FINAL REPORT

On the investigation of a serious accident on July 16th, 2018, by McDonnell Douglas MD-82 aircraft, registration LZ-LDM, upon approach for landing on the Tarbes–Lourdes–Pyrénées Airport, France

Aircraft Accidents Investigation Unit AAUI
Republic of Bulgaria

2020

Purpose of Report and Responsibility Level

Under Annex 13 of the Chicago Civil Aviation Convention of 07.12.1944, Regulation 996/20.10.2010 of the European Parliament and the Council on the investigation and prevention of accidents and events in Civil Aviation and Ordinance No. 13/27.01.1999 of MT (last amendment and addition - 22.01.2016), the investigation of an aviation event aims at identifying the reasons that led to the event to eliminate and exclude these in future **without identifying someone's guilt or liability**.

CONTENTS

List of abbreviations

AO	-	Airline operator;
A/C	-	Aircraft;
DG CAA	-	Directorate General Civil Aviation Administration;
BULATSA	-	Bulgarian Air Traffic Services Authority;
A/C crew	-	Aircraft crew;
CAA	-	Civil Aviation Act;
AMRAIU	-	Aircraft, Maritime and Railway Accident Investigation Unit;
CR	-	Capital Repairs (overhaul);
CNP	-	Control navigation point;
MTITC	-	Ministry of transport, information technology and communications;
ATS	-	Air Traffic Services;
MO	-	Maintenance organization;
CAMO	-	Continuing airworthiness maintenance organization;
FL	-	Flight level;
IFR	-	Instrument Flight Rules;
Runway	-	Take-off/Landing runway;
MP	-	Maintenance Programme;
FM	-	Flight Manual;
AAIU	-	Aviation accident investigation unit;
SOP	-	Standard operating procedures;
p.	-	page;
A/THR	-	Auto thrust;
AGL	-	Above ground level
ALT	-	Altitude;
AP	-	Autopilot;
ATIS	-	Automatic terminal information service;
ATPL	-	Airline transport pilot license;
DFDR	-	Digital Flight Data Recording;
EASA	-	European Aviation Safety Agency;
FCOM	-	Flight Crew Operating Manual;
FCTM	-	Flight Crew Training Manual;
FDR	-	Flight Data Recorder;
FL	-	Flight level;
FMA	-	Flight Mode Annunciator;
FPA	-	Flight Path Angle;
GAT	-	General Air Traffic;
GW	-	Gross Weight;
ICAO	-	International Civil Aviation Organization;
QAR	-	Quick Access Recorder;
QRH	-	Quick Reference Handbook;
M	-	Mach Number;
MSN	-	Manufacturer Serial Number;
MTOW	-	Maximum Take-Off Weight;
NM	-	Nautical Mile;
PIC	-	Pilot in Command;
UTC	-	Universal Coordinated Time;
V/S	-	Vertical speed.

1. Introduction

Date and time of the aviation event: 16.07.2018, 07:35 h UTC.

All times in the Report are given in UTC.

Notified: Aircraft, Maritime and Railway Accident Investigation Unit Directorate (AMRAUD) and Directorate General "Civil Aviation Administration" (DG CAA) of the Republic of Bulgaria,, Bureau d'Enquêtes et d'Analyses pour la Sécurité de l'Aviation Civile of France (BEA), the European Commission, the European Aviation Safety Agency (EASA), The International Civil Aviation Organization (ICAO), the National Transportation Safety Board (NTSB) of the USA.

Under Article 3, paragraph 1, i. "a" and Article 5, paragraph 1, in relation to Article 2, paragraph 16 of the Annexes to Regulation (EU) 996/2010 of the Parliament and the Council of the European Union, the Bureau d'Enquêtes et d'Analyses pour la Sécurité de l'Aviation Civile, classifies the aviation event as a "Serious Accident", and under Article 6, paragraph 2 of the same Regulation, proposes the investigation to be carried out by the AAIU of the Republic of Bulgaria.

AAIU at the AMRAIU Directorate of the MTITC, under Article 6, paragraph 2 of Regulation (EU) 996/2010 accepts to investigate the aviation event and filed case No. 08/16.08.2018 on the inventory of the AAISU, enclosing the materials obtained by the BEA of the Republic of France. Under Article 5, paragraph 1 of Regulation (EU) No. 996/2010 on the investigation and prevention of accidents and incidents in civil aviation, Article 142, paragraph 2 of the Civil Aviation Act of the Republic of Bulgaria from 01.12.1972 and Article10, paragraph 1 of Ordinance No.13 of the Ministry of Transport of 27.01.1999 on the investigation of aviation accidents, a Commission for investigation of the serious incident was appointed by Order No. RD-08-324/03.08.2018 of the Minister of Transport, Information Technology and Communications.

Summary: When performing a charter flight under flight number BUC 8115 from Catania Airport (LICC), Italy, to Tarbes-Lourdes-Pyrénées Airport (LFBT), France, a MD-82 aircraft with a LZ-LDM registration, owned by the AO "Bulgarian Aviation Charter", operated normally in the take-off stage, on route and a descent to a height of 380ft AGL in the landing approach. At this height, the aircraft broke the descent profile. At distance 480m before threshold of RWY 20, the aircraft was at 46ft AGL. The runway threshold was past at a height of 35ft, a little bit to the right of the centerline. At 350 meters after the runway threshold, the captain executed a "go-around", but without a change in engine thrust. The A/C flew a total of 1680 m without increased engine thrust at a height of 46, 35, 33, 107 and 50ft above the ground respectively, with a respective reduction in speed closed to stall. After GA thrust of the engines were applied, the A/C recovered the profile and the crew continued the flight normally to the alternate airport Toulouse.

Safety Investigation Commission pointed out the following reason for the realization of the aviation event:

Pilots mistakes in crew coordination and in flight technology in bad weather conditions during the landing approach and the go-around procedures at the Tarbes-Lourdes-Pyrénées Airport, France.

2. Factual information

All the facts of the flight history, its preparation and realization, as well as the realization of the aviation event, the Commission received from the flight crewmembers, the crew records, witness explanations and the ATSA data at Tarbes-Lourdes-Pyrénées Airport.

2.1. Flight History

2.1.1. Flight number and type, the last point of departure and time, and planned destination point

Flight Number: BUC 8115.

Type of flight: Passenger charter flight.

Last point of departure: Catania Airport (LICC), Italy.

Take-off time: 05:12 h.

Planned destination point: Tarbes-Lourdes-Pyrénées Airport (LFBT), France.

2.1.2. Flight preparation and description of the flight

The description of the preparation and realization of flight is done on the grounds of the explanations of the crew and the studied company documents, related to the flight realization.

According to the planned schedule of AO "Bulgaria Air Charter", on 16.07.2018, a standard crew, consisting of captain, co-pilot and cabin crew of 4, must perform a charter flight BUC 8115 on the following route and timetable: 05:00 LICC - LFBT 07:20. The crew had enough time to rest before the flight. A special preliminary flight preparation as per the Flight Manual of the AO was not performed on the day before the flight, because the crew had flown this route a week before, on 09.07.2018.

At 04:00 AM, the crew of 6 arrived at the Catania Airport to perform the flight.

The Captain following the Airline SOP did the pre-flight briefing.

The weather conditions along the route and on the destination allowed the performance of the flight:

METAR LFBT160400Z AUTO 28009KT 9999-RA VCTS FEW042/// OVC076/// CB 19/17 Q1015
TEMPO 28020G40KT BKN007 BKN040CB=

TAF AMD LFBT 160318Z 1603 / 1624 27008KT 9999 BKN020
TEMPO 1603 / 1609 28020G40KT TSRA BKN007 BKN040CB
PROB30 TEMPO 1609 / 1612 28015G25KT SHRA BKN014 SCT 035 TCU=

At the briefing, it was pointed out that the co-pilot would fly as PF and the captain would be PNF. The flight crew did the pre-flight check of the aircraft under the operator's SOP. The Captain as PNF made the exterior check and monitored the loading of luggage. The co-pilot, as PF, prepared the cockpit and FMS. The FMS database was up to date, which was registered in the technical logbook page №144006 of 10.07.18.

