# FINAL REPORT

of civil aviation safety investigation

of the accident in Alba County

## CLASSIFICATION

<table>
<thead>
<tr>
<th>Classification</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Accident</td>
<td>Romanian Aviation Academy</td>
</tr>
<tr>
<td>Owner</td>
<td>Romanian Aviation Academy</td>
</tr>
<tr>
<td>Operator</td>
<td>Romanian Aviation Academy</td>
</tr>
<tr>
<td>Manufacturer</td>
<td>BRITTEN-NORMAN</td>
</tr>
<tr>
<td>Aircraft</td>
<td>BN-2A-27</td>
</tr>
<tr>
<td>Registration country</td>
<td>Romania</td>
</tr>
<tr>
<td>Registration</td>
<td>YR-BNP</td>
</tr>
<tr>
<td>Location</td>
<td>In the vicinity of Horea village, Alba County</td>
</tr>
<tr>
<td>Date and time</td>
<td>20.01.2014 / 13.47 UTC (15.47 LT)</td>
</tr>
</tbody>
</table>
AKNOWLEDGEMENT

This REPORT presents data, analysis, conclusions and recommendations on civil aviation safety, of the Civil Aviation Safety Investigation Commission appointed by the Director General of CIAS.

The flight safety investigation was conducted in accordance with the provisions of the Government Ordinance No. 51/1999 concerning the technical investigation of civil aviation accidents and incidents, approved with amendments and additions by Law No. 794/2001, of the REGULATION (EU) No. 996/2010 of the European Parliament and of the Council from 20 October 2010 on the investigation and prevention of accidents and incidents occurred in civil aviation and repealing of Directive 94/56/EC and the provisions of Annex 13 to the Convention on International Civil Aviation signed at Chicago on 7 December 1944.

The objective of civil aviation safety investigation is preventing the occurrence of accidents and incidents, by effective determination of causes and circumstances that led to this occurrence and establishing the necessary recommendations for civil aviation safety and it HAS NOT THE PURPOSE of finding guilty, individual or collective responsibilities.

As a consequence, the use of this REPORT for other purposes than preventing the occurrence of accidents and incidents might generate misinterpretations.

This is an English translation of the original document in Romanian language provided on our website and if there are any discrepancies between this document and original Romanian one, the original prevails.
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# Glossary

<table>
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<th>Abbreviation</th>
<th>Description</th>
</tr>
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<tbody>
<tr>
<td>CIAS</td>
<td>Centrul de Investigații și Analiză pentru siguranța aviației civile / Civil Aviation Safety Investigation and Analysis Center</td>
</tr>
<tr>
<td>OACI/ICAO</td>
<td>Organizația de Aviație Civilă Internațională/ International Civil Aviation Organization</td>
</tr>
<tr>
<td>AESA/EASA</td>
<td>Agentia Europeană pentru Siguranța Aviației/ European Aviation Safety Agency</td>
</tr>
<tr>
<td>AAIB UK</td>
<td>Air Accidents Investigation Branch</td>
</tr>
<tr>
<td>NTSB</td>
<td>National Transportation Safety Board</td>
</tr>
<tr>
<td>IFR</td>
<td>Instrument flight rules/ Reguli de zbor instrumental</td>
</tr>
<tr>
<td>VFR</td>
<td>Visual flight rules/ Reguli de zbor la vedere</td>
</tr>
<tr>
<td>LT</td>
<td>Local time / timpul local</td>
</tr>
<tr>
<td>NM</td>
<td>Nautical mile / Mile nautice</td>
</tr>
<tr>
<td>SSAVC/RAA</td>
<td>Școala Superioară de aviație civilă/ Romanian Aviation Academy</td>
</tr>
<tr>
<td>AACR/CAA Romania</td>
<td>Autoritatea aeronautică civilă română/ Civil aviation authority</td>
</tr>
<tr>
<td>FL</td>
<td>Flight level/ Nivel de zbor</td>
</tr>
<tr>
<td>TWR</td>
<td>Tower / Turn de control</td>
</tr>
<tr>
<td>kts</td>
<td>Knots / Noduri</td>
</tr>
<tr>
<td>Mhz</td>
<td>Megahertz/</td>
</tr>
<tr>
<td>QNH</td>
<td>barometric pressure adjusted to sea level/ Presiunea atmosferică redusă la nivelul mării</td>
</tr>
<tr>
<td>RVR</td>
<td>Runway Visual Range/ Vizibilitatea în lungul pistei</td>
</tr>
<tr>
<td>ATC/CTA</td>
<td>Air traffic controller/ Controlor trafic aerian</td>
</tr>
<tr>
<td>APP</td>
<td>Approach control service/ Serviciul de control de apropiere</td>
</tr>
<tr>
<td>ACC</td>
<td>Area control centre/ Serviciul de control regional</td>
</tr>
<tr>
<td>AMA</td>
<td>Area minimum altitude /Altitudinea minimă de siguranță în zonă</td>
</tr>
</tbody>
</table>
ft Feet/ Picioare
hPA hectoPascal
FIC Flight information centre/ Centrul de informare a zborurilor
METAR Meteorological Aerodrome Report/ Raport meteorologic de aerodrom
ROMATSA Administraţia română a serviciilor de trafic aerian/ Romanian air traffic services administration
MEP Multi-engine piston/ Multi-motor cu piston
IR Instrument Rating/ Licenţă de zbor instrumental
SEP Single engine piston/ Mono- Motor cu piston
LAPL Light aircraft pilot licence/ Licenţă de pilot aeronave uşoare
AN-2 Antonov An-2
IL-18 Ilyushin Il-18
PIC Pilot-in-command/ Pilot Comandant
ELT Emergency Locator Transmitter/ Emiţătorul de localizare pentru situaţii de urgenţă
TAF Terminal aerodrome forecast / Prognoză meteorologică de aerodrom
ADS Automatic Dependent Surveillance/ Sistem de Supraveghere dependent automat
VOR/ILS VHF Omnidirectional Radio Range /Instrument landing system/ Radiofar omni-direcţional VHF/ Sistem de aterizare instrumentală
DME Distance Measurement Equipment/ Echipament de măsurare a distanţei
NDB Non-directional beacon/ Radiofar non-direcţional
AP Autopilot/ Pilot automat
GPS Global position system/ Sistem de poziţionare globală
VHF COM Very high frequency communication/ Comunicaţii pe frecvenţe foarte înalte
CWS Control Wheel Steering/ Volan de control
ISU General Inspectorate for Emergency Situations/ Inspectoratul General pentru Situaţii de Urgenţă
<table>
<thead>
<tr>
<th>Acronym</th>
<th>Definition</th>
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<tr>
<td>SAR</td>
<td>Search and rescue/ Căutare și salvare</td>
</tr>
<tr>
<td>COSPAT-SARSAT</td>
<td>Space System for the Search of Vessels in Distress - Search and Rescue Satellite-Aided Tracking/ Sistem spațiu pentru căutare de Nave în primejdie – Căutare și salvare prin satelit asistată de urmărire</td>
</tr>
<tr>
<td>SID</td>
<td>Standard instrument departure/ Plecare instrumentală standard</td>
</tr>
<tr>
<td>STAR</td>
<td>Standard Arrival Route/ Rută standard de sosire</td>
</tr>
<tr>
<td>°C</td>
<td>Celsius degree/ grade Celsius</td>
</tr>
<tr>
<td>Mbar</td>
<td>milibar</td>
</tr>
<tr>
<td>IMC</td>
<td>Instrument meteorological conditions/ Condiții meteorologice instrumentale</td>
</tr>
<tr>
<td>RACR-RA</td>
<td>Romanian Civil Aeronautical Regulation – Air rules/ Reglementarea Aeronautică Civilă Română – Regulile aerului</td>
</tr>
<tr>
<td>AIP</td>
<td>Aeronautical Information Publication/ Publicație de Informare aeronautică</td>
</tr>
<tr>
<td>CTR</td>
<td>Controlled traffic region/ Spațiu aerian controlat</td>
</tr>
<tr>
<td>TMG</td>
<td>Touring Motor Glider/ Planor cu motor pentru turism</td>
</tr>
<tr>
<td>ATO</td>
<td>Approved Training Organization/ Organizație de instruire autorizată</td>
</tr>
<tr>
<td>OM</td>
<td>Operations Manual/ Manualul Operațional</td>
</tr>
<tr>
<td>AOC</td>
<td>Air operator 's certificate/ Certificat de operator aerian</td>
</tr>
<tr>
<td>MCCI</td>
<td>Multi-Crew Cooperation Instructors/ Instructor de multi-cooperare în echipaj</td>
</tr>
<tr>
<td>AMSL</td>
<td>Altitude above mean sea level/ Altitudinea măsurată de la nivelul mării</td>
</tr>
<tr>
<td>ATS</td>
<td>Air traffic services/ Servicii de trafic aerian</td>
</tr>
<tr>
<td>VMC</td>
<td>Visual meteorological conditions/ Condiții meteorologice minime</td>
</tr>
<tr>
<td>MOPSC</td>
<td>Maximum Operational Passenger Seating Configuration/ Configurație operațională maximă a așezării pasagerilor</td>
</tr>
<tr>
<td>CRM</td>
<td>Crew Resource Management/ Managmentul Resurselor echipajului</td>
</tr>
<tr>
<td>ANM</td>
<td>National Agency of Meteorology/ Agenția Națională de Meteorologie</td>
</tr>
<tr>
<td>FAA</td>
<td>Federal Aviation Authority/ Autoritatea Aeronautică Federală (SUA)</td>
</tr>
<tr>
<td>METEOSAT</td>
<td>Artificial satellites aiming to gather weather data/ Satelită artificiali cu</td>
</tr>
</tbody>
</table>
scopul de a aduna date meteorologice

UTC Coordinated Universal Time/ Oră universal coordonată

rpm Rotations per minute/ Rotații pe minut
SYNOPSYS

CLASSIFICATION
Accident
Owner
Romanian Aviation Academy
Operator
Romanian Aviation Academy
Manufacturer
BRITTEN-NORMAN
Aircraft
BN-2A-27
Registration country
Romania
Registration:
YR-BNP
Location:
In the vicinity of Horea village, Alba County
Date and time:
20.01.2014 / 13.47 UTC (15.47 LT)

On 20.01.2014, the Civil Aviation Safety Investigation and Analysis Center (CIAS) was notified indirectly by phone about the accident. Subsequently CIAS received an „Air Safety Report” (ASR), from the operator representing the written communication of the accident in which it was involved a BN-2A-27 aircraft, registered YR-BNP.

CIAS notified the following organizations about the accident occurrence: International Civil Aviation Organization (ICAO), European Aviation Safety Agency (EASA), the Investigation Body in Great Britain - AAIB which has the quality of manufacturer State of the aircraft and the Investigation Body in the United Stated of America – NTSB that has the quality of manufacturer State of the engines. The last two organizations designated accredited representatives for this investigation.

BN-2A-27 aircraft, radio call indicative "RFT 111", performed a flight from Bucharest – Băneasa Airport to Oradea Airport, having on board a crew of two pilots and 5 passengers. The flight was performed based on an IFR flight plan, the aircraft took off at 13.38 LT. The last radio communication between the aircraft and the air traffic agencies was made at 15.34.51 LT, at the distance of approximately 52 NM from the point ROŞIA (air radio reporting point). At 15.47 LT a passenger of the aircraft informed by phone that the aircraft crashed, but without being able to communicate their exact location. The wreckage of the aircraft was located after almost 5 hours from receiving the information, in the vicinity of Horea commune, Petreasa village, Alba County.

As a consequence of the accident, the aircraft was destroyed, five of the persons on board were injured and two died.

The cause of the accident occurrence consisted in the engine shutdown due to the severe icing of carburettors based on the following favouring causes:
- incorrect assessment of risk factors specific to the development of this flight due to long interruption from flight and to the crew’s lack of experience on BN-2A-27 aircraft, included in MEP class;
- incorrect decision of the aircraft Captain to fly for a long period of time in icing conditions;
- incorrect decision of the aircraft Captain to take off with a weight over the maximum admitted limit and with gravity center position outside the limits calculated and imposed by the manufacturer;
- incorrect decision of the aircraft Captain to continue the mission in IMC flight conditions on IFR flight rules below AMA;
- long-time flight interruption and lack of experience of the crew on this MEP class aircraft.

NOTE: Expressing time will be made in local time (LT), for calculating time in UTC there will be dropped two hours (UTC = LT – 2).
Expressing speed is made in KTS, with reference to the Ground Speed, according to the downloaded GPS data.

The occurrence was notified to CIAS in written, being registered with the number 0002/20.01.2014.

The flight safety investigation was conducted in accordance with the provisions of the Government Ordinance No. 51/1999 concerning the technical investigation of civil aviation accidents and incidents, approved with amendments and additions by Law No. 794/2001, of the REGULATION (EU) No. 996/2010 of the European Parliament and of the Council from 20 October 2010 on the

1 FACTUAL INFORMATION

1.1 History of the accident

1.1.1 Flight preparation

Starting with 2006 the Romanian Aviation Academy (RAA), as air operator, signed a service providing contract with the Ambulance Service Bucharest - Ilfov, consisting in providing on demand passenger transport missions. In this contract signed between the parties, it was specified the provided aircraft, as well as the maximum number of passengers that each aircraft type could carry.

On 20.01.2014 the Ambulance Service requested by phone the transport of a medical crew of five members from Bucharest to Oradea and back. According to the list of available aircraft provided in the contract and taking into account the number of passengers, it was designated for this commercial flight BN-2A-27 type aircraft, registered YR-BNP.

At approximately 10:00 o’clock, the crew came at the dispatcher of RAA, prepared the mission, but due to the meteorological situation at the Airport Baneasa, that did not meet the minimum takeoff / landing conditions for this aircraft type, the mission was postponed.

Taking into account this postponement, the pilot in command took the decision to make a ground turnover in order to verify the steering system the wheel in front of the aircraft. He assigned this check to be made by the co-pilot and another pilot within RAA, the Captain remaining at the dispatcher to follow the evolution of the meteorological situation. Between 12.24LT and 12.29 LT the assigned crew performed a take-off roll on the airport platform, observing that the system worked properly.

After the improvement of the weather conditions, without repeating the mission preparation, the pilot in command took the decision to perform the flight and it was submitted the flight plan, available starting with 13.10 LT.

Datele consemnate în planul de zbor au fost:
- crew speed of 120 Kts;
- flight rules I- „Instrumental Flight Rules (IFR)”;
- flight level 120 (FL 120);
- route - LRBS (BĂNEASA Bucharest Airport) – SOKRU (reporting point in TMA Bucharest) - low-altitude air route L 622 – ROȘIA (reporting point on L622) – LROD (ORADEA Airport);
- flight time estimated at two hours;
- backup aerodrome – LRAR (Arad Airport).
The crew arrived at the aircraft at 13:00 LT, made the exterior control of the aircraft, observing that it was available for flight. During this period of time the passengers for this flight also arrived to the aircraft.

The pilot in command and the co-pilot got into the aircraft, the first occupying the right pilotage post, and the second the left pilotage post. The Captain got into the aircraft without performing passenger safety briefing and without supervising their boarding.

After checking the cockpit they got in touch by radio with “Ground” Băneasa, for starting the engines and performing the take-off roll on runway.

1.1.2 Flight development
At 13.26.54 LT, the crew requested from Ground Băneasa the approval to start the engines, on the frequency of 129,950 MHz. Ground Băneasa approved the start of the engines and communicated to the crew the weather conditions on the airport in that very moment, “clear to start, note that at Băneasa QNH 1010, temperature +6, wind 040 7 knots, visibility 1200 meters with RVR on 07 over 2000, foggy air, climb 300 feet, temporary visibility 2000 de meters. Minute 27”.

The aircraft started the take-off roll at 13.29.55 LT and at 13.38.41 LT it took-off from „Aurel Vlaicu” Bucharest– Băneasa International Airport (LRBS), having as destination Oradea Airport (LROD).

TWR Băneasa communicated to the crew that after take-off to maintain the flight direction 080, to climb at FL 120 and to enter on frequency 118,25 MHz with Approach Bucharest (APP Bucharest).

After the initial radio contact, the air traffic controller (CTA) APP Bucharest communicated to the aircraft to maintain the initial direction 080 and to continue the climbing flight. At 13:43:35 LT, the aircraft received the approval to perform a left turn, in climbing to FL 120 and to fly directly to the point Roşia located on route L 622.

The climbing flight, after reaching the altitude of 5000 ft, was conducted with a continuously decreasing climb rate, which according to the co-pilot’s statement, at some point turned into zero.

During flight to the point Roşia, at 14:06:00 LT, because the aircraft didn’t reach FL 120, CTA APP Bucharest communicated with the pilot, insisting on FL 110, as being the minimum flight altitude on this route "Roger but minimum level is 110". The pilot communicated that he would maintain level 100 for 7 minutes, after which he would climb to 110 "Ok will maintain for another 7 minutes then will climb to 110".

At 14:09.00 LT, alerted by the system, CTA APP Bucharest re-entered in contact with the aircraft drawing the attention on this alert "RFT 111, descent alert below the minimum level is activated, climb, are you climbing to FL 110?". The pilot answered to this message with a confirmation that he was heading to level 110, but with a small climb rate, "I'll slowly climb to FL 110".

At 14:09:13 LT the aircraft was handed over to the next flight control area, Area Control Center (ACC) Bucharest, KONEL sector, on frequency 122,025 MHz, which at 14:09:45 LT asked the crew to continue climbing at FL 110.

After almost 24 minutes of flight, the pilot in command informed CTA ACC, that he was facing icing issues, that he had to descend to FL 100, announcing that due to the icing encountered conditions he would maintain FL 100-105, mentioning that he couldn’t climb higher "We try to maintain at 100-105 due to icing, it can’t fly higher".

At 14:35:59 LT, CTA ACC, alerted by the guidance system about the flight altitude of the aircraft in relation to the minimum flight altitude in the area (AMA), communicated to the crew the AMA of 10.500 ft "We inform you that AMA in this area is 10500 ft" and, at the same time the QNH pressure of 1006 hPa. The pilot
answered that he was aware of the flight altitude at which the aircraft flew and that he was trying to gain altitude, but none of the crew members fitted on their altimeter on the submitted QNH pressure.

Starting with 14:34 LT, according to the co-pilot’s statement, the crew faced a decrease of aircraft speed on the context of the engine power decrease due to the increased icing of the carburettors. This fact forced the co-pilot (who was controlling the flight controls), to disconnect the aircraft autopilot and to perform a flight in controlled descent in order to maintain safety speed. At that moment the aircraft was flying over a compact ceiling of clouds.

The descent flight was performed over this ceiling of clouds, but approaching its upper base which was uneven and in order to avoid entering the ceiling, the crew had to make frequent changes of direction from left / right. When the ceiling was no longer compact and it allowed the crew to see the ground, the aircraft descended below it, at 8500 ft. When exiting the ceiling, the crew obsered a locality on the right side, that they considered to be Victoria or Făgăraș (according to the co-pilot's statement).

At 14:42:03 LT, the Captain announced ACC Bucharest KONEL sector that he would descend to altitude 80, meaning 8,000 ft and that he would enter the radio frequency 129,4 MHz, corresponding to the Flight Information Center – FIC Bucharest "Bucharest RFT111, we will descend to 80 and we'll enter on 129,4.”. FIC is the air traffic agency ensuring the radio connection ground-air only for information and warning on the potential conflicts between aircraft, having as assigned area the G class airspace.

At 14:42:10 LT, the crew got in touch through radio connection with FIC Bucharest, informing that they flew from Băneasa with the destination Oradea, that they would descend, due to icing, from FL 110 to 8,000 ft according to the barometric altimeter set at QNH 1007 hPa pressure and they estimated landing to Oradea at 16,35 LT.

When exiting the responsibility area of FIC Bucharest, the following area traveled by the aircraft was CTR Sibiu area. The pilot in command contacted through radio CTA TWR Sibiu approximately four miles before its area of responsibility, informing them that they would enter the area at FL 90, not being able to climb higher due to icing "With 90 now to Oradea, we enter in your area, due to icing we can’t climb more.” At the same time he asked and received from CTA TWR Sibiu the following meteorological information valid for Sibiu area: "RFT111, the last METAR at Sibiu, variable wind of 2 kt., visibility 10 km or more, scattered clouds at 6600 ft., temperature of 13 degrees, dew point of 6 degrees, QNH 1006 Hpa”.

While approaching to Sibiu the co-pilot proposed to the pilot in command to land on Sibiu but he took the decision to continue flight to Oradea.

During crossing CTR Sibiu, out of the radio conversations between CTA TWR Sibiu and the crew, it resulted that the aircraft faced the difficulty of climbing in a short period of time from FL 80 to FL 90 required by the air traffic controller. Otherwise the pilot in command finally communicated that since he exceeded the runway center line, instead of continuing the climbing flight, he would descend to FL 80 "Sibiu, 111,
approach, if so, we exceeded the runway center line anyway, we’re descending to
80, because it is impossible to do more than that”.

When exiting CTR Sibiu area, CTA communicated to the crew to get in touch with
FIC Bucharest on one of the radio frequencies 136,575 MHz. or 136,225 MHz. The
crew informed that they couldn’t use these radio frequencies and they requested
connection with another agency of which radio frequency falls within the possibilities
of the aircraft radio station ”We don’t have with 136 at these stations. We’ll remain at
129,4.”.

Till exiting from CTR Sibiu, after the coordination had with the traffic controller
due to the fact that he couldn’t use any of the FIC frequencies available for that area,
the crew received a frequency that corresponded to the traffic agency from ACC.
At the altitude of 8.500 ft, flying in descend to 8.000 ft, the crew managed to contact
for information at 15:18:41 ACC Bucharest NAPOC sector, ”We passed by Sibiu,
almost 20 miles, to Oradea, we have level 85 due to icing and Bucharest information
cannot hear us on 129,4. We appealed to you”.

The aircraft continued the flight to Oradea, and after 9 minutes of flight,
at 15:27:48, CTA ACC, NAPOC sector communicated them to switch on the radio
frequency 124,1 Mhz.

On this segment the radio transmission was altered, so that the last position
report, at 15:34:51 LT, was received by the traffic agency through another aircraft in
flight, which acted as a relay.

After existing from CTR Sibiu the flight continued between two cellings of cloud.
The lower ceiling was not compact and in some areas it allowed the observation of
ground. The co-pilot proposed to continue the flight under this ceiling with the ground
on sight, but the pilot in command took the decision to continue the flight between
ceilings telling the co-pilot that in need they shall descend through a gap under the
ceiling.

As the aircraft flew to Apuseni Mountains the ceiling became compact and it
reappeared the icing at the carburettors’ level, manifesting itself in the loss of engine
power delivered, reducing implicitly the advancing speed. This speed reduction
forced the co-pilot to perform a controlled descent of the aircraft, having as
consequence the continuation of flight in the overflown ceiling.

After the aircraft entered the ceiling, the phenomenon of icing manifested not only
on the engines but also with ice depositions on wings, windshield and on the helmet
of the two engine propellers. During this descending flight, in the ceiling, without
visibility, the engines started to function intermittently. The intermittent operation was
determined by the de-icing maneuvers, performed by the pilot in command, having as
effect their uncontrolled restart.

According to the recordings of ROMATSA at 15:44 LT, the transponder on the
aircraft has no longer communicated with the ground recording station. At that
moment the aircraft flew at an altitude of 6300 ft.

According to the data downloaded from the GPS unit, at 15:46:57, the aircraft
crashed in a wooded area that was situated at the altitude of almost 1600 m, in the
coordination point N 460 33’ 15,45” and E 220 58’ 49,53”.
At the initial contact with the pine trees in that area, both engines were stopped uncontrollably. In this situation the crew only had the possibility of pulling the sticks and maintaining the aircraft on direction, in order to harmonize the ground contact.

As the aircraft descended, the impact with the pine trees logs became rougher causing the breakage of parts from wings structure. After the rough impact of the right wing with a thicker pine tree log, exactly before ground impact, the aircraft pivoted to the right, taking contact with the ground slightly inclined on the right. The sudden breaking caused the plans to partially crush the cockpit structure, more on the right side.

When the impact took place the co-pilot was thrown out of the cockpit, the pilot in command was caught in the cockpit structure and one of the passengers sitting on the fifth row of seats, was projected over the forth row, stopping in the backseat from the second row. After the impact, the aircraft did not catch fire, the passengers, excepting the one seriously injured, helped each other to get out of the wreckage. Two of the passengers also evacuated the seriously injured female-passenger, they also tried to remove the pilot in command, but he remained incarcerated in the wreckage. The intervention teams reached the accident site after approximately five hours from its occurrence, out of the seven persons on board only five were rescued.
1.2 Injuries to persons

<table>
<thead>
<tr>
<th>Injuries</th>
<th>Crew</th>
<th>Passengers</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fatal</td>
<td>1</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Serious</td>
<td>1</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>Minor</td>
<td>-</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>None</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>TOTAL</td>
<td>2</td>
<td>5</td>
<td>7</td>
</tr>
</tbody>
</table>

1.3 Damage to aircraft

The aircraft was totally destroyed due to impact with the trees of a forest and the ground.

1.4 Other damage

N/A.
### 1.5 Personnel information

#### 1.5.1 Pilot in command

<table>
<thead>
<tr>
<th>Pilot in command</th>
<th>Male, 55 years</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>License</strong></td>
<td>B 737 300-900 Expired</td>
</tr>
<tr>
<td></td>
<td>IR (ME)</td>
</tr>
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<td>30.09.2014</td>
</tr>
<tr>
<td></td>
<td>FI(A)-MEP (land)</td>
</tr>
<tr>
<td></td>
<td>02.04.2015</td>
</tr>
<tr>
<td><strong>Medical certificate, valid until</strong></td>
<td>Class 1 and class 2</td>
</tr>
<tr>
<td></td>
<td>12.10.2014</td>
</tr>
<tr>
<td></td>
<td>LAPL</td>
</tr>
<tr>
<td></td>
<td>14.10.2015</td>
</tr>
<tr>
<td><strong>Flight experience</strong></td>
<td>Total 15261 hours 10 min</td>
</tr>
<tr>
<td></td>
<td>Out of which 637 hours 53 min, in 2011 – 2014 (RAA)</td>
</tr>
<tr>
<td></td>
<td>IAR</td>
</tr>
<tr>
<td></td>
<td>42 hours 24 min</td>
</tr>
<tr>
<td></td>
<td>AN-2</td>
</tr>
<tr>
<td></td>
<td>2245 hours 57 min</td>
</tr>
<tr>
<td></td>
<td>IL-18 navigator</td>
</tr>
<tr>
<td></td>
<td>1505 hours 09 min</td>
</tr>
<tr>
<td></td>
<td>B 733/735/736/400/800</td>
</tr>
<tr>
<td></td>
<td>10829 hours 47min</td>
</tr>
<tr>
<td></td>
<td>MEP class</td>
</tr>
<tr>
<td></td>
<td>538 hours 29 min</td>
</tr>
<tr>
<td></td>
<td>PIPER 34-496 hours 12 min.</td>
</tr>
<tr>
<td></td>
<td>BN 2A 27-42 hours 17 min.</td>
</tr>
<tr>
<td></td>
<td>SEP class</td>
</tr>
<tr>
<td></td>
<td>CESSNA172-99 hours 24 min</td>
</tr>
</tbody>
</table>

**In MEP class– 538 hours 29 min. out of which:**
- PIPER 34 plan – 496 hours 12 min performed as follows:
  - Student - 20 hours 42 min;
  - PIC - 93 hours 48 min;
  - Instructor - 377 hours 30 min;
  - Co-pilot - 4 hours 12 min.
  The last flight on this aircraft, before the accident, was performed on 14.01.2014 lasting 4 hours 18 min., out of which 2 hours during night in a commercial mission.
- BN 2A 27 plane - 42 hours 17 min performed as follows:
  - Student – 6 hours;
  - PIC - 22 hours 52 min;
  - Instructor – 5 hours;
- Co-pilot – 8 hours 25 min.

