

# FINAL REPORT

# For the investigation of the accident of the aircraft PIPER 34 Seneca II, With registry markings D-GLLW, happened on 06.09.2016 in Skopje, Republic of Macedonia

# **Commission for accident investigation**

Version:	0.2
Date:	04.12.2018.
Ref. number:	







# **FINAL REPORT**

For the investigation of the aircraft accident PIPER 34 Seneca II, With registry markings D-GLLW, Which happened on 06.09.2016. in Skopje, Republic of Macedonia

Commission for accident investigation D-GLLW





#### FILE INFORMATION

#### FINAL REPORT Of the accident investigation of the aircraft PIPER 34 Seneca II, With registry markings D-GLLW, which happened on 06.09.2016. in Skopje,

#### Republic of Macedonia

Version:	0.2				
Date:	04.12.2018.				
Ref. number:					
Abstract					
Treviso, PIPER 34 Seneca II, with registry markings D-GLLW, which happened on 06.09.2018 in the area around the village Kozjle, near the international airport Skopje, Republic of Macedonia. In the final phase of approaching to the international airport Skopje, the aircraft fell on the ground, whereupon the pilot and all passengers died.					
The investigation was opened upon the legal obligations of the state where the accident took place.					
The authority of KINSIV is to perform the investigations with its investigators and to prepare a report.					
ן י א	Date:   Date:   Ref. number:   Abstract   cident investigation of th   stry markings D-GLLW, while   iternational airport Skopje, the aircr   egal obligations of the state				

This report can be freely used solely for the purposes of educational processes.

For all additional information, please contact KINSIV.

Contact de	etails:	
KI	NSIV	
"Pa	artizanski Odredi Blvd" no 17A/1-1,	I
10	oo Skopje,	,
R.	Macedonia	

Phone.: +389 71337830 Fax: +389 email: <u>info@kinsiv.mk</u>





#### Aircraft accident and incident investigation committee

The Aircraft accident committee of the aircraft PIPER 34 Seneca II with registry markings D-GLLW, which happened on 06.09.2016 in the area of the village Kozhle, near the international airport Skopje, Republic of Macedonia, has been formed with the decision of the Aircraft accident and incident investigation Committee number 06-91/2 dated form 28.06.2018.

POSITION	NAME, LAST NAME AND SIGNATURE	DATE





#### TABLE OF CONTENT

1.		Introduction	11
	1.1	Flight history	.11
	1.2	Passenger's injuries	.11
	1.3	Aircraft damages	.11
	1.4	Other damages	.11
	1.5	Information about the people in the aircraft	.12
	1.5.1	Aircraft leader – captain	.12
	1.5.2	Passengers	12
	1.5.3	Flight controller	.12
	1.6	Information about the aircraft	12
	1.6.1	Technical data of the aircraft	12
	1.6.2	Maintenance and airworthiness of the aircraft	13
	163	Fuel	13
	164	Mass and balance of the aircraft	12
	1.0.4	Mass and balance of the anchart	11. 11
	171	Sypontic situation	1/
	1.7.1 1 Q	Padio-navigational systems and surveillance systems	+ 1/1
	101	Conoral data	1/
	1.0.1	Jestrumental precedure for landing	.14 1E
	1.9	Data regarding the simpert Skenie	10
	1.10	Data regarding the amport skopje	.10
	1.11	Devices for high recording	.17
	1.12	Information about the accident site	.17
	1.12.1	Accident site	.17
	1.13	Aircraft scrap	19
	1.14	Medical and pathological findings	20
	1.15	Fire	20
	1.16	Survivors	20
	1.1/	Search and rescue – SAR	20
	1.18	Investigation techniques	21
2.		Research and analysis	22
	2.1	Flight performance	22
	2.2	Analysis of the flight history	23
	23	Horizontal and vertical profile	24
	2.3	Movement route of the aircraft	26
	2.1	Meteorological condition	-0 7
	2.5	SVNOP analysis and reports for the adjacent route of the flight of D-GLLW within	- /
	SKUD	IF FIR	77
	252	Analysis of the meteorological satellite charts	<u>,</u> 72
	2.5.2	Analysis of the radar images from the meteorological radar center Topolchani	27
	2.3.3	(YXMP)	28
	2.5.4	Analysis of the appearance of atmospheric electrical discharges	28
	2.5.5	Analysis of METAR reports from airport Skopje (LWSK)2	28
	2.5.6	Conclusion about the meteorological conditions	80
3.		Conclusion	1
	3.1	Findings	1
	3.2	Accident reasons	21
	3.21	Direct reasons	, <u>-</u> 1
	3.2.1		