The passengers boarded on time and the aircraft took off at 05:12:20 AM from RWY 08 of Catania Airport with fuel 15 800kg on board and actual take-off mass 64 600kg.

The flight to the destination airport was normal, without deviations from the prescribed flight plan, on flight levels FL 300, FL 320 and fl 330 consecutively, in smooth weather. In the Barcelona region, just before the top of descent, the aircraft started avoidance a large cloudy system with CB activity.

At 07:11:12 AM, the A/C started descent at magnetic course of 357° in icing conditions and moderate turbulence, down to FL100.

At 07:20:20 AM, ATC "Toulouse-coordination" permitted a lower flight level for BUC 8115. The coordination of "Pyrenees Approach" gave flight level FL80 to navigation point TEPTI.

At 07:23:13 AM, the ATC of the Approach called flight BUC 8115 and gave course to navigation point TBO. At that moment, the plane was crossing flight level FL140 slightly to the East from TEPTI.

At 07:23:37 AM, the ATC called again flight BUC 8115. The pilot answered that he was descending to flight level FL80. The dispatcher instructed the A/C to descend under the ILS Z approach procedure for RW20. The pilot asked for confirmation of the permission and the latest weather conditions.

At 07:24:56 AM, the ATC gave the latest information: visibility 5км, rain, storm, clouds FEW 1900ft, SCT 2500ft, OVC 4300ft. The PIC acknowledged the weather and asked about the latest wind direction.

At 07:26:16 AM, the dispatcher gave wind direction: 190°/ 8kts, QNH1018mb.

At 07:27:05 AM, the ATC asked the pilot to confirm that the plane was avoiding the CB, and the PIC confirmed and said he would maintain course 290° for 5NM more. Based on DFDR, the slats and flaps were extended at 11° at ALT 9400ft, then the A/C maintained FL 80 for about 40 seconds, after that continued to descend according to the approach scheme. During the descent, the aircraft was all the time in moderate turbulence and icing, down to FL100. At flight level FL100, the aircraft exited the dense clouds.

At 07:28:52 AM, the A/C competed avoidance, turned to the left at a course of 230°, and extended the flaps to 15°.

At 07:30:00 AM, the aircraft started descent at a course of 204°, reported interception of ILS for runway 20. The landing gear, the flaps and slats were extended consecutively. The ATC Approach transferred the flight BUC8115 to the Tower frequency.

At 07:30:59 AM, the crew called Tower and reported full interception of ILS. ATC required confirmation when the A/C reaches 4NM from the runway and gave latest weather information: wind 200°/10kts, Runway – wet.

At 07:33:39 AM, ATC informed the A/C that it was raining and gave wind information: 200°/11kts, CB.

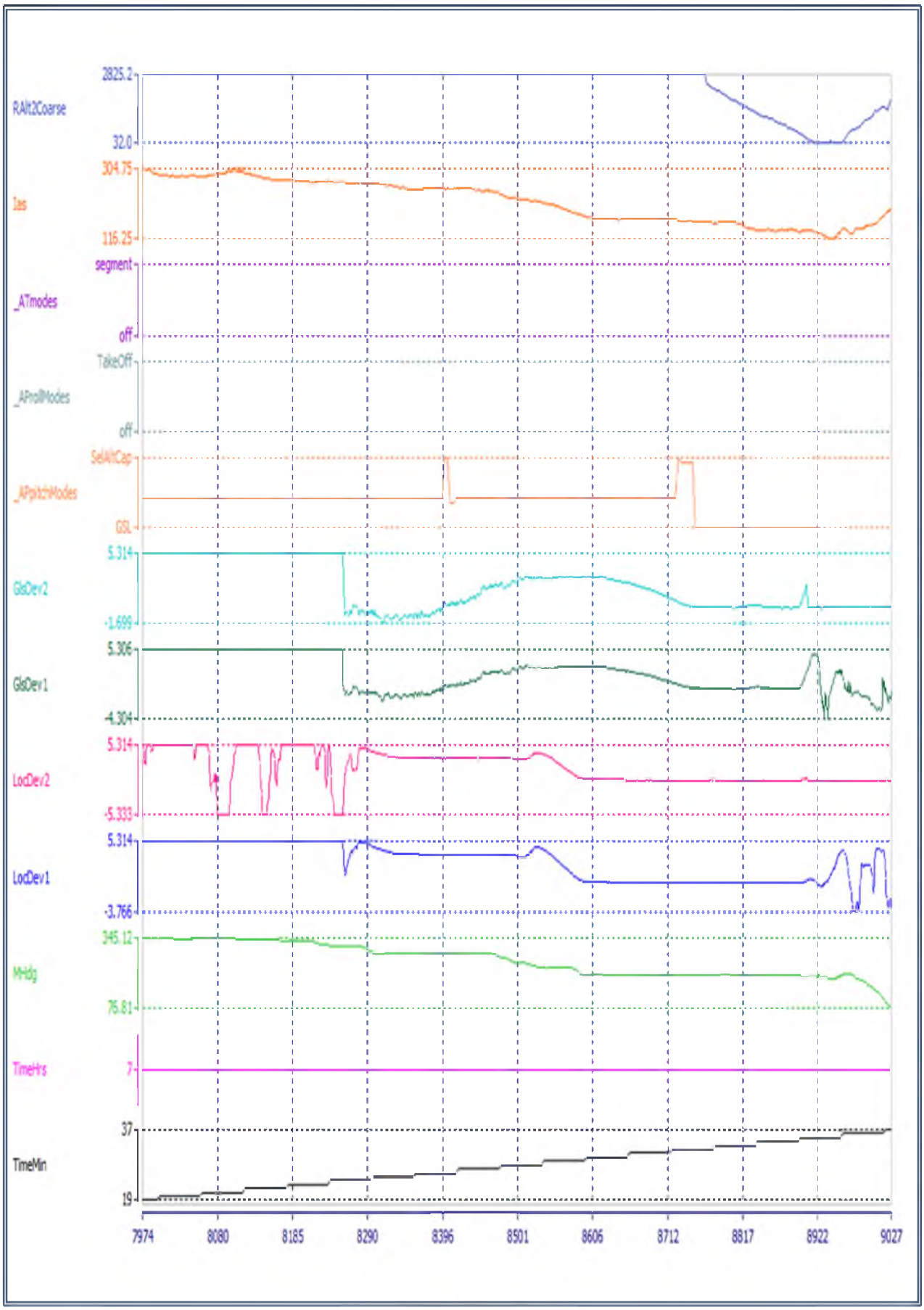

Figure 1a

At 07:33:56 AM, according to the FDR: at altitude 2200ft and speed CAS 140kts, the A/C was fully configured, on the course and glide slope of ILS RW 20 with AP and ATHR ON. All stabilized approach criteria were covered.

Note: *All altitudes in this report are based on the FDR data pressure QNH 1013mb.*

At 07:34:57 AM, FDR data show that the autopilot was ON (AP engaged) and the auto-thrust control is engaged in a "SPEED" mode (A/T Mode "Speed"). Both they working perfect, regardless of whether difficulties and the A/C was in a perfect position in space towards the airport at full interception along ILS RW20. ALTbar 1450ft and ALTradC1/// 469.844ft, Head 200.556°, CAS 136.75kts, deviation from glide GldDev1/// 0, and deviation from course LocDev1/// -0.018. Right then, the co-pilot switched off the active autopilot No.2 and started manually to control the plane, while the auto throttle remained in the "Speed" mode at a set speed of 140kts. Immediately after the manual control, the plane was exposed to strong wind gusts and heavy rain. The co-pilot failed to hold the plane on course and glide. The plane began to deviate to the left of the course, as well as from the glide with aircraft sinking under the glide.

The PIC assessed the situation and took control. He started a correction to the right by banking at 10-13° and increased the pitch in order to keep the descent profile. The Autothrottle remained engaged in the "Speed" Mode with set speed of 140kts and continued to automatically keep that set speed, but despite the increased pitch and engine throttle, the plane kept sinking under the glade, although not so much.

