Figure 13).

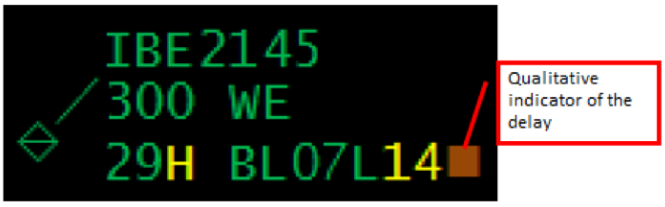


Figure 13. Radar label for an inbound aircraft with a changed sequence number

The task of sector executive controllers is to hand off the traffic under their responsibility to the Final Sector in keeping with the order specified by the QM, while sector planning controllers are required to inform the QM if they swap the order numbers of two aircraft in their sector with consecutive sequence numbers. In short, feeders are not to call into question the sequence set by the QM nor coordinate changes between them, since the sequence has to be coordinated beforehand.

1.17.4. Analysis conducted by the air traffic service provider (ENAIRE):

The investigators had access to the internal report written by the service provider, which identified the following safety recommendations:

- Forward the investigation report to the Head of Operations at the TMA and to the FMP[8] Manager so they can evaluate the possibility of using it at the next meeting of TWR and TCA[9] Chiefs to remind them to check for the presence of H or L wake traffic, for takeoffs from the non-preferred runway and other circumstances that call for reducing the capacity of the ARR LEBL sector in order to increase operational safety and avoid saturation.
- Send the report to the ATS Division (TMA Head of Operations) so as to evaluate the tasks that the Final planning controller/QM can do (decisions to make and timelines for making them) in order to manage traffic safely and efficiently.
- Provide the investigation report to the controllers involved in the Final (planning and executive) and T3 (planning and executive) sectors and, if possible, have them discuss the causal factors with which they contributed to the incident.

8 Flow Management Position.

9 Technical Flow Control.

- Evaluate the possibility of improving the AMAN tool so as be able to use the EAT[10] provided by the tool.

1.18. Additional information

1.18.1. Actions taken by ENAIRE and AESA

As a result of various loss of separation incidents[11] that occurred in the Barcelona TMA, the CIAIAC decided to issue the two following safety recommendations on 2 November 2016:

REC 49/16. "It is recommended that ENAIRE identify the hazards and assess the risks associated with the recent events at the Barcelona TMA involving a loss of separation, and propose mitigation measures in coordination with AESA".

REC 50/16. "It is recommended that AESA review the hazard identified and assessment of risks associated with recent loss of separation events in the Barcelona TMA, as well as the proposed mitigation measures that ENAIRE was recommended to undertake in REC 49/16".

In the events analyzed, and which resulted in the above recommendations, situations were identified in which there was a lack of coordination.

In the wake of the actions taken by AESA and ENAIRE, and to comply with the recommendations made, the service provider drafted a plan of action. From the areas of action identified, the most relevant to this report are presented below:

- AC 1.1 Evaluate the need to provide targeted TRM training, with a specific scope, in addition to that specified in the unit's Training Plan.
- AC 1.2 As a result of AC 1.1, provide targeted TRM training, with a specific scope, in addition to that specified in the unit's Training Plan.
- AC 2 Operating Circular and Safety Bulletin

  An operating circular and safety bulletin are issued in an effort to better apply measures to improve adherence to the procedures contained in the Operations

10 Expected Approach Time.

11 IN-038/2016: Inadequate coordination between the air traffic controllers in sectors D1E and TGR by clearing two aircraft to make practically simultaneous approaches to runway 02 at the Girona Airport.
IN-028/2016: The sector DDI controller spoke with the sector PP2 controller to ask about the proximity alert received involving the two aircraft, obtaining no reply due to overlapping communications.
IN-029/2016: The lateral flight paths of the aircraft crossed without taking into account their different vertical rates, leading to a loss of separation between them.

Manual, Letter of Agreement (LoA), etc., which are intended to ensure that procedures are applied during transfers and coordination between sectors.