3.2.2	Indirect reasons	.32
3.2.3	Recommendations	.32
Annexes		33





#### LIST OF TABLES USED IN THE REPORT

Table 1 Review of casualties in the accident and level of injury severity	11
Table 2 Total mass of the aircraft before the flight take off	13
Table 3 Airport data	
Table 4 Meteorological data Gjurishte	27
Table 5 Meteorological data Petrovec	27
Table 6 Meteorological data	30

#### LIST OF IMAGES USED IN THE REPORT

Image 1 Map of the instrumental approach – ILS RWY 34	15
Image 2 Airport map	16
Image 3 Accident site – general orientation	17
Image 4 Accident site – topographic map	18
Image 5 Accident site – cadaster parcels	18
Image 6 Disposition of debris according to sectors	19
Image 7 Vertical profile of the flight	24
Image 8 Horizontal and vertical profile of the flight	25
Image 9 Horizontal path of the aircraft	26





#### LIST OF ABBREVIATIONS AND TERMS USED IN THE REPORT

MAP	Missed Approach Point
LWSK-LIPH	International ICAO marking for airports (Skopje– Treviso)
LT	Local time
LDA	Landing Distances
HP	Horse-power
IMC	Instrumental Meteorological Conditions
IFR	Instrument Flight Rules
ICAO	International Civil Aviation Organization
САА	Civil aviation agency
IAF	Initial Approach Fix
HSI	Horizontal Situation Indicator
GPS	Global Positioning System
F/O	Flight Officer
FH	- Flight hours
FDR	Flight Data Recorder
FC	Flight Cycle
FAF	Final Approach Fix
ELT	Emergency Locator Transmitter
DME	Distance Measurement Equipment
DH	Decision height
CNS	Communication, Navigation, Surveillance
BR	Mist
ATS	Air traffic services
ATIS	Automatic terminal information service
ASDA	Accelerate Stop Distance Available
ARP	Airport Reference Point
ARO	Air Traffic services reporting office
AFC	Airport flight control
AIP	Aeronautical Information Publication
AIC	Aeronautical Information Circulars
AD	Airworthiness Directive





MDA	Minimum descent altitude
MDH	Minimum descent height
MEA	Minimum Enroute altitude
METAR	Meteorological Aerodrome Report
MSA	Minimum sector altitude
MSL	Mean sea level
NDB	Non-Directional Radio Beacon
NM	Nautical mile 1nm=1852m
NOSIG	No significant change
NOTAM	Notice To Airman
OCA/H	Obstacle Clearance Altitude/Height
OKL	Local Flight Control
ОМ	Outer marker
ΡΑΡΙ	Precision approach path indicator
PIC	Pilot in Command
РТО	Program for technical maintenance
PWC	Pratt and Whitney of Canada
QFE	Atmosphere pressure at the airport
QNH	Atmosphere pressure, sea level
ROC	Rate of climb
ROD	Rate of descent
RWY	Runway –take off – lading path
SB	Service bulletin
SID	Standard Instrument Departure
SKC	Sky clear
STAR	Standard Instrument Arrival
SWC	Significant Weather Chart
TAF	Terminal Area Forecast
THR	Threshold
TODA	Take Off Distance Available





TORA	Take Off Run Available		
UHMR	Hydro-meteorological Office (Of Republic of Macedonia)		
USA	United States of America		
UTC	Coordinated Universal Time		
VASIS	Visual Approach Slope Indicator System		
VFR	Visual Flight Rules		
VMC	Visual meteorological conditions		
VOLMET	Meteorological information for aircraft in flight		
VOR	VHF omnidirectional radio range		
ZVP	Law on air flights		





# 1. Introduction

## 1.1 Flight history

The aircraft PIPER 34 Seneca II with license plates D-GLLW, according to the duly announced flight plan for 06.09.2016, has registered flight route from the airport LIPH Treviso-Italy to LWSK Skopje - Macedonia. There is no information on the course of the flight along the route, except for the testimonies of the witnesses from the other two airliners that fly into the group together. According to them, the flight proceeded routinely. The aircraft announced entry into FIR Skopje to the authorized air traffic control where it has been accepted and vectorized by the radar for installation in the instrumental approach for the runway 34. The communication takes place routinely, without any special difficulties (on several occasions there are unclear words by the pilot). The aircraft is visible on the radar screen with all necessary parameters (identification, height, travel speed, direction of movement). The controller flies the aircraft by giving him flying courses and heights to which he should descent. During the flight, the aircraft receives routine weather information on time. Before starting the instrument approach, the controller determines that the aircraft is higher and offers the option of turning a full circle to the right in order to reduce the height in order to properly position the instrumental approach for the runway 34. The procedure is normal and the aircraft establishes the instrumental approach after which it was transferred under the authority of the tower controller Skopje. Immediately after the transfer of jurisdiction, radio and radar connection to the aircraft is lost, after which a search and rescue procedure is started. Parts of the aircraft were found after a search of a location called Kozhle, 14.5 km south of threshold 34 on the runway at Skopje Airport.