As rate of flights before the accident the last four flights, all commercial having the quality of PIC on board, were performed as follows:
- **28.12.2012** – 2 hours;
- **29.12.2012** – 1 hour 50 min;
- **05.02.2013** – 2 hours 30 min;
- **06.02.2013** – 2 hours 12 min.

### 1.5.2 Co-pilot

<table>
<thead>
<tr>
<th>Copilot</th>
<th>Male, 24 Years</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>License</strong></td>
<td></td>
</tr>
<tr>
<td>IR (ME)</td>
<td></td>
</tr>
<tr>
<td>MEP (land)</td>
<td></td>
</tr>
<tr>
<td>SEP (land)</td>
<td></td>
</tr>
<tr>
<td><strong>Valid until</strong></td>
<td></td>
</tr>
<tr>
<td>SEP (land)</td>
<td>31.10.2015</td>
</tr>
<tr>
<td>MEP (land)/IR</td>
<td>31.08.2014</td>
</tr>
<tr>
<td>FI (A)-SEP (land)</td>
<td>11.05.2014</td>
</tr>
<tr>
<td><strong>Medical certificate, valid until</strong></td>
<td></td>
</tr>
<tr>
<td>Class 1</td>
<td>21.02.2014</td>
</tr>
<tr>
<td>Class 2</td>
<td>21.02.2018</td>
</tr>
<tr>
<td><strong>Flight experience</strong></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>886 hours 12 min</td>
</tr>
<tr>
<td>Planor</td>
<td>40 hours 58 min</td>
</tr>
<tr>
<td>SEP</td>
<td>738 hours 03 min</td>
</tr>
<tr>
<td>MEP 107 hours 11 min</td>
<td>PIPER 34 - 85 hours 36 min</td>
</tr>
<tr>
<td></td>
<td>BN 2A 27- 21 hours 35 min</td>
</tr>
</tbody>
</table>

**In MEP class** – 107 hours 11 minutes out of which,
- PIPER 34 plane – 85 hours 36 min performed as follows:
  - Student – 20 hours 24 min;
  - PIC – 14 hours 24 min;
  - Co-pilot – 50 hours 48 min.

The last flight on this aircraft before the accident was performed on 13.01.2014 lasting 42 min., within a commercial mission.

- BN 2A 27 plane – 21 hours 35 min. performed as follows:
  - Student – 6 hours;
  - Co-pilot – 15 hours 35 min.

As rate of flights on this aircraft before the accident the last four flights, all commercial having the quality of co-pilot on board, were performed as follows:
- **24.11.2012** – 2 hours 48 min;
- **25.11.2012** – 2 hours 42 min;
1.6 Aircraft information

BN 2A 27 Islander aircraft is a twin-engine ultralight plane, monoplane with wing up, used as short transport courier for passengers, cargo or special missions.

It is entirely built of metal with a spacious cockpit for pilots and cabin for passengers. It has three big access doors that along with the windscreen and windows allow a very good visibility. A small door in the left rear providing external access to the cargo hold. Five double seats mounted on skids in the floor providing comfortable conditions for one or two pilots and for the eight or nine passengers.

YR-BNP aircraft is arranged in passenger/school variant with double control, specially equipped with devices for schooling public transport pilots on IFR, VFR and for flight in light icing conditions.

The aircraft is equipped with two piston, air-cooled, carburetted engines of 260 HP manufactured by AVCO-LYCOMING type O-540-E4C5.

The engines directly activate two metal propellers with two variable pitch blades manufactured by HARTZELL PROPELLER.

The rectangular wing is equipped with electric flaps for take-off, landing and zero positions. The fuel tanks are integrated in the wing structure.

The leading edge strips of the wing and of the empennage are fitted with pneumatic de-icing system, electrically controlled.

The engine nacelles have the structure fixed on the underside of the wing.

The flight controls are mechanical, through cables to ailerons and direction and by rods to elevator. The direction and elevator are provided with compensators controlled through cables.

The landing gear is tricycle, non-retractable with the back wheel oriented through the rudder pedals. The main landing gear legs have each two wheels equipped with disc brakes hydraulically controlled from both rudder pedals.

The aircraft is equipped with autopilot, enabling the controls of ailerons, elevator and its compensator through three electric servomotors.

<table>
<thead>
<tr>
<th>Engine</th>
<th>Left</th>
<th>Right</th>
</tr>
</thead>
<tbody>
<tr>
<td>Model</td>
<td>O-540-E4C5</td>
<td>O-540-E4C5</td>
</tr>
<tr>
<td>Engine series</td>
<td>L-18357-40A</td>
<td>L-22609-40</td>
</tr>
<tr>
<td>Total operating time since the last overhaul up to 13.02.2013</td>
<td>698.2 hours</td>
<td>698.2 hours</td>
</tr>
<tr>
<td>Main crankshaft series</td>
<td>77869</td>
<td>V212X</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Propellers</th>
<th>Manufacturer</th>
<th>Piece code</th>
<th>Series</th>
</tr>
</thead>
<tbody>
<tr>
<td>Left propeller</td>
<td>HARTZELL</td>
<td>HC-C2YK-2CUF</td>
<td>AU11440B</td>
</tr>
<tr>
<td>Right propeller</td>
<td>HARTZELL</td>
<td>HC-C2YK-2CUF</td>
<td>AU11567B</td>
</tr>
</tbody>
</table>

The last certificate of releasing the aircraft into service was issued with the number 220084 on 12.12.2013. This was issued after the works performed to the aircraft according to the maintenance program. There were performed inspection works for 100 flight hours, 500 flight hours and for corrosion detection.

### 1.6.1 ELT System – Emergency Locator Transmitter

The aircraft ELT system is ARTEX C406-2 type. It was installed in April 2007 by RAA.

The ELT system is automatically activated by a gravitational internal switch in case of aircraft crash. It can also be activated manually by a switch situated in the cockpit, in case of imminent danger or in case of testing the system operation.

When activated the transmitter of the ELT system emits a distinctive tone, for up to 72 hours on the frequencies 121.5 MHz and 243 MHz. Moreover, the unit emits a coded digital message, for 24 hours on the frequency 406.025 MHz, which includes the aircraft identification code that is internationally agreed and a country code to identify the country in which the aircraft is registered. In this case the code is A1064D6A6339AD1.

The digital message broadcasted on the frequency 406.025 MHz, which is immediately captured by SAR satellites, is used to determine the area of the aircraft crash site, area having a radius of 3 km.

The system includes the following components:
- a transmitter mounted on the left-rear side of the aircraft fuselage, behind the partition wall of the cargo hold and the tail of the aircraft;
- a speaker mounted in the tail of the aircraft;
- an antenna wire (121.5/243 MHz), situated laterally up on the left-rear side of the fuselage;
- an antenna wire (406.025 MHz), situated laterally up on the right-rear side of the fuselage;
- a control button and a warning lamp mounted in the cockpit.
The speaker (rear fuselage) and the warning lamp (cockpit) will operate whenever the ELT system is activated to alert the crew in case of accidental activation. The system can be turned off by operating the cockpit control or the one mounted on the transmitter in ON position, then immediately in OFF / ARM.

The system installation was made according to the bulletin issued by the aircraft manufacturer, B-N GROUP LTD, NB-M-1705/19 APR 2007. This bulletin contains installation instructions of the ELT system.

The installation kit of the system mounted on this aircraft according to the bulletin contains the following components:

<table>
<thead>
<tr>
<th>Piece Code</th>
<th>Description</th>
<th>BN Piece Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>455-5000</td>
<td>C406-2 Basic package, ELT</td>
<td>345207061</td>
</tr>
<tr>
<td>110-324</td>
<td>Wire antenna, 121.5 MHz, 243 MHz, ELT</td>
<td>344101524</td>
</tr>
<tr>
<td>110-329</td>
<td>Wire antenna, 406.025 MHz, ELT</td>
<td>344101533</td>
</tr>
<tr>
<td>455-6196</td>
<td>Cockpit switch, ELT, C/W Kit Inst.</td>
<td>340003386</td>
</tr>
<tr>
<td>150-1120</td>
<td>Coax Connector, TPS, 50 Ohm, Right</td>
<td>341402533</td>
</tr>
</tbody>
</table>

The Kit received from the manufacturer was accompanied by the certificate of conformity EASA FORM 1 type. When finishing the system installation on the aircraft, it was issued according to the procedures, the Certificate of Aircraft Realising into Service, certificate attesting that the ELT system installed on the aircraft was functional and that the aircraft was ready to be released into service.

### 1.6.2 De-icing system

**De-icing of the carburettor**

The carburettor of each engine is equipped with a heating system for preventing the ice to appear in the intake area. The system has the form of an air box, mounted under the carburettor at its base, inside which is a valve that is controlled by a lever on the bottom of the center console within the cockpit.

The command is made mechanically from the cockpit by the pilot. The control is made based on the indications given by the carburettors’ thermometer and the operation symptoms of the engine.

The hot air collectors are mounted around the exhaust assemblies of each engine and they are connected to the air boxes through a flexible sleeve resistant to high temperatures.

The intake air normally passes through the air filter mounted in front of the box and then it is deviated by the valve to the carburettor intake. When hot air is needed for de-icing the carburettor, the movement of the control levers on the center console in the cockpit will rotate the valve, cutting the normal intake air. When the intake air is drawn from inside the engine cowls, it passes through the flexible sleeve, resulting an increase of air temperature. The hot air passes then through the intake of the carburettor.
Cell de-icing system

Cell de-icing is made through cyclic detachment of ice deposits due to inflation of some rubber chambers on the leading edges of the wing, stabilizer and drift.

A pneumatic system, powered by two dry air pumps motor-driven, activates the inflatable rubber chambers installed on the leading edges of the wings and on the aircraft empennage. Enabling and operating the pneumatic system are electrically controlled. A cyclic synchronization unit ensures the alternative inflation and deflation of the rubber chambers. The selection panel, having a green light, is illuminated during the inflammation periods of the chambers. This system should not be continuously driven, but it should be intermittently used when the ice deposits exceed the thickness of 24.5 mm.

Propellers de-icing

The de-icing system of the propellers is electric and it is driven by a switch on the switches panel of the pilot. The system is electrically powered by using a cyclic synchronization unit and the collecting brushes situated on the propellers hub, at the heating elements incorporated in the propeller blades at the bottom of the leading edges of blades, preventing ice deposition. An ammeter is mounted on the upper instrument panel in the cockpit. It indicates the power impulses when the system is turned on. A green area within the ammeter indicates the normal operating period.

Windscreen de-icing

A transparent panel electrically heated is mounted on the exterior at the base and center of each windscreen. A switch situated on the switches panel of the pilot offers him the possibility to select this facility in order to maintain the central and bottom side of the left windscreen without ice depositions. In order to avoid the possibility of windscreen or exterior panel overheating, their heating must be stopped when obtaining a clear visibility.

De-icing of the Pitot tube and of the STALL DETECTOR critical angle transmitter

De-icing is made through electrically heated elements, driven by a switch situated over the cell and propeller de-icing switches.

1.7 Meteorological information

On 20.01.2014 the crew arrived at the dispatcher for preparing the assigned mission. The service dispatcher has provided the necessary information such as: METAR, TAF for the take-off and landing aerodromes, synoptic maps of Romania, all these made available by ROMATSA.
At 10:30, the weather conditions on Băneasa Airport, did not allow the take-off of BN-2A-27 aircraft. The pilot in command stood in the dispatcher room monitoring the evolution of weather conditions and when they met the required conditions, he took the decision to perform the mission.

**Flight conditions at take-off time (13:38 LT):**

**BUCHAREST–BĂNEASA (LRBS), 13.30 TL**
- Complete coverage: 8/8; partial coverage 3-4/8;
- Cloud ceilings: 30 m and 60 m;
- Phenomena: foggy air;
- Horizontal visibility: 1 km;
- Runway visual range: higher than 2000 m;
- Ground wind: 60°/ 8 knots;
- Air temperature: 6°C;
- Dew point: 5°C.
- Atmospheric pressure, QNH: 1010 hPa.

**METAR LRBS 201130Z 06008KT 030V090 1000 R07/P2000 R25/P2000 BR**
**SCT001 OVC002 06/05 Q1010 0719//95 TEMPO 1500=**

Flight conditions from SIBIU (LRSB), 14:30 LT

- Significant clouds: 3-4/8;
- Significant clouds ceiling: 1980 m;
- Phenomena: none
- Horizontal visibility: 10 km or higher than 10 km;
- Ground wind: variabile / 4 knots;
- Air temperature: 13°C;
- Dew point: 6°C.
- Atmospheric pressure, QNH: 1006 hPa.

**METAR LRSB 201230Z VRB04KT 9999 SCT066 13/06 Q1006=**

After crossing the Meridional Carpathians, at 14.48, while flying in CTR Sibiu the pilot in command asked for the weather conditions at the aerodrome from the traffic controller, receiving the following information:” RFT111, the last METAR at Sibiu, variable wind of 2 kt., visibility of 10 km or more, significant clouds at 6600 ft., temperature of 13 degrees, dew point temperature of 6 degrees, atmospheric pressure QNH 1006 Hpa”.

### 1.8 Aids to navigation

BN2 Islander aircraft was equipped with the following navigation / radiolocation means:
- two ADF stations (radio compass), Bendix King KR 85 type, frequency band 200-1700 KHz;
- two VOR/ILS navigation stations, Bendix King KX 170B type, frequency band 108 – 117,95 MHz;
- one DME station (radio telemeter), Bendix King KN 65A type, frequency band 962 – 1213 MHz;
- a marker receiver, Bendix King KR 22 type, frequency 75 MHz;
- a radio altimeter, Collins ALT-55B type, frequency 4300 MHz;
- a weather radar, Bendix RDR-1400 type, frequency 9375 MHz;
- a GPS receiver, Garmin Aera 500 type.

The central instrument panel contains the radio navigation instruments VOR/DME and ADF, as well as the control panels of the radio navigation stations. The instruments indicate the relative position against a selected ground station. They allow the pilot to maneuver the aircraft along a predetermined route without any visual reference of the ground. In this case the radio navigation Instruments are used for lateral navigation.

The ADF radio compass is used for navigation by means of some non-directional radio phares (NDB) from ground or of some broadcasting stations, by determining the bearings compared to these stations. On board of YR-BNP aircraft there were mounted two such ADF radio compasses.

VOR radio navigation system is the primary navigation means used in civil aviation for national airline flight. VOR radiophares from ground are oriented towards the magnetic north and transmit azimuthal information to the aircraft. If the VOR station is also equipped with a DME station (Distance Measurement Equipment) then the VOR/DME station type and provides information on both the azimuth as well as the aircraft distance compared to the station. YR-BNP aircraft was equipped with two such VOR radio navigation stations and a DME station incorporated in the VOR receiver no. 1.
The aircraft was additionally equipped with a GPS receiver used according to the co-pilot statement, as primary navigation. The installed GPS receiver was not part of the instrumental radio navigation systems, but it was temporarily mounted on the right stick. The information provided by this GPS were used for navigating, positioning, avoiding some dangers like traffic, field and bad weather conditions. The information is displayed on a color display of 4.3”.

BN2 Islander aircraft was equipped with a (PA) Collins AP 107 autopilot system. It consists of the following components:
- a computer/control unit (the PA computer and its control panel) mounted on the main instrument panel;
- a Pitch/Turn Control unit mounted behind the stick on the left;
- three actuators, one for controlling the ailerons, one for the elevators and one for the elevators’ trimmer.

The actuators are controlled by the Computer/Control unit. The roll and pitch information is given by the gyro horizon, the directional information is given by the gyro compass and the VOR radio navigation unit, and the information on the altitude is given by an Altitude Hold unit. Above and in the left side of the pilot is situated the Trim-in-Motion warning speaker, warning that can also be heard in the headset. A Control Wheel Steering button is mounted on the stick, on the right side, and the
button for switching off the PA is mounted on the left side of the stick. A general switch of the autopilot is mounted on the main instrument panel.

When the autopilot is connected and an operating mode is not selected on the control panel, PA accepts commands for roll and pitch either from the Control Wheel Steering (CWS), either from the roll and pitch selectors on the Pitch/Turn Control unit (see fig. 10). Operating the roll/pitch selectors determines the automatic deselection of any active operation mode in that very moment (lateral or vertical).

The indicators of the selected modes are an integral part of the selectors corresponding to control panel of the autopilot:

- **ENGAGE**: Green triangle is illuminated anytime the AP is connected
- **DISENGAGE**: Green triangle is illuminated anytime the AP is disconnected
- **TRIM-UP**: trim-up AP control
- **TRIM-DN**: trim-down AP control
- **HDG**: HEADING mode is selected
- **NAV**: NAVIGATION mode is selected
- **APPR**: APPROACH mode is selected (normal approach)
- **ALT**: ALTITUDE HOLD mode is selected
- **B/C**: APPROACH BACK COURSE mode is selected
Disconnecting the autopilot can be made by pushing the disconnect button on the stick, either by selecting DIS position on the control panel of AP (see fig 11),
either by selecting the general switch of AP in OFF position (see fig. 12).
For NAV mode it is necessary to select a VOR radiophare frequency on the station VOR 1.

1.9 Communications

The aircraft is equipped with two communication stations of the type Bendix – King KX170B, P/N 069-1020-00 and S/N 39499, 52664 respectively.
The frequency band of the two communication stations is between 118 MHz and 135,975 MHz and it has 720 VHF COM channels.
The radio communications were established by the aircraft with the air traffic controllers responsible for the following traffic segments that the aircraft travelled since take-off until losing the radio signal: Ground Băneasa – 129,95 MHZ, TWR Băneasa – 120,8 MHZ, APP Bucharest – 118,25 MHZ, ACC Bucharest –KONEL sector – 122,025 MHZ , FIC Bucharest – 129,4 MHZ, TWR Sibiu – 122,7 MHZ, ACC Bucharest –NAPOC sector – 127,075 MHZ, ACC Bucharest –BUDMO sector – 124,1 MHz.
Towards the end of the flight when the aircraft could not be in direct contact with any radar station of ROMATSA, it communicated with ACC Bucharest – BUDMO sector through another aircraft that was in flight in that area, this one acting as a relay between YR-BNP and ACC Bucharest –BUDMO sector.

1.10 Aerodrome information

N/A.
1.11 Flight recorders

BN-2 aircraft type is not equipped with CVR and/or FDR. The investigation commission had available only the recordings made by the air traffic management agencies and the data registered on the auxiliary GPS used by the crew.

1.12 Wreckage and impact information

The aircraft wreckage was found in the vicinity of Horea village, Alba County in a wooded area at an altitude of almost 1600 m, in the coordination point N 46° 33' 15,45" and E 022° 58' 49,53".
The area in which it was found is an inaccessible area.

![Figure 12](image)

In fig. no. 14 there are marked the following symbols:
- green vehicle → it shows the approximate location to which you could go with terrain vehicles;
- red utility van → it shows the approximate location to which you could go with the tractor and by foot;
- blue plane → wreckage position.

![Figure 13](image)

From the observations and measurements made at the accident site it resulted that the aircraft, from the first contact with the pine trees till the ground impact traveled horizontally, a distance of almost 110m, on direction E-V.
The wreckage was oriented on the direction of approximately 330°, at an angle of 40-45° from the transverse axis and of almost 20-30° to the right from the longitudinal axis.

![Figure 14](image1)

After the first impact with the pine trees tip, the aircraft continued the descent trajectory which led to increasingly tough contacts with the pine trees. The aircraft with approximately 13-13.5 m before the stopping position hit with the right plan a pine tree that was uprooted, at almost 2/3 from the fuselage, impact that led to breaking a wing segment. At impact the aircraft turned to the right, continuing descent movement until the violent ground contact.

At ground impact, due to inertia, the central plan was separated from the fuselage and it moved in the advance direction which caused deformation / clogging of the front part of the fuselage and especially of the cockpit thus leading to the incarceration of the pilot on the right piloting post.

![Figure 15](image2)
The two plans have suffered deformation and breakage and thus the deicing pneumatic system of the wings was destroyed.

The investigation commission also found that the wire antenna responsible for broadcasting the signal of 406,025 MHz was broken from its basis.

Mark of strike with a hard body, probably tree branches or remains, on the fuselage surface close to ELT antenna.
The commission also found that the transmitter LED was flashing, sign that it was activated.

![Figure 18](image18.png)

The coaxial cables of the two antennas, the electrical connections of the transmitter, as well as the electrical connections of the speaker, were plucked at the output coming from the transmitter.

![Figure 19](image19.png)

From the statements of the ISU crew arrived at the accident site, it appears that to avoid any risk of fire due to a strong smell of gasoline, the power supply battery of the aircraft was disconnected and because a signal sound could still be heard from the aircraft tail, due to difficult access to ELT transmitter, the electrical connections as well as the cables of the antennas were plucked from the transmitter of the ELT system.
Linear graph

Figure 20 Linear graph
At the accident site there were also identified the following components:

- fragment of the aircraft left wing, situated close to the right wing, in relation to the final position of the aircraft;
- fragment of the aircraft right wing, situated at a distance of almost 8 m from the wreckage;
- tip of left wing, situated at a distance of almost 11 m laterally on the right in the front side of the aircraft;
- fragment from windscreen, situated at a distance of almost 9 m in front of the aircraft;
- remains of fuselage, situated at almost 5 m from its tail on the axis E-V, under several broken branches;
- documents from the pilot’s folder, in the close proximity to the aircraft wreckage;

At the accident site there were also identified the board instruments such as:

![Board Instruments](image)

**Figure 21 Board instruments**

A) Left flight control instrument panel;
B) and C) Central instrument panel;

D) Right flight control instrument panel;

E) Engine and propeller control levers block;
1.13 Medical and pathological information

The pilot in command, who after the impact remained incarcerated in the wreckage, according to the forensic report, died as a consequence of the "tissue anoxia through mechanical respiratory disorders which was a consequence of a compressive thoraco-abdominal trauma with rib fractures and visceral injuries". The result of the toxicological examination was negative and the blood alcohol content was zero %.

The co-pilot, who after the impact was thrown of the cabin, according to the forensic report, had traumatic injuries that did not endanger his life but he needed a large number of days for medical care.

The investigation commission did not find evidence to show there existed psychological factors or of incapacity that might have affected the performance of crew members.

Out of the five passengers of the aircraft, a passenger was not injured, three passengers had traumatic injuries that did not endanger their lives, but they needed a variable number of days of medical care, and the fifth suffered fatal injuries. According to the forensic report her death was violent and it occurred through hypothermic and traumatic shock (spine fracture level C5).

1.14 Fire

N/A.

1.15 Survival information

After the aircraft crash, the passenger who suffered minor injuries got out of the wreckage and announced telephonically this occurrence. The ELT system of the aircraft broadcasted a signal only on the frequency 121.5 MHz.

The search and rescue operation started but without knowing the exact position. The search teams weren’t able to establish the position from telephone conversation due to several factors such as: the aircraft crashed in a mountainous area, in the woods, the lighting level was low and the visibility conditions were low because of the weather. The search teams were unable to triangulate the mobile telephony signal and also unable to receive the signal broadcasted on 121.5 MHz. And there existed also disagreements on interpreting the data transmitted by the passenger. The search lasted almost five hours and they were successful due to the involvement of the local population. The evacuation of victims up to the ambulances was performed with improvised means but under the supervision of SMURD personnel.

None of the persons on board of the aircraft was wearing the seatbelt, but one of the passengers instinctively put his seatbelt on when the engines started to function intermittently, the aircraft entering on a descent flight profile. This was the
passenger who suffered minor injury. It can’t be analyzed the influence of the deformations produced at impact by the aircraft on the injuries suffered by the passengers because of the fact previously mentioned, namely that neither the crew nor passengers, except for one, have used the seatbelts that the aircraft seats were equipped with.

1.16 Tests and research

1.16.1 Examination and download of the data registered by the portable GPS

The data from the portable GPS equipment on board of the aircraft were downloaded with the aid of the Air Accident Investigation Branch (AAIB), the national investigation body in Great Britain.

The unit was examined in order to establish if connecting a new battery and downloading the data from the unit using normal methods is safe. The data from the unit were downloaded using the Garmin Base Camp software. The downloaded data were exported to folders using a series of different formats.
The data was inspected using Google Earth and Excel and it was established that the accident’s flight was captured by GPS using the normal function of track logging.

The obtained results were used for the reconstitution of the aircraft trajectory in horizontal projection.

1.16.2 Technical examination of ELT system

There were performed operating tests of the ELT system, ARTEX C406-2 type installed on YR – BNP aircraft.

In order to determine the operating condition of the ELT system, the investigation commission of CIAS went to the accident site on 16.02.2014.

Thus, it was followed if the ELT system installed on the aircraft broadcasted on the three frequencies: 121.5 MHz, 243 MHz and 406,025 MHz. There were also made determinations concerning the power of the broadcasted signal.

The ELT system was rebuilt (the transmitter, the coaxial cables and the two antennas of 121.5 MHz and of 406,025 MHz were assembled together) and it was activated the switch on the transmitter.

The first part of the test was performed using the antenna of 406,025 MHz found on the wreckage at the accident site.

It has been established that the transmitter of the ELT system broadcasted a signal on the frequency of 406,025 MHz, but the signal hasn’t enough power to reach the SAR satellites for warning the COSPAT-SARSAT system.

The second part of the test was performed using a new antenna, having the same piece code as the original one 110-329.
Figure 24 Whip antenna

Figure 25
This time the COSPAS-SARSAT system was alerted after almost 12 minutes from activating the ELT system. After 21 minutes from alerting the COSPAS-SARSAT system, there were generated the following coordinates:

- **46 33.8 N 022 59.0 E**

The point found by these coordinates was at approximately 1,05 km in a straight line on direction NV from where the wreckage was found at a quota of 1508 meters.

![Figure 26](image)

To determine why the wire of the antenna broke and the moment (in time) of its rupture, the base of the antenna (piece found in the wreckage) was subject to laboratory tests. Also, for the breaking attempts, it was provided a new antenna for the laboratory, identical to the one found on the wreckage.