- AT0.1 Determine the relevant capacity values for the Final, T-1-2-3-4 Sectors.
- AT0.2 State a capacity for the Final, T-1-2-3-4 Sectors resulting from ATO.1.
- AT4.1. Establish measures to improve the application of traffic control measures by control room and TCA chiefs, including an analysis of: cherry picking, analysis and adaptation of all STAM (Short-Term ATFCM[12] Measures), potential measures (TONB – Takeoff Not Before, miles in trail, tactical rerouting, etc.) and analysis of the application of immediate measures (approval request). Special attention to unusual operational situations, including the following: adverse weather, unexpected runway blockages, expected takeoffs from non-preferred runway. As concerns the presence of heavy or light wake aircraft, this will be considered with the previous assessment of the most suitable measures within the context of the sustainable and stated capacities, as well as of the infrastructure capacity and considering the operational situations that may arise.
- AT4.2 Establish a guide for monitoring active traffic limits.

The service provider, ENAIRE, conducted the evaluation specified in the recommendation on analyzing the tasks performed by the QM, which ended up confirming what was presented in the FHA (Functional Hazard Assessment) session in terms of how the AMAN tool relieves the Final planning controller of having to do certain tasks. The work overload to which the Final planning controller can be subjected was confirmed to be infrequent, and therefore the splitting of his duties is not justified. In any case, if the controller doing the duties of planner on final approach (or in any other sector) feels overloaded, the duties of the Supervisor allow him to occasionally assist said controller in his functions.

The service provider was also asked about the technical development of the simulators used in the ATM training system so as to adapt them, to the extent possible, to better reflect the actual performance of aircraft and winds in the ELR configuration. The reply given indicates that the air traffic generation component allows specifying the wind in a range of predefined layers and that the aircraft performance cannot be adjusted by airline, either in the GTA[13] or in the air control system.

Even so, ENAIRE forwarded to the Training and Evaluation Department, as well as to the Technical Training Office, the need to improve the simulator's settings to the extent possible.

12 ATFCM: Air Traffic Flow and Capacity Management.

13 GTA: Air Traffic Assessment.

1.18.2. Initiatives carried out by the air navigation service provider

As of the date on which this report is presented to the CIAIAC for approval, ENAIRE informed that it presented a document to the National Aviation Safety Agency titled "Barcelona Airport. Proposal for Modifying Instrument Arrivals and Approaches and New Transitions", which proposes restructuring the maneuvers included in the Barcelona TMA and updating the navigation specification to RNAV 1 (GNSS and / DME/DME). It also analyzes the creation of new maneuvers for transitioning to the ILS approach to speed up and optimize traffic flow within the TMA.

These new maneuvers are expected to be implemented by the summer of 2018.

1.18.3. Language to be used in air-ground communication

This section collects the information of section b) of the precept SERA.14015 (Standardized European Rules of the Air) on the "Language to be used in air-ground communications"

> *The English language shall be available, on request of any aircraft, at all stations on the ground serving designated aerodromes and routes used by international air services. Unless otherwise prescribed by the competent authority for specific cases, the English language shall be used for communications between the ATS unit and aircraft, at aerodromes with more than 50 000 international IFR movements per year. Member States, where at the date of entry into force of this Regulation, the English language is not the only language used for communications between the ATS unit and aircraft at such aerodromes, may decide not to apply the requirement to use the English language and inform the Commission accordingly. In that case, those Member States shall, by 31 December 2017 at the latest, conduct a study on the possibility to require the use of the English language for communications between the ATS unit and aircraft at those aerodromes for reasons of safety, so as to avoid incursions of aircraft on an occupied runway or other safety risks, while taking into account the applicable provisions of Union and national law on the use of languages. They shall make that study public and communicate its conclusions to the Agency and the Commission.*

Taking this section into account, Spain informed the European Commission on 3 October 2017 of its decision not to apply the requirement to use English as the only language in communications between ATS units and aircraft at Spanish aerodromes with more than 50,000 International IFR movements per year.

1.19. Useful or effective investigation techniques

Not applicable.

2. ANALYSIS

2.1. Description of scenario

On 7 August 2016, at 08:14, the Barcelona Airport's configuration was changed to the non-preferred ELR configuration, with landings on runway 07L and takeoffs from runway 07R. The approach control service was set at 38 operations/hour from that moment on, although an assessment of the traffic factors show that 36 operations/hour should have been.

The incident occurred when two aircraft were maneuvering to the LOC RWY 07L, one from the right, with callsign EZY18EP, and another from the left, with callsign VLG3001. The closest point of approach between to aircraft was 1.4 NM horizontally and 200 ft vertically. Both crews correctly responded to the TCAS resolution advisory.