## 1.2 Passenger's injuries

Injuries	Crew	Passengers	Total number in the aircraft	Other
Mortal	1	5	6	
Serious				
Light				
No injuries				
TOTAL	1	5	6	

Table 1 Review of casualties in the accident and level of injury severity

The captain, the pilot and 4 (four) passengers were Italian citizens, one passenger was Kosovo citizen.

#### 1.3 Aircraft damages

The aircraft suffered structural damages; it has been dismembered and destroyed completely.

#### 1.4 Other damages

At the accident site, the remains of the aircraft, although widespread on a larger surface, did not cause damage and damage to third parties.





#### 1.5 Information about the people in the aircraft

#### 1.5.1 Aircraft leader – captain

The pilot of the aircraft is a 59-year-old man in good health. He, at the same time, performed several functions at the club as follows:

- o Club president
- o CFO of the club
- o Pilot

Additional information about the pilot:

- 1. Date of birth 28.10.1957
- 2. Total number of flight hours 1.205,14 /hr.
- 3. Total IFR flights 151,14 /hr.
- 4. Last IFR flight before the accident 05.07.2016
- 5. Total number of flight lessons on type PA-34 Seneca II 120,58 /hr
- 6. History of all flights during the last year before the accident 13.09.2015 to 06.09.2016 >> 16,37 / hr.
- 7. Licenses of the type TB9, TB21, PA28R, PA28RT, PA34-200, S.208, P66C, Maule MX7
- 8. Valid license for type, rating SEP/Land until 31.05.2017, MEP/land 31.10.2016, IFR sep & mep 31.10.2016
- 9. Valid IFR rating until 31.10.2016 (MEP & SEP IFR)

#### 1.5.2 Passengers

Passengers on board are 4 (four) male and 1 (one) female passenger.

#### 1.5.3 Flight controller

The air traffic controller is an experienced controller with a valid license and a medical certificate for work at the workplace executive controller in TMA Skopje.

#### 1.6 Information about the aircraft

#### 1.6.1 Technical data of the aircraft

Piper PA 34 Seneca II is a two-engine aircraft with metal construction. He was registered in Germany. The aircraft had seats for four passengers. Manufacturer: Piper Aircraft Type of aircraft: Piper PA 34 Seneca II Production year: 1980 Serial number: 34-8070170 Total weight: 1.470 kg Engine manufacturer: Continental Motors Engine type: Continental TSIO-360E Number of engines: two Approval: The aircraft is maintained according to a base maintenance agreement in accordance with the approved Maintenance Program in Brescia (Italy)





Total flight duration: 1328 hours and 46 min (2008 – 2016)

#### 1.6.2 Maintenance and airworthiness of the aircraft

The club has an agreement with the CAMO organization, which takes care of the regular servicing of the aircraft according to the manufacturer's program. The maintenance is done according to the program.

This aircraft has an incident when landing in a flight in August 2010, with one active engine landed with no lowered alignment, with a structural disruption of the aircraft. The incident caused structural damage to the aircraft and damage to the aircraft's launch units. After the successful repair of the structural disruptions and the launching units, the airplane is issued a certificate of airworthiness by the service organization without any additional observations on the aircraft or recommendations in the airworthiness maintenance program of the aircraft. To return the aircraft to airworthiness after the incident in August 2010, and thus ensure that the servicing is done in the correct manner and all recommendations from the aircraft manufacturer and the manufacturer of the launching units are observed. In the aircraft maintenance program recommended by the manufacturer, no regular overview of structural disruptions from existing ones is provided for in the regular inspections of the aircraft.

#### 1.6.3 Fuel

Before take-off from Treviso the aircraft was loaded with 345 kg of fuel (according to data obtained from Aero Club in Treviso).

#### 1.6.4 Mass and balance of the aircraft

Туре	Mass in kg
Total mass of empty aircraft	1469,70
Total mass of the fuel in the aircraft	345.91
Total mass of 5 male people	404.85
Total mass of 1 female person	68.75
Total mass of luggage in the aircraft	91
	2380.21
Туре	Mass in Kg

#### Table 2 Total mass of the aircraft before the flight take off

Туре	Mass in Kg
Total mass of aircraft before take-off	2380,21
Maximal allowed mass of aircraft for take-off	2072,92
	307.29

The total mass of the empty aircraft was taken from the Weight and Balance report from the aircraft made on 29.09.2011 by Bosio Motori Aeronautica Motichiari-Italy. The mass of the fuel before the flight was obtained on the basis of the statement of Mauro Zabiti - the financial manager of the club owned by the aircraft.