From the macroscopic, SEM (elemental morphology) and stereomicroscopic analyzes it results the following:

1. The material the antenna is made of is a ferrous alloy, high alloy (cca. 18% Cr and 8%Ni), being also easily attracted by a magnet, which leads to a ferritic austenitic stainless steel, with a small proportion of ferrite in the structure (only the ferrite is ferromagnetic!); which is also why immediately after the rupture, at its surface, it was formed a protective layer of chromium oxide, very sticky and resistant to atmospheric corrosion, therefore the material not showing corrosion primers (reddish spots) or rusty areas;
Figure 27 Morphology of rupture surface, in cross section; ductile-fragile character

Figure 28 X-ray spectrum for the analyzed micro-volume
2. The support of the antenna is made of brass, which was then chromed (the local scratches reveal a yellow material) and the support doesn’t have magnetic properties, not being attracted by a magnet;

![Image](image1.png)

**Figure 29**

3. “The positioning” and “continuity” of the rupture character through pulling/tensioning, respectively through crushing/compression both in cross section as well as in longitudinal section lead to the statement that the rupture took place after a direct load and in an extremely short time (shock), this occurring instantaneously;

4. The presence of the striking area and the absence of three areas specific to fatigue rupture lead to the statement that the wire of the antenna snapped due to violent action, which occurred relatively perpendicular to its axis its;

5. The distance from the base of the antenna where it broke, coincides with the bevel on it, being in fact positioned next to the rupture;

![Image](image2.png)

**Figure 30**
6. The sudden breaking attempts and the ones of fatigue rupture by bending respectively that were performed in the laboratory had as main purpose to obtain a rupture surface with morphology as similar as possible with the one of the analyzed antenna. It clearly results a strong resemblance of the sudden rupture morphology of the antenna wire, the small differences resulting from two ways of considering breaking: stereomicroscopic image and SEM image respectively.

Subsequently to the accident, the investigation commission of CIAS went to the accident site equipped with two metal detectors to search the wire of the broken antenna.

It was established a search perimeter along the impact trajectory of the aircraft, which was later divided into sectors.
The yellow line represents the aircraft trajectory at impact.

Distance between points:
- between 10 – 5 there are 75m;
- between 3 – 6 there are 24m;
- between 2 – 8 there are 24m.

When the weather conditions allowed this, the investigation commission went to the accident site to search the broken segment of the antenna. The investigation commission observed that the accident site suffered major transformations compared to the moment of the accident occurrence, namely most of the pine trees were cut down. Thus, the enclosed area for searching the antenna wire had obstacles of abandoned logs and cut branches, which made the search difficult.

After two days of search, this segment of the antenna could not be found. The result of this investigation phase is not considered to be conclusive.
1.16.3 Engine technical examination

Between 20 – 24 October there have been evaluated and tested the two engines at their manufacturer Lycoming Engines from Williamsport locality, state of Pennsylvania, SUA.

The boxes in which the two engines were transported were opened in the presence of the investigation commission representatives.

The first unsealed box was the one in which it was the right engine with L-22609-40 manufacturing series. The box was sealed with the seals of CIAS and the integrity of the box and of the contents were not affected during shipping.

The engine was mounted on a special support and and they started its evaluation in order to check the operation condition.
There were performed the following operations:

- There were replaced the rods of the rocker arms that were affected after the accident (intake pipe of cylinder 5, exhaust pipe of cylinder 6).

- It was replaced the air intake pipe of cylinder 1 (hit).

- Because the electrical cables that link the magnetos and the spark plugs were broken, there were replaced the caps of the magnetos with some that had appropriate cables.
- The spark plugs were demounted, inspected and cleaned.

- The piston heads were inspected through the spark plugs orifice.

- The ignition moment was checked (magnetos adjustment).

- The accessories on the engine were demounted and in their place there were mounted caps.

- Because the carburettor body was broken during the accident, it was replaced with a standard carburettor that is used for this engine type.

- It was mounted an exterior oil filter, that subsequently to engine test would be sectioned and inspected.
- Also, in order to monitor the engine parameters while testing, there were mounted speed, oil pressure and air intake pressure sensors;

Once the engine preparations, in order to test the operation, finished it was mounted on the test bench.

The engine was started and it was run the full testing automatic program.

After finishing the test, the engine was demounted from the test bench and it was taken to the examination room where the oil filter was demounted and inspected. Then the engine was repacked and sealed in the box in which it was shipped.

Then it was examined the second engine (left) with L-18357-40A series. Also, the integrity of this box as well as its content were not affected during shipping.

There were followed the same steps as for the first engine. Thus, this engine was also evaluated in order to establish its operation condition.
There were performed the following operations:

- There were replaced three caps of the rocker arms, cylinders 1, 2, and 6.

- There were replace two rods of the rocker arms that were bent at cylinder 6.

- It was checked the ignition moment (magnetos adjustment)

- It was replaced the condenser of the left magneto because it was found broken.
- There were replaced the caps of the magnetos with some that had appropriate cables, because the electrical cables that link the magnetos and the spark plugs were broken.

- The spark plugs were demounted, inspected and cleaned.

- There were replaced two air intake pipes that were hit (cylinders 1 and 3) and a lubricating pipe (cylinder 1).

- Because the body of the carburettor was broken, it was used for testing a standard carburettor for this engine type.

- It was also mounted an exterior oil filter that was sectioned and inspected after the testing.

As in the case of the first engine, there were mounted sensors to monitor the engine parameters. After the engine was prepared for testing, it was mounted on the test bench.
The full testing automatic program was run following and registering the engine operation parameters.

After testing no technical anomalies were found in the engines operation.

2 ANALYSIS

2.1 General

On 20.01.2014, after the manager of RAA was informed on the arisen mission, he announced the crew on duty that day, namely the Captain, who had also the position of chief flight instructor. He announced his co-pilot, who was not in Bucharest at the moment. Thus, the first person who arrived at the dispatcher, the place established for preparing the mission and filling the operational flight plan, was the Captain.

The co-pilot arrived at the dispatcher around 10:00 LT, it may be assumed that in this period of time, since the Captain arrived till the co-pilot’s arrival, the designated Captain already started collecting information and had already taken a decision on how to perform this mission.

When the co-pilot arrived the meteorological situation on the departure airport was not favorable and under these conditions, the Captain held a briefing concerning the mission, a briefing with the weather conditions available at that moment. The mission, according to the filled flight plan and to the operational manual requirements, was planned to be performed following the IFR flight rules on lower level flight route 120. Taking into account the flight performances of this aircraft, it is possible that the pilot might have intended from the beginning to fly at the minimum level of 110, that would have ensured the safety altitude for this flight, but also for the flight plan to be accepted and approved, considering the fact that it was applied the semi-circular system through which when flying on 180° - 359° magnetic direction, it is obligatory to use the even-numbered level routes, in the flight plan it was specified level 120.

It was no evidence to lead us to the conclusion that during briefing there were taken into account the possible icing conditions, which according to the
meteorological maps could have been encountered up to 6500 ft. They did not discuss about a backup plan for the situation in which they would have to cancel the IFR flight plan and to perform the mission following VFR flight rules.

Also, for this mission it wasn’t studied the low level map with the lower level routes, for extracting the minimum AMA sector altitudes along the planned flight route, and with the other additional information that this map provides.

The investigation Commission did not find the SID and STAR maps from Băneasa Airport (LRBS) in the aircraft, but nor the ILS or NDB instrument approach maps for Oradea Airport (LROD).

We insist on this mission preparation phase, moment considered by us very important in the way it influenced the conducting of flight mission. In the period of time from holding the briefing to taking the decision of performing the flight, the co-pilot was engaged in activities that implied leaving the dispatcher enclosure, and when returning to the dispatcher, although the operational manual provides holding the briefing 60 minutes before performing the mission, the Captain did not restart the briefing, but he only said that there were good conditions for take-off and they left to the aircraft.

During the investigation, analyzing by comparison the file content of the pilot in command with the one from the dispatcher, the Commission found that in the pilot’s file there were fewer documents referring to weather information than in the dispatcher’s, but the pre-flight information bulletin was updated to the time of departure. It was not considered the strict compliance with the requirements of the operational manual, namely the same documents in the pilot’s file to be also found in the dispatcher’s file. But nothing from the information obtained during the investigation led us to the conclusion that the pilot in command was not aware of the meteorological situation at the destination aerodrome and on the flight route.

In this situation, the co-pilot left in mission being aware only of a part of the meteorological information, compared to the one to which only the Captain had access, without studying the weight and balance sheet and without establishing who and how on board of the aircraft, would cover the duties of pilot flying (PF) (the one controlling the flight controls) and pilot not flying (PNF) (the one monitoring the flight).

During the investigation the Commission established that the main navigation means used by the Captain in this mission was a portable GPS, but during the hole mission preparation remained in the aircraft, thus the crew did not check its database and did not enable the special flight mission they were about to perform. Also, not only the GPS was all the time in the aircraft but the aircraft bag as well, the content of which is specified in the operational manual and that should have been verified by the crew during flight preparation. The Commission found that this bag has not been verified by the crew members not even after arriving at the aircraft. The Captain’s approach of this phase - mission preparation – was one that may be considered routine because it wasn’t the first time he performed this mission, on an identical route, the difference being that he focused only on the changing weather conditions at Băneasa Airport.

According to the weight and balance sheet, document which is part of the Captain’s file and is filled at mission preparation, found in his file at the accident site,
the aircraft was outside the flight envelope both at take-off as well as at landing, given the fuel tank accepted configuration on board and the total number of persons planned to be in the aircraft (detailed analysis at pct. 2.3.3). In this situation, even if the dispatcher on duty drew the Captain's attention on this issue, the Captain didn't take any of the possible measures required. He had two options, to no longer perform the mission with this aircraft in this configuration or to reduce the fuel quantity.

In the expense of these options had at disposal, the Captain decided to continue the mission with the same fuel quantity, the same number of passengers, informing the dispatcher that he would consider, on boarding, to distribute the passengers on the aircraft seats so as to comply with the weight and balance limits. This distribution was not carried out and otherwise, from our analysis it results that it was impossible to make the framing in the weight and balance limits imposed by the manual.

According to the operational manual, when the passengers arrived at the aircraft, the Captain should have held a briefing for their safety through which to communicate them how to get in the aircraft, how to hold their luggage, how and when to use the seat belt, how and at whose indication they can loosen their seat belt, how to behave in case of special circumstances, where the first aid kit is situated. All this points and also others should have been on a card format easy to use, and this document should have been permanently in the aircraft at the Captain’s or the co-pilot’s reach if the latter would have been designated to hold the briefing.

After boarding the passengers, preparing the cockpit by the crew and starting the engines, at 13:29:55 LT the aircraft started the take-off run to align with the runway in order to take-off. The take-off went smoothly and occurred at 13:38:41 LT. Being in touch with the air traffic control agency, the aircraft received indication to continue the climbing flight in order to reach the planned FL 120.

In the analysis of the environment in which the flight took place, the investigation Commission took into account the recordings of the signal transmitted by the aircraft transponder provided by ROMATSA and the scheme developed after downloading the data of the GPS used by the aircraft.

After take-off, the aircraft was transferred to the following air traffic control agency, APP Bucharest, which had the responsibility to guide the aircraft till the limit area of TMA Bucharest. During flight, in this responsibility airspace of APP Bucharest, normally the aircraft should have reached the flight level under the submitted plan, FL 120, but this time after almost 50 minutes of flight, BN -2A aircraft, did not manage to reach that flight level. Actually, according to the survivor pilot’s statement, the crew was facing an engine loss of power determined by icing conditions in the flight area, therefore the aircraft could not climb to flight level declared under the flight plan.

In all the radio conversations generated on this issue between the Captain and the traffic controller, the pilot transmitted permanently through different messages that he would climb to the planned flight level. At no point, he transmitted that the aircraft would have trouble, problems that would prevent climbing to the required level and he did not require assistance either. It is obvious that the icing problems, but possibly also the ones of weight and balance affected the aircraft flight.
performances, this being one of the moments in which the investigation Commission considers that as Captain, he should have made an evaluation of the flight in terms of safety and to decide to continue the flight or to turn back to the departure aerodrome. At the time of flight the aircraft was flying in IMC conditions, but it was out of the ceiling and the Commission assumes that the decision of continuing the mission was based on the fact that the crew was in a position to observe and avoid any obstacles that would have exceeded the upper base of the ceiling. Also, the Captain that occupied the pilot not flying position, assumed responsibility both for what the co-pilot work entails within the crew but also for work with the icing system of the two engine carburettors. The icing system got through the encountered icing conditions, but this was also due to the fact that the aircraft was not in the ceiling and flew in low humidity conditions.

This icing affected so much the aircraft flight performances that at one point it reached a zero climb rate, forcing the co-pilot occupying the pilot flying position to stabilize it the horizontal flight, hence the radio conversation through which the Captain communicated to APP Bucharest that he would fly another 7 minutes at level 100 after which he would climb to level 110, "Ok will maintain for another 7 minutes then will climb to 110".

Still within the conversation from minute 14:06 LT, it entered into question the minimum en route level of FL 110, this FL 110 normally represents the flight route altitude for the same airline, but flown backwards.

According to the regulations a traffic controller approves an aircraft, if it requires this and if it is possible in terms of air traffic, to fly on a route with one level below the planned flight level which was accepted according to the flight plan. Being in TMA and APP Bucharest having the responsibility of vertical airspace, from the altitude of 2000 ft till FL 175, it is absolutely normal to control the flight of this aircraft, but noting that IFR flight under the minimum area altitude is prohibited, except the take-off and landing procedures. This area minimum altitude (AMA) is defined as being the lowest altitude that can be used in instrument meteorological conditions (IMC). AMA is published on route maps and when preparing the mission the Captain had the obligation to study these minimum altitudes and note down the AMA values for the areas he was going to overfly.

In RACR-RA - air rules at art. 5.010.2 – “minimum levels” – it is specified that an IFR flight would be performed at a level that is not below the established and published minimum flight altitude (AMA). The compliance with this requirement guarantees a safe flight even in ceiling flight conditions.

While the aircraft approached the northern limit of TMA Bucharest, it entered in the area in which AMA changed, from 2800 ft it became 10500 ft. In these conditions the aircraft that maintained FL 100, the equivalent of 10000 ft, according to the standard pressure which is 1013 mbar, generated an altitude alert in the air traffic controller’s system, the latter asking again the pilot if he could climb to FL 110, the pilot communicating that he would climb, but slowly, "I'll slowly climb to FL 110".

This is another moment that highlights the Captain’s decision, who regardless of the regulations provisions to perform the flight at least at FL 105, considering that being above the ceiling he had a good control of the flight, decided to continue the
mission. Thus the traffic controller was put in the unclear situation, which he might not faced before, through which the aircraft did not climb to the required flight level, the pilot not answering clearly that he would do so, but on the contrary giving the impression that he would follow the advice of the controller to climb to the required level, but with a very slow climbing rate.

At 14:09:13 LT the aircraft is handed over to the following air traffic agency ACC Bucharest, KONEL sector and this one, after establishing the radio connection, requires the aircraft to climb at FL 110.

After 24 minutes of flight, time in which the aircraft was above AMA, but without reaching FL 110, in the radio conversation between the controller and the pilot in command, the latter communicated for the first time, and thus registering in the recording system from ROMATSA, the fact that the aircraft cannot fly higher than FL 100-105, due to icing conditions he was facing, ”*We try to maintain 100-105 due to icing we cannot fly higher*”.

After a while, at 14:35:59 LT, CTA Bucharest communicated once again to the crew that AMA is of 10500 ft and they also gave them the QNH pressure of 1006 hPa. This indicates that the aircraft had reached below AMA, and the purpose of communicating the QNH was that at least a crew member to fit on his altimeter on this pressure, in order to read the same altitude to which on a VFR map, are written the obstacles altitudes.

After another 6 minutes of flight, at 14:42:03, time in which the aircraft practically performed a continuous controlled descent flight, possibly due to the de-icing system of the carburettors that did not cope with the icing conditions, this affecting the engine operating performance, the Captain required to descent to level 80 and to switch the frequency on 129.4 Mhz with FIC Bucharest, ”*Bucharest RFT111, we will descent to 80 and we enter on 129.4*”.

The descent flight mentioned above was performed outside the ceiling, of which upper base was not uniform, presented excrescences and according to the recordings on GPS, but also according to the survivor pilot’s statement, the aircraft made frequent changes of direction for short periods of time, in order to avoid passing through these excrescences, that would have accentuated the icing process of the carburettors.

When the Captain took the decision to switch to FIC Bucharest, the ceiling was no longer compact, and the crew had the possibility to see the ground and to descent to an altitude of 8500 ft. At that moment the aircraft had already passed the Meridional Carpathians and the crew already established where they were by visual orientation, identifying the large localities in the area.

This is an important moment to analyze, because in terms of ACC responsibility area KONEL sector, that according to the regulations responds of AMA up to 10500 ft, below this altitude the radio connection is provided by the information agency FIC Bucharest, with which it was requested to enter in connection. In this situation the ACC control agency considered that this IFR flight transformed into a VFR flight.
According to the regulations in force the pilot in command should have given a radio report requiring to quit IFR flight and to switch to VFR flight, but the Captain did not give this report. In these conditions it arrises the question – according to which flight rules he continues this mission.

In terms of traffic controllers, who are supported by the provision of not performing an IFR flight below AMA, the aircraft switched to VFR flight, it got out of the controlled airspace, C class airspace, it entered in G class uncontrolled airspace and from that moment it is the responsibility of the Captain to secure their protection of air navigation, the air traffic control agency having for this class airspace only the role of information for avoiding the possible conflict situations with other aircraft. But this role is also limited and it depends on the communication of the aircraft position by entering in radio connection with the information agency.

It should be mentioned that in the G class airspace, VFR flight, the bilateral stable radio connection is not a requirement. As it concerns the pilot in command, it is possible that he might practically considered he did not cancel the IFR flight plan, otherwise there was no discussion within the crew on changing flight rules.

In this VFR variant, the flight mission, as mentioned above on the mission preparation phase, was not prepared and otherwise in the operator’s operational manual it is clearly written that such flights are performed only in IFR, being accepted in certain conditions also short segments performed in VFR, but then returning to IFR.

The fact that the mission was not prepared for VFR, but the conditions imposed the application of VFR flight rules, would have meant landing on Sibiu airport, then the crew should have prepared the VFR variant and fill a new flight plan.
It is possible that in the Captain’s opinion this might have represented an additional time that they didn’t have given the mission emergency.

The opinion of the investigation Commission is that the Captain should have taken into account that for covering the distance from Bucharest to Sibiu he needed almost 1 hour and 30 minutes given that the segment from Sibiu to Oradea represents more than half of the total covered trajectory, and the mission according to the data in the flight plan was of 2 hours.

The flight in CTR Sibiu went smoothly in weather conditions compliant with the situation transmitted upon request by TWR Sibiu, very good conditions, but we can also notice here that if the pilot in command considered that everything went back to normal, the Commission further observed that it was very difficult for him to comply with the traffic controller’s demand of climbing from FL 80 to FL 90. As a confirmation of the statements above we’re reproducing the radio conversation had after the aircraft intersected the runway center line through which the pilot in command affirmed that if they have already passed the runway center line, they would no longer climb, but on the contrary they would descent to FL 80, affirming that it would last too long to climb to the requested FL 90 "Sibiu, 111, approach, we have already passed the runway center line, so we’re descenting to 80, because it is impossible to do more than that”.

No less important is the fact that when approaching to Sibiu Airport, the co-pilot proposed landing there, but the Captain decided that he would continue the flight. The Commission was unable to identify the elements the Captain relied on in taking this decision, because at that moment he flew at 8600 ft, the air line he planned his mission on was FL 120, the minimum route level, at the moment, was FL 110, and AMA 10400 ft, following that when exiting from CTR Sibiu on the flight direction to Oradea, this would change and be 8000 ft. We can assume that the aircraft did not climb on time to FL 90, because the carburettors were still affected by icing and if we take into account the weather information we had at disposal since the mission preparation, in which the isotherm of 0°C was situated at 6500 ft, the chosen FL 80 was not a level that would have ensured the solving of the icing problems.

The flight went normally until near exiting from CTR Sibiu when CTA TWR Sibiu indicated to the crew that in order to contact FIC to enter on the frequencies 136.575 MHz or 136.225 MHz. These frequencies were not published in AIP, being still in testing. Due to the limitations of the radio stations on board of the aircraft, the crew could no use the frequencies in testing but that would have ensured a good bistable radio connection with FIC. Given that on the frequency of 129.4 MHz, frequency published in AIP, FIC couldn’t have been contacted, the pilot in command in coordination with CTA TWR Sibiu found the backup solution to enter in radio connection for information with the control agency superior to G class airspace in which the flight was taking place. It must be understood that ACC Bucharest had as responsibility only C class airspace and that in the current situation the traffic controller did not take the aircraft in radar surveillance.

The flight altitude chosen on the sector after exiting from CTR Sibiu was an altitude at the limit of AMA and it imposed the application of VFR flight rules. After exiting from CTR Sibiu the aircraft flew between two cloud ceilings out of which the
initial lower ceiling was not a compact one, this allowing the crew to observe the ground but not continuously, which does not correspond to VFR flight rules. The co-pilot proposed the captain to change the flight scheduling and to continue the flight under this ceiling, but this time too the Captain did not accept the proposal of the co-pilot and he decided to continue the mission at the same flight altitude. The investigation commission considers that the co-pilot’s proposal of continuing the mission below the ceiling they were overflying at that moment would have been a decision allowing the mission to be continued safely and that would have clarified under which flight rules the mission would have continued.

Taking into account how the flight took place after crossing the Meridional Carpathians, lead us to the conclusion both for the traffic controllers but also for the co-pilot that the mission was performed under VFR flight rules. This is reasoned for the traffic controllers by the fact that since the aircraft entered in connection with FIC, it was further handed over as VFR flight, and for the co-pilot through his proposal of flying below the ceiling and to maintain the ground on sight.

While the aircraft advanced to Oradea, this ceiling became compact thus losing visual contact with the ground, the aircraft performing a kind of instrument flight at the limit of AMA. With the approach to Apuseni Mountains, the commission considers that two aspects can be taken into account, first – after changing the radio frequency entering in the responsibility area of BUDOP sector, the crew no longer had a stable radio connection and second – the icing on the carburators has accentuated, which affected the aircraft flight performances.

The aircraft could no longer maintain FL 80, the co-pilot (controlling the flight controls), having to make a descending flight evolution of the aircraft, in order to maintain the aircraft on a safety flight profile, resulting in continuation of flight in the lower ceiling, ceiling which until then was overflown.

Descending under 8000 ft and performing flight in the ceiling practically means that it was performed an IFR flight, but below the minimum safety altitude (AMA). Otherwise entering the ceiling generated also the increase of icing phenomenon, this time with icing also at the airplane structure level.

Analyzing this final part of the flight, since the radion frequency changed for BUDOP sector and until the impact, taking into account the data registred at ROMATSA and overlapped with the data from the portable GPS it can be assumed that from the moment of descending below AMA till the imposition by the meteorological situation of the IFR flight rules, the aircraft flew at least 17 minutes. We can assume that when entering into the ceiling the Captain would have changed his decision and instead of continuing the mission he would have made a turn of 180 degrees and he would have returned to Sibiu, this accident could have been prevented. As the time passed and it advanced to Apuseni Mountains, therefore to higher quota, the more the decision to return became impossible because due to the icing they were facing, the flight was already performed in descent and the turn of 180 degrees would have meant a even higher loss of altitude, all this due to the quick and substantial reduction of distance between the aircraft and the ground.

We can assume that the Captain’s decision to continue the mission was based on more elements:
- his desire to perform the mission even if the flight was performed at the limit of the regulations. In the operator’s operational manual it is clearly stated that such missions can be performed only applying IFR flight rules, but it can also be admitted for short segments the performance of flight under VFR rules. That’s why the commission considers it is possible that the pilot in command might have thought that the flight performed since they interrupted the radio connection with ACC and switched to FIC until they entered in radio connection with CTA TWR Sibiu might have been considered a segment on which it was flown under VFR rules after which the mission continued as an IFR flight.

- the fact that the aircraft managed to pass the Meridional Carpathians, which was a higher obstacle than Apuseni Mountains, flying in icing conditions of the carburettors and operating their de-icing system.

- wrong evaluation of risk factors that might have influenced the flight performance when existing from CTR Sibiu. The investigation commission assumes that this error was possible because the Captain was a pilot with an experience of over 12 000 flight hours performed on line transport aircraft, therefore flights performed under IFR rules, many of them in IMC weather conditions, which led to a different personal perception of the risk of performing flight in the ceiling.

- in our opinion the lack of flight experience on BN-2A-27 aircraft. The total of 42 hours and 17 minutes performed on this aircraft until the date of the accident and even these performed with interruptions, at long intervals, are a proof that allows us to assume that at least in terms of evaluating the risk factors he could easily make incorrect assessments.

Shortly after the icing phenomenon was accentuated the crew faced a serious icing of the carburettors which led to an intermittently, uncontrolled shutdown of each engine. Restarting them is also performed in an uncontrolled manner, while the carburettor was de-icing the engine restarted. It was a moment, when according to the co-pilot’s statement, the Captain was surprised by the shutdown of an engine and when he was alerted that this stopped, he acted urgently the de-icing lever for the engine in cause.

The work with de-icing system of the carburettors was carried out by putting the de-icing lever of a carburettor on hot air for, and then after the carburettor temperature encreased and the engine recovered, the lever was again turned off. A possible explanation of the fact that he was surprised by the engine shutdown may be also his overloading because at the same time the Captain took care of the aircraft plans de-icing. From reaching this flight phase, the investigation commission considers that the crew remained without backup options, because they were flying in descent, in a mountainous area and in cloud ceilings.

The co-pilot controlling the flight controls, in this situation was doing nothing but ensuring the safe speed and maintaining the aircraft flight direction, but on descent trajectory. It is possible that in this situation the Captain might have hoped that they would come out of the ceiling, they would regain visual contact with ground and they would be able to pass Apuseni Mountains to the destination airport but at a low altitude, by applying VFR flight rules. There is a noticeable moment on GPS
recording at 15:39:53, in which it can be noticed that the aircraft descent flight was accentuated.

The investigation commission considers that this is the moment when the problems that the aircraft was facing actually accentuated.

The crew was surprised by the emergence of pine trees, because being in the ceiling they had no visibility nor a safety minimum altitude established, altitude established since preparation under which to prepare the aircraft and passengers for a forced landing. In none of the moments from this final phase when the crew faced these problems, according to the statements of the survivor witnesses, the Captain did not announce his passengers to prepare for a possible forced landing, so that the impact of the aircraft with the pine trees caught them unprepared and without having their seatbelts on, only one passenger occupying the left seat on the fifth row instinctively put his seatbelt.

While the aircraft descended into the coniferous forest, its plans were disjointed on segments and symmetrically left - right, in the end the aircraft taking contact on the right side with a thicker pine tree trunk, it pivoted around it and it took contact with the ground with the front of the plane, perpendicularly to the traveling direction slightly inclined on the right. This is when we assume that the fatally injured passenger, on the fifth row was projected from the seat he occupied, stopping in the seatback of the second row of seats, and the co-pilot was thrown out of the aircraft.

Out of the five passengers who were in the aircraft, the one who was projected from his place suffered a serious injury, three passengers suffered injuries that did not require hospitalization, and the passenger who wore the seatbelt was not injured. This one and the other three passengers, came out of the aircraft wreckage and soon after that he was helped by one of the wounded passengers to extract out of the aircraft the seriously injured passenger. After the impact with the ground the co-pilot, as a result of his propulsion out of the aircraft, was injured on his head and...
legs, and the pilot taking into account that the aircraft took contact with the ground on his side, was seriously injured and couldn’t be removed from the aircraft, this being incarcerated.