This report also highlights the information given by the air traffic controllers who were interviewed in terms of how various aspects may have combined in the incident.

The analysis considers the following aspects:

- Actions taken by the approach controllers.
- The coordination among the controllers at the unit.
- Airspace and TMA procedures.
- Managing the arrival sequence with the AMAN tool.
- Corrective actions taken by the service provider.

2.2. Actions of air traffic control personnel during incident

2.2.1. Actions of Final Approach planning controller and QM

The sequence specified by the AMAN tool at 09:08:28 had been validated by the Final planning controller and QM. The situation was as follows, as shown in Figure 4:

- Four aircraft in contact with feeder Sector T4 that were inbound from the north (3, 4, 5 and 6) that had not intercepted the localizer yet and had already left the SLL IAF. The first two had a heavy wake turbulence, which required them to be spaced 4 NM apart, with the next aircraft (number 5) 5 NM behind.
- Four aircraft were inbound from the south (7, 8, 9 and 10), and thus in contact with feeder Sector T3. The first of these had already left the VIBIM IAF.

- Three further aircraft (11, 12 and 13) inbound from the north and had not yet reached the SLL IAF, spaced fewer than 5 NM apart, the minimum distance required between aircraft to comply with procedures at the unit.

The QM decided to prioritize the traffic from the north over that from the south to reduce the effect of Sector T4 on the SLL IAF and shorten the average delay. According to the statement made by the planning and executive controllers in Sector T4, the QM controller coordinated this change with them beforehand but did not immediately change the AMAN sequence. According to AMAN system data, the QM validated the first change in the arrivals management system at 09:11:19, moving EZY18EP ahead of VLG3001.

At 09:13:12 a new change was made when two other aircraft inbound from the north were moved up in the sequence, ahead of VLG3001. These changes are deemed to have been entered into the AMAN tool late. They were also not verbally coordinated with sector T3, possibly due to the high workload to which the controller was subjected.

In light of these two changes, and without evaluating whether they were appropriate given the traffic situation, the coordination was not effective, since the change in sequence was not coordinated with Sector T3, and it was reflected in the AMAN tool after it was coordinated with Sector T4. This led to confusion among the T3 controllers, which could have been avoided if the QM had coordinated the changes with said sector.

2.2.2. Actions of the executive controller in sector T3

The ENAIRE document "AMAN Operational Mode in the Barcelona TMA" assigns the QM the responsibility of determining the order in which the feeder sectors have to deliver traffic to the Final Sector. In addition to this responsibility, the QM has authority over said order, meaning the QM does not have to coordinate the sequence[14] with the feeders, but rather has to inform them of the sequence by means of the yellow sequence number in the label.

The T3 executive controller noticed that the AMAN sequence had changed just as he was about to instruct VLG3001 to exit the hold and start its approach. He assumed it was a mistake in the AMAN tool and asked out loud from his post if the sequence had been changed, and thinking that someone replied no, continued with his assumed sequence.

14 The approach sequence predefined by the system could be altered by circumstances, such as: performances of traffic, weather, etc. The modifications will be raised by the QM in coordination with the affected Sector (s).

As stated in the first paragraph of this point, the T3 controller did not act in accordance with the document "AMAN Operational Mode in the Barcelona TMA" and did not follow the sequence validated by the QM. Moreover, the T3 controller did not directly confirm with the QM if he had changed the sequence, which is deemed to be a coordination error.

The T3 executive controller instructed VLG3001 to leave the RUBOT IAF heading north at 5000 ft, meaning he did not comply with the procedures specified in the operations manual, which states that the aircraft must be cleared to descend to 4000 ft. As a result, the traffic ended up at the same altitude at EZY18EP.

However, the radar data show that the controller acted in keeping with this procedure at all times, meaning this mistake could have been a consequence of the confusion caused by the changes sudden made to the AMAN and/or by the volume of traffic he was handling.

As a result, the situation at the time in the Final Sector involved three aircraft established on the Localizer and four more that had not reached the Localizer but that were on the Final frequency, ahead of VLG3001. In short, the aircraft was transferred to Final (09:14:59) in conditions that made it impossible for the executive controller to correctly vector the aircraft and comply with the specified approach sequence. As indicated in the interview, before transferring VLG3001, the T3 controller noticed the presence of aircraft from the north that were flying outbound from the runway Localizer. He assumed they would continue in that direction and thus that they would be of no concern to VLG3001.