# 1.7 Meteorological data

## 1.7.1 Synoptic situation

Lowering the cold air mass in the upper layers of the atmosphere early on 05.09.2016, leads to the formation of a cyclonic convection at a height (500 hPa) above the northern part of the Balkan Peninsula. The same leads to cyclogenesis in the lower part of the atmosphere, in the mid-Adriatic region. The center of the ground cyclone is moved to the region of southern Italy / Ionian Sea in the period 05.09-18Z to 06.09-00Z, while the altitude zone is moved from the location above the middle Adriatic to southern Italy during the day 06.09-00Z. The formed cyclone, both in height and on the ground, remains relatively stationary in the coming days, but with the most pronounced impact on 06.09.2016.

As of 05.09.18Z, in the next 24 hours, the territory of the Republic of Macedonia is under direct influence on a warm atmospheric front, with clearly defined elements that characterize it.

An analysis of the SYNOP reports was carried out, and it came to the conclusion that during the period from 06.09-00Z to 07.09-00Z, Macedonia's cloud coverage was complete (8/8) with occasional exceptions, but not less than 7/8. The base of the clouds during the mentioned period was generally between 600 and 1500 meters (AMSL), in conditions of stratified (layered) cloudiness. The altitude above the FL100 according to prognostic materials was southeast with speed of around 30 kt.

Between FL 050 and FL 100 the expected (predetermined) airflow according to the prognostic materials and the synoptic situation is also from the southeast direction at a speed between 20 and 25 kt.

The height of 0 ° C isotherm during the day on the territory of Macedonia was about 3,500 meters (AMSL), i.e. between FL 110 and FL 120.

#### **1.8 Radio-navigational systems and surveillance systems**

#### 1.8.1 General data

Radio navigation devices operate in the terminal zone at the Skopje airport:

- o VOR SKJ
- o DME SKJ
- o ILS RWY34 MSK with appropriate markers OM and MM
- o DME MSK
- o NDB PT

Flight control serves the terminal zone with two secondary and one primary radar. During the crash, all radar, navigation and surveillance systems operated normally.





#### 1.9 Instrumental procedure for landing

ILS RWY 34 is the instrumental procedure giving the aircraft landing permission at the Skopje Airport. The ILS RWY 34 instrumentation procedure is published in the Aeronautical Data Collection of the Republic of Macedonia with AIRAC AMD 52, date of publication 30.09.2014 and entered into force on 11.12.2014. With AIRAC AMD 56, published on 17.03.2016, and entered into force on 26.05.2016, the magnetic variation has been changed and the new values are published on the map, while the remaining parts of the instrument procedure remain unchanged.

The ILS RWY 34 instrument procedure was developed in accordance with the rules contained in ICAO DOC 8168, Aircraft operation, Vol I and Vol II.



Image 1: Map of the instrumental approach – ILS RWY 34





## 1.10 Data regarding the airport Skopje

#### Table 3 Airport data

Airport ref. point	021 37 17E 41 57 42N		
Location of the airport ref. point	On the runway, half way		
	between threshold 34		
	and 16		
Above sea level height	238 m		
Magnetic variation	4º E (2013)		



Table 3 Airport data





## 1.11 Devices for flight recording

The aircraft did not have flight recording devices.

#### 1.12 Information about the accident site

#### 1.12.1 Accident site

The accident site itself is part of a wider hilly region that spreads from the river Vardar and the river Pcinja, all the way to the Skopje valley. Relief is a mountainous terrain rising north of the valley of the river Vardar with a distinctively steep slope with a height difference of about 135 meters from the base to the top of the hill and continues to the north with a slight decent in height. The eastern and western slopes end up in streams with occasional watercourses. Most of the surface of the hill is forested with low and middle stubble oak forest.



Image 3 Accident site – general orientation

The wider location of the fall of the aircraft is spatially located west of the village Kozhle with an air distance of about 1.6 km, and north-west of the mouth of the Pchinja River in the Vardar River with an air distance of about 2.1 km.







Image 4 Accident site – topographic map

The place of the fall of the aircraft is located on the shadowy place Dolni Sinodorid in the wider area called Kremenje in the area of the village Kozhle, municipality of Petrovec. It is part of the Skopje administrative region located in the northern part of the Republic of Macedonia.



Image 5 Accident site – cadaster parcels





## 1.13 Aircraft scrap

The remains and parts of the aircraft are widespread on the northern and eastern slopes of the hill to an area of about 2.5 ha. The area on which the remains are spread according to the Geodetic Cadastre Information System belong to the cadaster parcels KP 2013, KP 2017, KP 2018, KP 2019, KP 2020, KP 2021, KP 2026 of the Cadaster Plan with the nomenclature 7I9- 15 in the cadastral municipality of Kozhle.

The greatest distance between the markings of the remains and parts of the aircraft is 290 m in the north-west direction and 90 m in the north-east direction.



Image 6 Disposition of debris according to sectors

The positioning was performed on the found remains and parts of an aircraft that were previously signalized with visible numbered markers and divided into four sectors:

- Sector A with 40 markers;
- Sector B with 11 markers;
- Sector C with 95 markers;
- Sector D with 29 markers.