2.2 Flight operations
2.2.1 Crew qualification

In order to check the crew competency on this aircraft, the commission analyzed the activity of the crew members since the end of 2011, when the Captain started to work for this operator.

According to the performed analysis, taking into account the applicable regulations in force, both pilots were properly qualified and licenced for this kind of mission with this aircraft.

It’s necessary to understand the legal framework in which the crew performed its activities, namely the crew should have had valid MEP (land) (Multi-Engine Piston) licences, a class including all aircraft with two piston engines designed to be operated only by one pilot. This MEP class (land) is published in EASA flight crew list for type qualification and licences approval.

The list clearly states that for the MEP (land) class, the qualification is not individual for each aircraft, but it is necessary training for the differences between the aircraft in this list.


In this regulation at article FCL.010 Definitions, it is defined what has to be understood by class, namely "Aircraft Class" means a classification of aircraft with only one pilot who does not require a type qualification.

At art. FCL.710 Class and type qualifications – variants it is stated:

*(a) In order to extend his/her privileges to another variant of aircraft within one class or type rating, the pilot shall undertake differences or familiarisation training. In the case of variants within a type rating, the differences or familiarisation training shall include the relevant elements defined in the operational suitability data established in accordance with Part-21.

(b) If the variant has not been flown within a period of 2 years following the differences raining, further differences training or a proficiency check in that variant shall be required to maintain the privileges, except for types or variants within the single-engine piston and TMG class ratings.

(c) The differences training shall be entered in the pilot’s logbook or equivalent record and signed by the instructor as appropriate."

At art. FCL.725 Requirements on the issuance of class and type qualifications, there are stated the steps to be followed for obtaining the class qualification:

"(a) Training course. An applicant for a class or type rating shall complete a training course at an ATO. The type rating training course shall include the mandatory training elements for the relevant type as defined in the operational suitability data established in accordance with Part-21.

(b) Theoretical knowledge examination. The applicant for a class or type rating shall pass a theoretical knowledge examination organised by the ATO to demonstrate the level of theoretical knowledge required for the safe operation of the applicable aircraft class or type."
(c) Skill test. An applicant for a class or type rating shall pass a skill test in accordance with Appendix 9 to this Part to demonstrate the skill required for the safe operation of the applicable class or type of aircraft. The applicant shall pass the skill test within a period of 6 months after commencement of the class or type rating training course and within a period of 6 months preceding the application for the issue of the class or type rating.

After obtaining the license in order to maintain its validity there should be applied the provisions of art. FCL.740 Validity and renewal of class and type qualifications, stating that:

"(a) The period of validity of class and type ratings shall be 1 year, except for single-pilot single-engine class ratings, for which the period of validity shall be 2 years, unless otherwise determined by the operational suitability data, established in accordance with Part-21.
(b) Renewal. If a class or type rating has expired, the applicant shall:

(1) take refresher training at an ATO, when necessary to reach the level of proficiency necessary to safely operate the relevant class or type of aircraft; and

(2) pass a proficiency check in accordance with Appendix 9 to this Part."

Taking into account the legislation mentioned above it must be understood that this process is supervised directly by the Romanian Civil Aeronautical Authority. The pilots’ licensing or renewal is made by CAA after studying the file of each one of them. The whole ground or flight training programme for issuing and renewing of the licence is approved by this authority which observes that these programmes shall comply with the legislation in force.

The Pilot in Command

Following the steps mentioned at art. FCL.725 the Captain received the MEP (land) class qualification as pilot in command with IR (instrumental rules) on 11.11.2011, valid until 01.11.2012, on this occasion also renewing his language skills for English LEVEL IV, valid until 10.11.2014.

On 11.04.2012 he received the FI(A) – MEP (land) qualification valid until 02.04.2015 stating his position as flight instructor for the aircraft in this class. On 30.08.2012 the MEP licence was renewed after the skill test completed on 10.08.2012 on a Piper 34 plane, with validity until 11.09.2013.

On 02.09.2013 the MEP qualification was renewed, valid until 30.09.2014.

On 11.10.2013 he also received the IRI (A) (Instrument Rating Instructor) qualification valid until 31.05.2016.

He obtained the last qualification on 20.01.2014, when RCAA issued the MCCI (Multi-Crew Cooperation Instructor) qualification document MCCI.

For flying on BN-2A 27 plane, the Captain attended the flight training for the extension of the class qualification for this aircraft type between 28-29.11.2011.

In the time periods 16-20.01.2012, 20-22.11.2012, 08-12.04.2013, he followed the recurrent training for flight crew and flight dispatcher staff organized by the air operator.

According to the operator’s records, the Captain started to operate some MEP class aircraft, when he started to work for the RAA. Until then he was a line pilot having an experience of more than 14000 flight hours, on Boeing aircraft. In the time...
until the accident he accumulated 538h 29 min in MEP class out of which on PIPER 34 airplane – 496 h 12 min and on BN 2A 27, 42 h 17 min.

As it can be easily noticed most of the MEP flight hours were performed on PIPER 34 airplane in MEP class, while only a reduced number of hours were performed on the BN-2A 27 airplane, but the investigation commission considers that taking into account the professional experience of the pilot, there would not have been a problem if these hours wouldn’t have been performed at such long periods of time, it should be noted that the last break was of 11 month. In terms of observing the regulation everything is normal and legal, since the MEP class has no conditions for aircraft type and variants.

It’s enough not to have interruptions from flight in the class for considering that during the licence’s validity any aircraft in the class can be operated. The regulation doesn’t establish restrictions according to the frequency each aircraft is operated within the class. For a better understanding we consider the precise situation of the Captain who flew the Piper 34 on 14.01.2014 and, analyzing the frequency, there was no flight interruption longer than one month. In comparison to these analyzing the frequency of flights on BN 2A 27 aircraft, till the accident, the commission found a frequency of at least 2 months when the pilot did not fly on this aircraft, after which he finally had an interval of over 11 months.

Taking into account that the last flight in the class was performed on 14.01.2014 it can be considered that according to applicable regulations in force the pilot was able to perform the flight mission on 20.01.2014 with BN-2A 27 aircraft, without requiring a familiarization or training renewal.

In the opinion of the investigation commission, the fact that there is no restriction imposed by the regulations in force limiting a pilot to perform directly commercial missions with an aircraft of the same class, but which he didn’t operate for a long period of time, requires that this situation shall be analyzed and corrected.

The commission considers this thing as very important since within the same class there can be major differences between aircraft, such as in our case where the Piper 34 aircraft has an injection fuel supply system while BN-2A aircraft engines are supplied by a carburettor. There is no use that during icing conditions flight the pilot is up-to-day with the Piper 34 training, of which engines do not require de-icing systems while for the BN-2A he needs to operate the carburettors de-icing unit, requiring operation experience.

As a short reminder, the Captain has restarted the operation of BN-2A 27 aircraft after an 11 months period when he didn’t operate this aircraft at all, performing directly a commercial passenger flight, IFR, in IMC meteorological conditions. This was possible because the regulations in force at that date, but also the actual ones do not include renewal training conditions for an aircraft in the class if he didn’t fly for a long period of time, but this break falls within the 12 calendar months.

Thus, the commission analyzed the Captain’s activity on this aircraft in terms of his experience, who assumed on board the non-flying pilot position, but he took all the decisions in his Captain position. We consider that the errors in assessing the real situation of the aircraft could have been determined by the interruption of
operation of this aircraft, the last one for more than 11 months. Thus, we are in the situation when we have a pilot with a great flight experience during his career, with a good MEP class experience, but an insufficient training on this aircraft.

**Co-pilot**

In August 2010 the co-pilot obtained the MAP IR qualification on Piper Seneca 24 aircraft, owning also a SEP (land) (Single - Engine Piston) licence, and having the qualification of instructor in this class. His revalidation program followed the same steps as in the Captain’s case observing the regulations in force, the last revalidation for MEP class, being received on 20.06.2013 valid until 31.08.2014.

For the flight on BN-2A 27 airplane, on 03.08.2012 the co-pilot attended the class for training in flight to expand his class qualification on this aircraft.

He also attended recurrent training sessions for flight crew and flight dispatchers organized by the air operator in the time periods 16-20.01.2012, 20-22.11.2012, 08-12.04.2013 and also attended the theoretic course of MCC (A) multi-crew cooperation in May 2010 with a synthetic training in 2013.

Also for the co-pilot analyzing the operation frequency on BN-2A aircraft the commission noted the same phenomenon as for the Captain, he started flying this aircraft in August 2012, the last flight was performed in November same year, then the next two flights on 5 and 6 February 2013. After February 2013 the pilot flew this aircraft only in the day of the accident, which is again an 11 months break. In the same time the co-pilot continued to fly in this MEP class, but on Piper 34 aircraft, where the last flight was recorded on 13.01.2014, meaning that according to the regulations in force there was no infringement by flying on BN-2A 27 after such a long interruption.

Practically the arguments presented during the analysis of the Captain’s flight experience are completely applicable also for the co-pilot.

The investigation commission analyzed in terms of flight techniques of the co-pilot’s, since he was handling the flight controls. In our opinion he succeeded to maintain the aircraft speed above the stall speed and heading. This is also supported by the aircraft evolution after the engines shutdown, the crew controlling the aircraft attitude until the hard impact with the pine trees trunks.

### 2.2.2 Operational procedures

Analyzing the operation of the crew on board in this flight, the investigation commission studied the commercial flight operational manual, document issued by the operator and approved by RCAA.

Thus, the points 1.4.3 and 1.4.4 of this manual state:
"1.4.3. Authority

The commander has full authority over:

The execution of his flight with regard to airplane operation and safety, all POB, from closing until opening of the doors.

1.4.4. Authority in an Emergency

The commander has the authority and responsibility to declare an emergency situation whenever deemed necessary. He is authorized to deviate from any procedures and regulations and to follow any course of action deemed necessary in the interests of safety in an emergency situation. The commander shall fully inform CTA regarding action taken and flight progress while exercising his emergency authority.

The commission considers that the Captain applied the provision in order to deviate from procedures or rules, without informing the CTA agency about the emergency situation, the decision to switch to FIC Bucharest and to descent to 8000 ft could be understood as a notification of the way the flight will be further continued.

At point 1.4.5 there are stated the responsibilities of the Captain as follows:

"- Be responsible for the safe operation of the airplane safety of its occupants during flight;
- Have authority to give all deems necessary for the purpose of securing the safety of the airplane and of POB or property carried therein;
- Have authority to disembark any POB, or any part of the cargo, which, in his opinion, may represent a potential hazard to the safety of the airplane or its occupants;
- Not allow a person to be carried in the airplane who appears to be under the influence of alcohol or drugs to the extent that the safety of the airplane or its occupants is likely to be endangered;
- Have the right to refuse transportation of inadmissible POB, deportees or persons in custody if their carriage poses any risk to the safety of the airplane or its occupants;
- Ensure that all operational procedures and checklists are complied with in accordance with the Operational Manual;
- Not permit any flying staff to perform any activity during take-off, initial climb, final approach and landing except those duties required for the safe operation of the airplane;
- Not permit a flight data recorder if any, to be disabled, switched off or erased after flight in the event of an accident or an incident subject to mandatory reporting;
- Decide whether or not to accept an airplane with unserviceabilities allowed by the COL or MEL;
- Ensure that the pre-flight inspection has been carried out."

At point 1.4.6 Supervision and Co-ordination of Flight Duty, there are specified the Captain’s tasks in terms of flight duties that should:

" - Ensure that standard, emergency as well as security procedures and regulations are adhered to by all members of the crew on ground and in the air.
- Co-ordinate and distribute at his own discretion the duties of the various member of the crew, with regard to the composition of the actual crew.
Instruct and correct, especially his copilot anior pilot trainee and give them full support.
- Notify his superior whenever behavior I performance of a member crew is definitely beyond tolerable limits."

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Following all these provisions we can notice that these are all addressed to the Captain, no provision referring the co-pilot tasks. The commission did not identify any clear provision on what the co-pilot has to do from briefing until debriefing. As it can be noticed it is foreseen the Captain’s obligation to inform his hierarchic superior about the behaviour or performance of crew members. Since the crew tasks are not defined, implicitly the criteria for the Captain’s assessment is not defined.

Analyzing in term of operation according to the provisions of point 5.3.1.2 "Operation on more than type” it looks normal that the crew shall perform the mission on this aircraft type. It can be observed that the provision is applicable only when the pilot needs to conclude training with respect to the differences in the following cases:

- before operating another variant of an aircraft of the same type or another type of the same class currently operated, or

- when a change of procedures and/or equipment of types or variants currently operated requires additional knowledge and training on an appropriate training device."

"The minimum flight crew competence for operation on more than type/variant is in accordance with JAR FCL 1 for type rating.

The training of a crew member in command on one type or variant for another type or variant shall be conform JAR FCL 1; 1.245; 1.255; 1.261."

meaning, in the commission’s opinion, that it is applicable only if the pilots need to fly the same airplane, e.g. Piper 34, but another variant. In MEP class, according to the regulations in force, we have several variants of aircraft for which this Manual provision is applicable, but no aircraft types. In this situation the manual provides at point 5.3.1.3 "Familiarization training” that such flights should be performed, by taking into account the following situations:

- when operating another aircraft of the same type or variant, or

- when a change of procedures and/or equipment on that type or variant currently operated requires the acquisition of additional knowledge or skill."

Thus, no situation for the aircraft in the class is provided, so that any aircraft in the class, in our case MEP class, can be flown with a break not longer than 11 months.

The operational manual also requires a periodic controls and training program for pilots performing commercial flights, so the point 5.3.1.4 "Recurrent Training and Checking" states that:

"The training will be conducted by Chief pilot and/or Flight Operations Manager.

Each flight crew member must undergo recurrent training and checking for revalidation of the type rating combined with the revalidation of the instrument rating. The training and checking must be relevant to the type or class of airplane on which the crewmember is certified to operate.

The recurrent training is detailed in OM (AOC) , Part D, chapter 2.1C and compnese:

<table>
<thead>
<tr>
<th>Training</th>
<th>Validity Period</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>Annual and semi-annual training/checking</td>
<td>6 months alternatively</td>
<td>1;2</td>
</tr>
<tr>
<td>Emergency &amp; safety equipment training/CRM</td>
<td>12 months</td>
<td>1;3</td>
</tr>
<tr>
<td>Ground &amp; refresher training</td>
<td>12 months</td>
<td>1;3</td>
</tr>
</tbody>
</table>
Note 1: New validity extends from the date of expiry. In addition and except for the annual training/checking the new validity may be extended to the end of the month of the current expiry date. If planned before -3 months new validity extends from the date of revalidation.

Note 2: Planning tolerance is +0 I -3 months.

Note 3: Planning tolerance is +3 I -3 months.

Recurrent checking shall comprise:

operator proficiency checks shall include the following maneuvering:

- rejected take-off when a Flight Simulator is available to represent that specific aeroplane, otherwise touch drills only;

- take-off with engine failure between V1 and V2 or as soon as safety considerations permit;

- precision instrument approach to minima with, in the case of multi-engine aeroplanes, one engine inoperative;

- non-precision approach to minima;

- missed approach on instruments from minima with, in the case of multi-engine aeroplanes, one engine inoperative; and

- landing with one inoperative. For single-engined aeroplanes a practice forced landing is required.

- when engine out maneuvering carried out in an aeroplane, the engine failure must be simulated.

- the revalidation or renewal of the aircraft Type or Class Rating must be completed every 12 months and may be combined with the operator proficiency check.

- operator proficiency checks must be conducted by a Type rating examiner.

The results of proficiency checks will be mentioned in personal record and will be kept in each pilot's own file.

The proficiency check will be conducted by Flight Operations Manager and/or Chief Pilot."

It is noticed and there is the tendency to consider that the crew should have made a control each 6 months and therefore there wouldn't have been possible an flight interruption on BN-2A longer than 6 months. Actually the provisions refer to the class, therefore by making a control on Piper 34 aircraft the crew made the control within the class according to the provisions of point 5.3.1.4. Since in MEP class there are no aircraft types, put the crew in the position of legally performing a flight with BN-2A 27 aircraft in the MEP class after an 11 months break.

The investigation commission selected some provisions of the operational manual regulating the performance of such a mission:
8.1.4. En-route operating minima for VFR flights or VFR portions of flight.

<table>
<thead>
<tr>
<th>Airspace class</th>
<th>B</th>
<th>CDE</th>
<th>FG</th>
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<tr>
<td></td>
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<tr>
<td>Above 900m AMSL or above 300m above terrain, whichever is the higher</td>
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</tr>
<tr>
<td>At and below 900m AMSL or above 300m above terrain, whichever is the higher</td>
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</tr>
</tbody>
</table>

Distance from clouds
- Clear of cloud
- 1500m Horizontally
- 300m Vertically
- Clear of cloud and in sight of the surface

Flight visibility
- 8 km at and above 3050 m AMSL (Note 1)
- 5 km below 3050 m AMSL
- 5 km (Note 2)

Note 1. When the height of the transition altitude is lower than 3050 AMSL, FL 100 should be used instead of 10 000 ft.

Note 2. CAT A airplanes may be operated in flight visibilities down to 3000m, provided the appropriated ATS authority permits use of a flight visibility less than 5 km, and the circumstances are such, that the probability of encounters with other traffic is low , and IAS is 140 kts or less ".

8.3.1. VFR / IFR Policy

8.3.1.1. General

8.3.1.2. Choice of airspace

All route flight shall be operated within controlled airspace with advisory service or airspace with positive radar control, wherever possible except:

a) when authorized in the RM by the respective Flight Area Manager, or b) when the situation so earns (e.g. thunderstorm)

8.3.1.3. Choice of fight rules

All route flights shall normally be operated fully in accordance with IFR and an IFR flight plan shall be filed. No cancellation of an IFR flight plan is authorized. Non cancellation of an IFR flight plan does not precede the use of a clearance subject to maintain VMC for a limited a specified portion of a flight.

8.3.1.5. Operator VMC Minima

Only if at least the following flight conditions exist, shall a flight be considered as in VMC:

a) Flight visibility: 9km (5NM);

b) Distance from clouds: 600m (1200 ft) vertically 4,5km (2,5 NM) horizontally.

8.3.1.7. A VFR clearance may only be requested or accepted if all of the following conditions are met:

- Weather conditions for entire intended flight path are at least equal to the OperatorVMC Minima.

- Without VMC, clearance, fuel penalty or delay should result.

- The VMC operation is temporary only, i.e. for a short phase of climb, cruise, descent or approach

- Restricted traffic can be analyzed properly (knowledge of position, altitude and direction).
- The flight is able to establish its exact position and to maintain proper terrain clearance.

- A flight level altitude must be assigned."

Taking into account all these provisions conditioning the flight we can identify that the crew couldn’t cancel the IFR flight plan since according to the operational manual such case is unacceptable. Practically the crew needed to cancel the mission if it couldn’t follow the flight plan provisions. Therefore it is possible that the crew was flying in G class airspace below AMA, the Captain assuming they flew IFR, considering the flight section between KONEL and CTR Sibiu as a short VFR section, accepted according to the manual provisions.

It can be observed that after exiting from CTR Sibiu the Captain chose a flight altitude of 8000 ft, an altitude practically identical with the AMA on the route maps. Thus the aircraft was originally following the requirements of the regulations stating that IFR flights in G class airspace are possible, but not below AMA. Moreover, the manual doesn’t specify in what airspace type it can be conducted the IFR flight, just imposing the IFR flight rules. The moment when the flight altitude could no longer be maintained represents the moment when it should have been switched again to VFR rules, but this was impossible because the aircraft was overflying a compact clouds ceiling.

The investigation commission considers that was the moment when the Captain noticing that he couldn’t follow neither IFR, nor VFR rules, to decide to make a turn of 180° and apply an alternative solution such as landing on Sibiu Airport.

The manual also includes provisions regarding flying in icing conditions:

"8.3.8.3.4. During climb and cruise, anteing/de-icing equipment shall be used prior to entering areas with risk of icing. After climb-out, de/anti-icing equipment should be used according POH I AFM.

When entering an area of severe icing it should be tried to change altitude to a flight level with less icing. The time flying is severe icing conditions should be as short as possible. Therefore, the rate of climb shall be kept high when severe icing is encountered to leave the dangerous zone as quickly as possible."

"8.3.8.3.5. ……Engine and wing anti-ice should be switched on during descent prior entering clouds. Avoid icing conditions as long as possible to maintain normal handling characteristics of the aeroplane. That means stay out of clouds as long as possible until reaching glide slope when icing conditions are expected."

As it can be noticed there is clearly underlined that flying in severe icing conditions shall be as short as possible, and the area shall be left as quick as possible. This could also support the solution chosen by the Captain when departing from Băneasa Airport when choosing a high climb rate with a small advancing speed, this being also a possible explanation of the factor that influenced the time necessary to travel from Băneasa Airport to CTR Sibiu.

The operational manual at point 8.3.11.2 “Passengers on board” (POB) states that:

"The PIC shall instruct and brief the POB or have them instructed I briefed and ensure or are assured that each POB occupies a seat or berth with his safety belt, restraining belt or, where provided, harness properly secured:

- During taxiing.

- Before and during take-off or landing."
- Whenever deemed necessary in the interest of safety.

_It shall be recommended to POB to keep, when occupying their seats, their safety/restraining belts/harnesses secured during the entire flight._

The investigation commission noticed that, taking into account the provisions concerning passengers, the operator did not support the pilots in command in commercial flights by providing a check-list card including the points to be referred by the pilot during the passengers' safety briefing. It's possible that, for this flight, the Captain, who flew already with the same passengers, might have considered, as a routine matter, that the passenger briefing would be unnecessary. From the information we have it appears that the passengers did not wear the safety seatbelts nor before take-off.

In order to have a complete analysis, taking into account that the purpose of the civil aviation safety investigation is to prevent future similar accidents by issuing safety recommendations the commission used during the analysis also the provisions of the Commission of 5 October 2012 for establishing the technical requirements and administrative procedures on air operations under Regulation (CE) no. 216/2008 of the European Parliament and Council, even if at the moment of the accident this regulation was only partially applicable.

The investigation commission analyzed especially the FC SUBPART, FLIGHT CREW, which became compulsory in November 2014, just because in this case we face a wrong decision of Captain to continue the mission, based on a reduced experience and a very long flight interruption on this aircraft. Taking into account that in our opinion the flight crews licensing provisions for the MEP class do not solve the problem that a pilot with a long flight interruption on an aircraft in this class shall be required to perform a re-accommodation flight, we checked if this thing is covered by Regulation (EU) No. 965/2015.

We consider the following selection of provisions from this Regulation to be relevant:

**"ORO.FC.005 Scope"

This Subpart establishes requirements to be met by the operator related to flight crew training, experience and qualification and comprises:

(a) SECTION 1 specifying common requirements applicable to both non-commercial operations of complex motor-powered aircraft and any commercial operation;

(b) SECTION 2 specifying additional requirements applicable to commercial air transport operations, with the exception of:

(1) commercial air transport operations of sailplanes or balloons; or

(2) commercial air transport operations of passengers conducted under visual flight rules (VFR) by day, starting and ending at the same aerodrome or operating site and within a local area specified by the competent authority, with

— single-engined propeller-driven aeroplanes having a maximum certified take-off mass of 5 700 kg or less and a MOPSC of 5, or

— other-than complex motor-powered helicopters, single-engined, with a MOPSC of 5.
(c) SECTION 3 specifying additional requirements for commercial specialised operations and for those referred to in b(1) and (2)."

**ORO.FC.100 Composition of flight crew**

(a) The composition of the flight crew and the number of flight crew members at designated crew stations shall be not less than the minimum specified in the aircraft flight manual or operating limitations prescribed for the aircraft.

(b) The flight crew shall include additional flight crew members when required by the type of operation and shall not be reduced below the number specified in the operations manual.

(c) All flight crew members shall hold a licence and ratings issued or accepted in accordance with Commission Regulation (EU) No 1178/2011 \( (15) \) and appropriate to the duties assigned to them.

(d) The flight crew member may be relieved in flight of his/her duties at the controls by another suitably qualified flight crew member.

(e) When engaging the services of flight crew members who are working on a freelance or part-time basis, the operator shall verify that all applicable requirements of this Subpart and the relevant elements of Annex I (Part-FCL) to Regulation (EU) No 1178/2011, including the requirements on recent experience, are complied with, taking into account all services rendered by the flight crew member to other operator(s) to determine in particular:

1. the total number of aircraft types or variants operated; and
2. the applicable flight and duty time limitations and rest requirements.

**ORO.FC.105 Designation as pilot-in-command/commander**

(a) In accordance with 8.e of Annex IV to Regulation (EC) No 216/2008, one pilot amongst the flight crew, qualified as pilot-in-command in accordance with Annex I (Part-FCL) to Regulation (EU) No 1178/2011, shall be designated by the operator as pilot-in-command or, for commercial air transport operations, as commander.

(b) The operator shall only designate a flight crew member to act as pilot-in-command/commander if he/she has:

1. the minimum level of experience specified in the operations manual;
2. adequate knowledge of the route or area to be flown and of the aerodromes, including alternate aerodromes, facilities and procedures to be used;
3. in the case of multi-crew operations, completed an operator’s command course if upgrading from co-pilot to pilot-in-command/commander.

(c) In the case of commercial operations of aeroplanes and helicopters, the pilot-in-command/commander or the pilot, to whom the conduct of the flight may be delegated, shall have had initial familiarisation training of the route or area to be flown and of the aerodromes, facilities and procedures to be used. This route/area and aerodrome knowledge shall be maintained by operating at least once on the route or area or to the aerodrome within a 12-month period.

(d) Point (c) shall not apply in the case of performance class B aeroplanes involved in commercial air transport operations under VFR by day;

**ORO.FC.125 Differences training and familiarisation training**

(a) Flight crew members shall complete differences or familiarisation training when required by Annex I (Part-FCL) to Regulation (EU) No 1178/2011 and when changing equipment or procedures requiring additional knowledge on types or variants currently operated.

(b) The operations manual shall specify when such differences or familiarisation training is required.

**ORO.FC.130 Recurrent training and checking**
(a) Each flight crew member shall complete annual recurrent flight and ground training relevant to the type or variant of aircraft on which he/she operates, including training on the location and use of all emergency and safety equipment carried.

(b) Each flight crew member shall be periodically checked to demonstrate competence in carrying out normal, abnormal and emergency procedures.

**ORO.FC.135 Pilot qualification to operate in either pilot’s seat**

Flight crew members who may be assigned to operate in either pilot’s seat shall complete appropriate training and checking as specified in the operations manual.

**ORO.FC.140 Operation on more than one type or variant**

(a) Flight crew members operating more than one type or variant of aircraft shall comply with the requirements prescribed in this Subpart for each type or variant, unless credits related to the training, checking, and recent experience requirements are defined in the mandatory part of the operational suitability data established in accordance with Regulation (EU) No 748/2012 for the relevant types or variants.

(b) Appropriate procedures and/or operational restrictions shall be specified in the operations manual for any operation on more than one type or variant.

