

Aircraft Accident Report
Beechcraft Super King Air 200, Z3 - BAB
Mostar, Bosnia and Herzegovina
February 26, 2004

Aircraft Accident Investigation
Commission



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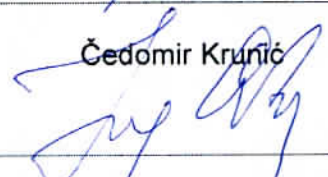
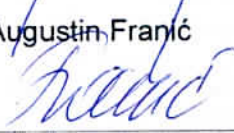
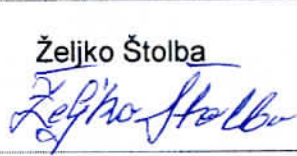


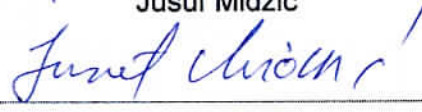
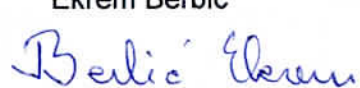
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AAIC for conducting the aircraft accident investigation of Beechcraft King Air 200, registered Z3-BAB, is nominated by Decision number 01-342-136/04 dated 02th March 2004, signed by Minister of Communication and Transport, Mr. Branko Dokić.

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TABLE OF CONTENTS

ABBREVIATIONS.....	10
INTRODUCTION.....	13
1 FACTUAL INFORMATION.....	14
1.1 History of the Flight.....	14
1.1.1 Previous activities.....	14
1.1.2 Route Flying.....	14
1.1.3 Approach to land.....	15
1.2 Injuries to Persons.....	16
1.3 Aircraft Damage.....	16
1.4 Other Damages.....	16
1.5 Personnel Information.....	16
1.5.1 Captain.....	16
1.5.2 Co-pilot.....	18
1.5.3 Aircraft maintenance mechanic.....	19
1.5.4 Air Traffic Controller.....	20
1.6 Aircraft Information.....	20
1.6.1 Aircraft Technical Data.....	20
1.6.2 Aircraft Maintenance.....	21
1.6.3 Fuel – quantity and quality.....	23
1.6.4 Mass and Balance.....	23
1.7 Meteorological information.....	24
1.8 Aids to Navigation.....	25
1.8.1 General Information.....	25
1.8.2 Approach Procedure VOR/DME RWY 34.....	25
1.9 Communications.....	25
1.10 Aerodrome Information.....	26
1.10.1 General Information.....	26
1.10.2 ATC Service.....	26
1.11 Flight Recorders.....	27
1.12 Wreckage and Impact Information.....	27
1.12.1 Distribution Pattern of Aircraft Parts at the Accident Site.....	27
1.12.2 Instruments.....	28
1.13 Medical and Pathological Information.....	29
1.14 Fire.....	29
1.15 Search and Rescue.....	29
1.15.1 Emergency Locator Transmitter.....	30
1.16 Tests and Research.....	30
1.16.1 Flight Recorders.....	30
1.16.2 Emergency Locator Transmitter.....	31
1.16.3 Approach Procedure VOR/DME RWY34.....	31
1.16.4 VOR/DME MSR.....	31
1.17 Organisational and Management Information.....	32
1.18 Additional Information.....	32
1.19 Useful or Effective Investigation Techniques.....	32

2	ANALYSIS	33
2.1	Introduction	33
2.2	Flight Operations	33
2.2.1	Crew Qualifications	33
2.2.2	Previous Activities	33
2.2.3	Flight Description	33
2.3	Aids to Navigation and approach procedure	36
2.3.1	VOR/DME MSR	36
2.3.2	Approach Procedure – VOR/DME RWY 34	36
2.4	Weather	37
2.5	Aircraft	37
2.6	Flight Recorders – FDR and CVR	38
2.6.1	Flight Data Recorder – FDR	38
2.6.2	Cockpit Voice Recorder – CVR	38
2.7	Search and Rescue	38
3	CONCLUSIONS	40
3.1	Findings	40
3.2	Cause of accident	41
4	SAFETY RECOMMENDATIONS	42
5	APPENDICES	43
	Appendix 1: Approach procedure VOR/DME RWY 34 at Mostar airport (BH DCA AIC)	43
	Appendix 2: Approach procedure VOR/DME RWY 34 at Mostar airport (Jeppesen)	44
	Appendix 3: Reconstruction of approach to Mostar Airport on 26th of February, 2004	45
	Appendix 4: Probable flight profile during the approach procedure on 26th of February, 2004	46
	Appendix 5: Accident Site Terrain Photos	47
	Appendix 6: Impact site and post - impact aircraft trajectory	50
	Appendix 7: Distribution pattern of the major parts of the wreckage	51
	Appendix 8: Photo Documentation of Accident Site	52
	Appendix 9.: Transcripts	65
	Appendix 9.1.: ATC Mostar Tape Transcript	65
	Appendix 9.2.: Combined ATC Mostar and CVR Tape Transcripts	67
	Appendix 10: FDR and CVR RUAG Report	72

ABBREVIATIONS

A&P	Airframe and Powerplant
ACC	Area Control Center
AD	Airworthiness Directive
ADF	Automatic Direction Finder
AFM	Aircraft Flight Manual
AIC	Aeronautical Information Circular
ALERFA	Alert phase
AND	Air Navigation Division
AOC	Air Operator Certificate
AOM	Aircraft Operations Manual
APP	Approach Control
ARINC	Aeronautical Radio Incorporated
ARM	Army of FYROM
ARO	Air Traffic Services Reporting Office
ARP	Aerodrome Reference Point
ASDA	Accelerate - Stop Distance Available
ATC	Air Traffic Control
ATMD	Air Transport and Maintenance Department
ATPL/A	Air Transport Pilot Licence/Aeroplanes
B&H	Bosnia and Herzegovina
BHDCA	Bosnia and Herzegovina Directorate of Civil Aviation
B-RNAV	Basic Area Navigation
CAA	Civil Aviation Authority
CCL	Croatia Control Ltd
COSPAS-SARSAT	Search and Rescue Satellite-Aided Tracking
CASSIC	Commandment Air des Systemes de Surveillance d' Information at de Communication
CPL/A	Commercial Pilot Licence/Aeroplanes
CSHSI	Cycles Since Hot Section Inspection
CSN	Cycles Since New
CVR	Cockpit Voice Recorder
DBK	VOR/DME Dubrovnik
DERD	Directorate of Engine Research and Development
DETRESFA	Distress phase
DGCA	Direction Générale de l'Aviation Civile
DIRCAM	Direction de la Circulation Aérienne Militaire
DME	Distance Measurement Equipment
DVOR	Doppler VOR
ELT	Emergency Locator Transmitter
FAA	Federal Aviation Administration
FAR	Federal Aviation Regulation
FBiH	Federation of Bosnia and Herzegovina
FDR	Flight Data Recorder
FIR	Flight Information Region
FL	Flight Level
FM	Frequency Modulation

FSDO	Flight Standard District Office
FYROM	Former Yugoslav Republic of Macedonia
GM-1	Jet Fuel
GPS	Global Positioning System
IAF	Initial Approach Fix
ICAO	International Civil Aviation Organization
IF	Intermediate approach
IFR	Instrument Flight Rules
IIC	Investigator In Charge
IMC	Instrumental Meteorological Conditions
INCERFA	Uncertainty phase
JAR	Join Aviation Requirements
JAT	Yugoslav Air Transport
JNA	Yugoslav People Army
LDA	Landing Distance Available
LQMO	ICAO designation for Mostar airport
MAC	Mine Action Center
MAPt	Missed Approach Point
MDH	Minimum Descent Height
METAR	Meteorological Aeronautical Report
MSA	Minimum Sector Altitude
MSR	VOR/DME Mostar
MTOW	Maximum Take-Off Weight
MUP	Ministry of Internal Affairs
NOTAM	Notice To Airmen
NTSB	National Transportation Safety Board
PAPI	Precision Approach Path Indicator
PF	Pilot Flying
PNF	Pilot Not Flying
PNI	Pictorial Navigation Indicator
PWC	Pratt & Whitney of Canada
RCC	Rescue Co-ordination Center
RWY	Runway
S/N	Serial Number
SAR	Search and Rescue
SB	Service Bulletin
SCT	Scattered
SFOR	Stabilization Forces
SFRJ	Socialistic Federal Republic of Yugoslavia
SI	Service Instruction
SID	Standard Instrument Departure
SL	Service Letter
SOP	Standard Operating Procedures
SSR	Secondary Surveillance Radar
STAR	Standard Terminal Arrival Routes
STCDS	Supplemental Type Certificate Data Sheet
SWC	Significant Weather Chart
TAF	Terminal Area Forecast
TC	Total Cycles
TODA	Take-Off Distance Available

TORA	Take-Off Run Available
TSN	Time Since New
TSO	Time Since Overhaul
TSO	Technical Standard Order
TT	Total Time
TWR	Tower
UTC	Universal Co-ordinated Time
VDP	Visual Descent Point
VF	Army of Federation of BiH
VFR	Visual Flight Rules
VHF COM	Very High Frequency Communications
VHF NAV	Very High Frequency Navigation
VIP	Very Important Person
VOR	Very High Frequency Omnidirectional Radio Range
WGS	World Geodetic System

INTRODUCTION

This report presents investigation findings of the aircraft Beechcraft Super King Air 200 accident that took place on 26th February 2004 during approach to Mostar airport.

Aircraft owned/operated by the Government of FYROM was undertaking approved flight from Skopje airport transporting state delegation to Mostar airport.

During the approach to Mostar in IMC, significant non-compliance with published procedure was made considering the position and altitude that caused an airplane crash.

Aircraft was destroyed, two (2) Flight Crew members and seven (7) passengers on board sustained fatal injuries.

Essential Information:

Operator:	Government of FYROM,
Aircraft Model:	Beechcraft Super King Air 200,
Manufactured by:	Beech Aircraft Corporation, Wichita, Kansas - USA,
Aircraft Registration:	Z3 – BAB,
Site of the accident:	South from Mostar airport, on radial 146° and at distance of 4,8552 NM from VOR/DME MSR,
Date and Time:	26th February 2004 at 08:00 hours,
Persons on board:	2 (two) Crew members and 7 (seven) passengers.

Investigator in Charge and two members of the investigation team were appointed by the Director General of the Directorate of Civil Aviation on 26th February 2004. Same were sent-out to the site of accident to assess the accident and gather data for instigation of investigation procedure. During the site of accident assessment representatives of the aircraft manufacturer and aircraft owner/operator were present as well.

Notification of accident was addressed on the same day to the State of Operator and State of Manufacturer of the aircraft involved and to ICAO.

In accordance with the Civil Aviation Law of B&H, Aircraft Accident Investigation Commission (AAIC) was appointed by the Minister of Communications and Transport, member of the Council of Ministers of B&H.

In work of the AAIC accredited representatives of the owner/operator from FYROM, FAA, NTSB and SFOR also participated. Draft report was sent to CAA of FYROM and NTSB, whose comments were taken into consideration before issuing this Final Report.

Investigation procedure was in accordance with: Annex 13 of the ICAO, Convention on International Civil Aviation (*Chicago Convention*), ICAO Documents, Civil Aviation Law of B&H and Manual of Aircraft Accident and Incident Investigation.

In accordance with regulations mentioned above objective of this Report **is neither to apportion the blame nor to assess liability.**

The sole objective of this investigation and the Final Report is prevention of the accidents and incidents.

Unless otherwise indicated, recommendations in this report are addressed to the regulatory authorities of the State having responsibility for the matters with which the recommendation is concerned. It is for those authorities to decide what action is taken.

In entirety of this report times mentioned are expressing local time unless otherwise is specified and geographical co-ordinates are WGS 84.

This Report is published by the Aircraft Accident Investigation Commission dated 05th May, 2004.

1 FACTUAL INFORMATION

1.1 History of the Flight

1.1.1 Previous activities

On 05th February 2004, Air Transport and Maintenance Department of FYROM Government (ATMD) received a request from Office of the State President for air transport service from Skopje to Mostar with departure time set for 1630 hrs, dated 25th February 2004 and return flight for 27th February 2004. Date and departure time were later modified to 26th February 2004, by the Office of the State President. State delegation intended to participate at the International Investment Conference in B&H. Request for aircraft over flight and slot time for Mostar airport were approved by the State authorities of B&H.

On 24th February 2004, flight crew was informed of planned flight and on the same day required flight planning were initiated. These planning included study of Jeppesen navigational maps and approach plates of Mostar airport and alternative airports – Sarajevo and Dubrovnik as well. This information was confirmed by the statement given from acting person in charge for the Air Transport Department (ATMD).

Flight crew received a request for the flight on 25th February 2004, co-pilot filled out a flight plan and submitted it to ARO at Skopje airport. Initial flight plan was not accepted due to omission of BARIT fix on the planned route. After the additional entry of that fix, flight plan was accepted and approved. On 26th February 2004 approximately at 0530 hrs co-pilot collected documentation required by ARO and MET Office at Skopje airport. Pre-flight briefing was concluded at the offices of ATMD at Skopje airport. Operational Journey Log was signed by the Captain. Mechanic and co-pilot commenced pre-flight inspection in accordance with check list and no remarks were made. Aircraft was to depart from Skopje airport at set departure time for 0630 hrs and arrival time to Mostar airport was set for 0735 hrs.

1.1.2 Route Flying

According to the route aircraft was supposed to fly via: GOSTI - W31 - MAVAR - UW43 - RETRA L604 - POD W47 - TAZ - R45 - DBK - L187 - BARIT - DCT LQMO, at FL 240.

Cockpit left seat was occupied by the captain, holder of valid ATPL/A, acting as *Pilot Not Flying*, and the right seat was occupied by co-pilot, holder of valid CPL/A I class acting as *Pilot Flying*. Engines were started at 0643 hrs and aircraft departed from Skopje/Petrovac airport at 0648 hrs.

The flight reconstruction of the aircraft Z3-BAB is composed by gathering data available from CVR and ATC.

The flight was performed through the airspace of: Macedonia, Albania, Serbia and Montenegro and Croatia in accordance with flight plan. While flying under ACC Belgrade and ACC Zagreb, flight crew was conducting approach briefing that was interrupted by communications from other airplanes, conclusively it is not possible to confirm final agreement between pilots for the approach procedure to Mostar airport. Upon transfer from FIR Belgrade to FIR Zagreb, aircraft was in responsibility zone of ACC Zagreb that provides air traffic service in airspace of Bosnia and Herzegovina from FL 100 up to FL 285, outside terminal zone of the airport and in airspace from FL 285 to FL 410 in accordance with signed agreement between BHDCA and CCL Ltd.

At 0736 hrs aircraft Z3-BAB, via MADOS, FIR boundary, entered FIR Sarajevo. After approved by ACC Zagreb aircraft was descending to BARIT, compulsory reporting point, at FL 140, and afterwards to FL 110. Flight crew at that moment could not establish with assertiveness position of BARIT fix and was attempting to locate it on the navigational map. Even though they did not locate BARIT fix they have confirmed flight towards BARIT fix.

1.1.3 Approach to land

ACC Zagreb at 0746 hrs transferred the aircraft to APP Mostar. After the establishment of radio communication with APP Mostar flight crew was informed of the runway in use and actual weather conditions at Mostar airport. Flight crew accepted approach procedure VOR/DME RWY 34.