At 07:35:16 AM, the plane was at ALTbar 1122ft (by QNH), hight ALTradC1/// 95.625ft, speed CAS 140.25kts, heading 203.629°, glide deviation GldDev1/// 4.522 and followed the landing direction without deviation, LocDev1/// 0.518.

The approach was totally out of the standards and the required parameters for the stabilized approach, significantly under the glide, but the PIC did not command a "Go-around".

At 07:35:18, on ALTbar 1109ft and ALTradC1/// 85.087ft, CAS 138.75kts, heading 204.747°, glide deviation GldDev1/// 4.521 and landing direction LocDev1/// 0.453, the PIC switched off the automatic thrust control A/T (Autothrottle OFF).

At 07:35:22, ALTbar 1089ft and ALTradC1/58.906ft, speed CAS 135.75kts, heading 200.556°, GldDev1/// 4.542 and LocDev1/// 0.073, the Captain increased the pitch from 4° to 11° without increasing the power of engines with the throttle disengaged, and the plane, at 480 meters before the threshold of RW20 was about 40ft +/- 5ft and flew horizontally at that height for 10 seconds. The speed dropped from 136 to 128kts. Within these 10 seconds, precisely at 07:35:29 AM, the A/C crossed the threshold of RW20, hight ALTradC1 /// 37.422ft, at a speed of CAS 129.5kts, heading 196.123° to the right of the centerline without changing the engine power, while the captain tried to turn the plane to the left.

Extremely concerned about the situation, the co-pilot offered "GO AROUND".

After about 5 seconds and a 350m flight into the runway, the captain commanded "GO AROUND", pressed the "TO/GA" button and started following the flight director arrows, further increasing the airplane's pitch, but not noticing that the thrust control unit (Autothrottle) was still OFF and did not put manually the throttle control in the required take-off position for a"Go Around".

From the height reached above the terrain of 40ft to 480m before the threshold of RW20, until the decision for "Go Around" at 350m in the runway, the A/C traveled a total of 830 m, flying with this minimal engine thrust at close to critical angles of attack, that remained when the Autothrottle control unit was turned off in Speed Mode at the set speed of 140kts. The co-pilot did not pay attention to the position of the throttle controls and speed deviations and did not assist PIC in bringing the engines to a take-off mode.

At 07:35:36 AM, ALTradC1/// 66.328ft, speed CAS 124.00kts, the co-pilot retracted the flaps on the captain's command from 40° directly to 11° (retracting time 17 seconds), and 3 seconds after the beginning of this process started the retraction of the landing gear ALTradC1/// 88.594ft, CAS 118.75kts, (retracting time 6 seconds), armed the GA altitude, selected speed 180kts and disarmed the spoilers.

The speed continued to decrease and at this very moment of retracting the landing gear, at 07:35:44 AM, it reached its minimum of CAS 116.25kts at a pitch of 15°.

Figure 1

Disarming the spoilers, the co-pilot noticed that the throttles were not put forward in the „Go Around mode, informed the captain that the thrust is not set for "Go Around" and got the command to put them into the necessary mode.
At 07:35:47 AM, ALTradC1/// 71.797, CAS 119.5kts, the throttle controls were pushed aggressively forward from EPR 1.3 to EPR 1.9/20. Later on, he additionally move them forward to the maximum. The parameters of both engines reached maximum values:
Left Engine: EPR 2.04, N1 98.5%, N2 99.2%, EGT 609.1,
Right Engine: EPR 2.16, N1 109.7%, N2 103.9%, EGT 645.5
Engine No. 2 reached the maximum values of the parameters and the captain made some adjustments.
At 07:35:50 AM, the angle of pitch and attack had reached their maximum values – 19.8° and 38.6° respectively at ALTradC1///49.922ft and CAS124kts.
During these activities, the aircraft flew another 850 m along the runway. The A/C had flown a total of 1680 m from the beginning of the flight with close to the critical angles of attack on 480 m before the threshold of RW20 to the bringing out of engines up to G/A.
At 07:36:05 AM, ALTbar 1425ft, ALTradC1/// 342.5ft, CAS 141.75kts, Head 209°, the engines thrust was lowered to the normal climb power and then the A/C started to turn left to course 080°.
At 07:38:00 AM, the flaps were retracted from 11° to 0°.
At 07:38:21 AM, the Autothrottle was turned on.
At 07:38:46 AM, the Autopilot 2 was turned on.
The flight to the alternate airport Toulouse and the approach continued without any deviation from the standards. Landing in Toulouse at Runway 32L is at 08:07:04 AM with speed CAS 133 kts, Ny 1.23, GW 56 t and Fuel 6000 kg.
After completing the flight, the captain did not report what happened to the AO management.


BAROMETRIC ALTITUDE
ALTITUDE_computed [ft]
RAD LTITUDE
RAlt1Coarse [feet]
RAlt2Coarse [feet]
IAS
Ias [kts]
MAG HDG
MHdg [Deg]
VERTICAL SPEED COMPUTED
VerticalSpeed_computed [feet/min]
GLIDESLOPE DEV

Figure 1b


GlsDev1 [Dots]
GlsDev2 [Dots]
LOCALIZER DEV
LocDev1 [DOTS]
LocDev2 [DOTS]
AP PITCH MODES
_APitchModes []
AP ROLL MODES
_APermModes []
_AProllModes []
EGPWS
GPWSGlsWarn []
GPWSTerrWarn []
AP Status
extendedata
APStatus []

Figure 1c

2.1.3. Location of aviation occurrence

The aviation event was realized on 16.07.2018 г. at 07:35 AM, on the Tarbes–Lourdes–Pyrénées Airport, France, in daylight. The airport is located 9 km South-West of the town of Tarbes, at the foot of the Pyrenees mountain range.

The control point is with coordinates N 43°11'06" W 0°00'07", an airport altitude of 1259ft (384m).

2.2. Injuries to persons

Injuries	Crew members	Passengers	Other persons	Total
Deaths	0	0	0	0
Serious	0	0	0	0
None	6	136	0	142
Total	6	136	0	142

The passengers and crew did not have any injuries.

2.3. Damage to aircraft

None.

2.4. Other damages

No other damages.

2.5. Personnel information:

2.5.1. A/C Pilot in command

Man	61 years old
License:	BGR. FCL.ATPA Issued on 22.03.2013 by BG CAA Valid until 30.04.2019
Qualifications:	PIC DC9 80/MD88/MD90.
Medical Validity:	Class 1, valid to 31.10.2018
Medical restrictions:	None.
Proficiency in English:	English Level 4, valid to 19.11.2018
Flight experience:	Total flight time: 24200 flt. hrs. Total on the type of A/C: 6100 flt. hrs. On the type of A/C as Captain: 6100 flt. hrs.
Pilot education:	Higher
Specialty:	Engineer pilot.
Assigned minimum on MD80/82:	CAT III A 24.04.2012 LVT 125 m 24.04.2012
Last Prof. Check	Revalid. Prof. Check 10.03.2018
Last Line Check:	13.05.2018
Last course CRM:	Recurrent 07.02.2018

Pre-flight check course on Part 145: 10.03.2018/12.03.2018 total 08:00 hours.

Information on the working hours and rest:

For the last 24 hours:	5:30 flight hours;
For the last 30 days:	90:50 flight hours;
For the last 90 days:	153:25 flight hours.
Rest before the flight:	15:50 hours.
Aviation events until present:	No.

The Commission assumes that the captain has the necessary training and qualifications for his functional duties and that there is no breach of the rules on working time and pre-flight rest periods.