**ORO.FC.200 Composition of flight crew**

(a) There shall not be more than one inexperienced flight crew member in any flight crew.

(b) The commander may delegate the conduct of the flight to another pilot suitably qualified in accordance with Annex I (Part-FCL) to Regulation (EU) No 1178/2011 provided that the requirements of ORO.FC.105(b)(1), (b)(2) and (c) are complied with.

(c) Specific requirements for aeroplane operations under instrument flight rules (IFR) or at night.

1. The minimum flight crew shall be two pilots for all turbo-propeller aeroplanes with a maximum operational passenger seating configuration (MOPSC) of more than nine and all turbojet aeroplanes.

2. Aeroplanes other than those covered by (c)(1) shall be operated with a minimum crew of two pilots, unless the requirements of ORO.FC.202 are complied with, in which case they may be operated by a single pilot.

**ORO.FC.230 Recurrent training and checking**

(a) Each flight crew member shall complete recurrent training and checking relevant to the type or variant of aircraft on which they operate.

(b) Operator proficiency check

1. Each flight crew member shall complete operator proficiency checks as part of the normal crew complement to demonstrate competence in carrying out normal, abnormal and emergency procedures.

2. When the flight crew member will be required to operate under IFR, the operator proficiency check shall be conducted without external visual reference, as appropriate.

3. The validity period of the operator proficiency check shall be six calendar months. For operations under VFR by day of performance class B aeroplanes conducted during seasons not longer than eight consecutive months, one operator proficiency check shall be sufficient. The proficiency check shall be undertaken before commencing commercial air transport operations.

(c) Line check

1. Each flight crew member shall complete a line check on the aircraft to demonstrate competence in carrying out normal line operations described in the operations manual. The validity period of the

line check shall be 12 calendar months.

(2) Notwithstanding ORO.FC.145(a)(2), line checks may be conducted by a suitably qualified commander nominated by the operator, trained in CRM concepts and the assessment of CRM skills.

(d) Emergency and safety equipment training and checking

Each flight crew member shall complete training and checking on the location and use of all emergency and safety equipment carried. The validity period of an emergency and safety equipment check shall be 12 calendar months.

(e) CRM training

(1) Elements of CRM shall be integrated into all appropriate phases of the recurrent training.

(2) Each flight crew member shall undergo specific modular CRM training. All major topics of CRM training shall be covered by distributing modular training sessions as evenly as possible over each three-year period.

(f) Each flight crew member shall undergo ground training and flight training in an FSTD or an aircraft, or a combination of FSTD and aircraft training, at least every 12 calendar months.

(g) The validity periods mentioned in (b)(3), (c) and (d) shall be counted from the end of the month when the check was taken.

(h) When the training or checks required above are undertaken within the last three months of the validity period, the new validity period shall be counted from the original expiry date.

ORO.FC.240 Operation on more than one type or variant

(a) The procedures or operational restrictions for operation on more than one type or variant established in the operations manual and approved by the competent authority shall cover:

(1) the flight crew members’ minimum experience level;

(2) the minimum experience level on one type or variant before beginning training for and operation of another type or variant;

(3) the process whereby flight crew qualified on one type or variant will be trained and qualified on another type or variant; and

(4) all applicable recent experience requirements for each type or variant.

(b) When a flight crew member operates both helicopters and aeroplanes, that flight crew member shall be limited to operations on only one type of aeroplane and one type of helicopter.

(c) Point (a) shall not apply to operations of performance class B aeroplane if they are limited to single-pilot classes of reciprocating engine aeroplanes under VFR by day. Point (b) shall not apply to operations of performance class B aeroplane if they are limited to single-pilot classes of reciprocating engine aeroplanes.

SECTION 3

Additional requirements for commercial specialised operations and CAT operations referred to in ORO.FC.005(b) (1) and (2)

ORO.FC.330 Recurrent training and checking — operator proficiency check

(a) Each flight crew member shall complete operator proficiency checks to demonstrate his/her competence in carrying out normal, abnormal and emergency procedures, covering the relevant aspects associated with the specialised tasks described in the operations manual.

(b) Appropriate consideration shall be given when operations are undertaken under IFR or at night.
(c) The validity period of the operator proficiency check shall be 12 calendar months. The validity period shall be counted from the end of the month when the check was taken. When the operator proficiency check is undertaken within the last three months of the validity period, the new validity period shall be counted from the original expiry date.

Analyzing the crew members data in the light of the previous articles we can conclude that those provisions were fully observed, but it can be also noticed that we face with the same problem, namely that these are clear provisions for types or variants of aircraft without taking into account that the MEP class doesn’t include aircraft types so that there can be applicable only some provisions regarding variants, which is not available in our case.

Therefore, in our opinion there is necessary to complete the article ORO.FC 240 with clear references for MEP class, including restrictions for flying a MEP class aircraft depending on the flight interruption, and these restrictions should be generally applicable no matter if we refer to types or variants of aircraft.

2.2.3 Meteorology

The analyse of meteorological conditions on January 20, 2014, from 13.00 to 16.00 LT en-route Bucharest - Băneasa – Sibiu – Oradea and in the area Poiana Horea (Cluj county)

The meteorological conditions for this flight required a detailed analysis and interpretation of the maps with real meteorological data. This analysis contributes to create a correct image of flight performed by BN-2A-27 aircraft, meteorologically speaking and to understand if the aircraft would have been able to successfully perform the flight mission as planned.

This analysis also takes into account the manufacturing characteristics of piston and carburettor engines.

On 20.01.2014 our country was under the predominant influence of a Mediterranean cyclone, centred close to the North of the Tyrrhenian Sea. The East-European synoptic context was completed by an anticyclone located close to the Baltic States.

In our country the atmospheric pressure was generally between 1001-1003 hPa in the western of Banat and 1015-1016 hPa in the extreme northern of Moldavia.
Also, in the reference period of time our country was under the influence of the adequate hot air mass from the Mediterranean Sea, in the post-frontal area of an atmospheric front with hot character belonging to the mentioned atmospheric depression, of which movement direction was from south-west to north-east (Figure 43).

![European synoptic map 20.01.2014 at 14:00LT](image)

In this context BN-3 aircraft flew the whole time in the hot sector of the Mediterranean depression, in the hot air mass influence area, post-frontal, determining the following flight conditions:

**Flight conditions at take-off (13.38 LT)**
- BUCHAREST-BÂNEASA (LRBS), 13.30 LT
- Complete coverage: 8/8; partial coverage 3-4/8;
- Cloud ceilings: 30 m and 60 m;
- Phenomena: foggy air;
- Horizontal visibility: 1 km;
- Runway visual range: higher than 2000 m;
- Ground wind: 60°/ 8 kts;
- Air temperature: 6°C;
- Dew point: 5°C.
- Atmospheric pressure, QNH: 1010 hPa.

**METAR LRBS 201130Z 06008KT 030V090 1000 R07/P2000 R25/P2000 BR**
- SCT001 OVC002 06/05 Q1010 0719//95 TEMPO 1500=

After crossing the Meridional Carpathians, at 14.48 LT the pilot requested TWR Sibiu the meteorological conditions which were the following:
SIBIU (LRSB), 14.30 LT
- Significant clouds: 3-4/8;
- Significant clouds ceiling: 1980 m;
- Phenomena: none
- Horizontal visibility: 10 km or more than 10 km;
- Ground wind: variable / 4 kts;
- Air temperature: 13°C;
- Dew point: 6°C.
- Atmospheric pressure, QNH: 1006 hPa.

METAR LRSB 201230Z VRB04KT 9999 SCT066 13/06 Q1006=

After exiting from CTR Sibiu, at the altitude of 8.500 ft. the aircraft continued to fly descending to 8.000 ft., and after 20 NM since exiting from CTR Sibiu the descendent flight continued until the crash.

After analyzing the maps with the real meteorological data observed at the National Meteorology Administration (ANM) stations, the radar images provided by the national meteorological radar network transmitted by the geostationary satellite for Europe METESAT-10 (Annexes 2-11), it appears that the flight was performed in the cloud system that was splitting after the passing of the atmospheric front, in the hot air layers corresponding to the hot sector of the depression, as follows:

- A layer of Altocumulus clouds, with a coverage of 5-8/8, locally 3-4/8 in the Meridional Carpathians area – CTR Sibiu, with cloud ceiling at approximately 2100 m and the upper limit at almost 3000, 3200 m (very likely in combination with Altostratus clouds, invisible from the ground, but detectable with satellite images and located at heights between 2500 m and 4000 m).

Figure 42 Meteorological map of Romania- real data observations at 13:00LT
Figure 43: Meteorological map of Romania - real data observations at 14:00 LT

Figure 44: Meteorological map of Romania - real data observations at 15:00 LT
Figure 45 Meteorological map of Romania - real data observations at 16:00 LT

Figure 46 Echotop radar image (Peak height of the clouds) at 14:36 LT
Figure 47 Echotop radar image (Peak height of the clouds) at 15:26 LT

Figure 48 METEOSAT 10HRV image 20.01.2014 13:30 LT
- The clouds layer situated at low altitude composed mainly of Stratocumulus and Cumulus clouds, cu nebulosity 6-8/8, locally 3-4/8 in the Meridional Carpathians area – CTR Sibiu, between 14.30-15.30 LT, with the lower limit between 500 m and 1000 m and the upper limit between 1000 and 1500 m.

- The lower clouds layer, composed of low clouds, Stratus type, present only on the first part of the flight route, in the plains area, nebulosity 8/8 and cloud ceiling between 60 and 300 m.

Taking into account the cloud types observed or estimated during flight, but also the meteorological observations and measurements, it resulted that the aircraft didn’t fly in a precipitation area. Therefore it can be appreciated that the Altocumulus and Altostratus clouds, mainly consisting of super cooled water drops, of relatively low dimensions, but also of ice crystals, determined icing conditions, most likely opaque, low and moderate icing. The icing degree was assessed taking into account the air temperature and the relative humidity of the air, based on real and interpolated data, provided by radio scanning performed by the aerologic stations in Bucharest and Budapest at 14.00 LT. Thus, after the forecasting materials issued by ROMATSA valid for 20.01.2014, at 14.00 LT, elaborated at 11.00 LT but also from the radio scanning data from Bucharest and Budapest at 14.00LT, the 0°C isotherm was situated at a height of 2100-2200 m in Bucharest area and at almost 2000 m in the aircraft crash area, the -5°C isotherm was at approximately 2800 m, the -10°C isotherm at the height of almost 3500 m and the -15°C isotherm at approximately 4300 m (Annexes 12-14).
Figure 52 Forecasting map of the significant meteorological phenomena, issued at 11:00 LT, valid for 14:00 LT

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</tr>
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Figure 53 Radio scanning data LRBS 20.01.2014 at 12:00 LT
The aircraft reached the level of 0°C isotherm at 13.52 LT and continued the ascending phase of flight, so that at 14.00 it reached the level of the -5°C isotherm, afterwards continuing to fly, until 15.42 at heights with ambient temperatures between -8 and 0°C, in icing conditions not exceeding the height of 3233 m. Taking into account the meteorological conditions observed or interpolated for the flight route, it can be concluded that the aircraft flew in low and locally moderate icing conditions, but the flight time of 1 h and 20 min, could have determined the accumulation of an ice quantity which could have modified the aircraft aerodynamic profile, increasing the advance resistance, increasing of weight, increasing the stalling speed, which determined difficulties in controlling the aircraft. Taking into account the nebulosity and the flight altitude, it can be considered that, most likely, low icing conditions and even traces of ice depositions occurred only on the route section between the Meridional Carpathians and CTR Sibiu. After passing by CTR Sibiu, in a high nebulosity, the ambient conditions determined a moderate icing.

Taking into account that the meteorological conditions of the accident occurrence on 20.01.2014 revealed the variable intensity icing involvement, as a very important phenomenon in determining the flight conditions, annexes 15 and 16 show the icing intensity related to the flight time and the aircraft ice deposition thickness, according to FAA (US Federal Aviation Administration) provisions.
### Icing intensity related to the flight time

<table>
<thead>
<tr>
<th>Level</th>
<th>Description</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Traces</td>
<td>Icing becomes visible, but it is not dangerous for flight operations, if these conditions are persisting not longer than 1 hour.</td>
<td></td>
</tr>
<tr>
<td>2. Low</td>
<td>Icing conditions persist more than 1 hour. Ice accumulation continues and starts to create problems to the aircraft. Temporary use of de/anti-icing systems prevents ice accumulation.</td>
<td></td>
</tr>
<tr>
<td>3. Moderate</td>
<td>Ice accumulation creates problems that can become dangerous. The use of de/anti-icing systems is compulsory.</td>
<td></td>
</tr>
<tr>
<td>4. Severe/strong</td>
<td>Ice accumulation is so strong that even the use of de/anti-icing systems doesn’t enable control or reduces risk. The area has to be left immediately.</td>
<td></td>
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</table>

### Icing intensity related to ice deposition thickness

<table>
<thead>
<tr>
<th>Level</th>
<th>Description</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Low</td>
<td>Ice accumulation between 0.6 and 2.5 cm/hour. Temporary use of anti/de-icing systems prevents ice accumulation.</td>
<td></td>
</tr>
<tr>
<td>2. Moderate</td>
<td>Ice accumulation between 2.5 and 7.5 cm/hour requires continuous use of anti/de-icing systems. The pilot shall leave the area as soon as possible.</td>
<td></td>
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<tr>
<td>3. Severe/strong</td>
<td>Ice accumulation is so strong and rapid that even the use of de/anti-icing systems doesn’t enable control or reduces risk. The area has to be left immediately.</td>
<td></td>
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</table>

It should be also taken into account the carburettor icing, which takes place with the highest frequency at ambient temperatures between -10°C and 25°C, in clouds, fog or precipitations, at any power regime of the engine. It has to be remarked that BN 2 aircraft, operated in most of its flight route in conditions that favoured the variable intensity of engine carburettors icing, but most of all moderate
and severe icing. Thus, only at heights between 3100 m and 3233 m, the icing conditions (between 12.10 – 12.35 LT) lead to the conclusion that the probability of carburettor icing was lower. After crossing the Meridional Carpathians, mainly in the high nebulosity area and when flying at almost 2400 m high (from 2480 m at 15.23 LT to 2392 m at 15.38 LT) and especially, during the final descendent flight phase until the aircraft crashed, based on the interpolation of Budapest radio scanning, on the real data observations and on the images provided by METEOSAT-10 geostationary satellite, the icing conditions have worsened, meaning a severe icing (Figures 59-63). The worsening of icing conditions is also revealed by the numerical weather forecast. For example the operation at 12.00 UTC of the limited area ALARO model, shows, concerning the forecasted relative air humidity distribution at the level of 700 HPa isobar surface (Figure 62), the humidity increase after overflying the Meridional Carpathians and in descending flight phase to values between 95 and 100%, with a probability close to the real situation, taking into account that the map has the validity hour of the forecast model.

Figure 55 Interpolation of radio scanning data at 14:00 LT (Bucharest): carburettor moderate-sever icing conditions at the height of 1445 m, climbing flight phase

Figure 56 Interpolation of radio scanning data at 14:00 LT (București): carburettor moderate-sever icing conditions at the heigh of 3100 m, climbing flight phase
Figura 57 Interpolarea datelor radiosondajului de la ora 14:00 LT (București): condiții de givraj moderat-sever al carburatorului la înălțimea de 2643 m, etapa zborului ascendent.

Figure 58 Forcasted distribution of relative humidity. ALARO model, basis 20.01.2014, at 14:00 LT, valid on 20.01.2014, at 14:00 LT.
Regarding the meteorological conditions in the area where the YR-BNP aircraft crashed, it must be taken into account that the closest meteorological station to the area of interest is Câmpeni, located at almost 30 km from the ground impact site. This is the reason why meteorological conditions can be determined only by interpolating the data provided by the ANM meteorological network. In the mountainous area there were also Stratus clouds with the ceiling of approximately 100-300 m, and in isolated locations, less than 100 m, associated with fog, which restricted the horizontal visibility to less than 1 km. Out of the witness’ statements (accident survivors and the first rescuers arrived on site) it resulted that the meteorological conditions were: dense fog, very low visibility (even less than 10 m) and low temperature.

Regarding the information concerning the real and forecasted flight conditions there might be drown the following conclusions:

The documents recovered from the aircraft wreckage certify that the crew had information about the real conditions at the take-off for Bucharest - Băneasa Airport, but also for Bucharest - Otopeni and Sibiu Airports, as well for the destination - Oradea Airport. The aeronautical forecasts in TAF format were available for each of the mentioned airports. Also, on board of the aircraft there were found two maps with forecast data for air temperature, wind direction and intensity with altitude of FL100 (700 HPa), valid for 06.00 UTC and 12.00 UTC, but with the date and time of running the forecast model 19.01.2014, 12.00 UTC. Concerning the forecasts for significant meteorological phenomena, in the aircraft it was found a forecast map elaborated by the National Aeronautical Meteorology Centre of ROMATSA, valid for 20.01.2014, 12.00 UTC, with the forecasted icing and moderate turbulence areas for FL 100-450.

The analysis of information material situated at RAA headquarters revealed that the following meteorological notifications and forecast maps issued by the National Aeronautical Meteorology Centre of ROMATSA, were available:
- METAR messages providing real meteorological conditions observed/measured at intervals of 30 min between 06.00Z-13.00Z, for Bucharest-Bâneasa, Oradea and Arad Airports;
- TAF messages, showing the aeronautical meteorological forecasts, valid for Oradea and Arad Airports between 05.00Z-14.00Z and for Bucharest-Bâneasa Airport between 05.00Z-11.00Z, airport for which, at 09:10Z, the meteorological aeronautical forecast was amended (updated) with a TAF AMD message;
- The map with forecasted air temperature, wind direction and intensity with altitude of FL 100 (700 hPa), valid at 12.00 UTC, having as the date and time of running the forecast model 19.01.2014, 12.00 UTC;
- The map with forecasted significant meteorological phenomena and the forecasted icing and moderate turbulence areas for FL 100-450, valid for 20.01.2014, 12.00 UTC;
- Two maps with the location of the forecasted atmospheric fronts and the forecast of clouds coverage, cloud types, lower and upper limits of cloud layers, significant meteorological phenomena from ground to 15000 ft., the level of 0°C isotherm, as well as the forecasted values of horizontal visibility and atmospheric pressure, maps valid for the hours 09.00Z and 12.00Z.

The analysis of the previously stated maps available at the RAA headquarters, shows a proper presentation of the high probability of icing conditions over FL 070 on the route Bucharest-Bâneasa – Oradea, but also reduced favourable flight conditions in the mountain areas, which required a careful analysis of the meteorological condition for a safe flight.

### 2.2.4 Air Traffic Control

In order to analyze this flight in terms of air traffic control, there must be taken into account the legislation in force and the provisions on aircraft operation, as well as requirements arising from them and therefore the following were considered:

**Flight Preparation**

Concerning the preparation phase of the flight ended with an accident, the researched information revealed an instrumental flight plan filed for a flight according to IFR rules. No discrepancies concerning the filed plan were identified.

According to ICAO Annex 2 – Air rules, section 3.3 Flight Plan; 3.3.1 Filling a flight plan, the procedures and regulations were observed. The flight plan indicated "I" for IFR.

Explanations: Section 8 of the flight plan – FLIGHT RULES AND OPERATION TYPE. This section indicates both the flight rules and the operation type. Flight rules are important due to different meteorological conditions regulatory requirements and to separation minima for instrumental and visual flights (IFR and VFR). Therefore in this section it might be written one of the characters (letters) representing the pilot’s intended flight type.
This section can be filled-in as: I for IFR, V for VFR, Y for initial IFR then switching to VFR (this aspect requires the pilot to announce ATS on cancelling IFR), Z for initial VFR followed by switching to IFR (this aspect requires the pilot to announce ATS the intention to switch to IFR, and requires clearance from the sir traffic controller). If Y or Z is filled-in, in the “ROUTE” section it must be specified the points where it is intended to switch form one kind of flight rules to another. Similarly, when repeated switches are intended, the used code must show the first switch, e.g. it will be used “Z” for VFR/IFR/VFR.

Taking into account that the filed flight plan for the investigated accident shows an intended IFR flight, it might be considered that during the flight preparation, the crew did not analyze a combined IFR and VFR flight, according to the requirements in force.

AS well in ICAO Annex 2 “Air rules” there is provided the following:

"CHAPTER 1 Definitions Air traffic advisory service.
A service provided within advisory airspace to ensure separation, in so far as practical, between aircraft which are operating on IFR flight plans. IFR. The symbol used to designate the instrument flight rules. IFR flight. A flight conducted in accordance with the instrument flight rules. IMC. The symbol used to designate instrument meteorological conditions.
And

CHAPTER 2. APPLICABILITY OF THE RULES OF THE AIR

2.3.2 Pre-flight action

Before beginning a flight, the pilot-in-command of an aircraft shall become familiar with all available information appropriate to the intended operation. Pre-flight action for flights away from the vicinity of an aerodrome, and for all IFR flights, shall include a careful study of available current weather reports and forecasts, taking into consideration fuel requirements and an alternative course of action if the flight cannot be completed as planned.

NOTE: Given the particular circumstances of the flight operation with this aircraft, the prevailing weather conditions in relation to the performance of the aircraft, the crossing of two mountain ridges, the minimum required flightlevel for the chosen route and the different minimum altitudes, are very important aspects in this flight scenario that, at some stage, could have required alternative course of action."

Additionally ICAO Annex 2 also includes provisions for VFR flights:

"CHAPTER 5. INSTRUMENT FLIGHT RULES

5.1.2 Minimum levels

Except when necessary for take-off or landing, or except when specifically authorized by the appropriate authority, an IFR flight shall be flown at a level which is not below the minimum flight altitude established by the State whose territory is overflown, or, where no such minimum flight altitude has been established:

a) over high terrain or in mountainous areas, at a level which is at least 600 m (2 000 ft) above the highest obstacle located within 8 km of the estimated position of the aircraft;

b) elsewhere than as specified in a), at a level which is at least 300 m (1 000 ft) above the highest obstacle located within 8 km of the estimated position of the aircraft.
Note 1.— The estimated position of the aircraft will take account of the navigational accuracy which can be achieved on the relevant route segment, having regard to the navigational facilities available on the ground and in the aircraft.

Based on the maps studied by the investigation commission of CIAS, the AMA valid for the time of this flight was variable depending on each crossed sector, in the Meridional Carpathians area being of 10500ft, followed by 10400 ft. in the area including CTR Sibiu, while in the accident area it was of 8000ft. The level recorded in the flight plan and approved by ANSP/CTA was FL120.

The minimum level of L622 route recorded in the flight plan was FL110 (except some sections).

ICAO Annex 2 also includes conditions and requirements for switching the flight rules by a crew operating an aircraft, also stating that the pilot’s decision to cancel IFR for VFR requires a rigorous analysis, so:

"5.1.3 Change from IFR flight to VFR flight

5.1.3.1 An aircraft electing to change the conduct of its flight from compliance with the instrument flight rules to compliance with the visual flight rules shall, if a flight plan was submitted, notify the appropriate air traffic services unit specifically that the IFR flight is cancelled and communicate thereto the changes to be made to its current flight plan.

5.1.3.2 When an aircraft operating under the instrument flight rules is flown in or encounters visual meteorological conditions it shall not cancel its IFR flight unless it is anticipated, and intended, that the flight will be continued for a reasonable period of time in uninterrupted visual meteorological conditions."

ICAO Annex 11 "Air Traffic Services", (Chapter 2, Section 2.6) shows the vertical classification and distribution of an airspace for a certain area. Starting from this classification and observing these requirements, AIP Romania specifies how is the civil aviation airspace classified and divided. So in the annex there are provided the following airspace sections for air traffic services provision, further on called ATS airspaces, identified and classified as follows:

"Class A. IFR flights only are permitted, all flights are provided with air traffic control service and are separated from each other.

Class B. IFR and VFR flights are permitted, all flights are provided with air traffic control service and are separated from each other.

Class C. IFR and VFR flights are permitted, all flights are provided with air traffic control service and IFR flights are separated from other IFR flights and from VFR flights. VFR flights are separated from IFR flights and receive traffic information in respect of other VFR flights.

Class D. IFR and VFR flights are permitted and all flights are provided with air traffic control service, IFR flights are separated from other IFR flights and receive traffic information in respect of VFR flights, VFR flights receive traffic information in respect of all other flights.

Class E. IFR and VFR flights are permitted, IFR flights are provided with air traffic control service and are separated from other IFR flights. All flights receive traffic information as far as is practical. Class E shall not be used for control zones.

Class F. IFR and VFR flights are permitted, all participating IFR flights receive an air traffic advisory service and all flights receive flight information service if requested.

Class G. IFR and VFR flights are permitted and receive flight information service if requested."
As previously stated, observing the provisions of annex 11, AIP Romania publishes the civil aviation airspace classification customized for the Romanian territory, as follows:

"Class A. IFR flights only are permitted, all flights are subject to air traffic control service and are separated from each other. Airspace Class A comprises: - TMA BUCUREȘTI."

"Class C. IFR and VFR flights are permitted, all flights are subject to air traffic control service and IFR flights are separated from other IFR flights and from VFR flights. VFR flights are separated from IFR flights and receive traffic information in respect of other VFR flights. Airspace Class C comprises: - all ATS routes in BUCUREȘTI FIR - All Aerodrome Control Zones (CTR): Arad, Bacău, Baia Mare, Băneasa, Otopeni, Cluj, Constanța, Craiova, Iași, Oradea, Satu Mare, Sibiu, Suceava, Târgu Mureș, Timișoara, Tulcea; - TMA CONSTANTĂ, TMA ARAD. - Airspace in BUCUREȘTI FIR above FL105."

"Class G. IFR and VFR flights are permitted and receive flight information service if requested. Airspace Class G comprises: all Control Zones of Aerial Work and Airfields of Sports Activity, all airspace in BUCUREȘTI FIR not designated with another class and Restricted Areas. The requirements for the flights within each class of airspace are as shown in the following table:"

...
Taking into account the previous presentation, according to the filed plan and analyzing this flight, the airspace sections were classified as:

- Bucharest Băneasa ATZ (Airport Control Zone) - Class A
- TMA Bucharest - Class A
- ACC en-route section - Class C
- CTR Sibiu - Class C
- FIR Bucharest - Class G

**Fight Phase**

Flight plan, CTA clearances and other relevant issues.

Ignoring the delay determined by the meteorological conditions from the departure Airport (Bucharest Băneasa), once the BN-2 aircraft required starting clearance, it was also granted the IFR flight approval, according to the flight plan.
Analyzing the scenario of this flight it can be noticed that on several CTA calls, the flight crew of BN-2 aircraft repeatedly provided information from which CTA could understand that the filed flight plan will be followed as well as the level included in this (FL120). Additionally, based on the co-pilot’s statements, the aircraft was operating as for VMC conditions when approaching and crossing the Meridional Carpathians. For a better understanding we illustrate that when the aircraft was exiting TMA at level FL100, it was flying over the clouds ceiling, thus, having a position that enabled observing possible obstacles along the followed route.