#### 1.14 Medical and pathological findings

The pathological findings of all persons (captain and 5 passengers) confirm that death is violent and occurred directly, i.e. in a short period of time as a result of multiple injuries to organs and body parts.

#### 1.15 Fire

At the site where the remains of the aircraft were found, there are no traces of fire. There are no traces of burning either on the decayed parts of the aircraft or on the bodies of the victims.

#### 1.16 Survivors

There are no survivors. The captain of the aircraft and all passengers suffered in the accident.

#### 1.17 Search and rescue – SAR

The responsibility and authority of the search and rescue service that is responsible for this accident is under the authority of the Civil Aviation Agency.

The SAR Operations Service within the Republic of Macedonia is located in the CAA, which is also competent to coordinate and undertake the necessary activities in the area of SAR operations.

However, given the staffing in terms of human potential and material technical equipment, it greatly minimizes the role of this segment in terms of time, place and opportunities that this organization can provide at the time of occurrence of this kind of events.

The competence to initiate the procedure for SAR in the Republic of Macedonia has the airport air-traffic control at the Alexander the Great Airport, which they have done accordingly in terms of time and manner of communication alarming the Ministry of the Interior, the Civil Aviation Agency. According to the positive legal regulations in the Republic of Macedonia, the units of the Ministry of Internal Affairs, MoD, CAA are involved in the action for SAR, while the other services are put on standby as the units of the fire department and the health care institutions.

On 06.09.2016, around 17.45 pm, by the flight control officer from Alexander the Great Airport in Skopje, the Police Station for Border Control stationed at the airport, Veliki, was informed that on that date, radio contact with the PIPER aircraft lost at around 17.36 pm (German national designation) at the landing stage. It flew from Treviso Italy, it was announced for landing at the Alexander the Great Airport for fueling, it was reportedly with 6 passengers and around 17.36-17.36 hours it was lost from radar to about 10 km. in the direction of Veles.

The duty officer of the Regional Center North at the Ministry of Interior of the Republic of Macedonia was alerted to the Sector for Internal Affairs Skopje and the Sector for Internal Affairs Veles and it was asked to undertake certain measures and activities in order to refer the field to the appropriate structures of the Mol and other authorities from the Republic of Macedonia in order to find the plane, and take all the rescue measures if a need arises.

SVR Skopje informs the appropriate structures of the Ministry of Internal Affairs, the Special Operations Department to include appropriate units for the realization of the search and rescue operation, the fire department in the city of Skopje, the healthcare organizations - Emergency Aid and the local hospitals, the Directorate for Protection and Rescue and the Aircraft accident and incident investigation committee, represented by the President of KINSIV, Sotir Kostov.

The department for special operations within MOI responded immediately by engaging the Quick Deployment Unit and the Special Task Unit, directing them to the area where the aircraft could be found.





The search zone is divided into two sectors, one in the direction from the village of Katlanovo to Veles, and the second one in the region of the village Kozle and a weekend settlement in the village of Blace where appropriate units from OPE and SVR Skopje have been sent. Due to the complex weather conditions, rainy weather, night hours as well as the terrain that is being searched, the search is difficult, but the units involved in the quest are maximally engaged to find the plane.

A local person from the village of Kozhle informed the units of the SVR Skopje, i.e. the patrol from the Petrovec Police Department that the most likely area where the plane could have fallen is the place called Jasikavec, which is located in a region in the village Kozhle. The area has been confirmed by police officers from police station Petrovec, after the site was located and parts of the plane were identified at the location, and after the remains of victims were identified. Immediately afterwards, the site was secured by the Quick Deployment Unit, which also confirmed that the remains of the plane were found and that there were no survivors. Due to lack of conditions for other activities, and since it was night time, the inspection at the accident site was postponed to start in the morning on September 7<sup>th</sup> 2016.

#### 1.18 Investigation techniques

The Commission used investigation technique, which was recommended by ICAO document 9756 – *Manual of Aircraft Accident and Incident Investigation*.





# 2. Research and analysis

#### 2.1 Flight performance

The aircraft announces its entry into FIR Skopje to the relevant air traffic control where it is accepted and vectorized by the radar for placement in the instrumental approach for the runway 34. The communication takes place routinely, without any special difficulties (in some occasions there are unclear words by the pilot). The aircraft is visible on the radar screen with all necessary parameters (identification, height, road speed, direction of movement). The controller guides him by giving him flying courses and heights to which the airplane should descend. During the flight, the aircraft receives routine weather information. Before starting the instrument approach, the controller determines that the aircraft is at a higher altitude and offers the option to turn a full circle to the right in order to reduce the height. The procedure takes place regularly and the aircraft establishes the instrumental approach and is then transferred under the jurisdiction of the tower controller.