At 0747 hrs aircraft was located at 25 NM from VOR/DME MSR was approved to descend to 6400 ft QNH in the direction to VOR/DME MSR. Flight crew confirmed descending altitude to 6400 ft and QNH altimeter setting. While descending to Mostar airport and during the approach procedure VOR/DME RWY 34 there were no other aircraft in zone of APP Mostar. Subsequent aircraft with registration mark OE-GCB, landed 30 minutes after the Z3-BAB aircraft accident.

During flight towards IAF DIRUK at the altitude 6400 ft and on radial 326° in the direction of VOR/DME MSR, flight crew commenced briefing for performing a turn above the fix DIRUK and assessment of weather conditions at Mostar airport (**Appendix number 3, 4 and 9**). Aircraft was descending in direction of IAF DIRUK and at distance 4 NM before IAF DIRUK reached the altitude of 4700 ft.

At 0751 hrs flight crew reported overhead IAF DIRUK, at distance 10 NM to VOR/DME MSR and was approved by APP Mostar for Approach procedure VOR/DME RWY 34. After IAF DIRUK, Flight crew performed left turn for 180° and established heading 146°, at altitude 4700 ft. After the turn aircraft proceeded on same altitude until distance of 15 NM from VOR/DME MSR. Left turn for 180° was initiated in order to intercept IF and to establish track for intermediate and final approach. At the same time flight crew commenced descending towards altitude of 4200 ft.

During last 60 degrees of the turn flight crew noticed that indications of DME and VOR were lost. Flight crew reported to APP Mostar that they do not have indication of VOR. After 18 seconds co-pilot confirmed to the captain that indicator VOR/DME has been established again and that everything is under control what was conveyed to APP Mostar by the captain.

At distance of 13 NM to VOR/DME MSR, after the approved by the captain, co-pilot disengaged auto pilot and had taken the control of the aircraft. Instructed by the captain, co-pilot at distance of 12 NM to VOR/DME MSR commenced descending from the altitude of 4200 ft, towards FAF, to the altitude of 1810 ft. During descent at distance approximately at 10 NM to VOR/DME MSR, flight crew extended landing gear. At distance of 7 NM to VOR/DME MSR or 0,3 NM after passing FAF, aircraft was at altitude of 2000 ft, and 14 seconds later, aircraft reached the altitude of 500 ft above terrain according to radio altimeter.

After passing 7 NM to VOR/DME MSR aircraft continued with descending on assigned radial 326°. And 31 seconds later (from 7 NM) aircraft reached the altitude of 1810 ft (MDA), or 1672 ft QFE (MDH). Immediately before the aircraft impacted the ground the co-pilot asked for permission from the captain to continue with descent, on what captain did not reply but ordered to co-pilot to increase the power being exactly what he did. After that aircraft impacted the tree and right after the ground as well. After impacting the ground airplane was moving in azimuth of 330° and in length of 149 m where it completely dismembered, destroyed and consumed by the post crash fire.

1.2 Injuries to Persons

INJURIES	CREW	PASSENGERS	TOTAL	OTHERS
Fatal	2	7	9	
Serious	0	0	0	
Insignificant	0	0	0	Not applicable
Non	0	0	0	Not applicable
TOTAL	2	7	9	

Fatally injured crew members and passengers were Macedonian citizens.

1.3 Aircraft Damage

Aircraft was destroyed and consumed by the post crash fire.

1.4 Other Damages

Airplane impacted at uneven karst terrain and parts scattered did not cause any damage.

1.5 Personnel Information

Information about the captain, co-pilot and mechanic are related solely to the information available by CAA of FYROM and information on flight controller are provided by DETAIR, part of SFOR mission in B&H.

1.5.1 Captain

General Information: Male, age 57, graduated at two year College for Pilot's in Belgrade on 17th December 1984.

History of employment: employed by Yugoslav Air Transport in Belgrade, Palair Macedonia - Skopje, Air Service - Skopje, CAA of FYROM - Skopje and ADTM of FYROM - Skopje.

He was working as co-pilot, captain and flight instructor for many airplanes in commercial category.

In period from 03rd December 2001 until 06th March 2003 he was working with CAA of FYROM as Flight Operations Inspector. From 2003 he is employed contractually by the ATMD of FYROM.

According to his personal file record, from 1992 onwards, it is found that no disciplinary measures were ever taken or any form of ban and that he never had any accidents or incident.

Licenses and endorsements: holder of Airline Transport Pilots License (ATPL) number 108/0173, issued on 09th March 1994 by the CAA of FYROM based on Pilots license number 473/3032 issued by the Civil Aviation Authority of Former Yugoslavia on 09th March 1982 ATPL was valid until 05th May 2004.

Captain endorsement on the B200 aircraft was obtained on 16th May 1979, and the Instructor endorsement for B200 aircraft was obtained on 30th June 1980. Abovementioned endorsements for the B200 aircraft were renewed on 18th April 1996.

His personal file with CAA of FYROM contains report by the Head of the Commission on exam administration for theoretical and practical module of examination, but there is neither evidence of the check list used during proficiency check nor any material related to theoretical module of the exam.

Possesses co-pilot and captain endorsement for F-100 aircraft. ATPL was renewed on 07th March 1997 with proficiency check on the aircraft model C-172. On 1998 he renewed his license for the aircraft model C-172 and flight time of 53,06 hours during license validity. ATPL was renewed on 11th July 2000.

Training: In period from 22nd November 1994 to 14th December 1994 he completed ground training and simulator training for F-100 aircraft. Ground training was completed on 11th January 1997 and simulator training from 26th October 1997 to 30th October 1997, for the B1900 aircraft.

In the training records with ATMD of FYROM Government numbered 32 for the year 2000, there is a training programme for re-validation of ATPL for the captain on the B200 aircraft, commenced from 02nd May 2000 to 16th June 2000, during which flying time was 88,55 hours.

Checks: Last proficiency check was conducted on 25th April 2003 on B200 aircraft, in order to renewe ATPL.

Type currency: Type rating for B200 aircraft was not renewed until the year 2000, due to type rating on F-100 aircraft until the end of 1995, and his ATPL was renewed on C-172 aircraft from 1995 until 2000. From 11th July 2000 until the accident date he was flying only on the B200 aircraft.

Medical fitness: His medical record number 01 shows that no sickness or injuries were recorded and no flight interruption was ever caused by his sickness. Latest medical check was on 12th November 2003 with validity period of six months.

Flight time and rest period: Seven days before the accident he had no flying activity. Last 30 days he performed eight (8) flights, with flight time of 13,0 hours. According to statement of his wife, the day before the accident he was with his family acting ordinary and had cup of tea before he went to sleep.

Flight experience and experience on B200 aircraft: Total flying time relating to aircraft types could not be established with assertiveness due to lack of records.

From the most recent application for ATPL re-validation, total flight time is divisioned by the flight rules and conditions conclusive with 05th May 2003 as following:

- VFR: 320,27 hours,
- Night: 1078,03 hours,
- IFR: 5560,02 hours,
- Total: 6958,32 hours,
- Simulator sessions: 404,40 hours.

In the last seven days, actually in the last 48 and 24 hours, he did not have any flying activity. During last 30 days he totaled 13,0 hours of flight time and in last 90 days he totaled 35,35 hours of flight time on B200 aircraft.

Checks: Last check was performed on 11th December 2003 on B200 aircraft in order to renewe his First Class CPL/A.

Interruptions in flying: No interruptions in flying were recorded.

Medical fitness: His medical record number 578 shows no injuries or sickness of any kind. No flight interruption was ever caused by his sickness or injuries. Latest medical check was performed on 26th December 2003 with validity period of 12 months.

Flight time and rest period: Seven days before the accident he had no flying activity and in the last month he performed eight flights with flight time of 13,0 hours.

Flight experience and experience on B200 aircraft: Pilot Log Book shows total flight time divisioned by the flight rules, conditions and aircraft types conclusive with 25th February 2004:

By Flight Rules and Conditions:

→ VFR:	317,55 hours,
→ Night:	220,30 hours,
→ IFR:	785,10 hours,
→ Total:	1323,35 hours,
→ Simulator sessions:	88,35 hours.

By Aircraft Types:

→ Utva-75:	126,50 hours,
→ Galeb-2:	238,20 hours,
→ Mig-21:	149,35 hours,
→ Zlin 242L:	206,20 hours,
→ C-172:	9,30 hours,
→ B200:	595,00 hours.

Until the accident, total flight time on B200 aircraft was 595,00 hours. In last seven days, or precisely 48 and 24 hours, he had no flying activity. In period of last 30 days he totaled 13:00 hours of flight time, and in last 90 days he totaled 35,35 hours of flight time on B200 aircraft.

Experience with Mostar airport procedures: Flight commenced on 26th February 2004 was his first flight to Mostar Airport from 1992. Before 1992 he was flying on military aircraft to Mostar airport, as a student of Airforce Academy.

1.5.3 Aircraft maintenance mechanic

General Information: Male, age 63, Graduated Mechanical Engineer – of Aeronautical vocation – in Belgrade and acquired BSc. in Aeronautical Mechanical Engineering.

Licenses and endorsements: Holder of *Aircraft Maintenance Mechanic Technician Licence* number 110/0142 issued for the first time on 15th June 1983 with A&P endorsements for Learjet 25 and B200 aircraft, issued by CAA FYROM on 25th February 1994. Licence was valid until 10th June 2005.

Above mentioned licence contains Technical Control Second Class endorsement (number 102) and A&P Instructor endorsement from 03rd November 1997.

Also holder of *Aeronautical Engineer Licence for Engineering Tasks* number 101/0142, with associated A&P endorsements for Transport Category aircraft from 21st November 1994 as well as special authorization for A&P Instructor from 03rd November 1997 and *Quality Control Inspector* from 25th February 1994. Licence was valid until 10th June 2005.

Medical check was performed on 21st May 2003 with 24 months validity time.

1.5.4 Air Traffic Controller

General Information: Male, age 49, French Citizen, member of French unit DETAIR, within SFOR.

Licenses and endorsements: holder of valid licence for Air Traffic Control issued by the French Ministry of Defence. According to the written confirmation from French Directorate of Civil Aviation (DGCA), military controllers can conduct commercial air traffic control considering that the licence was issued in accordance with Annex 1 of ICAO and French Civil Aviation Law.

Working experience: On air traffic control posts he has been working for 27 years and 8 months, and from those 8 years and 10 months on Approach Control post, which is required at Mostar airport.

Flight time and rest period: In last 48 hours he was regularly rostered for work and had no particular activities. On 26th February 2004 he was shifted on air traffic control from 0630 hrs to 0820 hrs.

Medical fitness: Last medical check was performed on 27th March 2002, with validity period of 24 months.

1.6 Aircraft Information

1.6.1 Aircraft Technical Data

Aircraft Beechcraft Super King Air 200, Serial Number BB-652, was manufactured in 1980 at the aircraft factory Beech Aircraft Corporation in Wichita (*Kansas – USA*). Aircraft was equipped with two turbo-prop engines PWC type PT6A-41 and two three-blade propellers type Hartzell HC-B3TN-3G.

Aircraft was delivered to Republic of Macedonia, at the time part of Socialist Federal Republic of Yugoslavia, in April 1980 and was entered into Yugoslav Aircraft Register on 25th April 1980 under register number 1293 and registration marks YU-BMF.

Aircraft was operated and maintained in accordance with applicable aviation regulations, by organizations approved by Civil Aviation Authority of SFRJ. After international recognition of FYROM, aircraft was on 08th April 1994 registered with Macedonian Aircraft Register under register number 002 and registration marks Z3-BAB, thus being transferred under responsibility CAA of FYROM. Certificate on Registration shows that Government of FYROM is the owner/operator of the aircraft.

By the end of April 1980 the first Certificate of Airworthiness was issued, determining the category as "*General*" and purpose as: "*Air transport of persons and goods for owners use*". This certificate was regularly renewed on annual basis. After registration into Macedonian Aircraft Register, on 08th April 1994 aircraft was issued first Certificate of Airworthiness number 002, with category specification: "*General*" and purpose: "*Air transport of persons*".

and goods for owners use". Aircraft category and purpose was changed on new Certificate of Airworthiness, on 08th April 1996. In this new certificate under category is stated: "Commercial" and purpose: "For own and commercial transport". Validity of this certificate was renewed on 08th April each year and was valid until 08th April 2004.

Aircraft was equipped for operations in IFR conditions at the time of the delivery and complied with all applicable airworthiness and operational requirements pertaining to particular aircraft category. Aircraft was delivered with installed *Flight Data Recorder FDR 501 Fairchild* and *Cockpit Voice Recorder Control Unit type A 100 Fairchild*. Major modifications applied on the aircraft, engine, propellers and equipment upon delivery are the following:

- 10th August 1993 - Installment of GPS Type TRIMBLE TNL 2101, P/N 81439-00-0232.
- 04th April 1995 – Replacement of three-blade propellers HC-B3TN-3G/T10178B-3R with four-blade propellers HC-D4N-3A/D9383K (STCDS No SA2698NM-S).
- 24th July 1996 – Installation of additional antenna system for radio-navigation equipment calibration (STCDS SA02 dated 24.07.1996.). Dashboard system as a complete unit was installed when required. Aircraft was used only twice for this purpose and in both cases simultaneously with aircraft also equipped for calibration of ground radio-navigated equipment.
- 26th March 1998 – Coupling GPS Type TRIMBLE TNL 2101, P/N 81439-02.240B with autopilot system and VHF NAV – B-RNAV requirement.
- 15th June 1998 – Equipment modification VHF NAV 1 and 2 in accordance with ICAO requirement Annex 10 - *FM Immunity*.
- 15th January 1999 – Installment of more advanced *Weather Radar System Bendix/King RDR 2000*.
- 30th September 1999 – Modification VHF COM 1 and 2 in accordance with ICAO requirement Annex 10 - *FM Immunity*. Installed VHF units are also complied with 8,33 KHz frequency channel spacing requirements.

All above stated modifications, and also other alterations as request by particular AD's and SB's were performed by Aircraft service Aero-Dienst GmbH in Nürnberg (Germany) or in approved subcontracted facilities.

1.6.2 Aircraft Maintenance

Aircraft was maintained in accordance with *Factory Aircraft Comprehensive Tracking System (FACTS)*, published by Raytheon Aircraft Company, in which the original aircraft manufacturer, Beech Aircraft Company, merged in September 1994. Aircraft Maintenance Schedule for Beech Super King Air 200 is presented in Chapter 5 of the Maintenance Manual. Maintenance Schedule and all subsequent revisions are subject to approval of the *Flight Standard District Office (FSDO)* of U.S. Federal Aviation Administration – FAA. ATMD of the Government of FYROM has received regular update of Maintenance Manual, including revisions of the Maintenance Schedule. Aircraft maintenance in accordance with Maintenance Schedule was approved by CAA of FYROM by Resolution 03 number 1620 from 28th June 1997. In Annex 2 of this Resolution is stated that maintenance must be in accordance with all applicable Airworthiness Directives issued by State of Design, Service Bulletins and latest revisions of the Maintenance Manual and other Manufacturer's or CAA of FYROM requirements .

Aircraft was maintained in foreign authorised service centers – in avio-service Transair in Geneva from its first use until July 1992, and Aero-Dienst GmbH facility in Nurnberg in later period. These maintenance organisations and their authorised sub-contractors were performing routine and additional maintenance tasks as well as all non-scheduled tasks,

modifications, application of AD and SB on the aircraft, engines, propellers and appliances. ATMD of the Government of FYROM performed a few 150-hour checks until July 1994 and from that time on all aircraft maintenance was performed by Aero-Dienst. Technical department of ATMD was performing only service checks, servicing aircraft with fuel, oil check in the engines, bulb replacements, control and possible servicing of aircraft batteries, tyre pressure check and pitot-static system leak tests, for what was accordingly equipped.