2.2.3. Actions of the Final executive controller.

The controller was notified by the planning controller in his sector of the conflict between the aircraft. He then contacted VLG3001 and instructed it to turn to 330°. He next cleared EZY18EP to descend to 3000 ft, his goal being to increase both the horizontal separation, which at the time was 4.1 NM on converging flight paths, and the vertical separation, since they were at the same altitude.

According to the data taken from the QARs on the aircraft, the crews of both aircraft complied with the instructions received, but did not expedite them. The crews responded like they did because the controller did not indicate the urgency of the instructions by using the word "immediately".

The controller also gave no traffic information to the aircraft or included in his instructions that they were for traffic separation purposes, which would have given more information to the crews on the need to make a quick evasive maneuver. The

stress resulting from the workload he had at the time and the unexpected situation he found himself in could explain why he did not give traffic information to the aircraft.

Furthermore, the first instruction given by the Final controller to VLG3001 to turn to heading 330° was insufficient to avoid the conflict, as a higher turn angle was required in the first instruction to increase the horizontal distance between them.

Both crews received a TCAS RA, and both complied with the procedures specified by the manufacturer, which increased the vertical distance between them. In the end, the closest distance between the aircraft was 1.4 NM horizontally and 200 ft vertically.

2.2.4. Evaluation of the coordination efforts

The AMAN system assigns a sequence number to each aircraft and specifies a departure time from the IAF. It is normal for the sequence assigned by the system to be modified in order to adapt and/or respond to the actual situation in the controlled airspace at the time (priority given to other aircraft, storms, missed approaches, change in runway configuration, runway inspections, etc.). Such modifications will occasionally require coordination between the feeder sectors and the QM, who is ultimately responsible for specifying the sequence that will be provided to the executive controller on Final.

In this incident, the controllers involved stated that the coordination could have been better, and alluded to various factors that hampered said coordination, such as: a constant and heavy traffic flow, non-preferred runway configuration (ELR), irregular and disperse airspace structure, the need to create gaps to allow aircraft of different categories to take off and flow of inbound and outbound traffic with respect to the Localizer course.

The fact that the control personnel were highly experienced at the unit and at their posts, that they had been favorably evaluated in the TRM courses and that they recognized the importance that coordination has in managing traffic is deemed to have been a positive factor.

All of the evidence collected during the investigation also seems to show that the controllers have a wide range of opinions in terms of which situations require coordination with the QM, and even in terms of how to communicate, be it face to face, walking to the QM's post or using the hotline[15].

15 The hotline is available at every control post, but it is rarely used as it delays coordination.

As concerns the failure to coordinate the aircraft, the air navigation service provider has analyzed three high-severity incidents that took place in the TMA recently. On two occasions (including this incident), coordination failures were detected at the APP LECB. There was also an incident en route where a coordination fault was identified. In the wake of these incidents, the service provider took the following steps:

AC 1.1 Evaluate the need to provide targeted TRM training, with a specific scope, in addition to that specified in the unit's Training Plan.

AC 1.2 As a result of AC 1.1, provide targeted TRM training, with a specific scope, in addition to that specified in the unit's Training Plan.

The actions taken by the service provider are deemed to be positive, as is any step that allows standardizing criteria among control personnel and relying less on individual judgments.

To this end, Section 4 of this report contains two safety recommendations directed at the service provider, ENAIRE, to have it consider these aspects.

Similarly, the scope of this controller training is applicable in those cases that require coordinating actions between APP LECB and TWR LEBL, as reflected in report IN-012/2016, which contains the following safety recommendation:

REC 59/17. It is recommended that ENAIRE, as part of its refresher training plans, include combined TMA-TWR TRM sessions that place special emphasis on coordination procedures that allow controllers to handle emergency situations.

2.3. Considerations on the language used in land/air communications

The communication between the crew members and the controllers is a factor related to safety in flight. The communications contained in section 1.9 show that two different languages were used in the same Final frequency, with the possible impact on the situational awareness of the crews.

However, in the present case, the VLG3001 crew should not have been affected by this fact, since the linguistic competence level allows them to attend both languages, while the crew of EZY18EP only had a partial composition of the situation.