**14:43:54 UTC** The aircraft announces the frequency of APP Skopje 120,300 MHz. The aircraft enters from FIR Tirana and is accepted on a radio connection by the flight controller authorized of TMA Skopje.

**14:43:59**, The aircraft has been identified by the radar at a position 5NM north-west of the MAVARlevel coordinate at FL130 flight level and instructed to fly to course 105 to be vectorized for the precise instrumental approach ILS for runway 34. The pilot confirms the flight instruction in Course 105.

**14:44:41** The pilot receives routine information on the current weather situation at the Alexander the Great Airport in Skopje. The pilot confirms the information about the current weather situation. **14:51:00** The flight controller issues routine information about the current position of the aircraft 39NM south-west of the runway and the distance to the landing point 62NM. The pilot confirms the information and announces that he is ready to descent.

**14:51:16** The controller issues an instruction to reduce the height initially to 11 000 (feet) per QNH 1015 and TL 120. The pilot confirms the instruction.

\* Note: because it is TL120, and the aircraft enters the FL130 initially in the standard atmosphere. **14:57:40** The controller issues an instruction to change the course in 090. The pilot confirms the instruction.

**14:58:09** The controller informs to change the QNH 1014. The pilot confirms the information.

**15:00:08** The controller issues an instruction to reduce the height to 10 500. The pilot confirms the instruction. The controller requests confirmation of the course 090, the pilot confirms, and the controller issues an instruction for a new course 095 and receives a confirmation by the pilot.

**15:00:26** The controller informs about the change of QNH 1015. The pilot confirms the information. **15:04:15** The controller issues an instruction to descend to the height of 9000, the pilot confirms the instruction.

**15:05:47** The controller provides information on the current position, 21 NM south of the runway and issues an instruction for a new course 050. The pilot confirms the course 050.

**15:06:20** The controller issues an instruction to descend to the height of 6000, the pilot confirms the instruction.

**15:07:18** The controller issues an instruction to descend to the height of 5000.

**15:07:21** The controller issues an instruction to change the course to the left at 020 for the purpose of receiving an ILS and instrumental approach of ILS34 has been approved, and to report establishment of an instrumental approach. The pilot confirms the new course 020 and informs to announce the establishment of the instrumental approach.





**15:08:54** The controller provides information on the final position of 14 NM and issues an instruction to descent to the height of 4000. The pilot confirms the information.

**15:10:32** The controller provides information about the final position of 9.5NM and that the aircraft is located above the vertical axis (glide path) and asks whether it wants to turn a full circle to the right in order to descent. The controller accepts the offered option.

**15:11:14** The controller gives an instruction for a new course, right 090. The pilot confirms the instruction.

**15:11:24** The controller provides information on changing the level of cloudiness due to bad weather and instructs a new course, right 100. The pilot confirms the instruction.

**15:11:34** The controller gives instructions when the aircraft reaches the height of 4000, to maintain it. The pilot confirms the height and course instruction.

**15:12:24** The controller gives an instruction for a new course, right 130. The pilot confirms the instruction.

**15:13:34** The controller gives an instruction for a new course, right 180. The pilot confirms the instruction.

**15:14:20** The controller gives an instruction for a new course, right 250. The pilot confirms the instruction.

**15:14:56** The controller gives instructions for a new course, right 300, approved instrumental approach ILS34 and to confirm the establishment. The pilot confirms the instruction for course 300 and confirms the established instrument approach.

**15:16:19** The pilot confirms the complete establishment of the instrument approach.

**15:16:21** The controller instructs the pilot to continue with the instrument approach and report to TWR 118.500. The pilot confirms the instruction and logs out.

**15:16:39** The pilot announces the TWR and informs that the instrument approach is fully established.

**15:16:43** The controller instructs you to achieve an OM (outer marker) achievement, the pilot confirms the application instruction.

As of this moment, there is no communication with the aircraft.

**15:18:34** The Flight Controller (TWR) calls the DLW aircraft but there is no response. The TWR controller notifies the TMA controller who also calls out to the pilot, both the frequency of APP and the emergency 121.500MHz, but there is no response. The TMA controller requires an I-FAGE pilot under the authority of TMA, and is also part of the D-GLLW-powered group, to try to establish contact with D-GLLW through its radio station. He tries to establish contact, but unsuccessfully.

The shift lead was informed about the loss of radio communication as well as for the loss of radar screen reflection, who started with search and rescue activities.





# 2.2 Analysis of the flight history

#### 2.3 Horizontal and vertical profile









Image 8 Horizontal and vertical profile of the flight





#### **2.4 Movement route of the aircraft**



Image 9 Horizontal path of the aircraft







## 2.5 Meteorological condition

# **2.5.1** SYNOP analysis and reports for the adjacent route of the flight of D-GLLW within SKOPJE FIR

The analysis was made on the data obtained from the SYNOP reports obtained from the measurements of the UHMR measurement positions near the D-GLLW flight route.