Aero-Dienst GmbH maintenance facility is a holder of FAR 145 and JAR 145 aircraft maintenance approvals, and is also approved by Macedonian Civil Aviation Authority on 02nd April 1997 (*Certificate of Approval* No 101/3/97 issued by *Ministry of Transport and Communications, Directorate General of Civil Aviation* of FYROM).

ATMD of the Government of FYROM did not have written general agreement with Aero-Dienst regarding scope of work encompassed by technical support, instead customized work packages were made on case-by-case basis. Authorized technical representative of AMDT was Head of Maintenance Department within AMDT, graduated aeronautical engineer with valid maintenance mechanic licence. This representative regularly supervised all work performed in these maintenance facilities - Transair and Aero-Dienst.

Due to low average utilisation of Z3-BAB, maintenance tasks were based on calendar time. Instead of performing four-phase maintenance checks in 200 flight hours intervals, phased checks 1, 2, 3, and 4 were performed at certain pre-determined dates so that full cycle of four checks was accomplished within time period of 24 months, as recommended in FACTS programme. For each of these phase checks, set of work tasks was created, which in addition to routine checks, also included all deferred tasks related to aircraft, engine, propellers or equipment, Hard Time Items, Life Limited Parts, AD's, SB's, inoperative aircraft equipment, modification required by aircraft operator, etc.

Based on the review of Technical Log, Aero-Dienst work reports, technical data recorded in Aircraft Log Book, Engine Log Books and Propeller Log Books covering period since last annual check in Aero-Dienst performed from 16th to 20th June 2003 until 26th of February 2004, and based on additional technical information provided from Head of the Maintenance Department of ATMD and also Inspector of Airworthiness & Registry Inspectorate Department CAA of FYROM, following significant airworthiness related findings were determined for the Z3-BAB aircraft:

- In the *Journey Log Book* not a single remark during flight was recorded in period from 3rd November 2003 to 13th February 2004. In "Remarks" column, crew was regularly reported "Aircraft and engines OK".
- Phase check number 2 was performed from 16th until 20th June 2003 as part of the annual check on TT 5752 and TC 4600, and incomplete tasks were deferred to period 21st - 23rd July 2003 and concluded on TT 5797 and TC 4624.
- Phase check number 3 was performed on 07th November 2003 on TT 5944 and TC 4670.
- Engine overhaul: LH Serial Number PCE-81469 and RH Serial Number PCE-81489 were performed in second quarter of 1993 on TT 2993 and TC 2812.
- Last Hot Section Inspection of both engines was performed in November 1999 on TT 4505 and TC 4019.
- Propeller overhaul: LH Serial Number FY 1214 and RH Serial Number FY 1215 were performed in 2001 on TT 1665 hours.
- Altimeter system test according to FAR 91.411 performed during phase check number 3 in November 2003.

- Test of navigation and communication equipment, FDR, CVR and ELT according to *Annual Avionic Inspection* was performed in April 2003. During this check CVR was found to be inoperative and FDR did not record *Heading*. Both recorders were sent to shop for repair.
- Last aircraft weighing was performed in July 1996 with re-weighing in 1999 following installation of new radar equipment.
- Last adjustment of magnetic compass was performed in May 1999.
- According to the list of Airworthiness Directives, Service Bulletins, Service Instructions and Service Letters related to B200 aircraft, engines PT6A-41, propellers HC-D4N-3A, installed equipment and their applicability, all AD's, SB's, SI's and SL's significant for aircraft airworthiness were applied within mandatory time frame.
- Before the flight performed on 13th February 2004, last flight before accident, aircraft had Total Flight Time of 6048 hours and Total Cycles 4716, which represents aircraft total flight time and cycles since new (TSN and CSN).
- Engine utilisation – equal for both engines totaling 6002 hours (TSN) and 4699 cycles, work from last overhaul 3002 hours (TSO) and 1881 cycles (CSO), from last Hot Section Inspection 1479 hours (TSHSI) and 670 cycles (CSHSI). Resolution number 12 5603/1 from 17th December 2003 issued by CAA approved extension of engine overhaul period for additional 100 hours – from 3000 to 3100, in accordance with SB 3003R20 of engine manufacturer PWC.
- Propellers had total of 2627 flight hours (TSN), and from last overhaul performed in May 2001 962 hours (TSO).

1.6.3 Fuel – quantity and quality

Before flight Skopje – Mostar Z3-BAB aircraft was re-fueled with jet fuel Jet A-1, on 26th February 2004, at 0530 hrs. On delivery receipt 000202, related to Z3-BAB aircraft re-fueling, quality of fuel was not specified. On *Delivery Vouchers* delivered to foreign air carriers after refueling in morning hours on the same day and from same fuel supply track was recorded that fuel quality is in compliance with DERD 2494 standard. According to previously mentioned delivery voucher, aircraft Z3-BAB was refueled with 730 litres or 591 kg of jet fuel with specific weight of 0,810 kg/dm³. According to copy from Aircraft Journey Log, in which pre-flight check was recorded before flight Skopje-Mostar, total fuel weight in the aircraft tanks was 2560 lbs. Considering the length of flight, fuel was only allocated in wing fuel tanks because there was no need for refilling the central fuel tank. Total capacity of the aircraft fuel tanks is 3660 lbs.

Analysis of fuel samples taken on 26th February 2004 from the air tank that supplied the aircraft Z3-BAB before departure from Skopje to Mostar, confirmed that fuel complies with applicable standards. Fuel analysis was conducted by Section for Crime – Technique of Ministry of Foreign Affairs of FYROM and by Inspekt-RGH d.d Sarajevo laboratory. Makpetrol A.D. Skopje submitted results on fuel quality GM-1 conducted on 13th February 2004 in DOKTA laboratory. This analysis refers to quality of imported jet fuel whose quality was confirmed before stored in underground fuel tanks at Skopje airport from where air tanks are supplied from.

1.6.4 Mass and Balance

Before taxing on Skopje airport the aircraft TOW was 12750 lbs, which was consisting of:

- Basic Empty Weight of the aircraft was 8220 lbs,
- Fuel weight was 2560 lbs,
- Weight of flight crew, passengers and luggage were 1880 lbs.

Taking into account fuel consumption of 200 lbs during taxing and approved MTOW of 12500 lbs the aircraft on take-off was within prescribed limits.

1.7 Meteorological information

Pre-flight meteo briefing on 26th February 2004, was done by co-pilot at Skopje airport before departure at 0550 hours when he collected meteo documentation for the flight (METAR, TAF for Mostar and alternative airports, SWC, upper wind and temperature charts). During pre-flight briefing, meteo conditions at destination were assessed to be in deterioration, due to movement of warm front over Herzegovina region, forecasted low visibility and heavy precipitation at Mostar airport. Icing conditions and thunderstorms close to front line were given as warning.

After initial contact with ACC Mostar at 0746 hours, flight crew acknowledged following weather conditions published in METAR at 0700 hours for Mostar airport:

- Wind : from 340°, at 10 kts,
- Visibility : 8 km,
- Recent weather : light rain,
- Cloud conditions (SCT) at 600 ft QFE, (BKN) at 1600 ft QFE, BKN at 7300 ft QFE,
- Temperature : 5° C,
- QNH: 1003 mb, 29.62 inHg.

Transcript from CVR and aircraft altimeters found on site of accident confirms that altimeters settings were correctly done. From early morning and during the day, site of the accident and approach area were completely covered with low layer clouds (METAR report stated: SCT 600 ft at 0700 hours and 200 ft at 0800 hours). Middle and lower scattered layers of clouds were generating rain with variable intensity. Satellite images of clouds presented compact clouds layer with clearly visible line of convective clouds along the line Mostar – Sarajevo.

Weather conditions at the time of accident according to official METAR report at 0800 hours were:

- Wind : from 280° at 6 kts,
- Visibility: 8 km,
- Clouds: SCT 200 ft QFE, BKN 1400 ft QFE, BKN 2300 ft QFE,
- Temperature: 6° C,
- Dew Point: 4° C,
- QNH: 1003 mb, 29,62 inHg.

This weather condition was caused by vast depression in which three centres of low pressure were identified with main centre above Scandinavia and two secondary cyclone centres: one above the Mediterranean and other above the Black Sea. Secondary centres were connected by warm front whose line on 26th February 2004 morning time was above B&H in direction of Metković-Mostar-Sarajevo, therefore very low base of clouds is self-explanatory in critical time. Upper south-western streaming of humid and unstable air from Mediterranean, particularly near the front line created multi-layered cloud formation with occasional convective centres.

Natural light conditions at the time and site of accident were daylight with reminder that position of the Sun was not relevant for further analysis, considering the flight was conducted in IMC.

1.8 Aids to Navigation

1.8.1 General Information

Mostar airport according to information given at AIC A11/03, is equipped with radio navigational instruments as follows:

VOR / DME

- Identification Mark: MSR,
- Frequency and channel: 116.9 MHz, Ch 116 X,
- Coordinates: N 43°15' 40.88'', E 017° 51'20.63''.

NDB

- Identification Mark: DNC,
- Frequency: 425 KHz,
- Coordinates: N 43° 08' 14.84'', E 017° 50' 50.54''.

PAPI

- Approach angle: 3.48° (6.1%).

Secondary Surveillance Radar (SSR)

- Secondary Surveillance Radar of DETAIR, French unit in SFOR, was in use until 06th March 2003
- NOTAMN D0143/03 with permanent validity was published on 06th March 2003, in which is stated removal of SSR and its service cancellation.

Runway 34 Lighting System

- Approach lights in length of 900 m,
- High Intensity,
- Type B flashing lights,
- Runway lights of high intensity.

1.8.2 Approach Procedure VOR/DME RWY 34

Approach procedure VOR/DME RWY 34 was made up by DIRCAM, following request of DETAIR Mostar, dated 21st February 2002, in accordance with ICAO Doc 8168/PAN OPS.

In July 2002 this procedure was calibrated using aircraft Mystare 20, and officially published in November 2002.

Approach procedure published in February 2003 is identical with procedure previously published in November 2002. Reason for re-publishing is cancellation of SSR at airport Mostar (**Appendix 1**).

1.9 Communications

Communications was organised and supervised by SFOR, located at mobile ATC unit. Operation and maintenance of communication equipment were SFOR responsibility. No difficulties in communication between pilot and flight controller were recorded during the approach. Communications and telephone lines were operating correctly.

On 27th February 2004 IIC took the magnetic tape with communication pilot-controller on frequency APP Mostar. Transcript of the tape confirms that communication was clear, understandable and in accordance with standards (**Appendix 9.1**).

1.10 Aerodrome Information

1.10.1 General Information

Information below are from AIC A11/03 from 06th February 2003 published by CRCO Ltd. on behalf of BHDCA, from approach plate 1.02 Mostar LQMO.

Airport:

- Name: Airport MOSTAR,
- ICAO indicator location: LQMO,
- Reference Point: N 43° 16' 58.44'', E 017° 50' 45.16'',
- Elevation: 156 ft (ARP),
- Magnetic variation: 2° E (98).

Runway:

- Runway identification: 16 and 34,
- Runway 16: magnetic direction 156°, threshold coordinates N 43° 17' 34.49'', E 017° 50' 24.91'',
- Runway 34: magnetic direction 336°, threshold coordinates N 43° 16' 22.50'', E 017° 51' 05.26'',
- Runway length: 2400 m (TORA, TODA, ASDA, LDA),
- Threshold elevation 16: 154 ft,
- Reference point elevation (ARP): 156 ft,
- Threshold elevation 34: 138 ft,
- Runway slope: 1.1 %.

Runway Lighting

- Runway 16: no approach lighting, runway lights are of high intensity, no PAPI,
- Runway 34: approach lighting length of 900m type B flashing lights of high intensity, runway lights are of high intensity, has PAPI (3.48° / 6.1%).

In accordance with *Memorandum of understanding regarding the opening of Mostar airport for Commercial Air Traffic signed on 12th November 1997* between SFOR and Council of Ministers of B&H and Federation of B&H, SFOR was responsible for condition and operation of airport Mostar. SFOR was responsible for ATC service, establishing and approval of approach procedures, accuracy, and validity of information, drawings and all data contained in the approach plates.

Runway condition on 26th February 2004:

- Runway was wet due to light rain.

1.10.2 ATC Service

DETAIR, French unit with SFOR, provided ATC service from mobile tower that was in nearby vicinity of runway.

Published and used approach procedure by the aircraft Z3-BAB was VOR/DME RWY 34 (**Appendix 1 and 2**).

1.11 Flight Recorders

Aircraft was equipped with Flight Data Recorder - FDR model 5424-501 Fairchild, P/N 15600-501 (S/N 7405) and Cockpit Voice Recorder - CVR A100 Fairchild, P/N 93-A100-10 Level 13, (S/N 5987), fitted in the factory prior to delivery. Flight Data Recorder, manufactured in accordance with Technical Standard Order TSO C51a and ARINC 542, is designed to record only basic flight parameters: airspeed, altitude, heading and vertical acceleration, on aluminum foil. Cockpit Voice Recorder is manufactured in accordance to Technical Standard Order TSO C84 and ARINC 557, to record on magnetic tape sound signals from position of the third crew member (channel 1), from microphone, mask and hand microphone of the co-pilot (channel 2), from microphone, mask and hand microphone of the pilot (channel 3) and from the cockpit area (channel 4).

FDR and CVR found on the accident site did not sustain major mechanical or thermal damage during the hit or fire on the aircraft (**Appendix 8, picture 8.14**). They were sent to authorised service *RUAG Aerospace Services GmbH* (Germany) on 03rd March 2004, for readout.

1.12 Wreckage and Impact Information

Panoramic view of the terrain from location of aircraft initial impact up to the resting place of the wreckage is given in Appendix 5. Impact path, coordinates of site of accident and terrain elevations are marked on the picture. Terrain locations marked as A, B, C and D can be seen more clearly on photographs **5.2, 5.3, 5.4 and 5.5**.

1.12.1 Distribution Pattern of Aircraft Parts at the Accident Site

The site of the accident is Matica hill, near village Huskovići, with coordinates N 43 11 30,81 and E 17 54 44,49. Just before impacting the ground the aircraft was in approach phase to runway 34 of Mostar airport. The aircraft was flying on radial 326 in direction VOR/DME MSR, at ground speed of approximately 130 kts and most probably with rate of descent of approximately 470 ft/min. Ground speed and rate of descent were given based on calculations and readings of the instruments shortly after the accident. Initial impact with tree was on elevation of 540,98 m (1774,863 ft). Landing gear was extended, and it was not possible to determine flaps position.

Appendices 6, 7 and 8 show places of the aircraft colliding with obstacles and dislocation pattern of parts separated during aircraft movement after impacting the ground. Locations of parts found are marked with numbers. All vertical distances are related to distance from the point of initial impact and horizontal distances from the axis of the aircraft movement path.

Considering distribution pattern longitudinally (in the direction of impact path) and laterally (perpendicularly to impact path), the wreckage stopped 149 m after the initial impact with the obstacle, dispersing parts in area 40 m wide. The terrain is separated with a stone wall, 1 m high and 0.5 m wide, angled back on the left side to approximately 80° in respect to the axis of the wreckage movement path. In relation to the axis of this path the wall was at distance of 89 m from location of initial impact as a referent point. From the referent point to the wall, the terrain is uneven and rocky, with scarce tree bushes and heaps of rocks and is sloping upward slightly. On 17 m from the initial impact there is a beginning of a rock heap with larger single stone. Collision with this heap, 5 m long and 1.5 m wide on back and 3 m on the front end, and its positioning right in relation to the axis of wreckage movement path, caused heavy damage to the aircraft.