In this regards the scenario conditions in which the aircraft were flying, at the time when the Final controller initiated communications in Spanish with VLG3001 and the reduced distance to the localizer that the controller had to separate the aircraft by procedure, it is considered that the use of the same language should not have

contributed to become worse the situation. The performance of the crews on the TCAS resolution was which ultimately resolved the conflict.

2.4. Aspects involving airspace and procedures

In their interviews, the controllers involved made reference to the problems posed by the current structure of the airspace and to the unique characteristics of the instructions in the relevant procedures. In light of these circumstances, it seems that high traffic situations may require an excessive effort, leading to an increased workload.

These unique characteristics are presented in Section 1.16.3.1 and involve: the number of IAFs present (two in each sector); the headings the aircraft take to leave them, and that place some aircraft on outbound headings, others on inbound headings and yet others on headings that are practically perpendicular to the Localizer; and the different distances between each IAF and the area where the Localizer is intercepted. On top of all this is the fact that vertical separation between aircraft is not assured, since they are cleared from two IAFs to descend to 4000 ft and from two other IAFs to descend to 5000 ft, meaning the aircraft's altitudes can be transitioning.

The operation of this structure seems to rely on large part on the ample experience of all of the controllers involved.

The radar data supplied for the investigation by the service provider show that three aircraft arrived from the SLL IAF that were separated by less than 5 NM. To increase this separation, the last aircraft was instructed to fly on heading 250°. According to the procedures described in the operations manual, aircraft have to leave the SLL IAF on headings between 230° and 240°. It adds that if the sequence coordinated with Final approach cannot be achieved using the indicated headings, the traffic must be cleared to hold. Although the decision to fly on 250° is deemed adequate in terms of achieving separation with respect to the preceding aircraft, it goes against the unit's procedures. This happened on two occasions in the minutes leading up to the incident.

It was also noted that the hand-off distance to Final by the feeder sectors did not rigorously adhere to that written in the operations manual. It adheres in the case when two consecutive aircraft in the sequence come from the same IAF, in which case they must be handed off 5 NM apart (with HIRO and not taking into account wake turbulence). But if the aircraft originate at different IAFs, the procedure states that the preceding aircraft in the sequence must be taken into account. The controllers stated that they deliver aircraft from their sector with a 10-NM separation between

two consecutive aircraft so that an aircraft from another sector can be inserted in between.

In this regard, the radar data showed that VLG6401 was cleared to leave the VIBIM IAF and was transferred to the Final frequency with no consideration given to the positions of the preceding aircraft. On this occasion, the executive controller on Final was able to vector it into the sequence ahead of the two aircraft that preceded it in the sequence established by the QM.

This thus seems to confirm the controllers' statement during the interview regarding the lack of adherence to procedures at times of high workload. In these circumstances, the procedures would have to be modified so as to provide the required separation in any scenario. Similarly, an airspace configuration based on the current needs would improve the operational safety in the airspace.

2.5. Aspects involving training of air traffic control personnel

The configuration of the Barcelona Airport in use at the time of the incident was ELR, which is a non-preferred daytime configuration that is only activated when limiting wind conditions are present. This condition means that it is the least used configuration.

Control personnel at the unit are rotated through every post of the approach sector so as to keep them proficient at every station. This rule is conditioned by the randomness in which said configuration is used. As a result, the likelihood that every controller will rotate through each of the two (executive and planning) positions in Sectors T1, T2, T3, T4 and Final while in the ELR configuration is small.

This variability, which stems from the very characteristics of the airspace and of the variable operational factors presented in Section 1.16.3.1, along with high traffic periods, mean that despite the proven experience of the controllers, the way in which they are trained must be evaluated.

In 2016, the controllers received two simulator training courses, one on non-preferred configurations (including ELR) and a refresher course on the Final approach Sector. All of them rated the training as positive, though they noted that the simulation conditions are different from actual operations; specifically, the simulated winds do not exist in reality, and neither does the performance of the aircraft, since during real operations, an aircraft's performance depends on the airline that owns the aircraft. The response between the simulator and actual situations is also different.