MEASUREMENT POINT: GJURISHTE (13590) – 854 MHB						
Term	Wind	Cloud	Cloud type	Visibility	Appear	
	[deg/m/s]	base		[km]	ances	temperature
	[			[]		[°C]
12 UTC	360/04	IN CLOUD	IN CLOUD	0.05	FG	11.8
15 UTC	340/04	IN CLOUD	IN CLOUD	0.05	- RA	12.7
18 UTC	290/04	IN CLOUD	IN CLOUD	0.05	- RA	14.8

#### Table 4 Meteorological data Gjurishte

#### Table 5 Meteorological data Petrovec

MEASUREMENT POINT: petrovec (13586) – 238 MHB						
Term	Wind	Cloud	Cloud type	Visibility	Appear	
	[deg/m/s]	base		[km]	ances	temperature
						[°C]
12 UTC	280/01	8/ 600 - 1000	St/Cu fra*	10	- RA	16.3
15 UTC	000/00	8/ 600 - 1000	Sc, Ns	10	- RA	15.9
18 UTC	260/01	8/ 600 - 1000	St/Cu fra*	10	- RA	15.1

\*Cloud on a bad weather – descriptive according the SYNOP coding charts

From the data stated in the reports there are no indications of the occurrence of fading, significant turbulence (no convective cloudiness), atmospheric electrical discharges have not been reported and there is no occurrence of significant wind and its significant changes in direction and strength.

## 2.5.2 Analysis of the meteorological satellite charts

The analysis was made on meteorological satellite images obtained from EUMETSAT. The recordings refer to the time interval 06.09-12Z to 06.09-18Z, with a time step of 1 hour. The following products were considered:

o RGB - E-VIEWo RGB - AIRMASSo RGB - E-DUSTo 10.8 INFRA RED





There is no indication of the presence of convective clouds on the satellite images, nor there are indicators of significant atmospheric turbulence in the territory of SKOPJE FIR.

# **2.5.3** Analysis of the radar images from the meteorological radar center Topolchani (UHMR)

The analysis was made on radar images obtained from the Topolchani meteorological radar center. The recordings were obtained from the channel with a wavelength of 3.2 cm. The following products were considered:

- o Maximal reflectivity
- o Height of maximal reflection
- o vertical cross-section of the maximal reflection

The radar center was operational during the day, but in the period between 15:54 and 17:17 local time there was a break in the work of the radar. Recordings from the period 17:17 to 17:29 local time are enough to make an insight into the situation during the fall of the aircraft. Made at a 4-minute time limit can be considered as representative.

From the radar recordings, a complete conclusion cannot be made regarding the meteorological phenomena along the zone of the final approach of the aircraft to the LWSK airport due to the radar constraints due to orographic obstacles.

What can be concluded is that radar reflections for the layer above 1800 meters during the crash period, the area of the approach zone do not indicate convective currents, which eliminates the possibility of strong turbulence.

## 2.5.4 Analysis of the appearance of atmospheric electrical discharges

The analysis was made according to the SYNOP reports of the UHMR, METAR reports from the LWSK Airport Meteorological Service, the archive records of the network of lightning detectors blitzortung.org.

Additionally, it is taken into consideration that blitzortung.org is a voluntary measurement network, but is taken as a data source because of its positive experience so far.

The analysis concluded that there were no electrical discharges in the D-GLLW flight zone through SKOPJE FIR.

#### 2.5.5 Analysis of METAR reports from airport Skopje (LWSK)

The METAR reports have been taken into consideration from the period from 14:30 UTC to 16:30 UTC on the day 06.09.2016.

# 201609061430 METAR LWSK 061430Z 00000KT 9999 -RA SCT010 OVC033 16/14 Q1015 NOSIG=

201609061500 METAR LWSK 061500Z 00000KT 9999 -RA SCT013 OVC040 16/15 Q1015 NOSIG=





201609061530 METAR LWSK 061530Z 29002KT 9999 -RA SCT013 OVC040 16/14 Q1014 NOSIG= 201609061600 METAR LWSK 061600Z 18006KT 6000 +RA SCT010 OVC040 16/15 Q1015 NOSIG= 201609061630 METAR LWSK 061630Z 16004KT 5000 +RA BKN010 OVC033 15/14 Q1015 NOSIG=

The current time at LWSK airport in the mentioned period was cloudy, with two-layer cloudiness, with the first layer at a height between 1000 ft and 1300 ft covering 3/8 -4/8 of the sky, while the second layer at a height of 3300 ft and 4000 ft, covered the entire sky. During the whole period, rainfall is observed, weak between 14:30 UTC and 15:30 UTC, and with strong intensity between 16:00 UTC and 16:30 UTC.