After the wall, terrain gradually declines and turns to a stone craterlike formation, where remaining of the aircraft stopped on the opposite side.

Sequences of breakage of the aircraft are determined based on impressions left by the aircraft collision with obstacles and positions of parts separated during the uncontrolled movement of the aircraft. After collision with 10 cm thick tree, which was cut off at 1.75 m from the ground, aircraft impacted with rocky part of the terrain. Aircraft firstly impacted with the nose wheel, secondly with the left and at last with the right wheel of main landing gear. Skid mark of the nose wheel, 2.2 m long, is visible at distance of 4.8 m from the initial impact with the tree. On distance of 2 m laterally, left wheels impressed a skid mark 10.3 m long, while the skid mark of 8.0 m in length, left by the right wheels, is located at distance of 4.4 laterally. At distance of 12.5 m the wheel skid marks disappeared and forceful impact to above-mentioned stone heap was made. During further movement, on distance of 78 m from the referent point, the right wing with engine, propeller and landing gear separated and the aircraft after a jump of about 70 m collided with opposite side of a stone craterlike formation, crashed and initiated fire. In remaining of the aircraft consumed by fire, corpse of a passenger, carbonated corpses of six passengers and two crew members were found.

After separating from the aircraft the right wing stopped at distance of approximately 83 m to the right from the axis of the impact path, inverted for 180° and started burning. Location where the right engine collided with the ground is at distance of 9 m from the right wing, and during further uncontrolled movement, went through the wall at distance of 16 m from the axis of the impact path and stopped at 1.5 m from the wall. The right propeller with reduction gear box was found on distance approximately 4 m ahead of the engine.

Part of the air conditioning system found at distance of 29 m, cockpit carpet with the rudder pedal found at 71 m and many minor parts show that during the collision to the above mentioned stone heap, aircraft sustained significant damage. During this collision structural damages of the landing gear, propeller blades and engine housings were made. As a result of the heavy damage of the nose part, cockpit was damaged as well, which is indicated by certain parts of crewmembers' clothes found before the resting place of the wreckage.

By examining breakages of the landing gear, engines and propellers, it can be concluded that fractures were caused by force encountering obstacles. Damage to propeller blades and bends on their ends show that damage and deformations were caused while propeller blades were run into blockages.

During the fire on the aircraft after impacting a side of a stone craterlike formation the log books and documents of the aircraft, and among them AFM, burnt. At approximately 10m behind place of impact to a side of a stone craterlike formation, many pages of "Super King Air model 200 Flight Safety Pilot Checklist - for training purposes only" were found, dated June 1996, with revision number 1 from October 1996.

1.12.2 Instruments

In fire captain's instrument panel was partially damaged, while co-pilots instrument panel was heavily damaged, where only altimeter stayed on place. Other instruments dropped out from their housings in the instrument panel. Panels in cockpit with command switches, fuses and signal lights were significantly damaged or burnt out. Instrument readouts after the aircraft accident (Appendix 8) are as follows:

- Both altimeters settings were set to 1003 mb,
- Both ADF selector boxes were set at frequency of 425 KHz,
- Radio-altimeter was blocked on 60 ft and warning altitude was set to 1780 ft.
- Both artificial and standby horizons indicated 15° climb and left turn.

- PNI (*Pictorial Navigation Indicator*) indicated selected radial 326°, pointers on both ADF indicated QDM 317° and bug on heading 315°.
- Torque indicators shown 1100 (left) and 1060 (right) ftlb,
- *Vertical Navigation Computer*, of FMS system indicated selected altitude of 8100 ft,
- Captain's vertical speed indicator indicated rate of descent of 550 ft/min.

1.13 Medical and Pathological Information

Post mortem examination findings conducted by the Institute for Court Medicine Sarajevo confirmed that shortly after the impact eight people were found dead as a consequence of impact, open flame and high temperature.

For one person death was enforced and happened immediately after, as a result of multiple injuries of organs and body parts.

Evidence of toxic substances within bodies of crewmembers was not on dispose to the Commission.

Identification of people remains was conducted by the Faculty of Medicine in Zagreb – Court Medicine Department.

1.14 Fire

Fire on the right wing after the fracture and separation from the aircraft, and fire on remaining part of the aircraft, after it hit a side of a stone craterlike formation, started because of fuel leakage from wing tanks as a consequence of major damage of the wings. Both fires developed high temperature, which can be concluded from melted aluminium alloy parts and other materials with lower melting points than aluminium alloy. Fire on the aircraft, after its stoppage, spread all over and consumed out left wing and entire body, except the aft part with tail surfaces. Tail surfaces were found in upside down position, leaned to the rest of the body and horizontal stabilisator.

1.15 Search and Rescue

On 26th February 2004 at 0812 hrs, after receiving information on lost radio communication with the aircraft, RCC undertook activities in accordance with the *Instructions on Organisation of Search and Rescue in Bosnia and Herzegovina* and *RCC Operation Plan*. After assessment of received information and announcement of DETRESFA, RCC initiated Search and Rescue activities.

In Search and Rescue activity, units of Ministry of Internal Affairs, Civil Protection, SFOR and VF BiH were involved, as well as demining teams. Other subjects in Search and Rescue system, fire fighters and hospitals, were also alerted.

On the first day, VF helicopters were unable to fly to designated search area, due to bad weather conditions. On the same day, SFOR helicopters were searching extensive area of the accident and did not notice accident location. Ministry of Internal Affairs of FB&H helicopter, was supposed to be involved in SAR operation, but because of the low cloud base and poor visibility, could not search the designated area. Helicopters involved in search, on the first day, did not receive ELT signal. COSPAS-SARSAT centre, from Bari – Italy, confirmed in writing that the ELT signal was not received on the day of the accident.

According to information provided by BH MAC, significant search area was mined, which affected field teams search more difficult and limited their movement.

Search operation continued on 27th February 2004 at 0630 hrs. First helicopter VF BiH was sent to the search area at 0740 hrs, and the second one was on standby. SFOR helicopter was also sent to the search area for coordination and convey of communication between

helicopters. SFOR helicopter received ELT signal at 0810 hrs, and consequently the site of the accident was located at 0824 hrs. VF Airforce helicopter, involved in SAR, received coordinates and flew to the accident site. Information of the accident site was passed to Air Traffic Control Mostar at 0832 hrs.

The site of the accident is Matića hill, near village Huskovići, at N 43 11 30,81 and E 17 54 44,49. After area demining inspection, Investigation team arrived to accident site, and after assessment of condition of the aircraft and passengers, the aircraft destruction and death of the crew and passengers was stated. Remainings of six passengers were grouped in the frontal and central part of the wreckage. Body of one of the passengers was outside the wreckage leaned on the rear part of the empennage, close to the horizontal stabiliser.

Remainings of eight passengers were evacuated on the same day and the next day remainings of one more passenger were evacuated.

Removal of the wreckage was performed on 28th February 2004, according to the procedures issued by the IIC.

1.15.1 Emergency Locator Transmitter

ELT was found on the site of the accident, type ELT 10, S/N 77273, in good condition (Appendix 8, picture 23). COSPAS-SARSAT in Bari did not register ELT signals after the accident. No signal was received neither by any aircraft flying in the ELT coverage area on the day of the accident, nor by any aircraft landed to Mostar airport. However, during SAR on the following day, SFOR helicopter, type UH-60, Raven-81, received weak ELT signals at 0810 hrs, and the site of the accident was found at 0824 hrs. After a while, ELT signals were also received by the crew of UH-1 VF BiH Airforce helicopter.

1.16 Tests and Research

1.16.1 Flight Recorders

FDR and CVR were opened, analysed and read-out from 03rd March to 06th March 2004 in approved *RUAG Aerospace Services GmbH*, in presence of authorised representatives of Bosnia and Herzegovina, FYROM and NTSB. Both recorders were in good condition. Opening and reading of aluminium foil FDR and magnetic tape CVR are described in RUAG service report (**Appendix 10**).

It was determined that FDR aluminium foil was in good condition, with only one side of the foil used, and remaining length sufficient for 125 hours of use. CVR magnetic tape was also in good condition.

During the FDR reading it was determined that Skopje-Mostar flight data was not recorded.

Readout of CVR magnetic tape revealed that only data from channel 4 from the cockpit area was recorded. Signals from other three channels were not recorded. Sounds recorded on the tape by the cockpit area microphone were not audible as well, especially internal conversations between the crewmembers. The audibility was corrupted by sounds and noises in the cockpit. Only crew communication with Air Traffic Controls was clearly understandable. Transcript was made after repetitive listening of the CVR and comparing it to the ATC tape.

Due to absence of recorded data on FDR foil from flight Skopje-Mostar on 26th February 2004, the foil was left in RUAG service for further examination. However, further attempts of data readout were also unsuccessful, as stated in official report.

1.16.2 Emergency Locator Transmitter

As ELT signal was not received on the day of the accident, on 26th February 2004, inspection and operational test of ELT was carried out by the expert team of the AAIC on 16th March 2004.

During the inspection and test of ELT it was determined that the switch was in ARM position, that the antenna cable of the external fixed antenna was ripped out from its connector, and that the flexible antenna was broken. According to the label on the housing, the batteries had expiry date of 15th September 2004. Opening the housing, containing 9 serial connected batteries, it was determined that joint of a connection between two batteries was disconnected because of the weak welding (**Appendix 8, picture 8.24**). Measuring the voltage of batteries separately, each battery had voltage of at least 1.45V. By overbridging the broken connection the batteries had output voltage of 13.5V. During the testing with serially connected batteries, ELT emitted signals when switch was in position "ON" but not in the position "ARM".

According to Aero-Dienst data, ELT check was performed in April 2003, in accordance with list AD 131 from March 2000. It is stated that during the check and corrosion test no irregularities were discovered.

1.16.3 Approach Procedure VOR/DME RWY34

Requested by AAIC, Air Traffic Service Agency Ltd of Serbia and Montenegro on 27th March 2004, using YAK 40 aircraft performed:

- Calibration Approach Procedure VOR/DME RWY 34, in accordance with ICAO Doc. 8071,
- Simulated flight of Z3-BAB during final approach phase on altitudes lower than published.

The results are as following:

- Approach Procedure VOR/DME RWY 34, only at the end of outbound leg of racetrack procedure at distance from 15.2 NM to 12.2 NM from VOR/DME MSR, on radial 146^o, at altitudes from 5200 ft to 4700 ft QNH, DME indication was lost and VOR signal was not reliable
- Signal VOR/DME MSR in above mentioned segment is not in compliance with ICAO Doc. 8071 (*Manual Testing of Radio Navigation Aids*) due to terrain.
- During the simulated flight starting at distance of 9 NM to 1 NM from VOR/DME MSR, on radial 146^o, and descending from altitude of 2800 ft to 1700 ft, VOR and DME indications were without interruptions or erroneous readouts.

1.16.4 VOR/DME MSR

Calibration results concluded that VOR/DME MSR facility is operating in accordance with standards.

1.17 Organisational and Management Information

ATMD of FYROM Government is the owner and operator of Beech Super King Air 200 aircraft, registered as Z3-BAB and Lear Jet 25, registered as Z3-BAA, which is not in airworthy condition at the time.

ATMD of FYROM Government consists of Air Transport Division and Maintenance Division, and is managed by Internal Organisation Regulations of FYROM Government, number 02-1388/1 dated 05th April 2002. Above mentioned act prescribes job positions requirements for four posts in Air Transport Division and three posts in Maintenance Division.

By reviewing documentation it was determined, that for positions and work assignments of Head of ATMD, instructor pilot, co-pilot and Head of Maintenance Division, four people were engaged contractually and not on full time basis.

Frequent changes of personnel of ATMD from beginning of the 90's, destabilized ability of this department and made it dependant on foreign technical support. That caused contractual engagement of pilot and maintenance staff that affected training and checking of flight crews, updating of flight and maintenance manuals and subscription on publications for aircraft operation and maintenance.

For conducting of operations, ATMD of FYROM Government was not backed by Operational Manual, but only Aircraft Flight Manual issued by the aircraft manufacturer was carried onboard. SOP manual, as a part of AFM, was used onboard. These documents were approved by CAA of FYROM.

Operation oversight is conducted by the Head of ATMD, as determined by the Internal Organisation Regulations. The ATMD does not possess any certificate or approval to conduct the operations. No evidence of incidents or accidents exists, according to information provided by CAA of FYROM.

1.18 Additional Information

1.18.1. Former SFRJ Civil Aviation Law is still in force in FYROM, published in "SFRJ Official Gazette No. 45" dated 01st September 1986 and bylaws based on this Law.

1.18.1 Examination of aircraft wreckage revealed that there were no evidence of in-flight explosion or fire, or any sign of terrorist act.

1.19 Useful or Effective Investigation Techniques

None.

2 ANALYSIS

2.1 Introduction

Factual information were analysed with focus on their contribution to the aircraft accident. According to this, analysis represents a logical link between factual information and conclusions.

2.2 Flight Operations

2.2.1 Crew Qualifications

The flight crew was licensed in accordance with Civil Aviation Law and licencing regulations in force in FYROM. The flight crew had valid medical certificates.

The Captain was experienced pilot, being employed by numerous airlines and holds many type ratings in the transport category aircraft. He did not fly to Mostar airport since 1992. ATMD does not have crew training programme or training record and checking forms. During the period between 02nd May 2000 and 16th June 2000 he renewed ATPL/A and type rating for B200 aircraft. Since then, he was flying on B200 aircraft only. The last proficiency check was on 25th April 2003 on B200 aircraft, in order to renew the licence. Last simulator training was in 1997, for B1900 aircraft.

Co-Pilot was employed by ATMD and was type rated for B200 aircraft. Before that, he had flight experience with various types of military aircraft. He did not attain enough experience for flying transport category aircraft. He did not fly to Mostar airport since 1992. He obtained type rating for B200 aircraft and co-pilot endorsement in 2001. Since then, he was flying on B200 aircraft only. Last simulator check was in 2000, as part of type rating programme for B200 aircraft. Last proficiency check was on 11th December 2003 on B200 aircraft, in order to renew First Class Commercial Pilot Licence.

2.2.2 Previous Activities

Pre-flight briefing was performed on 24th and 25th February 2004. On the first day, the focus was on analysis of navigation maps, approach plates for Mostar airport and filling out the Navigation Log. An error occurred during route planning, due to omission of BARIT fix in the previously submitted flight plan, what was corrected the following day. The crew did not pay enough attention to analysis of Mostar airport approach procedures, which is evident from CVR tape transcript. Although cloud ceiling was below MDA, and the weather forecast indicated trend of deterioration of weather conditions at Mostar airport, the crew decided to perform the flight. Before departure, the crew collected NOTAM's for Mostar airport issued for the previous ten days from ARO office on Skopje airport, but NOTAM D0143/03 issued on 6th March 2003 regarding the removal of SSR on Mostar airport was not included. The crew should have asked for valid NOTAM's for Mostar airport or the dispatcher of ARO office at Skopje airport should have presented them with all valid NOTAM's. Omissions in flight planning were mostly reflected on mistakes on final landing approach. The crew did not notice great discrepancies between published and actual positions and altitudes during the approach.

2.2.3 Flight Description

The analysis has been made based on the ACC Zagreb, APP Mostar and CVR tape transcripts. In the analysis, positions of the aircraft were calculated based on CVR tape transcripts comparing to procedure VOR/DME RWY 34.

2.2.3.1 Route Flying

The aircraft was 18 minutes delayed from the departure slot.