During the investigation, these observations were relayed to the service provider,

which in response conducted an assessment of the technical capacity of the simulator in terms of the introduction of wind layers and the parameterization of aircraft performance. The provider proposed forwarding to the Training and Evaluation Department and to the Technical Training Office the need to improve the simulator configuration to the extent possible so as to consider wind layers and improve aircraft performance, even if it is not airline specific.

The reply given by the service provider is deemed appropriate and thus a safety recommendation is not issued in this regard.

However, an assessment should be conducted to determine if a different airspace configuration would correct this deficiency.

2.6. Operation with the AMAN tool

The AMAN tool was implemented at the Barcelona TMA to improve the efficiency of approach sequencing. Every controller interviewed agreed that the tool offers several benefits, including a reduction in the workload at most of the stations. However, the controllers noted that during times of heavy inbound traffic, the QM, who also doubles as the planning controller on Final, can be subject to an excessive workload. Specifically, the controller who was acting as the QM during this incident reported feeling overwhelmed by the workload at the time.

ENAIRE conducted a risk analysis for implementing the tool at the TMA, as required by the applicable regulation. During the functional hazard assessment (FHA), the workload of the planning controller on Final was identified as a hazard. The analysis, however, deemed that this hazard was infrequent and could be mitigated by training and by the assistance provided by the supervisor.

Despite this, the following recommendation stemmed from the internal investigation into this incident:

Forward the report to the ATS Division (TMA Head of Operations) so as to evaluate the tasks that the Final planning controller/QM can do (decisions to make and timelines for making them) in order to manage traffic safely and efficiently.

Once analyzed, the service provider reaffirmed the conclusion of the FHA session in terms of how the AMAN tool offloads work from the Final planning controller/QM. The excessive workload in that position is deemed to be infrequent, and thus the option to split up the duties of the position was ruled out. In any event, as in any other sector, if the air traffic controller who is on duty as the Final planning controller is overloaded, the duties of the Supervisor include that of assisting the planning controller if needed on occasion.

2.7. Actions taken by the air navigation service provider

During the investigation into this incident, the air navigation service provider took steps to modify maneuvers in the Barcelona TMA. To this end, it presented to CIDEFO (Inter-Ministry Defense and Development Commission) a proposal to implement approaches, instrument arrivals and departures and new transitions at the Barcelona Airport. This proposal includes a restructuring of the maneuvers included in the Barcelona TMA that updates the navigation specification to RNAV 1 (GNSS and DME/DME). It also analyzes the creation of new transition maneuvers for the ILS approach.

3. CONCLUSIONS

3.1. Findings

A. Pertaining to VLG3001:

- The crew were qualified for the flight in question.
- The aircraft had a valid certificate of airworthiness.
- The aircraft was equipped with a traffic collision avoidance system with software version 7.1.
- The crew responded to the resolution advisory as per the Operations Manual.
- The crew informed air traffic control of the TCAS alert.

B. Pertaining to the crew of EZY18EP:

- The crew were qualified for the flight in question.
- The aircraft had a valid certificate of airworthiness.
- The aircraft was equipped with a traffic collision avoidance system with software version 7.1.
- The crew responded to the resolution advisory as per the Operations Manual.
- The crew informed air traffic control of the TCAS alert.

C. Pertaining to the Final planning controller and QM:

- The controller had a valid license and unit endorsement for the task he was performing.
- His duties included sequencing traffic by using the AMAN tool.
- At one point, he sequenced four aircraft inbound from Sector T4, four aircraft from sector T3 and three more from Sector T4. In the sequence, VLG3001 preceded EZY18EP.
- Later, as the traffic progressed, he modified the sequence on two occasions: in the first, EZY18EP was placed ahead of VLG3001, and in the second, two other aircraft inbound from Sector T4 were placed ahead of VLG3001.
- The sequencing changes were coordinated with sector T4 but not with Sector T3.

D. Pertaining to the executive controller in Sector T3:

- The controller had a valid license and unit endorsement for the task he was performing.
- He noticed that the traffic sequence had been changed.
- He asked out loud from his post if the sequence had been changed.
- He did not receive a reply from the QM.
- He instructed VLG3001 to start the approach, contrary to what the AMAN sequence indicated.
- He directed VLG3001 to a different altitude from that indicated in the operating procedure, and that was equal to that for Sector T4.