2.5.2. First officer

Man	39 year old
License:	BGR. FCL.CPA

	Issued on 20.01.2015 by BG CAA Valid to 30.04.2019
Qualifications:	COP DC9 80/MD88/MD90/IR/PBN.
Medical validity:	Class 1, valid to 26.05.2019
Medical restrictions:	None.
Proficiency in English:	English Level 4 valid to 04.04.2022
Flight experience:	
Total flight time:	2000 flight hours
On the type of A/C:	1200 flight hours
Retraining on A/C MD80/82:	23.02.2015 – 12.04.2015.
Assigned minimum on MD80/82:	as of 09.06.2016 CAT IIIA DA 50ft RVR 200m LVT 125m
Last check Prof. Check:	Revalid. Prof. Check 20.04.2018,
Last check Line Check:	27.05.2018
Last course CRM	Recurrent 07.02.2018
Pre-flight check course on Part 145:	19.04.2018/20.04.2018 total 08:00 h.
Information on working hours and rests:	
For the last 24 hours:	5:30 flight hours;
For the last 30 days:	86:55 flight hours;
For the last 90 days:	145:10 flight hours.
Rest before the flight:	15.50 hours
Aviation events to present:	None.

The Commission assumes that the co-pilot has the necessary training and qualifications for his functional duties and that there is no breach of the rules on working time and pre-flight rest periods.

2.6. Aircraft Information

2.6.1. Airworthiness Information

Type:	MD - 82;
Registration:	LZ-LDM;
Factory number:	53228;
Owner:	AO "Bulgarian Air Charter;
Manufacturer/date:	BOEING / 25.01.1995

Overhaul resource: Operated according to the approved Maintenance programme;
Total flown hours and cycles: 36184:40 hours and 26780 cycles to 16.07.2018 as per the Technical logbook page №144024 before take-off from Catania Airport;
Total resource: Operated according to the approved Maintenance programme;

Certificate of Registration:	No. 2286, issued by BG CAA, 19.06.2010;
Certificate of Airworthiness:	No. 2286, issued by BG CAA, 18.11.2011;
Certificate of Airworthiness validity check:	No. 2286, issued by BG CAA, 16.12.2016

Last periodical maintenance check: 2A Check, performed on 13.06.2018, based on record No. 6750-A-18, after which the A/C flew 180:35 hours and had 106 landings;
Last operational maintenance: Pre-flight check (Daily Check) is performed on 15.07.2018;
Engines JT8D-219;
Resource and service life: Operated according to the approved maintenance programme.
AO Bulgarian Air Charter operates the A/C as of 26.06.2010.
Within the operation period, the operational and periodical maintenance of A/C is done in periods and volume according to the Maintenance Programme for the MD 82/83 (MSG-3) aircraft, Revision 08.03.2016.
Before take-off from the Catania Airport, the PIC performed the preflight check and it was recorded in the technical logbook.
The AO has a valid Certificate for maintenance as per EASA PART 145 APPROVAL REF. No.: BG.145.0004 to the date of the aviation event.

The total fuel quantity after landing from a previous flight to CTA airport, with which the crew accepted the aircraft before departure was 2800 kg according to the record in the TLB page № 144024/ 16.07.2018.

At the CTA Airport, with 2800 kg fuel left, 17 303 l fuel was added with relative density 0,793 under document 0011468, registered in TLB page 144024, i.e. the total fuel on board of the aircraft before departure was 16 521kg.

The documents show that the aircraft before taxiing was with 16050kg of fuel (15850 before take-off + 200kg for taxiing). This was registered by the PIC in the TLB page №144024, but according to the same documents, the actual total fuel at the stand was 16521kg, or with 200kg for taxiing, the TAKE-OFF FUEL was 16 321kg, which is by 471kg more than the entry and this, in turn, means that the TAKE-OFF WEIGHT ACTUAL for the flight was actually 64 661+471=65132kg at MAX 66 678kg, and the landing weight is respectively: LANDING WEIGHT ACTUAL 56 861+471=57 332kg at MAX 58 060kg.

According to reviewed documents, all A/C systems and the engines were supplied with the required fuel, oil and hydraulic quantities, special liquids and gases for operating the flight and the A/C departed Catania Airport without any technical failures or defects.

The take-off mass and balance of the aircraft for the last flight was within standards, regardless of the mistake in fuel registration with 471 kg difference, and there were no remarks on the performance of all aircraft systems and engines in the process of taxiing, take off and throughout the flight. The parameters of engines and aircraft systems performance in the DFDR correspond to the established limits.

The Committee assumes that the maintenance of the A/C was done according to the established standards. The A/C and all its systems had the required resources for performing the flight.

2.6.2. Aircraft characteristics

Figure 2

The MD-82 aircraft, serial No. 53228, registration LZ-LDM, is a twin-engine jet airplane, designed to carry passengers on short-to-medium range sectors. The A/C is metal construction, single-aisle plane with low arrow-shaped wings, and two rear fuselage-mounted engines, with T-shaped construction of the tail, semi-monocoque fuselage with a retractable landing gear (see Figure 2).

The T-shape construction of the A/C tail panels determines its specific aerodynamic features in the specific situation.

The maximum take-off weight of the aircraft is 66 678kg. The empty weight of the aircraft is 37 480kg.

Upon take-off from CTA airport, the take-off weight of the aircraft was 65 132kg, which is below MTOW and the CG was within limits.

The aircraft weight at the approach for landing on LDE airport was 57 332kg, also below MLW.

There were no aviation events with this aircraft, affecting its structural integrity, its systems, and its engines in the time of its operation from the beginning of exploitation until now.

2.6.3. Information on the used fuel.

By the recordings in the Technical Logbook page No. 144024, completed before the flight of the event, the aircraft has 16 321kg of fuel, aviation kerosene JET A1.

The amount of fuel quantity, his type and quality are not relevant to the event.

2.7. Meteorological information

The meteorological observations of the actual weather at the LDE airport are carried out by an automatic monitoring station.

The automated aerodrome meteorological station automatically performs remote measurement and processing of the following meteorological values for both directions of the runway: wind speed and direction, visibility (MOR), runway visual range (RVR), base of clouds, temperature and air humidity, atmospheric pressure, as well as automatic data processing of visual observations for cloudiness (clouds amount and shape) and other adjustments that can be manually entered. The results of the observations are given on the weather display. To ensure the airport minimum for approach and landing, automatic updating is done every minute for the current parameters – surface wind, visibility (minimum at the beginning, middle and end of the relevant runway), base of cloud, the temperature, the air humidity, and atmospheric pressure.

The Commission analyzed the following meteorological data at the aerodrome during the flight event: airport flight meteorological instruction, preflight meteo information received by the crew at the CTA airport, the actual weather, forecast, ATC explanations about the weather at the time of the occurrence, explanation by the PIC, explanation from the co-pilot of the A/C, explanation by the three members of the cabin crew, data from the DFDR, the Certificate of suitability of the measuring meteorological equipment at LDE Airport, manufacturer, warranty maintenance and the last check for accuracy of measurement of all parameters.