During the flight, in communication with ACC's in Skopje, Tirana, Belgrade and Zagreb crew did not report any navigational or technical problems. Route legs and altitudes were correctly maintained.

At 0736 hrs, upon entering FIR Zagreb, the crew was maintaining FL 200 towards VOR/DME DBK (Dubrovnik). ACC Zagreb directed the aircraft to fly towards MADOS (boundary point between FIR Zagreb and FIR Sarajevo), and then to BARIT fix. The crew confirmed only MADOS.

During the flight, which was under control of ACC Zagreb, the aircraft was descending from FL 200 to FL 140 and from FL 140 to FL 110. During the descent the co-pilot did not call-out for Descent Check List, and the captain, as assisting pilot, did not warn co-pilot about it. In accordance with the Descent Check List, as a part of SOP, the crew during the descent did not determine:

1. Type of approach to be performed,
2. Airport elevation,
3. Minimum Sector Altitude (MSA),
4. Inbound track to Final Approach Fix (FAF),
5. Direction of turn for intercepting final track and altitude of the turn,
6. Minimum Descent Altitude (MDA),
7. Missed approach point (MAPt),
8. Visual Descent Point (VDP),
9. STEP - DOWN procedure (VOR/DME ARC),
10. Type of approach lighting
11. Runway conditions,
12. Approach speed,
13. FAF altitude,
14. Missed approach procedure: track, altitude and intention in case of a missed approach.

During the descent and initial approach to Mostar airport, the crew did not perform approach and landing briefing in accordance to above mentioned Descent Check List.

It is evident from CVR tape transcript that the crew had difficulties in finding BARIT fix as the final route point.

2.2.3.2 Approach Procedure

At 0746 hrs, ACC Zagreb transferred the aircraft to APP Mostar. The crew reported FL 110 to APP Mostar. APP Mostar informed on runway in use, type of the approach and actual weather conditions at the airport. Cloud ceiling was below MDA. The crew did not request detailed information on cloud position during the final approach phase. On departure airport Skopje, during the meteo briefing, the crew was warned on weather deterioration in Mostar airport zone.

From CVR transcript it cannot be determined if the crew performed Approach Check List. The flaps position during the approach could not be determined.

During flight there were no call-outs, required by SOP, from assisting pilot to pilot flying.

At 0747 hrs, the crew reported distance of 25 NM to VOR/DME MSR. APP Mostar approved descent to altitude of 6400 ft, set by QNH 1003 mb, and direction towards BARIT, what was confirmed by the crew. Instead of flying to BARIT, the crew continued flight to DIRUK and descended to altitude of 4700 ft without approval by APP Mostar. Inbound to DIRUK the crew should have maintained the approved altitude, and not go below MSA.

2.2.3.3 Initial Approach

At 0751:24, the crew reported DIRUK fix, at distance of 10 NM to VOR/DME MSR, when the aircraft was on altitude of 4700 ft. APP Mostar approved approach procedure VOR/DME RWY 34 (**Appendix 3 and 4, Point 1**).

The crew initiated left turn of 180° to intercept heading 146°. At 0754:49, in heading of 146°, at distance of 15 NM to VOR/DME MSR and on altitude of 4700 ft, the crew started left turn of 180° to intercept IF, determined by radial 146° and distance of 15 NM VOR/DME MSR. At the same time, they started descending to altitude of 4200 ft (**Appendix 3 and 4, Point 2**). According to Approach Procedure VOR/DME RWY 34 (**Appendix 2**), the crew had to maintain the altitude of 4700 ft until IF. The aircraft reached altitude of 4200 ft in the second third of the turn, at 0755:05. The crew did not follow prescribed procedure and before IF left altitude of 4700 ft (**Appendix 3 and 4, Point 3**).

At 0755:05, immediately after reaching altitude of 4200 ft, in ending phase of the turn, the crew noticed that DME and VOR had no indication and reported that to APP Mostar. At that moment the crew did not apply Missed Approach Procedure. After 18 seconds, at 0756:13, the indications of VOR/DME were re-established. The crew reported to APP Mostar "Now it is OK" and continued approach.

2.2.3.4 Intermediate Approach

With the captain's permission, at distance of 13 NM to VOR/DME MSR, the co-pilot took over handling of the aircraft. According to instructions for flying in adverse weather conditions it is recommended, in order to reduce crew's workload, approach should have been done with autopilot engaged, which was not done by the crew.

According to CVR transcript, it could be concluded that GPS was used during approach procedure VOR/DME RWY 34.

At 0756:29, the captain instructed co-pilot to intercept radial and to descend, at the same time asking him to which altitude. The co-pilot replied intention to descent from 4200 ft to 1810 ft, which is MDA. On approximate distance of 12 NM to DME, on track to VOR/DME MSR, which is 4.7 NM before FAF (**Appendix 3 and 4, Point 4**), the co-pilot started descending from altitude of 4200 ft.

The crew, according to procedure VOR/DME RWY 34, should have left the altitude of 4200 ft overhead FAF, determined by radial 326° inbound and at distance of 7.3 NM from VOR/DME MSR (**Appendix 3 and 4**).

At 0757:46, and approximate distance of 10 NM to VOR/DME MSR, crew extended the landing gear. Crew was descending without cross-checking altitude and distance by DME (*Step down procedure*). At distance of 4,7 NM by DME, aircraft was supposed to be at altitude of 2910 ft, at 3.2 NM by DME at altitude of 2130 ft, and from that point was to descend to MDA of 1810 ft .

2.2.3.5 Final Approach

At 0758:42, at distance of 7 NM VOR/DME, aircraft was at the altitude of 2000 ft, which was 2080 ft lower than prescribed altitude (**Appendix 3 and 4, Point 5**).

At 0758:56, 14 seconds after reaching previous position (7 NM VOR/DME), and in direction towards VOR/DME MSR, aircraft was 500 ft above the terrain according to radio altimeter. Even though, radio-altimeter is not to be used in VOR/DME approach procedure, altimeter that was found together with the aircraft remains had altitude decision height set on 1750 ft.

Captain noted that the height was 500 ft above terrain according to the radio altimeter, but appropriate action was not taken (**Appendix 3 and 4, Point 6**). Even though the captain instructed the co-pilot to retain altitude of 2000 ft, aircraft was descending slowly and after 31 seconds (passing 7 NM from DME) reached Minimum Descent Altitude (**Appendix 3 and 4, Point 7**).

Despite radio altimeter indication and reaching MDA at distance of 6,5 NM from MAPt, crew did not notice being situated at low height above the mountainous terrain and that aircraft safety was jeopardised. Most likely, the aircraft did not maintain the altitude.

Co-pilot asked the captain to continue with descent. Captain did not respond, but insisted on increasing the power and maintaining altitude. It could be concluded, from CVR tape transcript, that crew was unaware of the critical situation, consequently did not undertake appropriate action. Aircraft continued flight below 1810 ft QNH, or MDH 1672 ft QFE (**Appendix 3 and 4, Point 7**).

At 0759:36 aircraft collided with Matica Hill, in close proximity to village Huskovići, at altitude of 1774,863 ft MSL or 540,98 m (**Appendix 3 and 4, Point 8**).

2.3 Aids to Navigation and approach procedure

2.3.1 VOR/DME MSR

Reports of operation and calibration of VOR/DME MSR confirm that facility was operating properly and that calibration was conducted within mandatory time frame.

2.3.2 Approach Procedure – VOR/DME RWY 34

Aircraft Z3-BAB followed approach procedure VOR/DME RWY 34 on 26th February 2004 (**Appendix 2**).

During intermediate approach pilot reported to APP Mostar loss of VOR MSR indication, recorded at both ATC and CVR tape transcripts (**Appendix 9.1, 9.2**).

Approach procedure VOR/DME RWY 34 was calibrated on 19th July 2002, using aircraft Mystare 20, which was under command of CASSIC and based at ETEC, Villacoublay. During calibration, signal was tested at maximum altitude of 4700 ft and no loss of VOR indication was observed between 15,2 NM and 12,2 NM.

Results of Approach Procedure VOR/DME RWY 34 test, performed on request of AAIC, shows that in sector, at distance from 15.2 NM to 12.2 NM from VOR/DME MSR, heading 326^o, at altitudes from 5200 ft to 4700 ft QNH, DME indication was lost and VOR signal was not reliable.

2.4 Weather

In analysis of meteo conditions and its contribution to the accident, two essential elements are important:

- Based on meteo documentation and weather briefing, crew could assess that meteo conditions at destination were deteriorating and that cloud ceiling was below MDA. Consequently, final approach was to be performed in IMC conditions.
- In the terminal zone of Mostar airport meteo conditions were with low layer clouds at height 200-600 ft, and more compact cloud layer at height of 1410 ft. Both layers were mostly located in the area of final approach, completely obscuring the terrain. Therefore, the flight during final approach phase until the accident was conducted in clouds.

Light icing conditions were reported by captain of Goldeck Flug aircraft, registration mark OE-GCB, which landed at Mostar airport 30 minutes after the accident. Icing conditions and forecasted turbulences were not analysed, because they had no contribution to the accident, as well as wind at altitude with its tail component of 5-10 kts.

Analysis shows that crew decided to perform the flight, despite adverse weather conditions at Mostar airport.

2.5 Aircraft

According to the aircraft documents, Z3-BAB was registered with Register of FYROM and had Certificate of Airworthiness valid until 04th April 2004.

Aircraft was maintained according to Approved Maintenance Programme. According to maintenance records, list of accomplished AD's, SB's, SI's and SL's, status of Hard Time Items and Life Limited Parts and Technical Log Book remarks, aircraft was in airworthy condition.

No technical remarks were registered in the Journey Log Book in period from 03rd November 2003 to 13th February 2004.

ATMD of the Government of FMRJ did not have general written agreement with Aero-Dienst regarding maintenance of the aircraft Z3-BAB, instead maintenance was done on work order basis.

ATMD had only limited stock of consumables (oil, lubricates) and expendables (light bulbs, fuses), and was dependent of Aero-Dienst in all cases when parts replacements were required.

ATMD did not have required approvals and certificates to perform line maintenance and did not possess updated technical documentation for maintenance of Super King Air B200 aircraft.

No information regarding scheduled aircraft checks were recorded in Aeroplane Journey Log Book in a period between 03rd November 2003 until accident date. Information on completed maintenance tasks were only recorded in Aircraft Log Book and Engine Log Books. Propellers Log Books were not established and related data were recorded in appropriate Engine Log Books.

2.6 Flight Recorders – FDR and CVR

2.6.1 Flight Data Recorder – FDR

According to service reports (Appendix 10), flight Skoplje-Mostar on 26th February 2004, was not recorded. Previous data were recorded only on one side of the aluminium foil with remaining space for further 125 hours. Analysis shows that recorded data are incomplete and could not be exactly co-related to particular flights.

Aircraft record shows that FDR test was carried out on 09th April 2003, according to the Aero-Dienst report AD198 from October 2000, as a part of avionic inspection, on TT 5661:25 and TC 4558. Due to improper heading recordings, FDR was sent to authorised workshop Scandinavian Avionics A/S, where, according to 12463 BL report, a pressure cam malfunction was found. After replacing the pressure cam, FDR test was performed. FDR was installed back to the aircraft, after the check during the Phase check no. 2 in Aero-Dienst from 16th June 2003 to 20th June 2003.

According to ICAO standard in Annex 6 - Part I: Annex 6.3.1.3 and Annex II: 6.10.1.3, all FDR with metal foil should have been replaced before 01st January 1995.

2.6.2 Cockpit Voice Recorder – CVR

During CVR tape readout in *Ruag Aerospace Service MgbH*, it was determined that the only voices from cockpit channel (channel 4) were recorded. From other three channels: the third crew member (channel 1), the co-pilot (channel 2) and the captain (channel 3) no sounds were recorded. It is concluded that the speakers/microphone switch on audio selector box was in "speakers" position, which disabled recording of channels 1, 2 and 3.

During avionic inspection in Aero-Dienst facility, performed on 09th April 2003, CVR was found to be inoperative and it was sent for a workshop repair. The CVR was installed back to the aircraft during the Phase check no. 2 in Aero-Dienst from 16th June 2003 to 20th June 2003. Following the installation of CVR functional check was performed.

2.7 Search and Rescue

Reviewing available documentation, list of participants involved in SAR and communications records of RCC, and by assessment of all activities, it is obvious that all subjects prescribed by the Instruction for SAR in BiH were alerted.

RCC initiated an action in accordance with the above-mentioned Instruction and Operational Plan. Further on, Police, Civil Protection, SFOR, BH MAC, VF, and all other subjects related were informed, and appropriate action of field teams was requested. Helicopters and field teams were sent to the anticipated accident location. RCC estimated the accident site based on information available from APP Mostar, SFOR and field teams, and extensive search area was defined.

On the first day, air search operation was obstructed by adverse weather conditions: low clouds that covered hills in the Search and Rescue area, poor visibility, rain and wind. Efficiency of the SAR activities was affected by the fact that ELT was neither received by helicopters nor any other aircraft flying in area covered by ELT signal, Signal was also not received by COSPAS-SARSAT centre in Bari, Italy.

Land search operation was complicated because that in broader area was assumed minefields, as well as inaccessible terrain configuration. Beside this, inadequate knowledge of relevant documents regarding SAR activities, by certain participants, lead to overlapping of responsibilities and activities.

After analysis of activities undertaken the previous day, on 27th February 2004 areas and search method were set. Improved weather conditions enabled engagement of helicopters in SAR. SFOR helicopter received ELT signal, and consequently the site of the accident was located in early morning hours. Information of the accident site was passed to all relevant SAR participants. Demining team, AAIC and land search teams were sent to accident site.

3 CONCLUSIONS

3.1 Findings

1. Flight crew had valid licences and endorsements in accordance with Civil Aviation Law and by-law on qualifications, exams and licences required for work of the flight crew members in force in FYROM.
2. Before flight Skopje – Mostar, on 26th February 2004, aircraft was in airworthy condition.
3. Flight crew was rested, medically certificated and fit for the flight.
4. Crew pre-flight briefing was not adequate, regarding nature and conditions of the flight.
5. Before departure crew was informed that weather conditions at Mostar airport were deteriorating, and that cloud ceiling was below MDA.
6. Standard Operating Procedures (SOP) were not followed by the crew during flight.
7. During descent towards DIRUK fix, flight crew did not use the *Checklist* or carried out briefing for approach and landing.
8. During approach procedure VOR/DME RWY 34 a few inappropriate decisions were made:
 - Aircraft overflowed DIRUK (IAF) below altitude defined by the approach procedure VOR/DME RWY 34.
 - Descending turn was initiated during interception of IF and aircraft reached the altitude of 4200 ft at the end of the turn.
 - Descent started from altitude 4200 ft between IF and FAF, instead of maintaining the same altitude until FAF.
 - During final approach phase, the crew noticed distance of 7 NM from VOR/DME MSR and altitude of 2000 ft, but appropriate action was not taken, even though actual altitude was 2080 ft below than prescribed.
9. During intermediate approach phase crew lost indication of VOR and DME at second third of the turn towards IF, and after re-establishment of indications continued the flight.
10. GPS was used during approach procedure.
11. Test of approach procedure VOR/DME RWY 34 shows in sector, at distance from 15.2 NM to 12.2 NM from VOR/DME MSR, heading 326⁰, at altitudes from 5200 ft to 4700 ft QNH, DME indication was lost and VOR signal was not reliable.
12. Assessment of data presented in METAR and TAF reports for Mostar airport indicates that weather conditions and forecast was properly presented to the crew.
13. Aircraft was IFR equipped and maintained in airworthy condition, in accordance with applicable standards and regulations. Aircraft had all necessary documentation and approvals required for international air transport. Certification of Airworthiness was regularly renewed and was valid until 04th April 2004.
14. Based on examination and findings on engine, propellers, parts of landing gear, remains of aircraft structure and instruments read-outs, it can be concluded that engine was operating properly and that all breakages were enforced by impact of aircraft with the ground. This is also confirmed by content and calm tone in communication between crew members until the impact, noticed in CVR transcript.