E. Pertaining to the executive controller on Final:

- The controller had a valid license and unit endorsement for the task he was performing.
- Once VLG3001 was transferred, the scenario in the Final Sector was as follows:
  I. Three aircraft were established on the Localizer.
  II. Four aircraft were ahead of VLG3001, vectored to intercept the Localizer ahead of it.
  III. VLG3001 and EZY18EP were at the same altitude on either side of the Localizer.
- He inserted two departing heavy aircraft into the sequence.
- He did not provide traffic information to the aircraft.
- The phraseology used with EZY18EP did not include the term "immediately".
- The controller used different languages on the same frequency, although it did not contribute to become worse the situation.

F. Pertaining to the Approach Control unit:

- Approximately one hour before the event, the airport's configuration had been changed from West to non-preferred East (07L/07R) due to the prevailing wind.
- The Approach Control unit had been handling 38 operations/hour for an extended period of time.
- The traffic capacity was not evaluated. Later it was confirmed that the

conditions for such as evaluation had existed.

- The executive controller on Final had been scheduled for an interview involving a previous incident.
- Airspace structure that is highly dependent on the experience of ATC personnel.

G. Pertaining to the air navigation service provider (ENAIRE):

- In relation to this and other events closely spaced in time, ENAIRE took the following steps:
  i. *AC 1.1 Evaluate the need to provide targeted TRM training, with a specific scope, in addition to that specified in the unit's Training Plan.*
  ii. *AC 1.2 As a result of AC 1.1, provide targeted TRM training, with a specific scope, in addition to that specified in the unit's Training Plan.*
- The duties of the QM are maintained but with support from the duty manager if needed.
- ENAIRE has taken steps to restructure the maneuvers included in the Barcelona TMA and presented the relevant project to the CIDEFO (under consideration for approval if appropriate).

3.2. Causes/Contributing factors

The incident took place due to improper coordination between the Queue Manager (QM) and the executive controller for Sector T3.

The following actions led to the loss of separation between the aircraft:

- Prior to the event, no consideration was given to limiting arriving traffic.
- The Sector T3 executive controller did not follow AMAN procedures.
- The Sector T3 executive controller did not follow the unit's operating procedures when he transferred the aircraft to the Final Sector.
- The Final executive controller provided insufficient information to the aircraft.
- Use of incomplete phraseology by Final executive controller with aircraft EZY18EP.
- Approach control personnel were subjected to a high workload for an extended period of time.
- The complexity of the airspace's structure.

4. SAFETY RECOMMENDATIONS

An analysis of the findings revealed during the investigation indicates the existence of different criteria among the controllers in the various APP LECB sectors when it comes to interpreting traffic situations that require coordination and the way in which this is carried out.

The findings in question show that the traffic were not coordinated correctly in light of the approach sequence. On the one hand, the QM controller made several changes to the approach sequence that he did not coordinate with the T3 controllers, causing them to become confused. On the other hand, the T3 controller coordinated erroneously with the Final Sector, leading the latter to believe that the sequence established by the AMAN was not to be used.

Further, as presented in Section 1.18.1, several events took place in the Barcelona TMA airspace in which aspects involving coordination were identified, both among sectors within the same unit (APP LECB or TWR LEBL) and among controllers in two different units (APP LECB and LEBL TWR). As a result, this Commission issued two safety recommendations (REC 49/16 and 50/16) directed at ENAIRE (air traffic control service provider) and Spain's National Aviation Safety Agency (AESA), respectively.

The result of the actions taken by AESA led to ENAIRE proposing a series of actions involving coordination intended to correct the deficiencies identified by AESA.

Consequently, as concerns this report, this Commission deems it necessary to issue the following safety recommendation to the air navigation service provider:

REC 76/17. It is recommended that ENAIRE, as the air navigation service provider at both the approach unit and at the Barcelona Airport control tower, evaluate the need to provide targeted TRM training sessions, with a specific scope, in addition to those specified in the unit's Training Plan.

The scope of this recommendation shall consider those situations that require coordination between the APP LECB and TWR LEBL controllers.

REC 77/17. It is recommended that ENAIRE, as the air navigation service provider at both the approach unit and at the Barcelona Airport control tower, and as a result of the above recommendation, provide targeted TRM training sessions, with a specific scope, in addition to those specified in the unit's Training Plan.

The scope of this recommendation shall consider those situations that require coordination between the APP LECB and TWR LEBL controllers.

5. APPENDICES

None.