MTO data from 16.07.2018/06:00 AM UTC

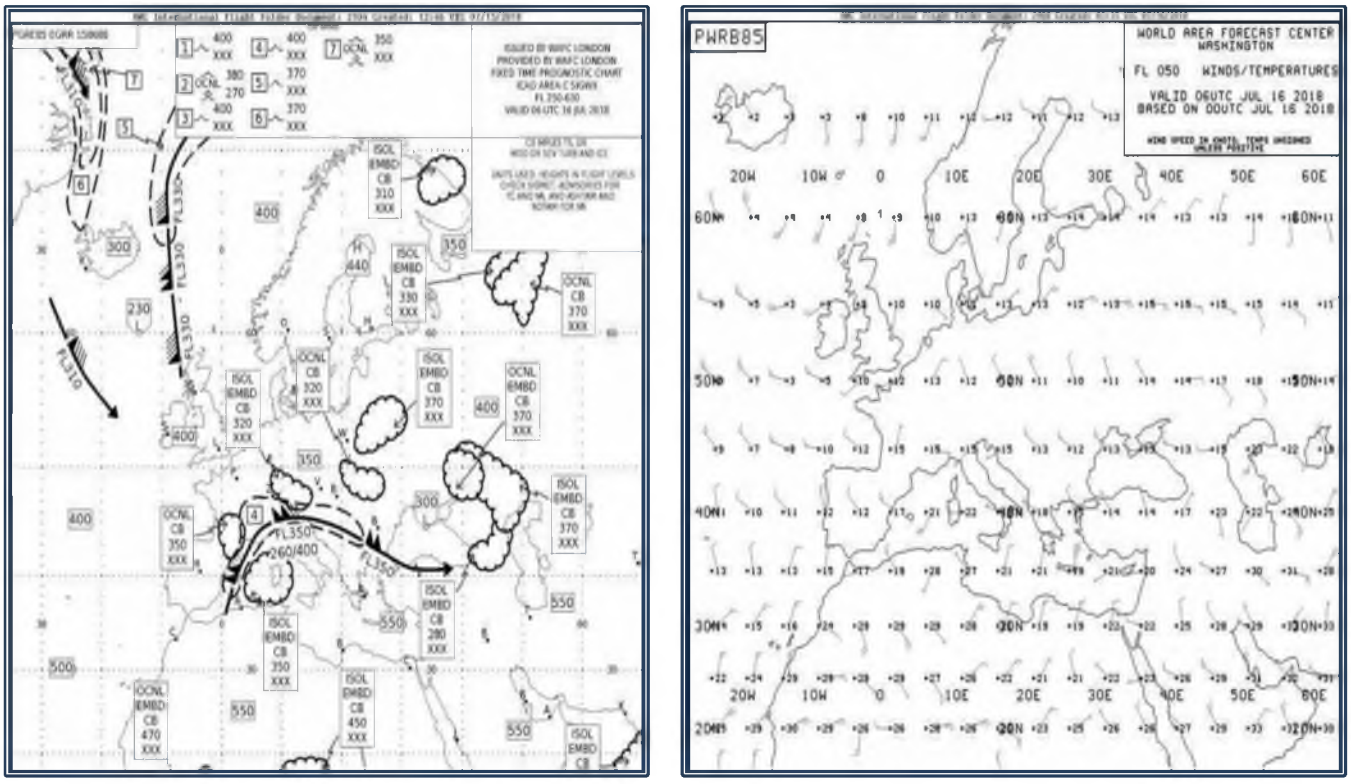

Figure 3

The information, given by the airport shows that the weather during the aviation event was significantly complicated:
Precipitation is intensifying in the Southern part of the country. There have been reports of thunderstorms in the Tarbes area with peak values at flight level FL350. The wind power at FL50 flight level is heading North at a speed of about 5kts. It should be noted that account is not taken of the possible gusts of wind in the information.

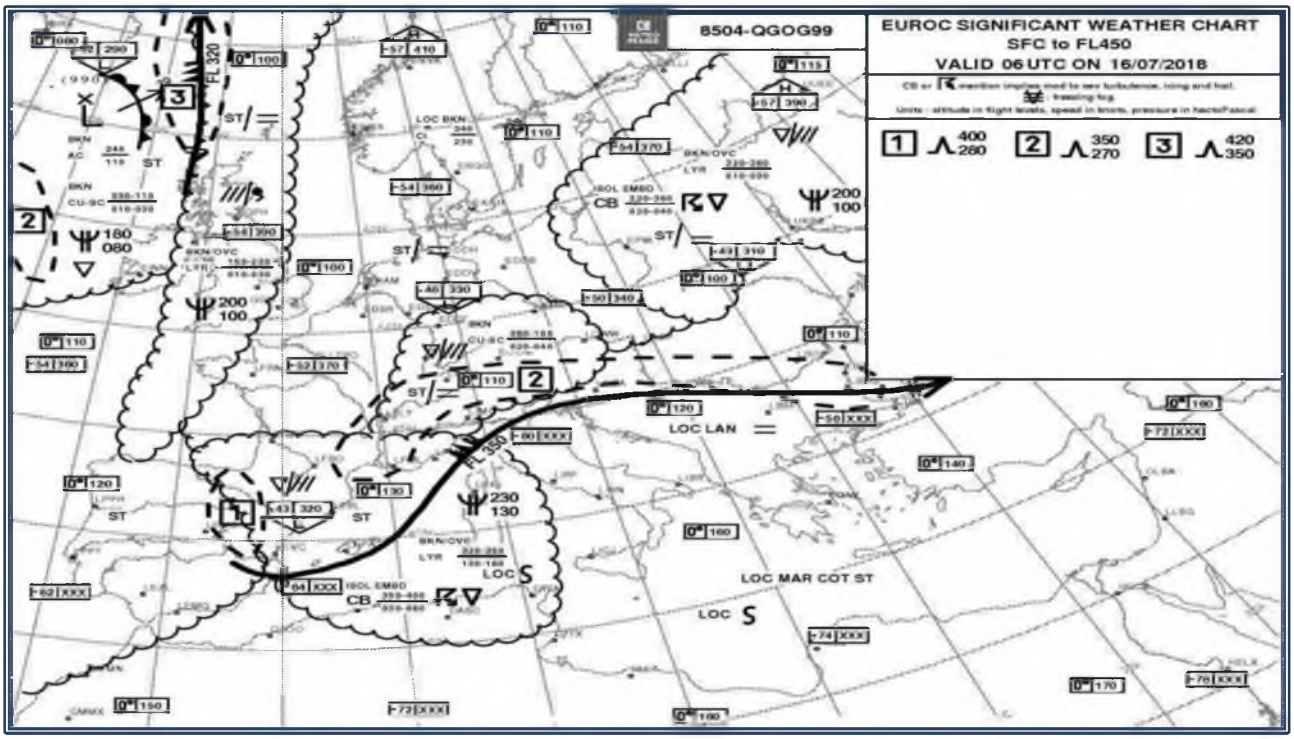

Figure 4

The map shows thunderstorms in the Southern part of LFBB, LFMS and part of the flight information area in the Mediterranean region. The expected maximum values are between FL350 and FL400, which implies more advanced and intense storms.

METAR, TAF and SIGMET:

1. METAR – 07:08 UTC

LFBT 160708Z 1606/1706 27008KT 9999 BKN020 TEMPO 1606/1610
28020G40KT 1300 TSRA BKN007 BKN040CB PROB40 TEMPO 1610/1615
28015G25KT SHRA BKN014 SCT035TCU=

2. METAR – 07:08 UTC

You can see the thunderstorms near the airport. At 07:30 AM, the storm influences the weather above the airport with decreased visibility (4500m).

LFBT 160700Z AUTO 25007KT 220V290 9000 RA VCTS FEW011///SCT034/// BKN045///
///CB 17/16 Q1018 TEMPO 28020G40KT 1300 TSRA
BKN007 BKN040CB=
**LFBT 160730Z AUTO 20010KT 4900 +TSRA BR FEW020/// BKN025///
BKN032/// ///CB 17/16 Q1018 TEMPO 28020G40KT 1300 TSRA BKN007
BKN040CB=**
LFBT 160800Z AUTO VRB05KT 6000 R20/1100U TSRA FEW011///
BKN018/// OVC024/// ///CB 16/16 Q1018 TEMPO 28020G40KT 1300 TSRA
BKN007 BKN040CB=

WSFR32 LFPW 160651
LFBB SIGMET 7 VALID 160700/160800 LFPW-
LFBB BORDEAUX FIR/UIR EMBD TS OBS AT 0650Z WI N4715 E00015 - N4715 E00200 - N4630 E00300 - N4215 E00230 - N4300 W00145 - N4430 W00145 - N4445 E00100 - N4715 E00015 TOP FL380 STNR NC