15. Aircraft was destroyed in collision with rocky terrain and later on consumed by fire.
16. All navigation aids at Mostar airport were operating properly.
17. All instructions transmitted by the ATC controller were in accordance with standards.
18. Radio communication between controller and flight crew as well as telephone line for co-ordination were operating properly.
19. On the accident day, SAR activity was difficult regarding weather conditions, inaccessibility and land mines in the area. Next day, on 27th February 2004, improved weather conditions and ELT signal reception enabled locating the site of accident. Noticed lack of co-ordination and insufficient induction with Instruction for SAR by the participants, had no effect on efficiency of SAR. In order to improve efficiency of all SAR activities, it is necessary to analyse all activities and to promulgate appropriate recommendations accordingly.
20. Organisational structure and management of ATMD was not in full compliance with regulations and standards for type of aircraft operation being performed.
21. ATMD does not have Operations Manual required for air transport for own use approved by CAA of FYROM.
22. CAA of FYROM did not conduct adequate safety oversight over ATMD.

3.2 Cause of accident

Aircraft accident of Z3-BAB is caused by:

Non-compliance with published approach procedure at Mostar airport, regarding distance and altitude, resulted in Controlled Flight Into Terrain (CFIT).

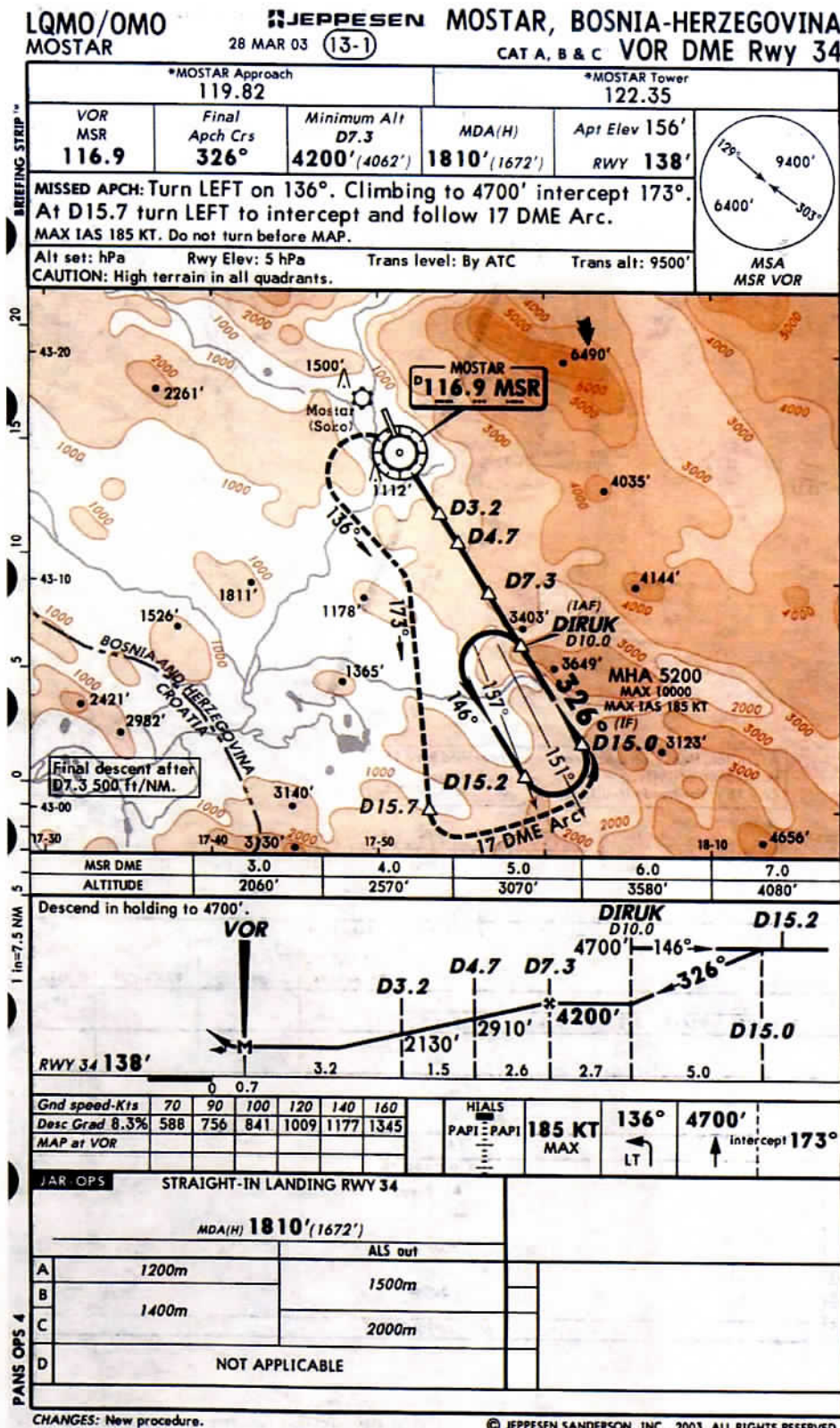
Probable Contributing Factors:

- Inadequate briefing of the flight crew for performing the flight,
- *Check list* was not consulted,
- Lack of Crew Resources Management (CRM) practice during flight,
- Flight crew decision to land at Mostar airport, despite cloud ceiling being below MDA,
- Flight crew decision to continue flight after loss of VOR/DME indication.

4 SAFETY RECOMMENDATIONS

1. ATMD should establish organisation in compliance with relevant regulations and international standards, and introduce Quality System for air transport for own needs and commercial services.
2. CAA of FYROM should establish full oversight over organisation and operations of ATMD.
3. BHDCA should review SID and STARS for all international airports in Bosnia and Herzegovina.

Appendix 2: Approach procedure VOR/DME RWY 34 at Mostar airport (Jeppesen)



Appendix 4: Probable flight profile during the approach procedure on 26th of February, 2004

Point 1

Time: 07:51:24
 Distance: 10 NM
 Altitude: 4700 ft
 Ground Speed: 215 Kts
 Initial turn
 Overhead IAF Diruk

Point 2

Time: 07:54:49
 Distance: 15 NM outbound
 Altitude: 4700 ft
 Ground Speed: 154 Kts
 Descending turn

Point 3

Time: 07:55:49
 Distance: 15 NM inbound
 Altitude: 4200 ft
 Ground Speed: 154 Kts
 No indication of VOR/DME

Point 4

Time: 07:56:29
 Distance: 12 NM inbound
 Altitude: from 4200 ft to 1800 ft
 Ground Speed: 145 Kts
 Descending
 Landing Gear extended between 12 and 10 NM

Point 5

Time: 07:58:42
 Distance: 7 NM inbound
 Altitude: 2000 ft
 Ground Speed: 145 Kts
 Level flight

Point 6

Time: 07:58:46
 Distance: 6,84 NM inbound
 Altitude: Descending below 2000 ft
 Ground Speed: 138 Kts

Point 7

Time: 07:58:56
 Distance: 6,457 NM inbound
 Altitude: Descending below 1810 ft
 Ground Speed: 138 Kts
 Descending below MDA

Point 8

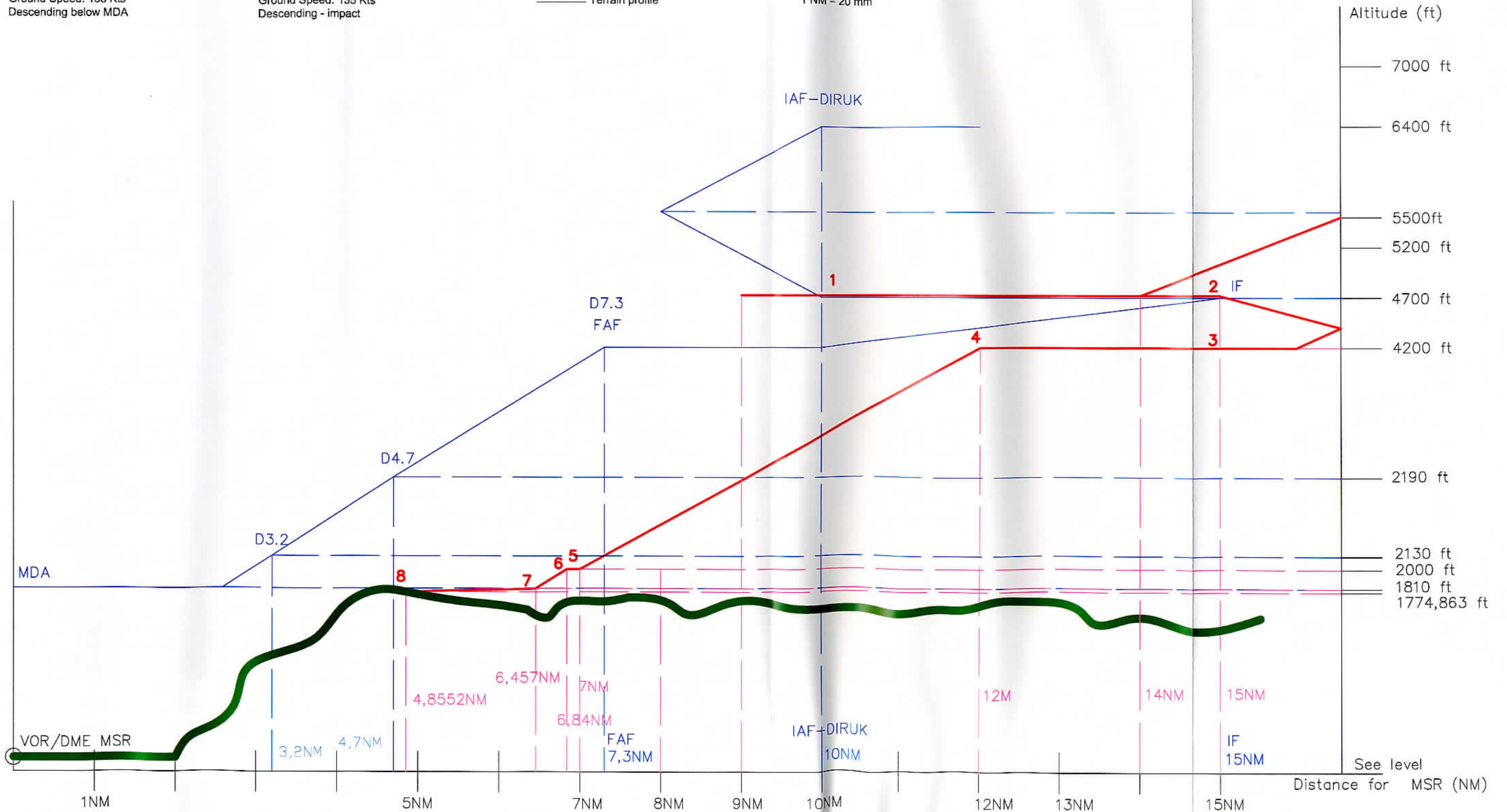
Time: 07:59:36
 Distance: 4,8552 NM inbound
 Altitude: 1774,86 ft (impact)
 Ground Speed: 135 Kts
 Descending - impact

Legend

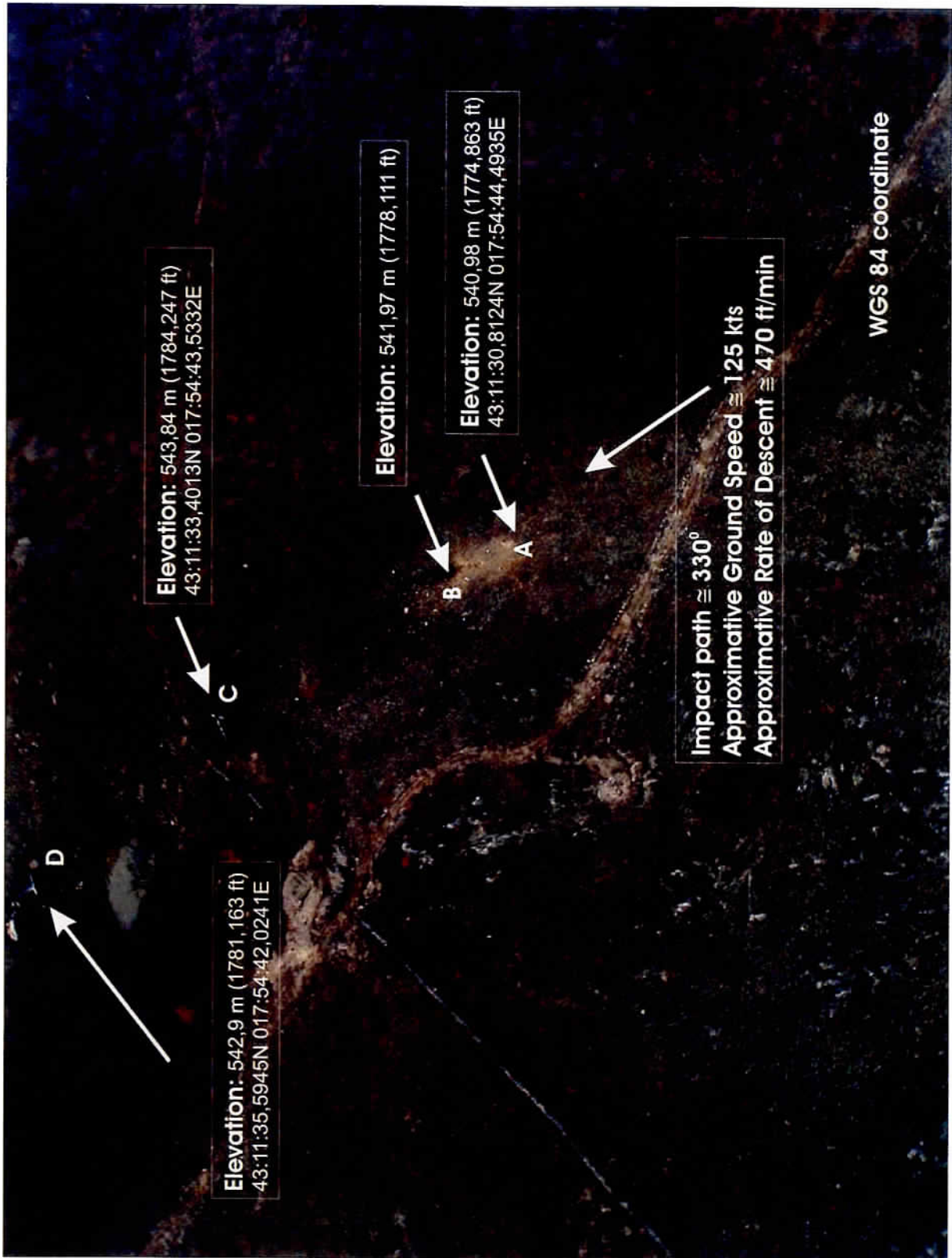
- Published flight profile
- Actual flight profile
- Terrain profile

Scale

- 1 ft = 0,025 mm
- 1 NM = 20 mm



Appendix 5: Accident Site Terrain Photos



Picture 5.1: Panoramic view of accident site



Picture 5.2: Initial impact with the ground (Mark A)