Thus, in the investigation commission’s opinion this was the method chosen by the Captain for crossing the mountains without observing the AMA required for the area. Analyzing the situation in which the traffic controller was, we shall state that the C class airspace on the flight routes within FIR Bucharest starts from FL 105, but radar service specific for this class is provided also for those published routes below this level. In our case, when asked, the crew always communicated that they will climb to FL110.

Legally speaking in ICAO Doc 4444 PANS-ATM there are provided the conditions when radar service is interrupted:

"8.6.7 Interruption or termination of ATS surveillance service

8.6.7.1 An aircraft which has been informed that it is provided with ATS surveillance service should be informed immediately when, for any reason, the service is interrupted or terminated."
Note.— The transition of an aircraft across adjoining areas of radar and/or ADS-B and/or MLAT systems coverage will not normally constitute an interruption or termination of the ATS surveillance service.

8.6.7.2 When the control of an identified aircraft is to be transferred to a control sector that will provide the aircraft with procedural separation, the transferring controller shall ensure that appropriate procedural separation is established between that aircraft and any other controlled aircraft before the transfer is effected.

Taking into account information gathered during the investigation and the A/G classification of the airspace, etc. for the airspace sections where the aircraft operated, the air crew decided to continue IFR operation in IMC/partially VMC conditions, however below AMA level and without clear cancelling of IFR operation.

During the investigation the commission observed several aspects of the way CTA in ACC Bucharest managed the switching of this flight from IFR to VFR, taking into account the moment when the crew decided to descent to FL80 and the transfer to FIC. According to the records it clearly resulted that CTA in ACC transferred the aircraft to the FIC operator when the captain decided leaving the C class airspace, applying the established procedure, procedure which is in conformity with the legislation in force.

Certain elements concerning the development of such a flight scenario are specified in the air traffic controllers’ training, e.g. in EUROCONTROL Common Core Content (CCC), a program incorporated in the relevant EU/EC legislation, it is referred the management of cases when an aircraft doesn’t follow/can’t follow the filled flight plan (FL/trajectory etc.) or it can’t maintain the approved FL because of (temporary) alteration of its flight performances.

Thus, the impossibility to keep the FL, but the confirmation of indications received from CTA through which the crew communicates that it will follow them after a certain time (due to slow climbing) are sensitive aspects for the operations of air traffic controllers.

Because of this ambiguous situation concerning the IFR rules followed by the crew and the way the transmission/communication of the crew with the air traffic service was conducted, the involved CTA staff considered that the aircraft switched from IFR to VFR flight. This operation was made without the crew/pilot’s confirmation of cancelling the IFR flight, by radio or any other method. Also, the investigation commission checked the regulations in force and consulted relevant experts and it determined that there is not foreseen the case when CTA should require the crew information on cancelling the IFR plan. However, taking into account that the aircraft was transferred to ACC after leaving TMA, it should have been advised by the CTA that the surveillance service would end when the descent would start and the aircraft would be transferred to FIC. From the point of view of CTA the flight was transferred to FIC as VFR flight (according to ICAO Doc.4444 PANS-ATM, section 8.6.7 Interruption or termination of radar service).

There is the possibility that the reason why the air traffic controller didn’t communicate the cancellation of radar surveillance, could be based on the fact that it was the Captain’s initiative to communicate the decision to descent to FL80, meaning 8000 ft., after QNH pressure, and entering into contact with FIC Bucharest. In these
conditions the air traffic controller assumed this was a cancelling request of the IFR flight plan, so that the rest of the mission should be performed under VFR rules. The operator from FIC Bucharest transferred the aircraft to the next air traffic agency from CTR Sibiu as a VFR flying aircraft.

When referring to an ambiguous situation we refer the fact that the crew permanently communicated that it would follow the flight plan and at a certain moment it communicated that they would maintains/descent a FL that was clearly below AMA and under the lower limit of the C class airspace, provided in the flight plan, but there was no communication of cancelling the IFR flight from the aircraft with the call sign RFT111.

In the communication between an aircraft approaching Sibiu Airport for landing and the air traffic controller from TWR Sibiu, it was traffic information from the later stating that BN-2 aircraft was a VFR flight. The Captain never intervened to correct this information and to announce TWR Sibiu that he didn’t cancel the IFR flight plan.

The crew would have had at disposal an option that they did not use namely when observing that they couldn’t maintain at least the AMA level in that sector, they should have communicated to the traffic controller that they declared the situation as an emergency one and they should have required his support. From the way the radio conversations went it appears that this possibility has not been used. To exemplify we illustrate the conversation between CTA ACC, KONEL sector and the crew:

“14:35:59 / CTA: RFT111…..

PIL: Spuneți

CTA: Vă informez că în zona aceasta AMA este 10500 ft.

PIL: Vă dați seama că știm, încercăm

CTA: QNH1006

PIL: Mulțumim. ”

(When transferring from APP, the frequence in KONEL sector was 122,025)

The aircraft was unable to follow FL 120 filed in the flight plan in any moment of the flight because of icing in the area the aircraft was operating at the moment (possible also because of the aircraft performances and limitations). Additionally, the filed flight plan had the FL 120 which was immediately above the minimum limit established for L622 – FL110 route (except certain sections indicated in the Lower airspace chart ENR 6-2 in AIP Romania).

During the investigation, while interviewing the ACC staff involved in the guiding service of this aircraft it was revealed that the managing staff of the duty team noticed the problems of this flight, and based on the consultations that followed, taking into account the aircraft position and that no emergency was declared, but it communicated that there are icing problems, it was decided that the only aid that could be provided and also to advice the pilot was to communicate the QNH pressure. The communication of this pressure had the purpose of transmitting to the
pilot not only the message that he needed to check the barometric altitude value to be able to read a correct altitude in relation with the height of the obstacles in the area, but also that the aircraft exited from CTA responsibility area and it was the Captain’s responsibility to ensure the aircraft protection. Therefore, when the Captain required explicitly descending to FL 80 and to be transferred to FIC, this was a confirmation that the judgement in the control room of ACC was correct and that the presumption that the Captain’s decision of cancelling the IFR flight plan was correct and, also normal.

After the analysis, in terms of air traffic control of this flight it is highlighted only the moment when the aircraft crossed the Meridional Carpathians being guided by APP Bucharest and ACC Bucharest KONEL Sector, because since the aircraft entered in radio connection with FIC operator, the Captain assumed responsibility for the protection of the aircraft in terms of air navigation and for cancelling the radio surveillance service.

The conclusion of the performed analysis is that it was developed an ambiguous scenario, putting the air traffic controller in a difficult situation.

Based on the regulations in force the air traffic controller is not authorized to give indications concerning the flight techniques and to take decisions instead of the Captain; according to the same regulations the air traffic controller could take the initiative to advise the crew, when descending below AMA, that the aircraft is out of the ATS responsibility and the radar service ended, but analyzing the flight we consider that the pilot’s decision to leave the C class airspace and to enter in communication with the FIC operator, has prevented the such an action of the air traffic controller.

The recurrent training program for air traffic controllers doesn’t include such scenario and the way such a situation should be managed by the air traffic controller (request of additional information, communication of the radar service termination, etc).

We hereby state that the regulations in force do not provide instruction for such a situation, namely when an aircraft doesn’t formally request the switching of flight rules form IFR to VFR, but it acts as it would have done so.

For the future the investigation commission considers as immediate measures till the regulations could be completed, that the air traffic controllers might consider requesting additional information and/or a confirmation of the involved crew on the flight rules it decided to follow.

Such a measure could clarify the way the flight is conducted (IFR or VFR) and could contribute to the crew’s awareness about the existing situation. We also consider that such measure could be applied after including it in the annual recurrent training plan in the section called „best judgment”, where together with the presentation of this flight scenario and with the ambiguous problems for the air traffic controller, should be offered as one of the available solutions for such a scenario.
2.2.5 Communication

As mentioned in section 1.9 the aircraft is equipped with two communication stations Bendix – King KX170B type, the frequency band between them being 118 MHz and 135,97 MHz.

Radio communication was established by the aircraft with the air traffic controllers responsible for the following sections from take-off until losing the radio connection: Ground Băneasa – 129.95 MHz, TWR Băneasa – 120.8 MHz, APP Bucharest – 118.25 MHz, ACC Bucharest – KONEL sector – 122.025 MHz, FIC Bucharest – 129.4 MHz, TWR Sibiu – 122.7 MHz, ACC Bucharest – NAPOC sector – 127.075 MHz, ACC Bucharest BUDMO sector – 124.1 MHz.

Towards the end of the flight when the aircraft was unable to contact directly any air traffic agency of ROMATSA, it communicated with ACC Bucharest, BUDMO sector with the aid of another aircraft in flight in that area, which acted as the relay between YR-BNP and ACC Bucharest – BUDMO sector.

Without a direct connection with the factors determining the accident, but according to the principles of a civil aviation safety investigation, the commission analyzed and focussed on the situation occurred when the aircraft left the TWR Sibiu control area, when the air traffic controller indicated the frequencies to contact FIC operator, 136.575 MHz or 136,225 MHz respectively.

The attention was drawn on this moment because the Captain communicated that both aircraft stations had no technical possibilities to show frequencies over 136MHz. Thus, there were several questions which, in the investigation commission’s opinion, required answers. One of these was why the crew was not aware about those frequencies of FIC Bucharest in that area and why the radio stations had no technical possibility to show these frequencies.

In order to clarify the legal aspects concerning the radio stations, the investigation commission, requested and received from the manufacturer of the station Bendix KING, over the NTSB, the official technical documentation of the two stations.

After reviewing these documents and after the physical inspection of the two stations it was found that the available radio frequency band is between 118 MHz and 135.975 MHz.

After discussions with RCAA representatives, the commission found that according to the regulations in force there is no obligation that the aircraft currently operated should be technically speaking equipped with radio stations covering the entire frequency band allocated to civil aviation, namely from 118 MHz to137 MHz.

There is also no obligation that an aircraft operating in the G class airspace of Romania shall have stations covering all frequencies allocated for this airspace. It was also found that CAA has no procedure/practice to inform the operators about new frequencies to enter into operation in Romania, even if these are in operational testing phase, and thus the operator is unable to determine in due time the necessity to improve/to modernise the equipment on board of the aircraft. Such information would avoid the situation when an aircraft would be unable to fly IFR in G class airspace where there are allocated frequencies beyond the technical possibilities of the radio stations on board.
Concerning the question why the crew wasn’t aware of the two frequencies, the investigation commission consulted the publications of AIP Romania (Aeronautical Information Publication) and noticed that the only frequency published for VFR flights in G class airspace was 129.4 MHz. Thus, the investigation commission requested clarifications from CAA as regulation authority and from ROMATSA as services provider.

After the discussions the investigation commission found that at the moment the two frequencies of 136,575 MHz and 136,225 MHz were in operational tests. Therefore, for improving the radio coverage of the G class airspace in FIR Bucharest, in 2009 ROMATSA requested the provision of new radio frequencies in areas where the existing frequency of 129.4 MHz did not ensure a bistable radio connection. Following the regulations in force, CAA provided to ROMATSA these two frequencies mentioned above.

When receiving the authorisation to use these frequencies from CAA, ROMATSA started the procedures to implement this improvement. From the point of view of the air traffic service provider these frequencies are considered to be frequencies under testing from the moment it is received the authorisation of the broadcasting equipment until the frequencies are published in AIP.

Independent of the working frequency regime, if the aircraft radio station would have operated this frequency it would have been enabled a bistable connection with FIC operator. Therefore, in the investigation commission’s opinion CAA should establish together with the air navigation service provider the moment and method to preventively inform the air operators about these changes.

### 2.2.6 Aids to navigation

While analyzing the navigation instruments on board of the aircraft, the investigation Commission noted that the ADF station no. 1 was tuned on frequency 622 KHz (see fig. 65), frequency unassigned to any radio navigation aid.

The second ADF station was tuned on frequency 521 KHz, corresponding to the frequency of NDB Băneasa station (BSW) – see fig. 66. According to AIP Romania, Oradea Airport (LROD) is served by a NDB station (ORA) on frequency 418 KHz. Even if the accident occurred at almost 55.5 NM (100 km) from Oradea, the ADF stations were not tuned on the frequency of NDB Oradea station (ORA) nor on the frequency of NDB Sibiu station (SIB) which operates on frequency 381 KHz and serves Sibiu Airport.
VOR radio navigation system is the main navigation aid used for flight on national air lines. VOR station provided with a DME station (Distance Measurement Equipment) is VOR/DME type and offers in formation both on azimuth but also on aircraft distance from the station. YR-BNP aircraft was equipped with two VOR radio navigation stations and a DME station incorporated in VOR receiver no. 1. The first VOR station was tuned on frequency 114.95 MHz (see fig. 67), and the second VOR station was on frequency 109.50 MHz (see fig. 68).
The Commission recreated the route followed by YR-BNP and noted that the frequency displayed by the VOR/DME station no. 1 is not used by any of VOR radiomarker in Romania.

At Sibiu it is indeed a VOR/DME radiomarker on frequency 114.00 MHz, but as specified in flight analysis, the fact that at the accident site, the investigation Commission did not find on board of the aircraft the maps with NDB procedures for landing at Sibiu and Oradea, the lower level route map or any other source of information concerning the frequency of the radiomarkers on the planned route, prepared to be used, shows that the frequency 114,95 MHz was mistakenly selected, being a possible action based only on the pilot's memory.

The second VOR station was set by the crew on frequency 109.50 MHz. When the accident occurred this station was turned off (see fig. 68), the displayed
frequency could not be used for this flight. This frequency corresponds to ILS station from Băneasa Airport, as well as to ILS station from Oradea Airport.

The GPS receiver on board of the aircraft was used, according to the co-pilot statements, as the main primary navigation aid. The installed GPS receiver was not part of the radio navigation instrumental systems, it was TEMPORARILY mounted on the right stick. The databases available in this GPS unit, the navigation database and the obstacle one respectively, were expired since 20th September, 2012, and the terrain database was available since the 1st quarter of 2012. For this database it is no validity term, the database being modified anytime it is necessary.

Even if this GPS receiver model may provide information on IFR flight, as well as VFR, its manufacturer restricts the use when using VFR, by notifying on the pilot's responsibility to carefully compare its indications with all the navigation sources, such as other radio navigation stations, visual observations, maps, etc.

The aircraft position, as well as the flight plan segments are precisely calculated by GPS, but the maps on which their representation is overlapped, come from low resolution sources, thus the aircraft positioning on the map is not accurate.

Also, the manufacturer fully transfers the responsibility to the pilot in the use of a GPS receiver with an expired database.

This GPS model is not recommended to be used independently for IMC flight or in other conditions in which the aircraft control is performed exclusively based on the instrumental information.

An available function at this GPS model is the one of presenting the situation of the terrain in the aircraft vicinity (Terrain function) - see Fig. 70. This allows displaying the terrain and obstacles altitude, in relation to the aircraft position, with reference to a database which may contain inaccuracies. That's why, the
information on ground and obstacles should be used only as a means for the awareness of the situation. On the device display there apppear warning windows to inform the pilot on the approach to terrain or obstacles, as well as on the uncertain rate of descent. These warnings depend on the alert parameters set in the GPS receiver menu.

The device provides information on the terrain in color codes, as follows:
- red, for terrain between the aircraft and the maximum distance of 100 ft under it;
- yellow, for terrain between 100 ft and 1000 ft under the aircraft;
- black, for terrain located at more than 1000 ft under the aircraft;
- a “X” symbol for the expected impact point.

The settings of the operation and warning mode were found by the Commission in the following configuration:
- red area cannot be manually modified;
- yellow area set at 1000 ft (maximum setting);
- black area cannot be manually modified;
- Look Ahead Time - determines the maximum time in which an alert is given. The setting was found at 120 seconds;
- Alert Sensitivity – allows the setting of alerts that are to be provided: Terrain, Obstacles, Rate of Descent. The setting was found on “High Sensitivity” for all three alerts, which allows for all the red and yellow warnings to be displayed at the time set in “Look Ahead Time” mode.

Also, the warning mode was found enabled by the comission, which leads to the conclusion that the crew could have acknowledged the danger of approaching the terrain 2 minutes before the impact.
The investigation Commission considers that it is possible that due to the GPS receiver position on the pilot’s in command stick, while during the descent flight he was busy and focused on operating the carburettors de-icing system, the crew did not notice and took into consideration the warnings generated by GPS. In our opinion the positioning of GPS in central position, on the instrument panel, would have allowed both crew members to observe and easily follow the information displayed on the GPS display.

BN2 Islander aircraft was equipped with a (PA) Collins AP 107 autopilot system.

The following operating modes of the autopilot can be selected on the instrument panel:

HDG - HEADING mode
NAV - NAVIGATION mode
APPR - APPROACH mode (normal approach)
ALT - ALTITUDE HOLD mode
B/C - APPROACH BACK COURSE mode

From the data previously presented, the VOR 1 station was not tuned on any functional frequency, thus the NAV navigation mode of the autopilot could not have been used.

The crew used the autopilot only in HDG functions and the roll selector in lateral mode, as well as the ALT mode and the pitching selector for vertical mode. These functions allowed the use of the autopilot by manually entering the AP settings for each flight segment, only by using the information provided by the GPS receiver.

2.3 Aircraft
2.3.1 Aircraft engines

In analyzing the operation of the engines installed on this aircraft, we wish to point out how carefully they have been tested. Thus:
The components affected after the accident were identified and replaced in order to allow the engines to operate in the testing cell.

They were fueled with 12 quarts (approximatively 11.4 liters) of AeroShell 100 oil (SAE 50).

The left engine (L-18357-40A) was inspected and prepared for being tested on the test bench.

The test was performed according to the manufacturer’s EG-180 rules which include the following steps:
- engine operation at 1500 rpm for 5 minutes;
- engine operation at 1800 rpm for 5 minutes;
- engine operation at 2200 rpm for 5 minutes;
- magnetos verification at 2200 rpm for 1 minute;
- engine operation at 2650 rpm for 5 minutes;
- engine operation at idle speed for 5 minutes.

The engine passed the magnetos failure verification and produced an average speed of 2664 rpm, at an intake pressure of 26.2 inch mercury column (13 psi).

The engine passed all the specific points listed in EG-180.

There were no technical anomalies in the engine operation during the test. It was nothing wrong with this engine, that might have affected the power supply made by the engine before impact.

The right engine (L-22609-40) was inspected and prepared for being tested on the test bench.

The test was performed according to the manufacturer’s EG-180 rules which include the following steps:
- engine operation at 1500 rpm for 5 minutes;
- engine operation at 1800 rpm for 5 minutes;
- engine operation at 2200 rpm for 5 minutes;
- magnetos verification at 2200 rpm for 1 minute;
- engine operation at 2650 rpm for 5 minutes;
- engine operation at at idle speed for 5 minutes.

The engine passed the magnetos failure verification and produced an average speed of 2716 rpm, at an intake pressure of 26.3 inch mercury column (13 psi).

The engine passed all the specific points listed in EG-180.

There were no technical anomalies in the engine operation during the test. It was nothing wrong with this engine, that might have affected the power supply made by the engine before impact.

EG-180 test, does not require the engine operation in icing condition of the carburettors.

Taking into account the testing result of the two engines, the investigation commission came to the conclusion that the decrease of power till the unclonrolled shutdown of the two engines was generated by the carburettors icing.
2.3.2 Weight and balance

The aircraft documentation (flight manual) contains the mass and balance diagram:

![Weight and balance diagram of Britten-Norman BN-2A-27 aircraft](image)

The highlighted lines in the diagram represent the weight and balance limits, and from the calculations it will result a point representing the position of the gravity center. In order to comply with the specifications issued by the manufacturer, according to this diagram, the resulting point must fall within these limits. These calculations are made both for take-off but also for landing.

In the Captain’s file among the documents elaborated for the organisation and development of flight, where the aircraft crashed, it was found the following weight and balance sheet, which had the position of the gravity center represented by a circle at take-off and by a square at landing:
It was elaborated by the dispatcher on duty along with the Captain while preparing the mission.

The data introduced for the elaboration of this sheet were the following:

- the amount of gasoline: 140 imp. gal. = 636 liters;
- luggage 50kg;
- crew weight: row 1: pilot 160 lb = 72 kg; co-pilot 140 lb = 63 kg;
- passengers:
  - row 2: passenger 1 – 180 lb = 81 kg; passenger 2 – 120 lb = 54 kg;
- row 3: passenger 3 – 125 lb = 56 kg; passenger 4 – 130 lb = 58.5 kg;
- row 4: passenger 5 – 130 lb = 58.5 kg.

The first thing to notice is that both at take-off but also at landing the aircraft gravity center is outside the flight envelope.

Further analyzing, it can be noticed that the flight time wasn’t introduced either which according to the filed flight plan it was of two hours.

Also the signatures of the Captain and of the dispatcher on duty are missing.

From studying the aircraft maintenance documents it results that it was this was fueled on 03.12.2013 with an amount of 420 liters of Avgas 100LL, and on 05.12.2013 with an amount of 220 liters of Avgas 100LL. The purpose of these two fuel supplies was to check the fuel quantity indicators on board of the aircraft.

When finishing the maintenance works, due to the fact that the aircraft was in works for 11 months, the Technical Director of RAA requested, and the General Director approved, the performance of a technical flight in order to test the correct operation of the instruments on board of the aircraft.

On 12.12.2013 it was performed a flight of 15 minutes in the area of Băneasa Airport. According to notes in the aircraft technical log, it took-off having on board a total amount of 640 liters of fuel.

In the accident day, the Captain asked about the amount of fuel which was in the fuel tanks of the aircraft. It was of 600 liters.

Respecting the law in force, and according to the Operational Manual of RAA, for the correct calculation of the aircraft weight and balance sheet, there are used the following standard weights: for males 96 kg = 213 lb and for women 78 kg = 173 lb.

The investigation commission filled a new weight and balance sheet, respecting the real positions of the passengers in the aircraft and their standard weights according to the operational manual, noticing that the aircraft gravity center both at take-off but also at landing was outside the aircraft envelope.
The opinion of the investigation commission is that in this situation the Captain could have chosen to modify the amount of fuel on board of the aircraft before performing the flight (in order to comply to the maximum allowable takeoff weight) and to position the passengers in the aircraft so that GC to move within the flight envelope. These options haven’t been used by the Captain.

Therefore, if the aircraft gravity center (GC) is outside the limits, in the front part, then:

- The value of the aircraft advance resistance increases, and consequently, the fuel consumption also increases, and the total flight distance and time decrease. Thus, in order to cancel the nose-dive tendency of the aircraft, the horizontal empennage must produce a balancing charge orientend downwards. The resulting position of the aircraft elevator, increases the advance resistance, which in its turn, increases the fuel consumption and reduces the total flight distance and time.
- The longitudinal stability of the aircraft increases but the longitudinal manageability decreases, resulting a bigger applicable effort in the chain of aircraft controls during maneuvers, this causing a corresponding increase of the pilot’s fatigue.

- The increase of the balancing charge in the rear part of the aircraft is equivalent to an increase in the aircraft weight, thus the value of the speed to which the aircraft will engage, will increase. An increase of the stalling speed has a significant effect on other performances of the airacraft: the take-off and landing speed will increase and the range of available speeds will be reduced and thus the safety margin will decrease.

- The take-off speeds V1, Vr, will increase. On ground, the plane rotates around the main wheels and using the elevator it raises the aircraft nose at take-off. If GC is in front of the main wheels, it occurs a force directed downwards that the elevator along with the cu passing airflow speed over it, must exceed. Thus, the aircraft needs to accelerate for a longer time in order to produce the necessary take-off speed.

The investigation commission considers that it wasn’t paid the necessary attention to the preparation of weight and balance sheet and the consequences on the aircraft performances weren’t analyzed either.

The fact that the aircraft weight at take-off was over the maximum admissible limit and that the aircraft gravity center was shifted to the front, outside the safety area recommended by the manufacturer, led to the alteration of the aircraft stability and performances.

2.3.3 Aircraft instruments

Altimeter

The commission analyzed the readings of the altimeters installed on board of the aircraft as they were found at the accident site. At the accident site on the altimeters it was observed that they were fitted on 1013 mb, which means that on the final trajectory of this flight the crew permanently read that they had an altitude higher with 198 ft (60 m), compared to the real latitude. For a better understanding we present the operation of the altimeter.

Thus: The altimeter is the instrument measuring the altitude or height above a reference level, such as pressure at mean sea level (QNH), pressure at runway threshold (QFE) or standard pressure (1013,25 mb), situated on board of the aircraft. Its operation is based on the principle of air pressure decreasing in relation to height.

The altimeter uses an aneroid capsule with constant pressure. Because the capsule walls are very elastic, they deform under the action of atmospheric pressure. The deformation, proportional to the external pressure variation, is transmitted to an indicating pointer through a transmission system, pointer that moves in front of a dial graduated in height units.

If the aircraft climbs then the atmospheric pressure decreases, the elastic walls of the capsule encounter a smaller resistance, therefore the capsule expands, actioning the transmission mechanism which, in its turn, gives the indicating pointer a
movement that is proportional to the deformation value. On the device dial there are indicated both the pressure units, but also the values of the corresponding heights.

The altimeter is provided with a "chocking" button (adjusting or bringing to zero), whose role is to enable the correction of errors due to changes of atmospheric pressure on ground, so the device always indicates the correct altitude based on the reference pressure.

The scale of the barometric altimeter must be set according to the flight phase. Therefore, these settings are the following:

Flight level – standard pressure is set (1013,25 mb) when flying with reference to flight levels, above the transition altitude;

Altitude – regional pressure (QNH) is set when flying with reference to the altitude above mean sea level, below the transition level. This setting is used in order to make the aircraft utilize in measuring the flight altitude the same reference with the one used in measuring the obstacle quotas, these being noted in the navigation maps with reference to the mean sea level;

Height – the altimeter settings indicate the height above the runway threshold (QFE) and is used when landing is made still on the departure airport, in case of simple flight maneuvers (e.g. Taxiing).

The non-corresponding setting of the pressure scale may result in large deviations from the approved flight level or altitude. Therefore, one of the errors generated by using the altimeter is that even if the pilot hears the correct transmission of the pressure settings he does not set or sets incorrectly the reference pressure.

In this case, the barometric altimeter settings when the accident occurred were adequate to the standard pressure (1013 mb) (see fig.75 and fig 76). Taking into account the low flight altitude and the obstacles existing in the area, the barometric altimeters should have been set using the QNH submitted by TWR Sibiu.

The pressure submitted by TWR Sibiu was QNH = 1006 mb. Taking into account that the pressure variation with height is 30 ft at 1 mb, it results an error of the altitude display of 210 ft (64m) higher than the real altitude.

The normal procedure when the settings of the barometric altimeter change is to set the pressure and to make a verification (cross check) with the settings of the other altimeter. In this case, none of the crew members has modified the barometric altimeter settings when receiving the QNH pressure from CTA.
As a conclusion to the foregoing, the commission notes that the crew, through the error of not fitting the barometric altimeter on QNH pressure submitted by CTA TWR Sibiu, has reduced its chance to appreciate correctly the aircraft position in relation to the obstacles quota.
2.3.4 Aircraft systems

ELT System – Emergency Locator Transmitter

- Installation and maintenance

The aircraft ELT system ARTEX C406-2 type was installed in April 2007 by RAA, according to the bulletin NB-M-1705/19 APR 2007, at the end of the work it was issued the Certificate of Releasing into Service, certificate attesting the installation and proper operation of the ELT system.