Figure 5

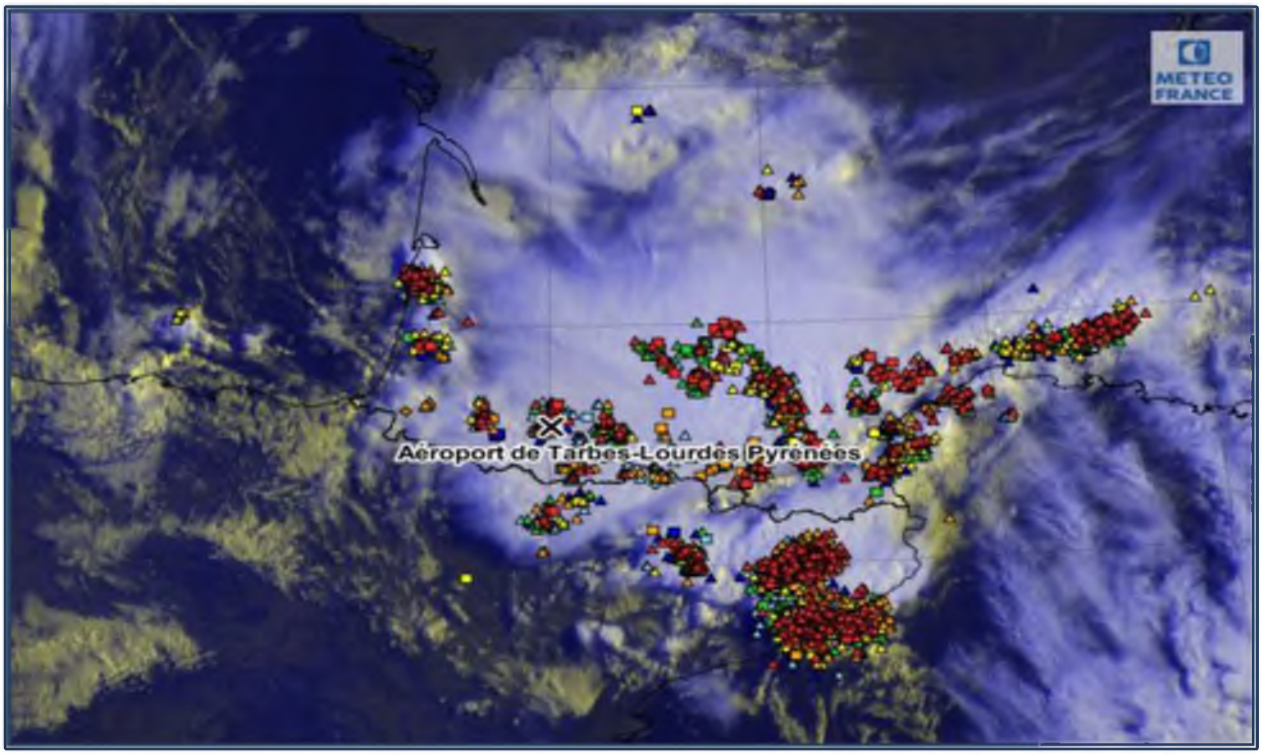

Figure 6

Figure 7

The picture shows the radar mosaic of conditions (in color reflection) with the lightning spots (orange-red symbol) at 07:30 UTC.

When zooming the picture around the airport area, we see a significant intensity of conditions in the Northern area of the airport.

The storm, coming from the West, continued its route to the East with an average wind speed of approximately 15kts. The surface wind direction being unstable over the airport (between 100° and 260°). The intensity of precipitation in the storm was significant, with an average of 60mm/h with a maximum of 78mm/h for about 20 minutes with a large number of lightning strikes in the area and 3 lightning strikes over the airport.

The Commission assumes that the meteorological situation has a direct impact on the flight in the area of the airport.

2.8. Navigation systems

At the time of the aviation event, the ILS CAT1 for RWY 20 was in force.

The last ILS ground check was performed on 07.04.2018. The parameters according to the inspection complied with the operational requirements and the system was recognized as fit to ensure flight safety without limitations of accuracy on course and glide. A flight inspection was performed on 19.04.2018 by the aircraft laboratory, equipped with the necessary equipment for control and adjustment of the system.

All of the airport navigation light systems have worked normally during the aviation event without interruption and switching to backup power mode. The last technical inspection was completed on July 11, 2018.

The Commission found that the navigation systems and the ATM facilities at the airport until, during and after the aviation event were operational, failures or back-up power supply did not occur.

The MD-82 aircraft, with registration number LZ-LDM is equipped with standard navigation equipment to perform an ILS approach on Runway 20 at the LDE Airport. By crew information and following the records in the technical logbook, the aircraft's navigation systems have worked normally under the technical requirements.

2.9. Communication systems

For the communication between A/C and ATC at the LDE airport, the standard two-way VHF radio communication was used, respectively at a frequency of 128.8 (Approach) and 119.05 (Tower). The radio communication was in English. The radio communication systems on both the aircraft and the airport had worked steadily and normally during the aviation event.

2.10. Airdrome information

The Tarbes–Lourdes–Pyrénées Airport is located at the foot of the Pyrenees Mountains (South Pyrenees Park), at the same distance halfway between the two cities of Tarbes and Lourdes, from which its full name (the names of the two cities and the name of the park) originated. It has an asphalt runway 02/20 with a length of 9821ft/2993m and width of 148ft/45 m.

Figure 8

2.11. Flight recorders

The DFDR data was decoded and analyzed by the Commission. Cockpit CVR data was auto erased and not able to be listen for the investigation purpose.

2.12. Information about the impact and the debris

The airplane had no contact with the ground at the time of the event and was not damaged.

2.13. Medical and pathological information

There are no consequences for the passengers and crew in the event, so medical and pathological research has not been performed.

There is no evidence that physiological factors or loss of ability have affected the crew's operational capability.

2.14. Fire

There was no fire at the time of the event.

2.15. Factors for Survival

As a major survival factor in the critical situation which the crew allowed to happen – height 33ft above the ground level, speed 116kts, and pitch 20° without power for "Go Around" for 1860m with

close to critical angles of attack, the Commission accepts the position of the throttles above idle at the moment before the auto throttle was turned off in SPEED mode at a set speed of 140kts.
Secondly, the Commission takes the corrected actions of the two pilots to break out of the critical situation as a factor for survival.

2.16. Tests and research

For the safety investigation, the following activities were carried out:
1. Research of the written reports on the aviation event, given by the ATS FC, LDE airport;
2. Research and analysis of the operational documentation of the A/C;
3. Analysis of the aerodynamic characteristics and the performance of the A/C;
4. Decoding and analysis of the DFDR;
5. Logical-probabilistic analysis of the possible causes for the realization of the aviation event.

Point 1: Investigation of the written reports on the aviation event, given by the ATC at LDE airport:
The notification for the aviation event is provided by ATC at LDE airport. As can be seen from the citation of the dispatcher's report and other people from the shift, they were "terrified" by the approach and the things, which happened, expecting the plane to crash at any moment. BEA was immediately notified in writing, after which the case was classified as a "serious incident" and handed over to the AAIU of the Republic of Bulgaria.
The report reads:
"One A/C MD82 of a Bulgarian company was performing an ILS approach for RW 20 around 09:30 AM, local time. The weather was stormy, very rainy, but the wind was weak. Given the meteorological conditions, we expected the plane, we expected to see it coming out of the cloud layer, and finally, we saw its lights being too low and too far. Thus, the plane would land at about 500 m before the threshold of the runway and to the extreme left of the runway (probably wind shear). The plane tried to return to the RWY axis, and its wings were low, over the threshold of the Runway, it retracted the landing gear to make a Go-Around.
Then the plane quickly came with a high pitch in attempt to climb, but the speed was low. The aircraft flew over the entire runway with abnormal high pitch, with a tail at 20 m from the ground, unable to climb and even lost some altitude. Total horror, we almost saw the plane collapsing at the end of the runway, with the same configuration as Airbus in Hamsheim. Then, at the end of the runway, and with this high pitch, it managed slowly to climb, flew very close to a hill, turned left, and was radar vectored to head North again. The plane then went to Toulouse, where it landed and in a few hours returned to us again."
On the grounds of this report, the local Flight Safety Unit prepared an official report with their analysis of the aviation event, which was submitted to BEA and sent to the Commission respectively. The report is included in the materials of the investigation.
The ATS flight investigation and analysis of the aviation event is fully covered by data from the DFDR on board the A/C, and the Commission, therefore, concludes that there is no reason to seek an objective technical failure of the Airport navigation systems, as well as the aircraft systems as an objective reason for the realized aviation event, which will be clarified below.
Point 2: "Investigation and analysis of the operational documentation of the A/C" – The results are set out in paragraph 2.6. of this report.
Point 3: "Analysis of the aerodynamic characteristics and the performance of the A/C", the Commission examined two aspects of the issue:

The first aspect – the positive influence of the "clean wing" with the rear location of engines on the A/C in the specific critical situation and
The second aspect – the "T-shaped" tail of the A/C as a negative influence.