In both periods, at 14:30 and 15:00, no wind was observed, at 15:30 the wind was weak with a mean direction of 290 ° and a mean 10 minute value of 2 knots. Low wind intensification was observed in the terms 16:00 and 16:30 with 10 minutes mean 6 knots, ie 4 nodes, respectively. The wind direction in the last 2 terms was south, ie 180 ° and 160 °.

Term UTC	Wind [deg/kt]	Cloud base [ft]		Cloud coverage	Visibility [m]	Appearances
14:30	000/00	first layer Second layer	<u>1000</u> 3300	<u>3-4 / 8</u> 8 / 8	10000	- RA
15:00	000/00	first layer Second layer	1300 4000	3-4 / 8	10000	- RA
15:30	290/02	first layer Second layer	1300 4000	3-4 / 8 8 / 8	10000	- RA
16:00	180/06	first layer Second layer	1000 4000	3-4 / 8 8 / 8	6000	+ RA
16:30	160/04	first layer Second layer	1000 3300	5-7 / 8 8 / 8	5000	+ RA

#### Table 6 Meteorological data





#### 2.5.6 Conclusion about the meteorological conditions

From the analysis of the available observed and measured values of the meteorological parameters that were present in the area of flight in the area of FIR SKOPJE, it was concluded that the flight of the D-GLLW aircraft took place in complex, instrumental meteorological conditions (IMC) and instrument flight rules (IFR). The flight took place in a cloud zone, which shows no significant turbulent characteristics, but in conditions of minimal visibility, as well as in smaller regions in the cloudy mass, where the precipitation was moderate to strong intensity.

There are no indications and evidence that meteorological conditions are a direct cause of the fall of the aircraft, but it should still be considered that the workload of the crew of the D-GLLW aircraft was increased due to the present meteorological condition.





# 3. Conclusion

#### 3.1 Findings

The D-GLLW aircraft accident, in which the aircraft captain and all passengers were affected, had a series of critical omissions, developments, conditions and a combination of them (chain of events) that had an impact on aircraft safety and the performance of the aircraft and the flight itself. Following an objective and expert analysis, carried out on the basis of all the information available to the Commission, the following findings were obtained:

- Weather conditions at the destination were complex.
- A certificate of airworthiness was issued to the aircraft after the crash in August 2010 and the structural disruptions of the aircraft. From this incident to the day of the accident on September 6, 2011, the aircraft has completed 670 hours of flight. At no time during this period no control and checking of the structure of the aircraft has been made.
- During the flight, until the beginning of the reduction, the captain did not declare any deviation from the planned and approved flight plan nor any technical problem with the aircraft. The aircraft, for unknown reasons, enters into a state of coarse flight movement a stooling, which has caused entry into a state of uncontrolled flight.
- In an uncontrolled flight, the aircraft receives an uncontrolled speed along a spiral track.
- The prevalence of parts of the aircraft on the ground, their position in relation to the fuselage, as well as the traces of the impact on the ground indicating the vertical path of movement of the remains found at the on-site inspection, indicate that the disintegration of the aircraft has started in the air.
- The aircraft fall detection device (ELT) did not broadcast any signal.
- After the inspection of the remains, it was determined that there was no fire, neither during the flight nor after the fall of the aircraft.
- There are no indications of a terrorist attack or the placement of explosives on the aircraft.

#### **3.2 Accident reasons**

#### 3.2.1 Direct reasons

Upon the conducted investigation and analysis of the collected evidence and available documents, the Commission can not determine the direct cause of the accident.

The Commission concluded that for an unknown reason, the aircraft at the stage of the established instrumental approach (ILS RWY 34) enters the flight mode - stooling

From the material evidence, it can be concluded that after entering the coarse flight mode, the aircraft moves uncontrollably along a spiral track and there are indications that in doing so, its structural decomposition into the air in several parts.

This assumption is based on the movement of an aircraft detected by the radar system, as well as from the position of the remains found at the scene of the accident.





#### 3.2.2 Indirect reasons

Based on the analysis of the available information, the Commission considers that the following factors contributed to the accident:

- Possible structural damage as a consequence of the August 2010 incident.
- The aircraft flew heavier than the maximum allowed.
- Possible impact on current complex meteorological conditions at the end of the flight.

#### 3.2.3 Recommendations

In case of severe incidents with consequences of structural disruptions of this type of aircraft, time checks of the repairs and control of them shall be foreseen.

Observe operational procedures for aircraft operation in terms of compliance with the prescribed limits for maximum weight and its schedule.

In the domain of CAA's operations:

- o Perform checks on the training of system units that would be involved in a possible SAR operation;
- o To carry out regular exercises for checking the capability for this kind of operation;
- o To organize procurement of sophisticated equipment that is needed for quality execution of the tasks in the field of SAR operation