Picture 5.3: Pile of rocks along the impact path (Mark B)

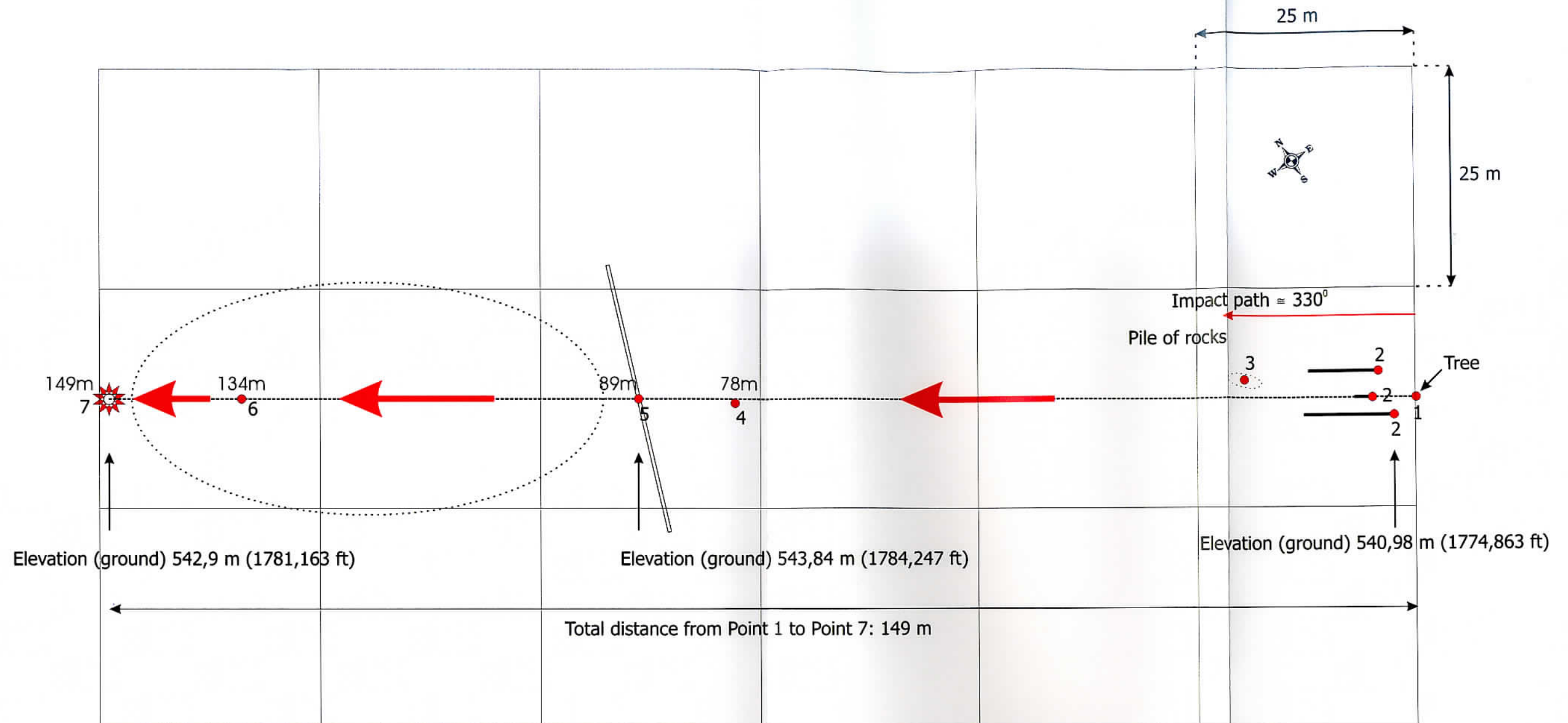


Picture 5.4: Stone wall (Mark C)



Picture 5.5: Resting place of the wreckage (Mark D)

Appendix 6: Impact site and post - impact aircraft trajectory

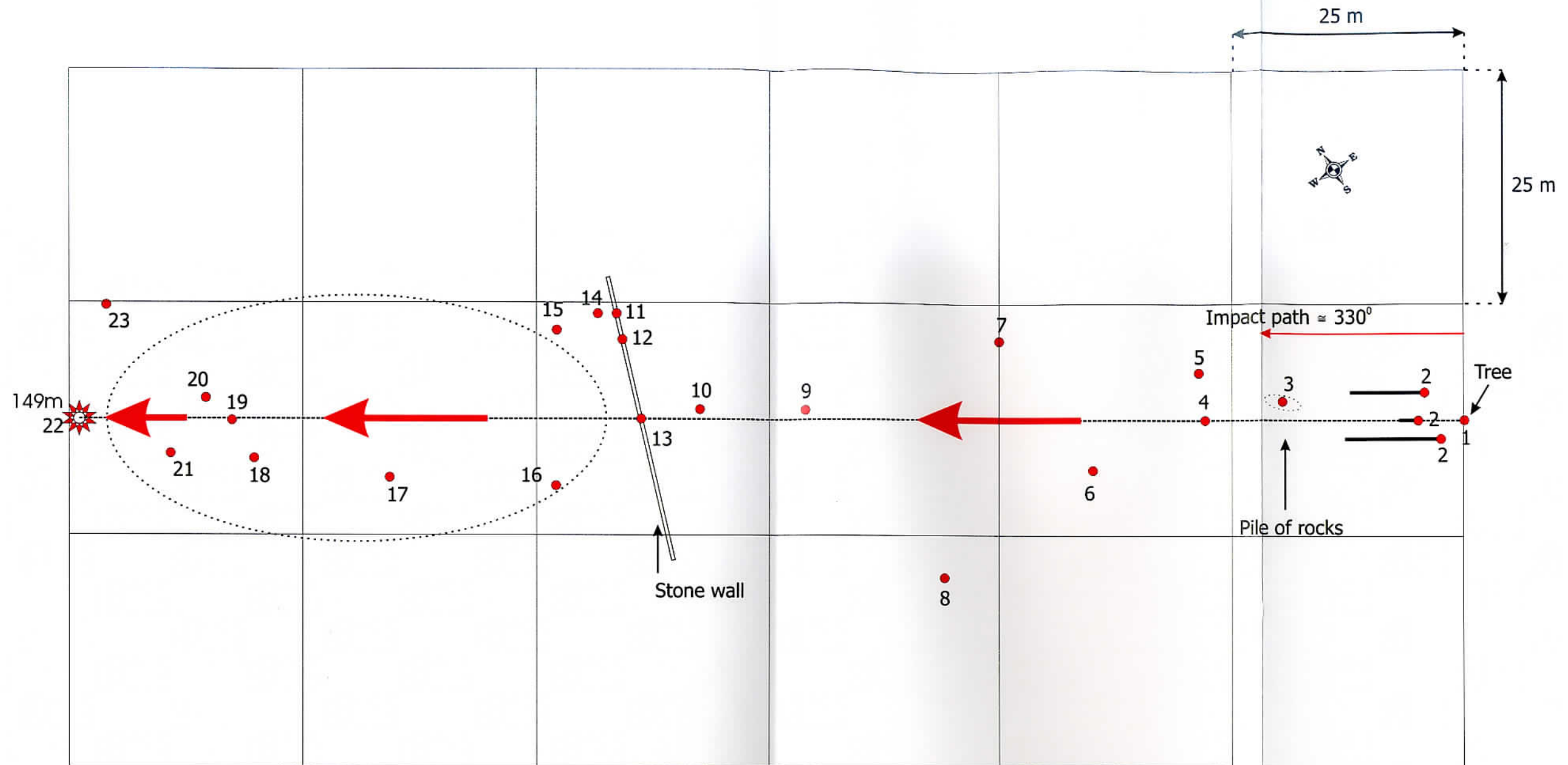


Legend

- | | |
|--|--|
| 1 Initial impact point with tree | 3 Pile of rocks |
| 2 The second impact point (ground):
- Impression of nose landing gear wheel of 2,2 m in length, at distance of 4,8 m from point 1
- Impression of left main landing gear wheel of 10,3 m in length, at distance of 2 m from point 1 and 2 m laterally from impact path
- Impression of right main landing gear wheel of 8 m in length, at distance of 4,4 m from point 1 and 3 m laterally from impact path | 4 Impression of right wing impact, at distance of 78 m from point 1 along the (impact path), and of 0.5 m laterally
5 Stone wall |
| | 6 Final impact with the ground, at distance of 45 m from the stone wall on the other side of the depression in karst along the impact path |
| | 7 Resting place of the wreckage |

Scale: 2mm=1m

Appendix 7: Distribution pattern of the major parts of the wreckage

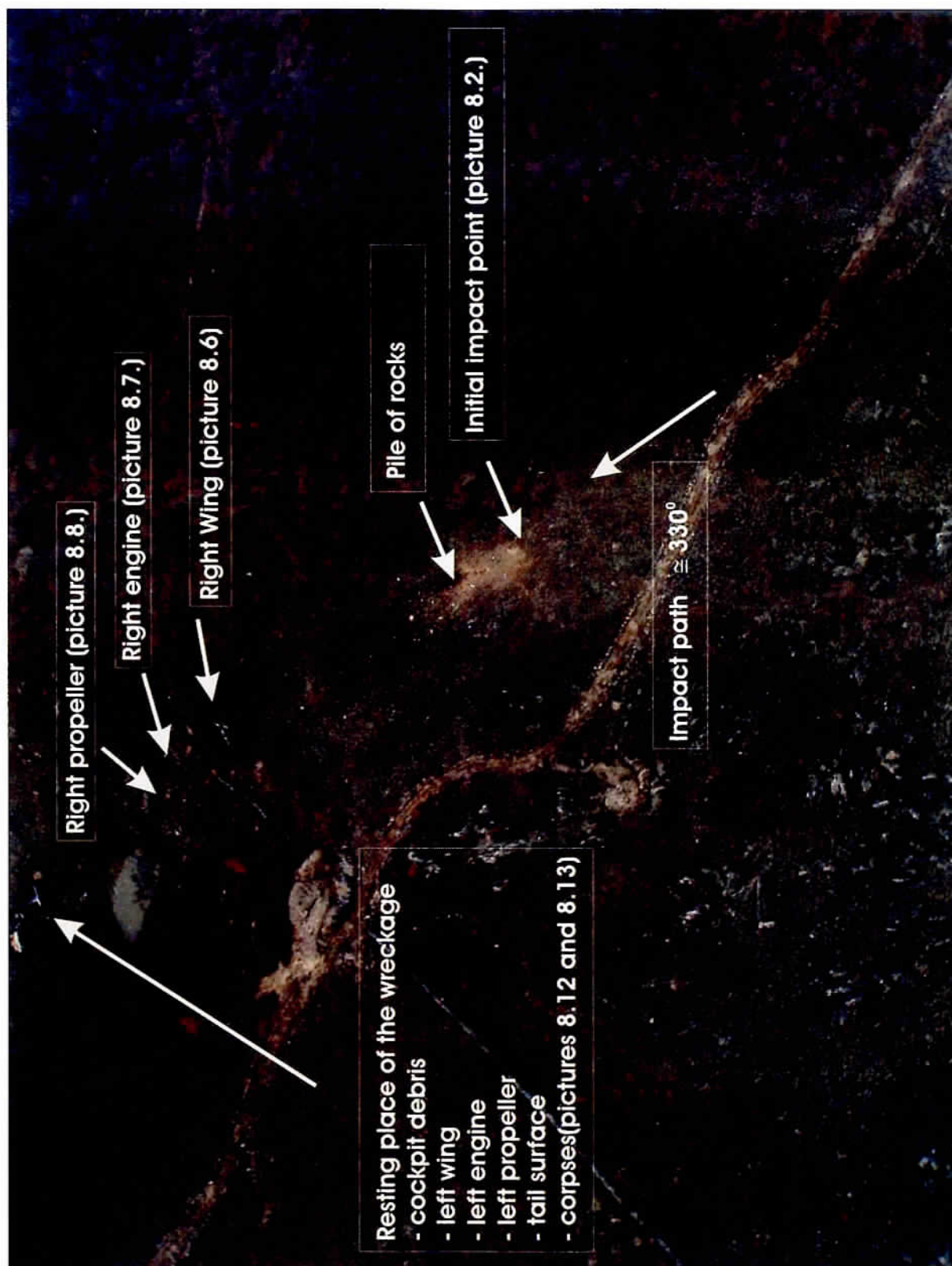


Legend

- | | |
|---|--|
| 1. Aircraft impact with the tree | 13. Stone wall damage |
| 2. Wheels impression into the ground | 14. Right engine |
| 3. Pile of rocks | 15. Right propeller |
| 4. Nose landing gear extension mechanism | 16. Left main landing gear wheel hub |
| 5. Part of the air-conditioning unit | 17. Shock absorber |
| 6. Nose landing gear cylinder | 18. Parts of the landing gear |
| 7. Right main landing gear cylinder | 19. Left propeller |
| 8. Pitot tube | 20. Part of radio system |
| 9. Cockpit carpet and rudder pedal | 21. Aircraft tire |
| 10. Right wing | 22. Fuselage, empennage, left wing, left engine, FDR, CVR, instruments panel and corpses |
| 11. Oštećenje kamenog zida od desnog motora | 23. Wheel |
| 12. Stone wall damaged by right wing impact | |