Comment on the first aspect:
All rear engine airplanes have an advantage compared to the airplanes with engines on pillars under the wings, due to the fact that the flow tearing off at the same angles of attack will come later due to the cleaner surface circulation of the slat, wing, and flap, which, in the situation, a flight without the necessary thrust and with great angles of attack, was critical.
Comment on the second aspect:

A significant drawback of this type of T-shaped tail design of the A/C is that, to some extent, depending on the wing area and the tail panels of the aircraft, there is a marked shadowing on the tail panels and the controllers by the wake of the wing at high angles of attack. This shadowing is a very dangerous phenomenon and is known as a "deep stall".

The deep stall is characterized by two consecutive, energetic pitch-ups – two energetic pitches that ultimately lead to uncontrollable aircraft in the second pitch-up. At both the pitch-ups, the aerodynamic focus of the airplane moves and the airplane decreased, partially recovered for a short time, and then decreased again and completely lost its longitudinal stability.

In all tests to study this phenomenon, it was found that at the first pitch-up with a pitch angle of about 20°, the flow wake gradually spread almost all over the wing, the aircraft was still controllable, and with extreme and vigorous rudder commands, it could, for a short time, continue the horizontal flight without descent, as the aerodynamic focus went back again and the longitudinal stability recovered instantaneously within a range of high angles of attack. The second pitch-up was caused by a loss of efficiency of the horizontal stabilizer, which was already in a highly disturbed flow and did not work – the output was fatal.

The Commission can assume with sufficient probability that the airplane was close to the first phase of this phenomenon, but this limit was not reached with the MD-82 airplane at the LDE Airport. Retracting the flaps from 40° to 11° led for a short time to reducing the drag, but, at the same time, reducing the surface of the wing at a critical moment, partially retracting the slats, further increasing the angle of attack to preserve the horizontal flight, as a result the drag increased again without the necessary thrust to compensate the resistance together with the A/C weight. At this point, the aircraft reached the limit of the wake almost all over the wing but did not pass it. This is evident from the DFDR where the retracting of flaps was accompanied by an altitude change from 33 to 107ft, then the aircraft again lost height, increased the pitch and went down to 50ft.

The crew's awareness that the airplane did not have the necessary engine thrust and advancing them into a GA mode at the last moment determines the favorable outcome of the situation.

Point 4: Decoding and analysis of the DFDR:

As explained above, in section 2.1.2, the PIC did not report what happened to the AO management and the maintenance staff on landing immediately, which did not allow the CVR data to be downloaded, listened to and analyzed to a full clarification of the situation in the aircraft cockpit.

However, the FDR data is provided for analysis to the Commission and serves as a basis for clarifying the actual time, place and configuration of the aircraft. In point 2.1.2. of this report, the parameters of the recording are given in minutes, seconds and all the necessary clarification of the actual situation.

Point 5: A logical probability analysis of the possible causes for the occurrence of the aviation event will be presented below in chapter 3. of this report.

3. Analysis

The safety investigation commission considered the following major hypotheses for possible causes that have led to the serious accident:

First hypothesis: An aircraft control system failure or other technical failure affecting the performance of the aircraft, especially its manageability, after switching off the autopilot and transferring to manual control.

Second hypothesis: Unfavorable meteorological phenomena, resulting in a sudden change in the aircraft trajectory during the landing approach.

Third hypothesis: Pilots negligence in the flying technology and CRM that led to the violation of standard operation procedures.

1. About the first hypothesis – technical failures, the Commission analyzed the airplane documents and FDR decoded data. There were no deficiencies in aircraft maintenance and technical failures that could affect aircraft control capability.

2. About the second hypothesis – unfavorable meteorological phenomena. According to the weather report provided to the flight crew before departure, the situation at the landing airport allows flight to be performed with attention to the crew for a possible weather worsening:

METAR LFBT 160400Z: 28009KT 9999 -RA VCTS FEW042/// OVC076///CB 19/17 Q1015 TEMPO 28020G40KT BKN007 BKN040CB=
TAF AMD LFBT 160318Z 1603/1624 27008KT 9999 BKN020 TEMPO 1603/1609 28020G40KT TSRA BKN007 BKN040CB PROB30 TEMPO 1609/1612 28015G25KT SHRA BKN014 SCT035TCU=
The take-off, climb and cruise of the flight were done in a care-free manner, in good weather conditions.
In the area of Barcelona, shortly before the top of the descent, the aircraft begun avoidance a large cloudy system with CB activity. During the descent, the airplane was in moderate turbulence and strong icing conditions down to FL100.
At and below FL 100, the aircraft came out of a dense clouds and the crew performed final preparation and briefing before landing. The landing decision was taken based on the current meteorological information:
METAR LFBT 160700Z 25007KT 220V290 9000 RA VCTS FEW011///
SCT034/// BKN045/// ///CB 17/16 Q1018 TEMPO 28020G40KT
1300 TSRA BKN007 BKN040CB=
There were scattered clouds in the airport vicinity with ground contact. With a left turn, the crew intercepted ILS RWY 20, keeping visual contact with the RWY throughout the approach. The approach to the height of 500ft AGL was stabilized.
At 460ft above the ground, the flying pilot switching off autopilot and continued the approach manually. At 380ft, the airplane experienced a strong gust of wind and floods with heavy rain. The aircraft drifted to the left of the course for landing. The co-pilot failed to correct the deviation in the course and glide in due time.
3. About the third hypothesis – mistakes in flying technology and crew coordination.
The Commission has requested and analyzed the explanations of the two pilots, read and analyzed the data of the DFDR. Meanwhile, the CVR data was deleted because AAIU received the information about the event late, and the cockpit conversations could not be analyzed and restored to 100%. With approximate accuracy, it can be assumed that:
The flight, from the switching-off of the autopilot by the co-pilot and transition to manual mode, was normal and in full compliance with the standard operating procedures of the airline operator. So far, the aircraft had been flying on localizer and glide path, which confirms that it was fully up and the navigation equipment at the airport has worked flawlessly.
After the sudden deviation of the aircraft to the left of the localizer and the ill-timed warding off by PF, the aircraft was outside the range of stabilized approach criteria and the PF should have to begin a Go-around" immediately. Instead, the Captain took over the control of the airplane but continued the landing approach to land by completing a course correction to the right. At 250ft, the airplane started to sink and went down under the glide path. The Captain, now PF, raised the nose to correct the loss of height by continuing the maneuver to come back to the localizer. Despite the nose lifting, the aircraft continued to lose height, and, at 80ft, the PIC aggressively commanded an increase in pitch, shut down the Autothrottle and succeeded in performing a horizontal flight at 46ft above the ground, at a distance of 480m from the threshold of the runway. At the same time, the airplane began to drift to the right of the localizer. The airplane crossed the threshold of the runway at a height of 35ft to the right of the RWY axle, while the PIC attempted to make a turn it back to the left.
Extremely concerned about the situation, the co-pilot, now PNF, offered "GO AROUND". After about 5 seconds, and overflying 350 meters into the runway, PIC commanded, "GO AROUND" and began to increase the airplane pitch. The co-pilot retracted the flaps from 40 to 11 degrees, saw that the altimeter height started to increase, as well as the positive value of the vertical speed and reported "Positive rate". PIC commanded "Gear Up". The co-pilot retracted the landing gear, "armed" the next altitude for a GO AROUND, set the speed to 180kts and "disarmed" the Speed brakes. During all this, after taking control when PIC switched off the Autothrottle, the aircraft was operated in a mode, close to "idle power" (IDLE) for 29 seconds without the necessary engine thrust to provide the speed. During the "disarming" of the Speed brakes, the co-pilot noticed the abnormal position of the throttle controls and found that these were not in "TOGA" position. He immediately asked the Captain if he