As a conclusion, the ELT system installed on the aircraft in April 2007, was properly installed, fulfilling the manufacturer’s indications submitted through the issued bulletin, NB-M-1705/19 APR 2007 respectively.

The maintenance program of the ELT system requires that for every 100 flight hours, to be performed an operation test of the system. On 26.11.2013 during the 100 hours works, it was carried out the inspection of the ELT system according to the manufacturer ARTEX manual: 25-62-11 last revision (valid at the time).

Therefore, the following elements were checked:
- the integrity of the two antennas,
- corrosion marks on the connectors of the two coaxial cables of the antennas,
- G-SWITCH functional control,
- checking the transmitted digital message,
- transmission on the two frequencies 121,5 MHz and 406,025 MHz.

While performing the tests, no nonconformities were found.

Also, in February 2013 during the same 100 hours work package it was also replaced the transmitter battery, on this occasion performing a functional test of the system. The expiration date of the battery is of five years from the date of installation, February 2018, respectively.

The performance of these works was noted in the “WORK SHEET – BASIC MAINTENANCE (FLB) No. BNP014B”.

- Operation

In order to determine the operation of the ELT system installed on the aircraft when the accident occurred, the investigation commission went to the accident site and in collaboration with ROMATSA they performed the testing of the aircraft ELT system. At the end of the test a report was generated.

The final conclusions of the test were that the ELT system installed on the aircraft when the accident occurred transmitted a signal on frequencies 121,5 MHz, 243 MHz and 406,025 MHz. On frequencies 121,5 MHz and 243 MHz the power of the transmitted signal was adequate (the antenna being intact), but due to the fact that the antenna of 406,025 MHz was broken, the signal transmitted on this frequency did not have enough power to activate the COSPAS-SARSAT system.
• Determining how and when the antenna broke

In order to make these determinations, the remaining antenna found on the wreckage was taken into a laboratory and subjected to tests and analyzes.

Thus, as a final result of tests and analyses, it can be stated that the antenna wire broke due to violent actions, which occurred relatively perpendicular to its axis, at a distance of almost 2mm from the embedding in plastic.

The material out of which the antenna is made is a ferrous alloy, high alloy (cca.18% Cr and 8%Ni), also being easily attracted to magnets, which leads to an austenitic-ferritic stainless steel, so immediately after breaking, on its surface, it forms a protective layer of chromium oxide, very sticky and resistant to atmospheric corrosion. This is the reason why the material does not present corrosion primers (reddish spots) or rusted areas.

Out of the detailed reasons, the exact moment of the antenna wire breaking cannot accurately be determined.

• Wreckage analysis

After examining the wreckage by the investigation commission, there were found dents on the aircraft fuselage which might indicate that during the aircraft crashing, starting with the moment of the first impact with the pine trees, the ELT antenna of 406,025 MHz might have be broken on contact with a pine tree branch.

From the deformations of the leading edge of aircraft wings it can be noticed that it took contact with the pine trees almost on its whole surface.

Also, the fact that the four fastening supports of the fuselage wings were found broken/detached from the fuselage shows the strong impact of the aircraft during crashing.
On the right side of the fuselage, in the upper part of the middle, on the antenna direction it was noticed a deformation of it, a clear sign that a contact with a branch/pine tree took place.
Also, on the upper part of the aircraft fuselage, exactly in front of the antenna, it was noticed that some of the rivets fastening the reinforcing plate of the support on which the antenna was fixed, had the paint chipped.
Analyzing the dents on the aircraft fuselage but also on the leading edge of the wings, out of the deformations suffered by the aircraft at the impact with the pine trees/ground, it can be concluded that from the impact with the pine trees, on a distance of almost 100m, the aircraft body was “whipped” by the trees branches, the result, among others, being the breaking of ELT antenna of 406,025MHz.

As a general conclusion, it can be asserted that the aircraft ELT system was operational on all three emergency frequencies 121,5 MHz, 243 MHz, 406,025 MHz, and the antenna responsible with the amplification of the emergency signal on the frequency of 406,025 MHz broke when the aircraft impacted the pine trees/ground, reason for which the signal transmitted on this frequency did not have the necessary power to reach the SAR satellites in order to alert the COSPAT-SARSAT system.

2.4 Human factors

2.4.1 Psychological and physiological factors that affected the involved personnel

The investigation commission, from the start of the investigation and until the issuance of the final report, did not find evidence to prove that the two crew members were not able to fly and would have had physical or psychiatric disorders. Both pilots were able to fly, having valid medical certificates Class 1 and Class 2.

Concerning how the crew operated, in terms of human factor, the commission considers that a few aspects should be underlined:

- the relationship between the Captain and the co-pilot was very good, the co-pilot having full confidence in the Captain. This confidence was based on the fact that the pilot in command was also one of the flight instructors who contributed to raise his qualification level, to obtain the IR qualification and to pass on this aircraft;

- the Captain was a line pilot with a vast flying experience within the transport aviation. This experience was constituted under the application of IFR flight rules specific to line flights, but the commission considered that this experience could not be automatically constituted in a VFR, G class airspace experience. Therefore, we are in the situation where the pilot had a vast experience in IFR flights, experience which was otherwise mainly used by the actual employer, but with limited VFR experience in G class airspace. When referring to limited VFR experience, we do not refer to the pilotage technique, but at the manner of preparing a VFR flight. An experienced pilot in performing a VFR flight mission in G class airspace, would always study, during preparation, the VFR map for the area he is going to overfly, would note safety altitudes along the route, would take into account the rate of some obstacles that he might encounter during flying, etc. Even if he prepared an IFR flight, such a pilot would always take into account to prepare also a VFR backup variant, covering all the aspects mentioned above;
- we consider that the risk assessment made by the Captain during the performance of this flight was influenced and affected by the IFR flight experience he had, but obtained on performing line transport aircraft, with complex avionics system, with jet engines. Therefore, we are in the situation where we have a pilot with a qualification level superior to the performances offered by this aircraft and unless he would acknowledge this, he would consider that if he can, then the aircraft can too, which in most cases turns into contributing factors for the occurrence of an accident.

2.5 Survival
2.5.1 Analysis on victims and fatalities

In analyzing the victims and the fatalities we started from the idea that six of the seven persons on board did not wear the seatbelt when impacting the ground. In this situation, especially the analysis of the injured in relation to the deformations suffered by the aircraft is not conclusive.

Out of the persons who suffered injuries, but that have not threaten their lives, the worst was the co-pilot who was thrown out of the aircraft when impacting the ground because he did not wear the seatbelt either. Therefore, his pilotage post suffered smaller deformations than the major ones occurred on the right side as a consequence of the impact, but it is difficult to say whether the cockpit structure deformations on the left side were produced only after the impact or also due to the propulsion of his body outside the aircraft.

Regarding the people who died we can assess the following.

- According to the forensic report the pilot in command suffered a compressive thoraco-abdominal trauma with rib fractures and visceral injuries. It must be taken into account that he occupied the right pilotage post, area that suffered the maximum deformations at ground impact, this being also the explanation why he remained incarcerated in the aircraft. He was also a big man and because he wasn’t wearing the safety seatbelt when impacting the ground, his body was propelled forward by kicking the flight controls with his chest, and the instrument panel with his head.

- According to the forensic report, the death of the female passenger who died was violent and it occurred through hypothermic and traumatic shock (spine fracture level C5). At the moment of the impact, she was projected forwardly from the seat on row five, stopping on the seatback of the second row. The victim’s evacuation out of the wreckage was made by the other fellow passengers, who tried till the rescuers’ arrival to ensure the survival of the victim. It is possible that if she would have worn the safety seatbelt, given that in comparison to what happened to the passenger in the same row, but who occupied the left seat and wore the seatbelt, that she might have escaped unharmed or at least with minor injuries. The commission came to this conclusion analyzing also the deformations suffered by the passenger cabin, especially in the area of the last row of seats.
2.5.2 Survival aspects

Since they got out of the wreckage, both the passenger that wasn’t injured but also the co-pilot announced the airplane crash by phone, but none of them was able to communicate the exact location where they crashed. It must be taken into account the fact that the aircraft crashed in a pine tree wood, in a mountainous area, at nightfall, in conditions in which the visibility was reduced and the lower base of the ceiling reached the ground at that altitude.

These factors, but also the shock of the accident have hampered the orientation possibilities of the survivors and the possibilities to guide the rescue teams towards the accident site. The rescue teams arrived at the accident site after almost 5 hours, the search operation was successful due to the involvement, in this classical stage of search and rescue operations, along with the specialized personnel of the local inhabitants who knew very well the characteristics and peculiarities of the field. In this period of time the Captain and the seriously injured passenger died.

The way in which the search and rescue operation was carried out was analyzed by the investigation commission through the competences it has, insisting in particular on the activity performed by CCSAR – Coordination center of search and rescue for aviation accidents, disposed at the headquarters of Romatsa. The forces that were designed for this operation are forces subordinated to the Inspectorate for Emergency Situations, which were managed through ISU coordination centers and they are part of the Ministry of Interior.

According to the documents that the investigation commission studied, at the time of the accident, CCSAR ROMATSA did not have any search and rescue force directly subordinated, but it only acted through ISU operational centers at county level, that according to the structure of a search and rescue system have the role of coordination sub-centers of such missions. Moreover the center from ROMATSA might have initiated such a mission only if the alarm information came from the traffic controllers.

If the information about the crash of an airplane enters the system by the 112 telephone emergency service, they alarm first the sub-center corresponding to the county from which 112 was called. The center from ROMATSA doesn’t have an operational role in such a situation, it is informed only that a search and rescue operation was initiated.

In case the antenna of 406 Mhz of the location electronic transmitter wouldn’t have been broken, the information about a probable position provided by satellites would have reached the coordination center from ROMATSA, and it would not have had other role than to transmit this information to the coordination sub-center which assumed the search and rescue mission coordination.

It should be mentioned that the search and rescue system as conceived at national level is atypical, because according to IAMSAR manual there are no coordination centers organized by types of accidents, namely a center for aviation accidents, a center for marine accidents and a center that in fact does not exist for terrestrial accidents, but on the contrary according to the manual it should exist.
depending on the national territory surface, a limited number of coordination centers. If the situation requires this, there can also be organized several coordination sub-centers, the coordination center delegating the activity to them. When referring to delegating the activity to sub-centers it is about the available forces and means, about a limited responsibility area about the nature of the relief.

The training, preparing and equipping activity of the personnel responsible to carry out search and rescue missions, therefore the funds and the legislation needed to carry out such specific missions, rests to the system management. This manager, coordinator of SAR system, has as main task, also the issuance of the search and rescue manual.

It must be understood that the coordination center from ROMATSA does not have the task of coordinating the entire national search and rescue system, it should be responsible only for the way in which a specific SAR mission is coordinated. In our concrete situation the SAR mission coordinator role disappears because the activity was delegated to the coordination sub-centers within ISU.

For a better understanding it should be mentioned that even when we talk about an aviation accident announced by the control traffic agency, the coordination center situated in ROMATSA cannot alarm directly the unit meant to carry out the search and rescue mission. In this situation it can only inform one of the operational centers of the inspectorate for emergency situations, which having the forces in direct subordination will alarm the SAR unit, assuming also the role of mission coordinator.

In Romania the Ministry of Transports is responsible for leading the coordination centers of aviation and naval accidents, but it does not have subordinated also the sub-centers delegated with the search and rescue activity, consequently, neither the forces and means acting in such a mission. Therefore the Ministry of Transports cannot be considered the manager of the national search and rescue system.

The commission did not identify the existence of an edited search and rescue manual at national level. The commission considers that it is mandatory to create a team that manages this system in the composition of which to exist representatives of all the ministries participating with forces and means to such missions and, as a priority to elaborate the national search and rescue manual using as basis the IAMSAR guide manual.

In the annex it is presented a detailed analysis of the actual search and rescue system, analysis based on the provisions of IAMSAR manual and on how such a system is conducted in other countries which have tradition and national legislation in force.
3 CONCLUSIONS

3.1 Findings

The safety investigation commission found the following during this investigation:

- in order to perform the mission due to the number of passengers, according to the contract, it was designated the BN-2A 27 aircraft, registered YR-BNP;
- from February to December 2013 the aircraft was immobilized for the performance of some planned maintenance works;
- the aircraft maintenance documents indicate that it was maintained in accordance with the legislation in force and the approved procedures;
- the last flight performed by the crew with this MEP class aircraft was on 06.02.2013, lasting 2 hours 12 min;
- on this aircraft the Captain had a flight experience of 42 hours 17 min, and the co-pilot an experience of 21 hours 35 min;
- the crew was capable to fly, having the licenses and medical certificates currently valid;
- for performing the flight it was completed, filed and approved an IFR flight plan;
- the preparation of the mission was made superficially, the mission file being incomplete;
- the weight and balance sheet shows that at take-off and landing, both weight and balance were outside the limits prescribed by the manufacturer;
- according to the weather information the Captain had at disposal, the zero degrees isotherm was situated at 6200 ft;
- the passenger safety briefing was not performed on boarding;
- on boarding, the Captain occupied the right pilotage post, and the co-pilot the left pilotage post;
- the main pilotage post, the seat that should usually be occupied by the Captain, is neither defined in the operator's operational manual, nor in the aircraft flight manual;
- during the whole mission performance the co-pilot had the role of pilot flying;
- on boarding, the passengers weren't told what seats to occupy in the aircraft;
- during the whole mission performance, the persons on board did not have the seat belts on, except a passenger who has coupled his seatbelt, before impact, on its own initiative;
- the crew used as main means of air navigation a portable GPS device, temporary mounted on the right stick, this not being part of the standard aircraft equipment;
- the navigation means from the aircraft standard equipment were not used;
- the aircraft did not reach the FL 120 written in the flight plan;
- even if it obtained approval from the air traffic agency for an immediately lower level namely FL 110, this was never reached;
- while crossing the Meridional Carpathians, the aircraft crew faced engine icing problems;
- while crossing the Meridional Carpathians, the flight level reached by the aircraft was at and below AMA limit;
- since the altimeters were fitted on the standard pressure of 1013 mbar this value was no longer changed;
- after crossing the Meridional Carpathians, at Captain’s decision, the aircraft descended at FL 80 continuing its mission in G class airspace;
- when exiting from CTR Sibiu the aircraft was flying at FL 80, at the limit of AMA, in G class airspace;
- the aircraft could not contact the operator of FIC Bucharest, on none of the two frequencies 136,225 MHz and 136,575 MHz;
- the bandwidth of radio stations installed on board of the aircraft was between 118 – 135,975 MHz;
- the frequency 129,4 MHz assigned to FIC Bucharest for the whole country did not provide radio coverage in that area, 136,225 MHz and 136,575 MHz were in operational tests;
- the radio connection for information was provided by the traffic agency of C class airspace;
- at the end of the flight phase the aircraft had no stable radio connection with the traffic agency;
- shortly after exiting from CTR Sibiu, the aircraft faced again the engine icing phenomenon;
- in order to avoid some critical flight parameters the aircraft was forced to adopt a continuous descending flight profile;
- the aircraft was flying on IFR rules in G class airspace, below AMA limit;
- with the emergence of icing and the performance of a descending flight, the aircraft continued its flight in the cloud ceiling it was overflying;
- during flight in the ceiling the aircraft faced a severe engine icing which in the end led to their uncontrolled shutdown;

- the engine start and shutdown was uncontrolled, but the phenomenon did not happen simultaneously at both engines;

- during flight in the ceiling the aircraft faced the emergence of icing at structure, windscreens and blades level;

- due to severe engine icing and to ice deposition on the aircraft structure, its height loss accentuated;

- due to icing on the final part of the trajectory, the engines stopped uncontrolled and simultaneously, thus the aircraft entering into a descending gliding flight;

- the crew was surprised by the appearance of pine trees, having the reaction of cabrating the aircraft in order to attenuate its impact;

- the distance traveled from the first impact with the pine trees till ground contact was of almost 110 meters;

- while traveling this distance, the aircraft plans suffered deformities and partial cuts;

- before ground contact the aircraft turned to the right with almost 90 degrees from the travel direction due to the rough contact with a pine tree trunk;

- the aircraft crashed in a mountanious, isolated, wooded with pine trees area;

- after the impact shock, the ELT system became operational, it transmitted on the emergency frequencies 121,5 MHz, 243 MHz and 406,025 MHz;

- the antenna transmitting on the frequency of 406,025 MHz broke during the impact of the aircraft structure with the pine trees branches;

- the aircraft that overflew the area, received only the emergency signal transmitted on the frequency of 121,5 MHz;

- the COSPAT-SARSAT system haven't been enabled from lack of data reception that should have been received if the antenna transmitting on the frequency 406,025 MHz wouldn't have broke;

- on impact the aircraft did not caught fire;

- on impact the co-pilot was thrown out of the aircraft, the Captain was caught in the deformed structure of the cockpit and one of the passengers on the fifth row of seats was projected over the fourth row stopping in the second row seatback;

- the Captain and the passenger who was projected from the occupied seat died;

- the passenger on the fifth row who put his seatbelt on did not suffer injuries;
- three passengers and the co-pilot suffered injuries that required hospitalization days;

- the accident was announced by the injured passenger;

- the search and rescue operation from the accident announcement, lasted almost 5 hours;

- during this flight the traffic controllers from APP and ACC BUCHAREST, who provided the radar surveillance service in A and C class airspace faced an ambiguous situation;

- in MEP class there is no aircraft type;

- by maintaining practice on one of the aircraft in MEP class, it is considered that the pilot has no flight interruption on any of the aircraft he operates in this class;

- in the operational manual edited by the operator and approved by CAA, the tasks of each crew member were not identified (Captain, co-pilot);

- it wasn’t identified the existence of any search and rescue national manual;

- the operator did not report the accident to CIAS according to RACR-REAC.300 Compulsory reporting of civil aviation accidents and serious incidents.

3.2 Causes of accident occurrence

Determining cause

- The cause of the accident occurrence consists in the engine shutdown as a consequence of severe icing of the carburettor;

Favoring causes

- incorrect assessment of risk factors specific to the development of this flight due to long interruption from flight and to the crew's lack of experience on BN-2A-27 aircraft, included in MEP class;

- incorrect decision of the aircraft Captain to fly for a long period of time in icing conditions;

  - incorrect decision of the aircraft Captain to continue the mission below AMA, in IMC flight conditions on IFR flight rules;

- incorrect decision of the aircraft Captain to take off with a weight over the maximum admitted limit and with gravity center position outside the limits calculated and imposed by the manufacturer;

- long time flight interruption and lack of experience of the crew on BN-2A-27, aircraft included in MEP class.
4 RECOMMENDATIONS

The investigation commission makes the following recommendations:

1. EASA should consider to establish some requirements for the air traffic service providers on the management of unintentional situations, such as possible infringements of the routes provided in the flight plan, of the minimum flight levels, of the minimum navigation requirements, and so on, determined by problems such as weather conditions, technical ones, determined by the aircraft performances and/or by other factors through which the air traffic controllers would require these crews confirmation on the flight rules they followed;

2. EASA should consider the necessity to complete:

   - the (EU) Regulation NO. 965/2012 of the Commission of 5 October 2012 for establishing the technical requirements and administrative procedures on air operations under Regulation (CE) no. 216/2008 of the European Parliament and Council, with an article providing clear references for MEP class, containing also restrictions for flight on a MEP class aircraft depending on the inerruption from flight, and these restrictions should be generally applicable whether considering types, variants or aircraft, and/or

   - the provisions of EU Regulation no. 1178/2011 of the Commission of 3 November 2011 for establishing the technical requirements and administrative procedures concerning civil aviation flight crew under Regulation (CE) no. 216/2008 of the European Parliament and Council on pilots’ licensing in MEP class, in the passage reffering to license validity, by introducing some additional requirements on its validity for the situation in which a pilot accumulates a longer-time flight interruption than three months on one of the aircraft in the class.

So that in future to avoid such situations in which after accumulating a long-time flight interruption on an aircraft in the class to have the possibility to perform directly a commercial flight without previous additional training on that aircraft.

3. The Ministry of Transports should initiate discussions with the rest of ministries that take part in the search and rescue missions for establishing the interministerial coordination committee of search and rescue missions in order to fullfill all the tasks provided in IAMSAR guide manual for such a management body (International Aeronautical and Maritime Search and Rescue).

4. CAA, in cooperation with ROMATSA, should elaborate a procedure to establish when and how the air operators and natural persons owning aircraft
would be informed about the possibility of entering into force of new radio frequencies and the areas served by them. Briefing would be issued in a reasonable period of time so that the operators would be given the necessary time for possible modifications of radio stations on board of the aircraft.

5. CAA, given its role in supervising the implementation of safety management system (SMS) by all air operators, should study the opportunity of completing the Operational Manual of air operators owning aircraft belonging to MEP class with additional requirements for situations when a pilot accumulates an flight interruption longer than three months on a MEP class aircraft.

6. CAA should impose all operators owning Britten - Norman (BN-2) aircraft to define in the Operational Manual the aircraft main pilotage post (seat that should normally be occupied by the pilot in command).

7. CAA should include in the audit program of all economic operators, the verification of the way in which RACR-REAC is implemented, especially, Chapter 3. Reporting procedure - RACR-REAC.300 Compulsory reporting of civil aviation accidents and serious incidents;

8. RAA, as air operator, should complete the Operational Manual with the duties of each crew member, so that to cover all phases of the flight mission, from mission briefing until its completion and the performance of debriefing.

9. ROMATSA should complete the recurrent training program of traffic controllers, in the "best judgment" part, with this ambiguous scenario and they should also recommend them to require additional information when an aircraft changes the flight rules without explicitly requesting this, underlining that it is preferable for the traffic controller to inform the crew that the aircraft would no longer receive radar surveillance services when circumstances require it.

5 ANNEXES

Annex 1. Search and Rescue Report;
Annex 2. Ground-Air Communications;
Annex 3. Relevant weather information form dispatcher’s file;
Annex 4. Relevant weather information found in the pilot's in command file on board of the aircraft;

Note: The documents and analysis objects used for the elaboration of the flight safety Investigation Report are confidential and they are stored at the Civil Aviation Safety Investigation and Analysis Center, according to legal provisions.
ANNEX 1
SEARCH AND RESCUE REPORT

The purpose of the Search and Rescue-SAR service is to locate, stabilize and
draw out the persons in difficulty. That could mean an excursionist on a mountain
slope, a sailor lost at sea, a survivor trapped in an urban disaster, a captured soldier
or a patient with Alzheimer wandering in the city streets. Each SAR type uses specific
techniques depending on the circumstances. For rescuing at sea with air or naval
means there are required skilled divers and helicopter pilots. In order to rescue a
soldier there are used Special Forces formations. For urban SAR there are needed
experts in dangerous materials and specialists in buildings structure.

In Romania it was chosen that the Search And Rescue-SAR should not be a
distinct service, with special designed forces and means, but a service included in the
one designed for emergency situations. This choice requires that the structures
dedicated by law to act in emergency situations, to act also in SAR operations. In fact
even the name of the regulation approved by GO 741/2008 namely „Regulation on
the management of emergency situations generated by the occurrence of a civil
aviation accident„, supports the assertion above.

In order to understand the SAR structure and how is it organized at national
level, in case of a civil aviation accident it is necessary a brief presentation of the
SAR system, presentation based on IAMSAR manual (International Aeronautical and
Maritime Search and Rescue). The purpose of this manual is to support, more
precisely to be a guide for all the signatory States of the Convention on International
Civil Aviation, of the International Convention on Maritime Search and Rescue and of
the Convention for the Safety of Life at Sea, in forming a SAR service, service that
can be part of a global SAR system.

The search-rescue service is a system that obviously consists of two parts:
- the first component is search, representing an operation that is normally
coordinated by a SAR Coordination Center (CCSAR), that used all the specialized all
the human and material resources for locating persons in an emergency situation;
- the second component, under the same coordination, is rescue and ensures
the takeover of the persons in danger, offering them primary health care or other
services depending on needs, transporting them in a safe place.

As it can be noticed from the foregoing, SAR system is a different service but
in some situations it is complement with the medical evacuation service known as
SMURD.

The role of SAR service is to search the persons sending a danger
signal/message, the aircraft transmitting a danger signal/message, the ships the
ships communicationg a danger signal/message, to locate them and to offer them
health care, including ensuring the transport of persons to a safe location,
from where the injured persons can be taken by the medical evacuation service. The
basic resource of this service is usually the air component (helicopters but also
planes). When due to objective reasons the air means can not be used, the following are added as reserve:
- for the marine environment - marine means;
- for terrestrial environment - terrestrial means.
Any SAR system must be structured in order to ensure all the functions, such as:
- receives, confirms and submits the notifications of the danger messages received from the alarm points;
- coordinates the search missions;
- coordinates the rescue and evacuation missions of the survivors to a safe location;
- ensures medical services, primary health or medical evacuation.

More generally in terms of management a SAR system is presented as follows:

<table>
<thead>
<tr>
<th>General level</th>
<th>Functions at general level</th>
</tr>
</thead>
<tbody>
<tr>
<td>SAR Coordinator</td>
<td>Management</td>
</tr>
<tr>
<td>SAR Mission Coordinator</td>
<td>Mission planner</td>
</tr>
<tr>
<td>Coordinator on site</td>
<td>Operational surveillance</td>
</tr>
</tbody>
</table>

SAR system cannot be organized and efficient without management and support in providing human and material resources. In order to ensure success for such a system, one of the key positions is represented by the SAR coordinator. This function can be represented by institutions or persons having the responsibility to ensure from managerial point of view an overview of the entire SAR system. There can be designated departments or ministries responsible for aviation or marine safety such as the Ministry of Transports incorporating Civil Aviation and Navy. But it rarely has all the necessary resources for SAR operations. That is why for using the resources designed for this service, there will be concluded agreements with military organizations or other organizations or agencies.

A close cooperation between various civilian and military organizations is essential. These agreements are implemented by various documents such as: plans, memoranda of understanding, etc.

Almost any state can provide the needs of SAR operations with a minimum financial cost, by using all the available resources, not only of those dedicated or with special destination. The Government, the economic agents and the population, generally tend to wish to support financially and materially the SAR system, but SAR managers must take the initiative and ensure all the arrangements for those seeking to support financially and materially the SAR system, so they can do this.
This SAR system can be established at national level, at regional level or both. Regardless of level, this process involves establishing one or more regions of search-rescue, depending on the ability to receive alarm signals/messages, coordinating and managing SAR service in the established region. **Coordination and management of the service is carried out by means of the Coordination Center of SAR (CC SAR).**

The basic requirements for developing an effective SAR system, must include:
- establishing the legal framework for SAR services;
- modalities to use all the available resources and also of additional ones if the situation requires it;
- establishing the responsibility geographical area resting upon CC-SAR and SAR sub-centers;
- providing SAR operational personnel, training it and also providing support personnel for leading and operating this system;
- providing adequate and functional communication capabilities;
- protocols, plans and related documents for achieving the objectives and defining the labor relations.