Scale: 2mm=1m

Appendix 8: Photo Documentation of Accident Site



Picture 8.1: Panoramic view of accident site, major parts distribution pattern



Picture 8.2: Initial collision with the tree and traces along the impact path



Picture 8.3: Landing gear shock absorber



Picture 8.4: Cockpit carpet and rudder pedal



Picture 8.5 Pitot tube



Picture 8.6: Right wing inverted by 180°



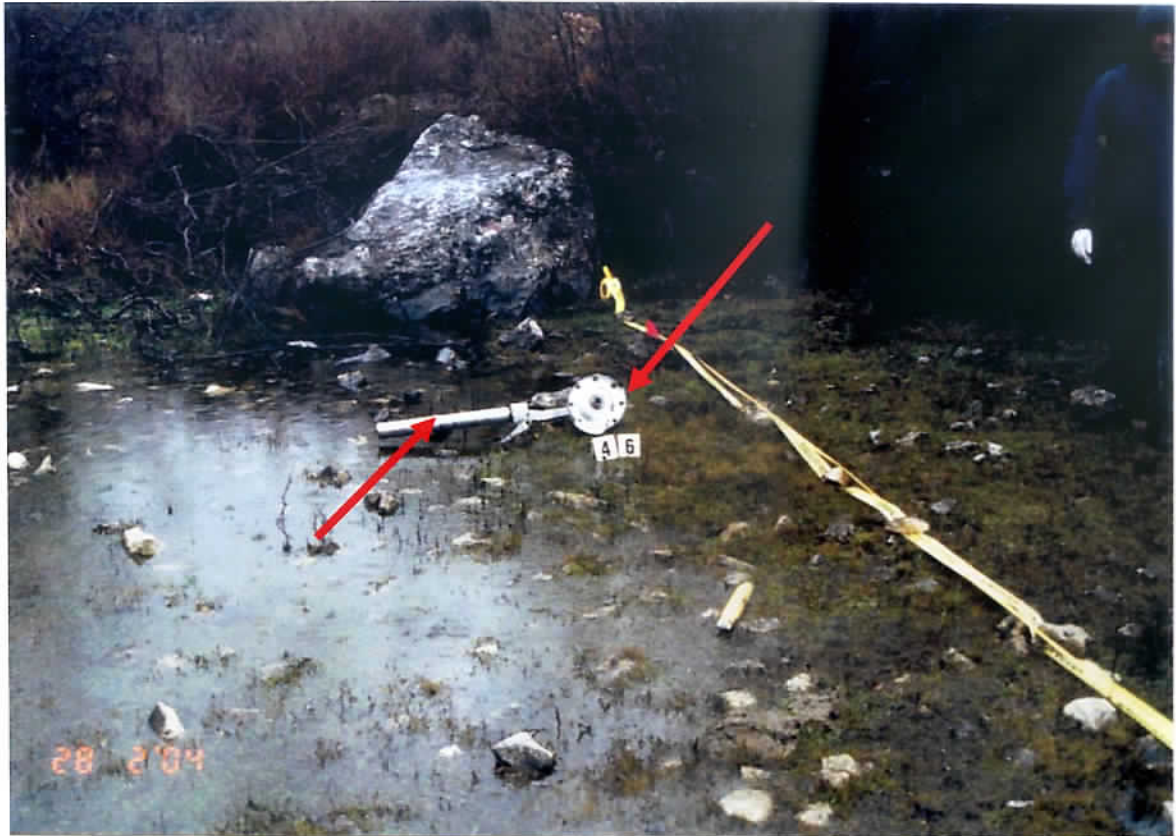
Picture 8.7: Right engine



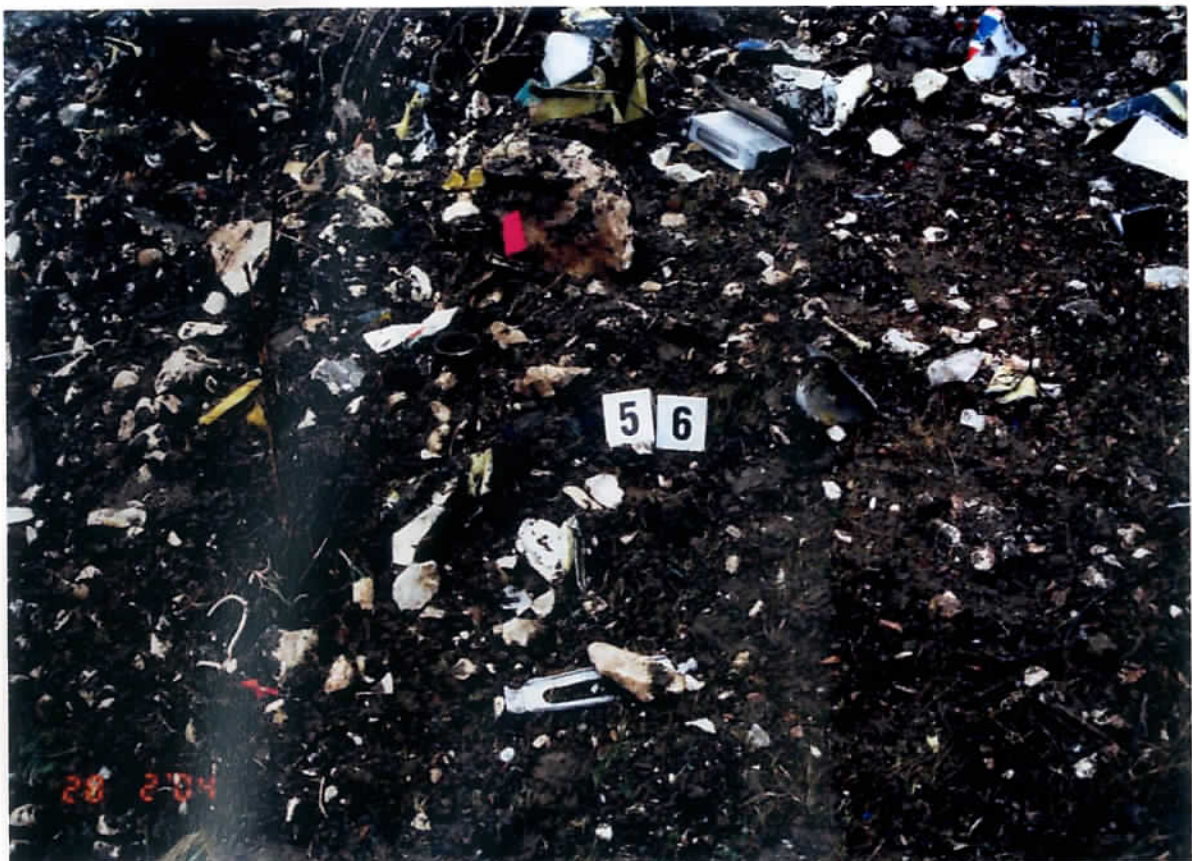
Picture 8.8: Right propeller and associated reduction gear box



Picture 8.9: Right landing gear wheel hub



Picture 8.10: Landing gear shock absorber and wheel hub



Picture 8.11: Dispersed aircraft parts close to resting place of the wreckage



Picture 8.12: Left propeller and tail unit



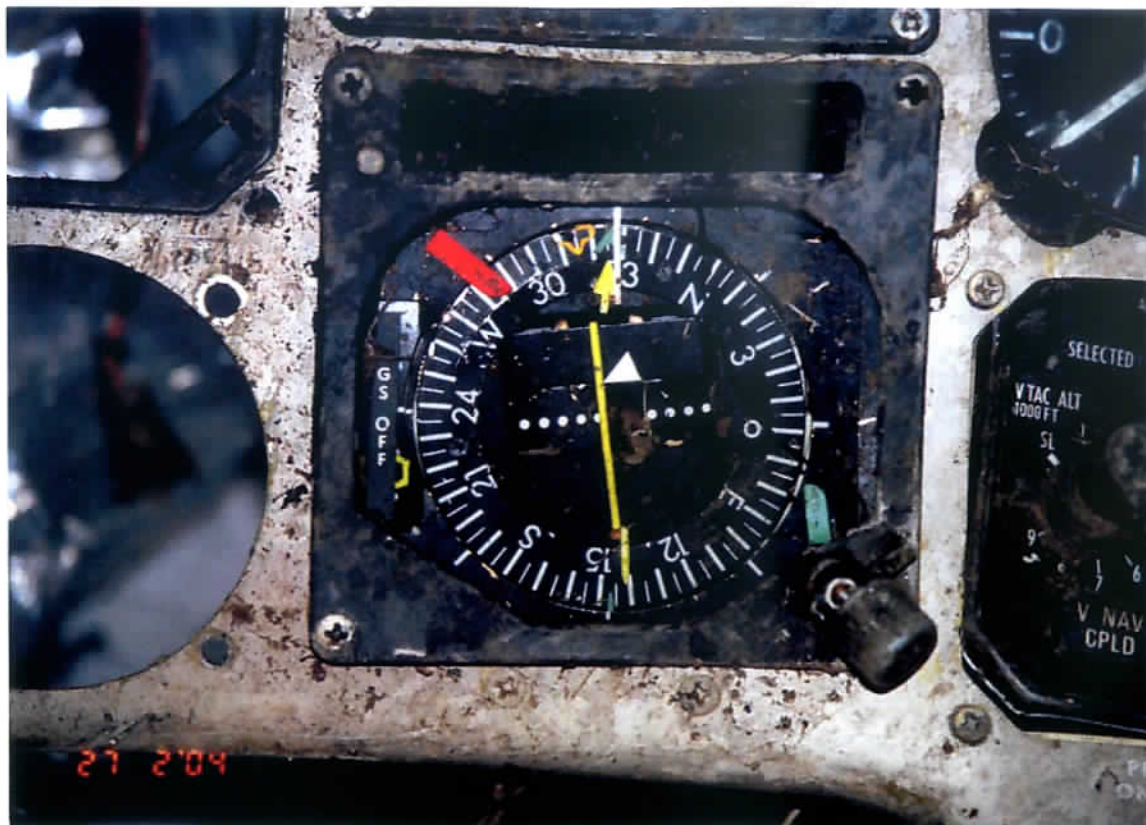
Picture 8.13: Tail unit, left wing, left engine and wheel at the resting place



Picture 8.14: FDR and CVR



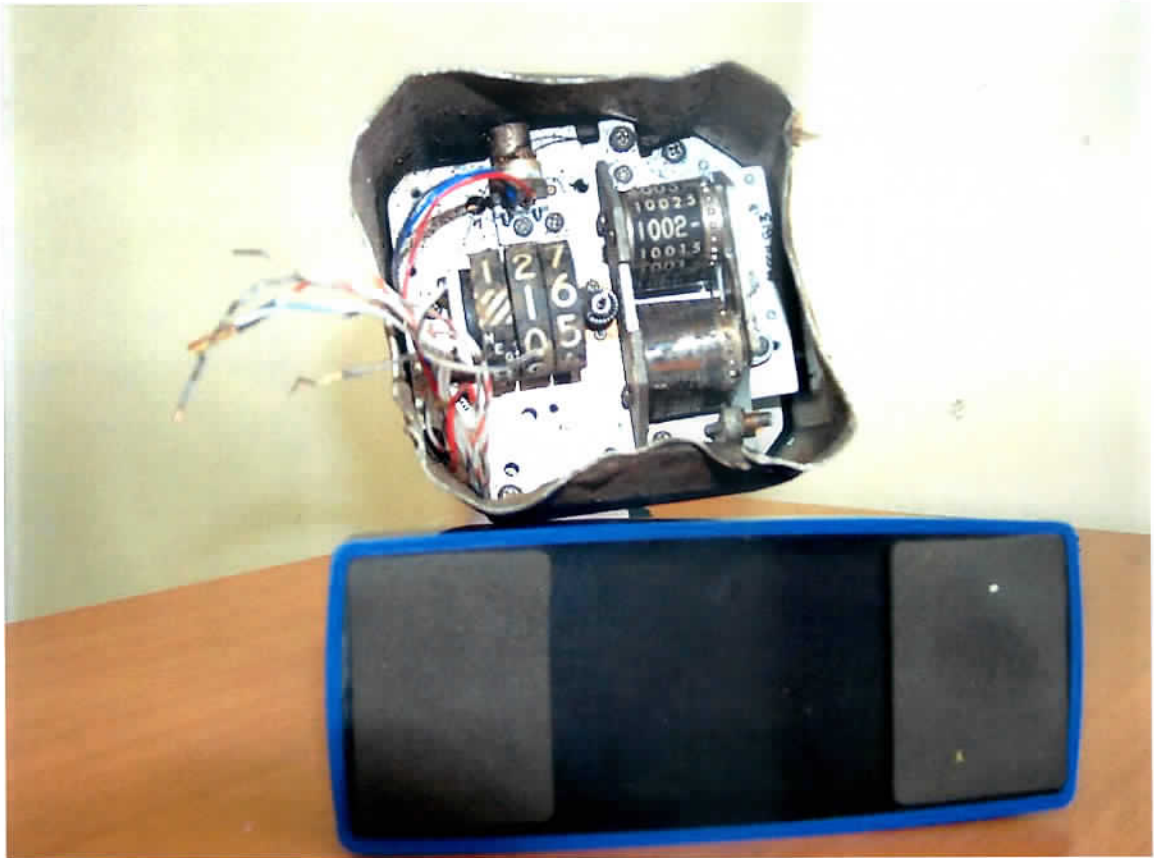
Picture 8.15: Instrument panel and equipment at the resting place



Picture 8.16: Pictorial Deviation Indicator (PDI)



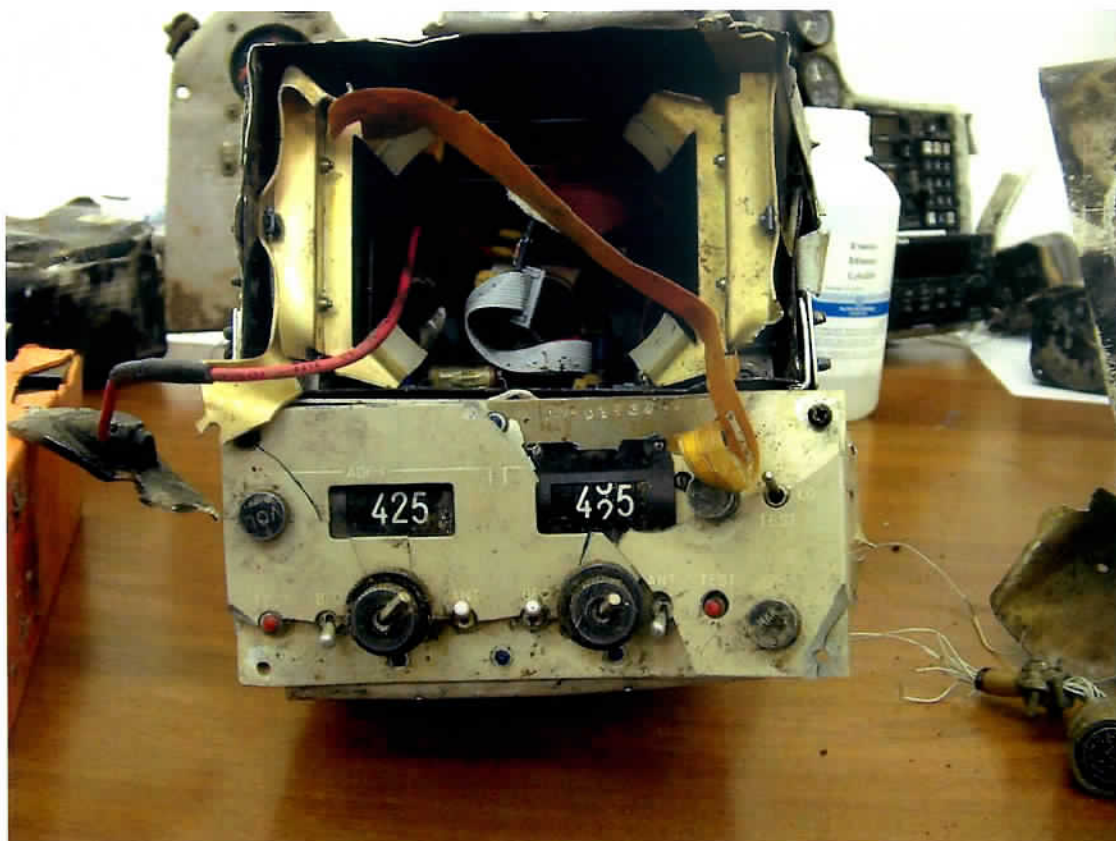
Picture 8.17: LH Instrument panel



Picture 8.18: Captain's encoding altimeter - front side



Picture 8.19: LH Instrument panel



Picture 8.20: ADF Selector Box



Picture 8.21: Co-pilot's artificial horizon



Picture 8.22: Captain's artificial horizon



Picture 8.23: ELT and switches position



Picture 8.24: ELT batteries loose connection

Appendix 10: FDR and CVR RUAG Report

RA Services

Referenz
Revision 2
Seite 9 von 9

Closing Statement:

The last recorded data's from the Flight Data Recorder shows no valid Indicated Airspeed and Pressure Altitude.

Also, the time synchronisation of Flight Data Recorder to the Cockpit Voice Recorder was not possible (description under point 1.1 to 1.4).

Both finding give the probability, that the recorded data's are not the data's of the accident

This data's are not reliable and should not be used for the investigation.

A Sound analysis of Pilot, Co-Pilot and 3rd Member Audio Chanel from the Cockpit Voice Recorder was not possible. The reason, the installation wiring of the CVR shows (audio input lines), that, if the Cockpit speaker was used, the Inputs lines of the CVR's Pilot / Co-Pilot and 3rd Member was disconnected.

The Cockpit Aera Mic information are recorded in a fairly good quality and can be used for accident analysis



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