had put the engines in the "TOGA" mode and received a command to push forward the throttle control. He energetically pushed the throttle control forward to stay and the second engine reached the following maximum values of the parameters: EPR 2.159, N1 102.657%, N2 103.871% and EGT 645°. PIC immediately intervened and corrected the mode of the engines.
During the decision and execution of the "Go-around" procedure, the aircraft flew another 850 meters along the runway, with its height on the radio-altimeter up to 33ft, smoothly rising to 107 and again down to 50ft. The pitch reached 20 degrees, and the CAS speed dropped to 116 knots.
Once the aircraft started to climb, the A/C crew carried out the "Go-around" procedure described in the Lourdes Airport scheme. They performed a holding pattern above TEPTI and, after an assessment of the current meteorological conditions, decided to go to the alternate airport Toulouse (LFBO). The approach and landing in Toulouse were normal.
Conclusion:
The Commission assesses the crew actions as inadequate to the procedures of the AO "Bulgarian Air Charter" and considers that with these actions, the flight crew contributed to the development of the situation to a critical safety hazard, such as:

1.Under the conditions of a sudden change of weather – heavy rain and gusty wind, which led to the destabilization of the approach, the A/C crew did not make a timely decision to "Go-around".

2. When completing the "Go-around" procedure, PIC as PF, whose attention was focused on bringing the aircraft to the runway central line and the very landing, did not put the engines in TOGA mode. The co-pilot as PNF, did not control the position of the throttle, the thrust mode and the speed, and did not promptly alert the PF that they had reached critical values.

3. The flight crew was under severe stress due to the extremely unfavorable meteorological situation and the unexpected deviation from the localizer and glide path.

Given the above, we can accept the following main reason:
Pilots' mistakes in the fling technology and crew coordination in the presence of adverse weather conditions during the landing approach and the "Go-around" stages at the Tarbes-Lourdes-Pyrénées Airport, France.

4. Conclusion

4.1. Findings

As result of the investigation, the Commission made the following conclusions:

1. Aircraft MD-82, serial number No. 53228, registration LZ-LDM, has valid:
   - Registration Certificate No. 2286, issued on 19.06.2010 by the DG CAA of the Republic of Bulgaria
   - Airworthiness Certificate No. 2286, issued on 18.11.2011
   - Certificate of Airworthiness validity check No. 2286
2. The airplane is operated by the AO Bulgarian Air Charter as of 26.06.2010
3. During the operation period, the operative and periodical A/C maintenance are done within the time limits under the "Maintenance Programs of the MD82/83 aircraft (MSG-3), Revision 08.03.2016".
4. At the date of the aviation event, the airline operator has a valid AOC under EASA PART 145 APPROVAL, REF. No.: BG.145.0004.
5. All aircraft systems and engines were refilled at the departure airport with the required quantity of fuel, oil, hydraulic liquid and gasses for the normal flight operation.
6. The take-off weight and balance are within the limits, regardless of the mistake in the recording of fuel with a difference of 471kg.
7. There were no remarks on the operation of all airplane systems and engines during all the flight.
8. The engines and airplane systems parameters, according to the FDR data correspond to the established operational modes.
9. The maintenance of the A/C was carry out according to the established standards.
10. The A/C and all its systems were with the required time limits for the flight.
11. The Actual landing weight at the LDE Airport was 57 332kg.

12. There were no other aviation events with the A/C affecting its structural integrity, its systems and its engines during its operation from the beginning of operation until the time of this serious incident.
13. The takeoff fuel from the CTA Airport was 16 321kg fuel and actual take-off weight was 65132kg.
14. The altitude FDR data are given on pressure QNH 1013mb.
15. The autopilot and engine thrust control in the "Speed" mode (A/T Modes "Speed") operated properly and the aircraft was in a perfect position in space compared to the airport at a moment of full capture of ILS RW20 on ALTbar 1450ft and ALTradC1/// 469.844ft, Head 200.556° at a speed of CAS 136.75kts.
16. The co-pilot was not able to hold the aircraft on the localizer and glide after switching off the autopilot.
17. After switching off the autopilot, the approach was totally outside the standards and the required parameters for a stabilized approach.
18. The PF (Co-pilot) did not initiate a go-around meneuvre.
19. The Captain took over control of the A/C from the co-pilot during the aviation event.
20. The Captain decided to continue the approach and did not command "Go-around".
21. The Captain did not operate the aircraft appropriately.
22. The co-pilot as PNF did not monitor the speed, height and engine parameters after the transfer of duties.
23. From the moment of reaching the height of about 40ft over the terrain to 480m before the threshold of RW 20, to taking the decision for Go-around at 350m further in the runway, the A/C flew at close to critical angles of attack with the engine mode set after the switching off the auto throttle in "Speed" Mode with a set speed of 140kts.
24. The Captain (PF) switching OFF the AT.
25. The co-pilot did not monitor the position of throttles and did not help PIC.
26. The aircraft speed reached CAS 116.25kts at pitch 15°.
27. The maximum values of pitch had reached 19.8° at ALT 50ft and CAS 124kts.
28. The total distance, flown by the aircraft from the beginning of flight with close to critical angles of attack at 480m before the threshold of RW 20 to the increasing the engine speed, was 1680m.
29. The PIC did not report the event to the AO Management.
30. The CVR data was not used during the investigation.
31. There is no evidence that physiological factors or loss of ability have affected the crew's operational capability.
32. The flight did not end fatally because the position of throttle was left as the mode of the engine was during the descent, before the switching off the Autothrottle, in the "Speed" Mode with a set speed of 140 kts.
33. The investigation and analysis of the aviation event by the Flight Safety Unit of ATS coincide with the DFDR data on board the A/C.
34. The A/C reached the limit of the wake almost all over the wing but did not pass it.
35. The crew's awareness that the airplane did not have the necessary engine thrust and putting them into a GA mode at the last moment determines the favorable outcome of the situation.
36. Without the CVR data, cannot throw light on the actions and interaction of the crew.
37. The weather conditions during the aviation event are significantly complicated.
38. The weather directly affected the approach.
39. The weather is the cause for the beginning of the aviation event.
40. The navigation systems and the Airport ATS to, during and after the aviation event were operating; there were no power failures or switching back-up power.

4.2. Causes

On the grounds of the analysis made the Commission points out that the serious accident is the result of the following cause:

Pilots mistakes in crew coordination and in flight technology in bad weather conditions during the landing approach and the go-around procedures at the Tarbes-Lourdes-Pyrénées Airport, France.

5. Safety Recommendations

Taking into account the causes of the serious incident and the deficiencies found in the investigation, the Commission recommends that the following measures should be taken to ensure the flight safety:
BG.SIA-2018/08/01. AO "Bulgarian Air Charter" must organize and carry out additional theoretical CRM training course, and the A/C crewmembers, who have caused the serious incident, must undergo a flight simulator check.
BG.SIA-2018/08/02. During the next flight simulator training session, all MD-82 pilots of AO "Bulgarian Air Charter" to include an exercise with similar conditions for flight performance as in the case of the serious incident.

On the grounds of Article 18, §5 of Regulation (EU) 996/2010, the safety recommendation issued will be recorded in the centralized European system SRIS (Safety Recommendations Information System).

The Investigation Commission reminds all organizations, to which flight safety recommendations are sent that, on the grounds of Article 18 of Regulation (EU) 996/2010 on Investigation and Prevention of Accidents and Incidents in Civil Aviation and Article 19, paragraph 7 of Ordinance No. 13 on the Investigation of Aviation Accidents are obliged to notify the Air, Maritime and Railway Accidents Investigation National Board in writing of the action taken on the recommendations made.

COMMISSION ON INVESTIGATION OF SERIOUS INCIDENT

Chairman

Mihail Kamenov