The main elements that make up this system are:
- communications within SAR regions but also with external SAR services;
- a CC-SAR for coordinating SAR services;
- if necessary, one or more SAR Coordination Sub-centers (SC-SAR);
- SAR resources including SAR units endowed with specialized equipment and trained, coached personnel, but also other resources necessary for conducting SAR operations;
- medical services, health care and evacuation services;
- coordinator on site, appointed according to needs, for coordinating the activities performed by all the participant forces at SAR operation;
- logistical resources to provide these services in conducting SAR operations.

The communication system within SAR is a seemingly simple one, but efficient, which actually creates the image of this system composition as shown in the following schematic presentation:
The main functions this communication system provides are:

- receiving the alarm signals transmitted by the equipment of the persons in danger;
- exchanging information within SAR mission between the person in danger, the coordinator of SAR mission, the coordinator on site and SAR resources participating in the mission;
- indicating direction, locating the position and the signal transmitted by the equipment used by the survivor so that SAR resources to go as close as possible to the place where the person in danger is.

The alarm posts include all the means involved in receiving the information about a possible dangerous situation and retransmitting it to CC-SAR or SC-SAR. These include means such as:- the unique national system for emergency calls, - air traffic units (ATS); - coast radio stations. The main task of these alarm posts consists of retransmission of received signals / messages to CC-SAR.

CC-SAR has an operative role, of coordinator of a SAR mission and it should be able to react rapidly and efficiently at a dangerous situation occurrence and this depends mainly on the information received from the alarm posts. The place where it is located should enable it to effectively fulfill its responsibilities in the designated search and rescue region. It can be located in an existing location. Very often the agencies responsible for communications, defense, internal, air
services, maritime or others that for fulfilling their main duties have an operational center which may, very quickly, be adapted for performing CC-SAR functions, represent the ideal location for it. These centers will not be dedicated only to SAR, but when the situation requires it, they will also operate as CC-SAR. This is possible when the skills of the staff in these centers, to coordinate other mission types specific to daily activities, are also the ones necessary to coordinate a SAR mission. However, additional staff or space may be needed, but this depends only on the number and complexity of SAR missions.

The disposal in an air control center (ACC) is a good solution and involves minimal costs. The equippement of CC-SAR would be established depending on the duties it is expected to fulfill. Training, exercise and experience are crucial for the proper functioning of a CC-SAR. The staff in its composition needs to be trained, coached in performing the coordination tasks of the available resources, in planning search and rescue. The qualification and certification process is used to ensure the accumulation of sufficient experience and maturity in judging the situations that the staff will face within a SAR mission. CC-SAR is responsible for the preparation of some complex plans to conduct SAR operations in their region. These plans should cover the whole region and they should be based on the agreements between CC-SAR and the institutions that provide resources for implementation or support SAR operations. The plans aim to become an essential aid in reducing the critical time of planning the search and in the coordination process of a SAR operation.

SAR Sub-centers (SC-SAR) are established when CC-SAR is not able to perform a direct and efficient control on SAR resources from the responsibility region. It can be indicated that for each sub-center to allocate also its own SAR region. These sub-centers are established when, for example, the communication means between CC-SAR and SAR resources are inadequate for direct coordination between them or where the local control of SAR operations would be much more efficient. In these situations, CC-SAR may delegate all its obligations to the established sub-centers. The more complicated the administrative system is and the communication system weaker, the more the authority that is given to a sub-center will be bigger, normally these sub-centers have limited responsibilities.

SAR Resources include units designated to perform SAR operations or other human and material resources that may perform and support SAR operations. A SAR unit consists of trained, coached and endowed personnel with appropriate equipment for the expeditious and efficient performance of search-rescue operations (SAR). SAR resources may be aerial, maritime or terrestrial. The resources selected to be SAR units must be able to reach the danger location in a short time and particularly to be able to provide one or more of the following operations:

- to provide care to prevent or reduce the severity of an accident and the worsening of survivors such as for example: escorting an aircraft or staying in vicinity of a sinking ship;
- to perform the search;
- to be able to distribute supplies and survival equipment at the accident site;
- to rescue the survivors;
- to provide initial food, medical needs of the survivors, etc;
- to transport the survivors in a safe place.

The equipment provided to these units designated to perform SAR operations must also ensure the coordination and location functions. It should be endowed with communication equipment that ensures a safe and quick contact with CC-SAR, with the coordinator on site and with the other SAR units; the mobility of forces depends on the number, speed, the disposal and efficacy of available aircraft, ships and vehicles.

The distribution of supplies and survival equipment for the survivors is provided through aircraft and ships in the endowment, the sort and amount of these supplies depend on the circumstance on site of the accident. Generally the helicopters and maritime means can deliver this equipment directly to the survivors, and the planes will either parachute the the supplies either will land to the nearest location to the accident site. Each SAR unit must necessarily be equipped with devices for indicating direction or location, maps of the area in which it currently operates, plotting equipment.

In supporting the activity of the units designed to perform SAR operations there can also be created units with a special destination for SAR. These being provided with a specialized equipment, will operate on demand and based on some arrangements made in time, in specific areas such as mountain or desert areas.

In the category other SAR resources there will be included those forces which currently are not part of SAR units, but which, with a minimum of changes, with a supplementation of the existing equipment and with additional training will be able to perform such operations.

**Coordinator on site (CFL)** represents a function that is directly connected with SAR units and which becomes active when for an accident more SAR units are involved. The SAR(CMS) mission coordinator within CC-SAR or from SC-SAR will appoint CFL, this might be a person managing one of SAR units acting within this SAR operation in progress. Usually up to designating a CFL, this function is performed by the commander of the first SAR unit that reaches the danger area.

**Medical services** and health that would be provided through the arrangements, protocols signed between CC-SAR and a recognized medical authority. For primary health care SAR units have a trained personnel, but in a situation that requires a medical evacuation they will appeal to the means provided in the agreements mentioned above.

**Logistic resources** represent those resources through which it is supported the operational part ensuring SAR service. Without these logistic resources the operational ones cannot effectively support SAR operations. These resources and the logistic services generally include the following:

- instruction and training means;
- communication means;
- navigation systems;
- medical means;
- aircraft landing fields;
- volunteer services (eg: Red Cross);
- maintenance means;
- research and development;
- planning;
- exercises;
- refueling services;
- data and information assurance services (eg: meteorological information)
- management functions.

Therefore, concluding, all these components that form SAR system, have only one purpose, to ensure the development of SAR operations.

These operations consist of finding one or more persons in a danger situation, to assist them and to ensure their transport in a safe location. The key to successfully build a SAR system is in the hands of SAR coordinator/manager. His actions (ensuring a legislative framework, policies, financial resources, etc.) have a direct and decisive impact on the efficiency and results of SAR operations. The duties of this coordinator were mentioned at the beginning of this report, but it should be stressed one very important duty, namely issuing and providing to all those interested a document called the National Search and Rescue Manual. It represents the transposition at national level of the International Aeronautical and Maritime Search and Rescue Manual-IAMSAR. The United States adopted the IAMSAR manual as internal document, and for customization they issued a national document, a supplement to IAMSAR manual, called “United States National Search and Rescue Supplement to the International Aeronautical and Maritime Search and Rescue Manual”. This supplement is issued by the National Committee of Search and Rescue which is that SAR coordinator/manager mentioned above. In Canada the SAR coordinator is represented by the Interdepartmental Committee of Search and Rescue supported by the National Secretariat of Search and Rescue, in Australia by the National Council of Search and Rescue, in Great Britain by SAR Strategic Committee supported by SAR Operators Group which has in its turn as advisory bodies the local SAR Committees, the marine and aviation Advisory Committee and the Advisory Committee for the region within the country.

Analyzing for example Great Britain, there are more publications for SAR, but the most important document is the one called “Search and Rescue Framework for the United Kingdom of Great Britain and Northern Ireland”. In this document at point 7.2.1 it is specified what is this SAR Strategic Committee and also which are its objectives, such as:
- to develop criteria for SAR resources concerning coverage, response and availability, consulting when necessary SAR Operators Group;
- to provide an overview to the ministries for improving SAR capacity, a efficiency and cooperation;
- to promote effectively and efficiently the cooperation between various governmental departments, the emergency services and other organizations, including the volunteer agencies, for ensuring an effective SAR service at national level and when necessary at international level;
- to establish regulatory and organizational framework as provided in the document;
- to determine the mandate for SAR Operators Group.

Furthermore at point 7.2.2 it is specified the composition of this committee, specifying the limitation of its content only for those organizations that may seriously contribute in establishing the strategic responsibilities and in issuing a policy for SAR service. The Committee consists of representatives from the following organizations:

- The Transport Department - ensures the position of President and Secretary;
- Ministry of Defense – ensures the position of Vice President;
- Interior Ministry;
- Department for communities and local administration;
- Navy and Coast Guard Agency;
- The Association of senior police officers from Anglia, Wales and Northern Ireland;
- The Association of senior police officers from Scotland;
- The Association of senior officers from firefighters service;
- Royal National Lifeboat Institution Agency;
- Prime Minister's Office.

In this report it is insisted on the composition and role of this SAR coordinator, detailing an example from another country, exactly for understanding its essential role. We specify again that this SAR coordinator does not have operative responsibilities, but only in establishing SAR strategy and policies.

SAR Strategic Committee from Great Britain has two annual meetings.

Analyzing the situation in Romania it can be concluded that this SAR coordinator is not established and by consequence there is no published national SAR manual which specifies who evaluates this system, what forces are designed, what duties have the service components, how and who ensures the material and human resources, who and where is provided the training, which international SAR processes are applicable, how is the communication system built and which are the frequencies assigned for SAR operations, etc.

It should be noted that CC-SAR from within ACC ROMATSA does not meet or is not going to act as coordinator of the national SAR service, it has only an operational role and only within SAR missions.

From a legal point of view in Romania it was issued the Government Decision No.741 from 09.07.2008 which approves the „Regulation on the management of emergency situations generated by the occurrence of a civil aviation accident, and the amendment of the Government Decision no. 74/1991 on the establishment of the autonomous administration „Romanian Administration of Air Traffic Services„- ROMATSA.

An analysis of the regulation approved by GD 741/2008 leads to the conclusion that it was issued in order to solve the emergency situations named in IAMSAR manual, volume II, chap. 6, point 6.15 „Mass rescue operations„ and the
emergency situations on aerodromes which are mentioned in IAMSAR manual at chapter I7 named „Emergency care other than search and rescue.”.

In order to understand what we refer to, we introduce from IAMSAR manual, the point 6.15 that specifies:

**Mass rescue operations** - means that type of operation involving immediate care of a large number of persons in danger and where the resources and authority of SAR system are inadequate, outdated. The demand for such operations is more rare than for SAR missions, but the potential consequences of these events are much more serious. Examples of scenarios in which it is necessary to act at mass rescue operations level are: floods, earthquakes, terrorist attacks, accidents with large passenger aircraft, naval disasters. In such incidents it can be involved a very large number of persons in danger, situated in an isolated and hostile environment. Preparing in advance to implement such large-scale operations and quick will critically influence their deployment and the prevention of human life loss.

The plans and exercises for the **Mass rescue operations** are relatively complex and represent a challenge for the organizers. At management level there shoyld be signed arrangements, in advance, between all the forces assigned to participate in addition to the means which normally participate in SAR missions.

Often these operations are conducted in a broad framework responding to an emergency situation where it is taken into account the limitation of damages, the control of pollution, the management of a complex traffic and the intense attention from the public and political factors.

In the light of the IAMSAR manual, the statement that the regulation approved by GD no.741/2008, does not address the current search and rescue operations (those operations that do not fit into the kind of mass rescue operations), it can be noticed that:

At Art. 4 there are mentioned the structures responsible with the management of emergency situations generated with the occurrence of a civil aviation accident, at point a) it is mentioned as structure of ministerial level, „The Ministerial Committee for emergency situations of the Ministry of Transports,“. Taking into account the provisions of art. 5, at first sight, it can be considered that this was appointed as the coordinator of SAR service, but as shown in the example above regarding the composition and responsibilities of SAR coordinator in Great Britain, it is raised the question: how could they do this to all the operational units specified in annex 1 of the regulation (1. Operational units of the Ministry of Interior and of the Administrative Reform; 2. Romanian Agency of life rescue at sea; 3. Operational Unitis of the Ministry of Defense) they are not subordinated to this ministry, so in order to accomplish the provisions of point b) of proposing measures to improve the coordination of actions of the involved units and structures, it would have been necessary a structure of this committees similar to the one in Great Britain;

At Art. 5, point d) it is provided that the suspension or termination of search and / or rescue operations should be taken by the Ministerial Committee at the proposal of coordination centers, but this means that every time a search and rescue operation is in process the committee should also meet. If for a case of the kind
referred to at mass rescue operations the meeting of the Ministerial Committee is justified, in the case of a small airplane, in which it can be involved only one person (the pilot), the measure is disproportionate in relation to the situation, and according to IAMSAR manual this decision belongs, based on the criteria established and regulated in advance, to the SAR mission coordinator, in this case CC-SAR or SC-SAR if the mission coordination activity was delegated to a SAR coordination sub-center.

At Art. 7, point b) CC-SAR ROMATSA has the duty of making proposals to modify the specific procedures, but this is possible only if it refers to the internal procedures used within the coordination center. According to IAMSAR manual the duty to publish, modify the search and rescue procedures lies to SAR service manager by modifying the content of the search and rescue manual;

At Art. 16, paragraph (1) it is provided that CC-SAR ROMATSA, after receiving the alarm from one of the structures mentioned at Art. 12 and which according to IAMSAR manual falls within alarming Posts, should start the search and rescue operation through one of the operational units mentioned at annex 1 of the regulation. But CC-SAR ROMATSA doesn’t have the possibility to directly alert any operational unit, because through operational plans of intervention in case of the occurrence of a civil aviation accident across a county, CC-SAR ROMATSA will announce the operational center of the emergency situations Inspectorate of the county across which it is supposed to search the aircraft and to rescue the survivors.

So CC-SAR ROMATSA is designed only to delegate the coordination of SAR missions, according to IAMSAR manual, to a SC-SAR (Search and rescue sub-center), so consequential in the entire country we have so many search and rescue sub-centers as many counties we have. So for a better understanding it can be analyzed in comparison with the United States of America which in the National Search and Rescue Supplement, at point 1.8.3 publishes the list with the SAR coordination centers and sub-centers for the entire territory and these are:

- RCC NORFOLK;
- RCC BOSTON;
- RCC MIAMI;
- RSC SAN JUAN (under RCC MIAMI);
- RCC NEW ORLEANS;
- RCC CLEVELAND;
- RCC ALAMEDA;
- RCC SEATLLE;
- RCC HONOLULU;
- RCC JUNEAU;
- RCC LANGLEY;
- RCC ELMENDORF.

So 11 coordination centers and only one sub-center for the entire territory of USA that operate directly with SAR units, compared with 2 coordination centers and 41 coordination sub-centers for the territory of Romania.
Moreover, in sustaining the statement that the system was designed for mass rescue operations stand even the intervention plans elaborated at county level and in which there are stipulated the institutions responsible for implementation at this level and which are specified as follows:

- County Committee for emergency situations;
- Ministry of Administration and Interior through county structures;
- Public Health Authority;
- County Ambulance Service;
- Ministry of Environment;
- Ministry of National Defense;
- County Office of Special Telecommunications;
- Ministry of Education, Research and Innovation through school inspectorate;
- County Branch of Red Cross;
- Local authorities;
- Romanian Information Service through county division;
- Ministry of Justice - Prosecutor of the county Court of Appeal;
- Other structures.

If it had to be made the scenario of a SAR operation for a small airplane with a total of three persons on board, this is as a whole a very simple one and it is in conformity with the communication system that was schematically presented in this report.

The alarm post notifies CC-SAR, this after issuing the search and rescue plans for the case concerned, it activates directly the SAR unit, by SAR unit it can be understood for example a single SAR helicopter.

The SAR unit performs the search, applying one the international search procedures specified in the national SAR manual, the search phase is considered completed when the aircraft was found or when CC-SAR decides it and temporarily or definitively declares that the SAR operation has ended. If the search is successful then it is proceed to the second phase, rescue, which is provided by the same SAR unit, in this case within the SAR elicopter crew there is one or two rescuers who are trained including to offer primary health care.

The persons are taken on board of the aircraft and transported depending on their condition, to a safe place. So it's a very short decisional line and few forces involved. This whole system was designed so that the time from receiving the information till starting the search to be as short as possible, and the SAR unit or units involved to be estimated so that they could be very well coordinated by the SAR mission coordinator who is in CC-SAR.

The coordinator on site function becomes active only when there are involved more SAR units, for example three helicopters. It was given as an example for a SAR unit an helicopter because generally the main resource used in SAR operations is the one of aviation, and as backup, when from objective conditions it cannot be used, the terrestrial resource is called.

In all the national search and rescue manuals to which the safety investigation Commission had access, the main resources is the aerial one. In Great Britain it was prvided by units designed especially for SAR by the Royal Air Force (RAF) and
Royal Navy following that in the future it will be covered by a joint military/civil service through 12 bases disposed around Great Britain.

At point 2.7.1. from The British manual it is specified that in SAR bases, in daylight between 08.00-22.00 o’clock, it is provided a SAR helicopter with action time of 15 minutes and if the situation requires a second aircraft with action time of 60 minutes, and between 22.00-08.00 o’clock it is provided an elicopter with action time of 45 minutes.

In comparison, in the operational intervention plans valid at the time the accident occurred and to which the Commission had access, for the aerial component provided by the special aviation unit of the Ministry of Internal Affairs in Cluj county, it is available an aircraft with action time of maximum 90 minutes between 07.30-15.30 o’clock and maximum 210 minutes outside these hours, and for the aircraft made available by the Ministry of National Defense in Alba county, the action time is not specified.

For this civil aviation accident an elicopter belonging to SMURD service took off, but it should be mentioned that the helicopters belonging to this service and that are in service of the special aviation unit, are helicopters that cannot be allocated to SAR service because of the way the crew is configured and the aircraft is equipped namely to provide aero-medical evacuation, and also it is not equipped with electronic devices for tracking or pointing direction.

Still in the British manual at point 2.6.1 it is specified that RAF provides for SAR service an airplane equipped with search electronic device, with action time of 60 minutes, 24/7, compared to Romania where the investigation Commission could not identify such an aircraft made available for SAR service. For illustration there are given from the manuals of Great Britain and Australia the way in which some SAR resources are disposed.
Figure 3 Resources made available by the Ministry of Defense and the Coast Guard in Great Britain
Figure 4 Resources made available for SAR service in Australia
The system emerging from the operational intervention plans, in case of the occurrence of a civil aviation accident, is one in which the main resource is terrestrial and implies the involvement of a large number of people, belonging to different structures and to whom it is very difficult and costly in financial terms, to be able to provide training and equipping specific to SAR missions. Moreover, in any document that the Commission had at disposal it could not identify where, when, who and how to perform training and certification for SAR missions of the personnel within the operational units provided in annex 1 from the Regulation on the management of emergency situations generated by the occurrence of a civil aviation accident.

At point 1.4.5 from the search and rescue manual of Australia it is stated that every effort must be made to achieve a sufficient SAR resource, that as soon as possible, with a satisfactory coverage factor, to perform the search in the established area. Anyway certain factors such as the worsening of weather conditions, the illumination level, may determine an optimal aerial search to become impracticable and in these conditions it must be taken into account the use of terrestrial SAR resources. Performing search in large areas only by terrestrial units it is usually impractical, but it can be performed in almost any weather conditions and it can offer a complete coverage for a restraint area where search cannot be performed from air. The terrestrial resource is very important when search is performed from air but rescue is provided by terrestrial units. So in conclusion, for SAR service the terrestrial and naval resource is a secondary resource to which it is appealed when the main resource, namely the aerial resource, cannot be used. Only in the case of a mass rescue operation it can be considered that the terrestrial and naval resources
become main resources. But in these conditions, when it is used the same system, designed for this type of operations or for SAR missions, it may not obtain good results.

Analyzing the search operation performed in case of the accident from Apuseni mountains, it must be specified as mentioned above, that the weather and illumination conditions imposed only the use of terrestrial resource, but for a very large area.

In SAR national manual of Canada, Annex 4E referring to the terrestrial search teams, at point 11, it is stated that:

- If SAR personnel it is not familiar with the area of the search, the SAR team must be completed at least with one competent guide, who knows the area very well.

Applying such a strategy may have caused the reduction of search time also in the case of the analyzed accident. It should be mentioned that the ELT (Emergency Locator Transmitter) installed on the aircraft transmitted on the frequency 121,5 MHz, and did not transmit on the frequency 406 MHz, because the corresponding antenna broke before the impact. In these conditions locating the aircraft through the COSPAS-SARSAT detection system was not possible, but it was possible by using the locating or pointing direction equipment, by narrowing the area or even locating the aircraft, using the ELT transmission on frequency 121,5 MHz.

Applying one of the procedures specified in IAMSAR manual, an airplane equipped for performing SAR missions could have locate or at least substantially narrow the search area, but the Commission could not identify in the studied documents if SAR service has such an aircraft.

In the national search manual of Australia, at point 4.5.14 it is stated that in some studies of accidents involving aircraft performing VFR flight but on a precise route, 79% were located in the limit of 10NM laterally from the trajectory, and 83% were located in the limit of 15 NM. These statistics are useful for the SAR mission coordinator for determining the search area. At point 3.8.44 it is stated that:

- In case if the survivors are seriously injured or they are in a hostile environment, the response time for SAR system must be measured in minutes. If the seriously injured survivors of any accident do not receive medical care, they will die within 24 hours.

In the case of the analyzed accident the aircraft was found in approximately 5 hours from the moment of warning, but this result cannot be considered a result of the way in which SAR system functioned.

Not unimportant it is that normally the coordination centers or sub-centers are provided with the information officer function who is specialized in the questioning the witnesses (according to point 1.3.21, letter c, from the Australian manual).

Taking into account that this accident was announced by one of the survivors, what is stated at point 3.8.38 from the Australina national SAR manual is not unimportant, namely it is stated that the result of the recordings from many SAR
operations shows that after the accident, the survivors physically capable, with a logical thinking system, could not achieve in a logical order simple tasks, causing the delay or even prevention of their rescue, therefore it is possible to assume that a person skilled in questioning the witnesses (survivors) could have taken into account the things stated above.

In conclusion taking into account all those presented in this report it can be said that this search and rescue operation was performed based on some operational intervention plans specific to mass rescue operations, the necessary time for searching the aircraft being determined by the participation of local people in the area, the search process, at night, was based on visual observation, but without the personnel involved in the search being specialist and equipped with night vision systems.

Therefore it is required a new approach of the system, through which the organization is appointed to coordinate this SAR service, attaching Annex H from IAMSAR manual, to evaluate this service and to impose the changes needed for its improvement, first of all to elaborate the national SAR manual which will act as a framework document. In order to do this it should be established an interministerial committee of the kind of those stated in this report.
ANNEX 2
GROUND-AIR COMMUNICATIONS

Conversations transcription – 129,95 MHz - Ground Băneasa

RFT 111: Băneasa, RFT 111

Ground Băneasa: RFT 111, go on

RFT 111: Pentru Oradea, gata de pornire

Ground Băneasa: Aveți liberă pornirea, notați la Băneasa QNH 1010, temperatura +6, vântul 040 cu 7 noduri, vizibilitate 1200 de metri cu RVR pe 07 peste 2000, aer cetos overcast 300 de picioare, temporar vizibilitatea 2000 de metri, minutul 27

RFT 111: 111 ready for taxi

Ground Băneasa: RFT 111 taxi left via Delta, the Follow Me will wait for you, call me when you have it in sight

RFT 111: Ok, left via delta, by Follow Me, call you when in sight

111 Follow Me car, in sight

Ground Băneasa: Yes Sir, follow it via Delta to holding point RWY 070, advice ready to copy

RFT 111: Go ahead

Ground Băneasa: 111 clear to destination Oradea via SOKRU point, FL on route 120, after departure set radar vector sequency 118.25, squawk code 4036

RFT 111: Ok clear to destination via SOKRU, FL 120, after departure vectoring by the APP 118.25, squawk code 4036, RFT 111

Ground Băneasa: I inform you that runway braking action is good

RFT 111, low visibility procedures

RFT 111 you may contact tower on 120.8, have an good flight, good bye

Conversations transcription – 120,8 MHz - TWR Băneasa

RFT 111: Băneasa, hello RFT 111, approaching holding point 07
CTA TWR: Good morning RFT 111, enter line-up and approach to the line 07

RFT 111: Lining-up 07, 111

CTA TWR: Spuneti-mi va rog, e ok asa cu treapta asta la balizaj sau doriti mai mult?

RFT 111: E bine. Gata de decolare 111

CTA TWR: După decolare, vântul din 060 cu 5 noduri. După decolare urcați pe cap 080 la nivelul 120

RFT 111: Confirm, după decolare cap 080. Decolăm 111

CTA TWR: RFT 111 ați decolat la minutul 38. Schimbați cu Approach 118.25

RFT 111: Confirm, Mulțumim.

Conversations transcription – 118,25 MHz – APP Bucharest

Time 13:38:57
RFT111: Bucharest APP bună ziua RFT 111, on heading 080
APP București: RFT 111, on heading 080 climb to 4000 ft
RFT111: 4000 ft, heading 080 RFT111

Time 13:41:20
APP București: RFT 111 are you on heading 080?
RFT111: Yes just now on heading 080

Time 13:42:13
RFT111: 111 când se poate am vrea direct la Roșia
APP București: Da asteptăm o decolare din Otopeni acum pe 08 stânga o să meargă în partea de vest, vă chem imediat.
RFT111: Confirm

Time 13:43:35
APP București: RFT111, continue climb FL 120, I’ll call you back for Roșia
RFT111: Roger RFT111
APP București: RFT111, turn left proceed to Roșia
RFT111: Proceeding Roșia thank you

Time 13:45:21
APP București: RFT111 expedite until crossing 5000 ft, expect a departure rwy 08R, westbound 4000 ft
RFT111: Roger sir
APP BUCurești: B737
Time 13:52:47
APP Bucuresti: RFT 111 report heading
RFT111: Heading 305 sir
APP Bucuresti: 305 roger, ROT 235 continue climb FL 200
ROT235: Continue climb FL 200, ROT 235
APP Bucuresti: And ROT 235 turn left 10 degrees for separation, you have at
distance 4.9 miles BN2 070 climbing slow moving
ROT235: Turning left new heading 280, I have traffic on TCAS, ROT 235

Time 14:06:00
RFT111: Approach, 111
APP Bucuresti: Standby
APP Bucuresti: RFT 111 did you call me?
APP Bucuresti: RFT 111 Bucuresti APP is calling you
RFT111: Yes sir, go ahead 111
APP Bucuresti: Are you maintaining FL 100 or are you climbing to FL 120?
RFT111: Maintaining 100 sir
APP Bucuresti: RFT 111 minimum level on your route is, due to mountains, is 110
level
RFT111: Ok, will changing on 129.4 on Bucharest
APP Bucuresti: RFT tell me again please the level, are you able to climb to FL 120?
RFT111: Negative sir
APP Bucuresti: Roger but minimum level is 110
RFT111: Ok will maintain for another 7 minutes then will climb to 110
APP Bucuresti: Roger RFT climb to FL 110
RFT: 111: Thank you sir.

Time 14:09:00
APP Bucuresti: RFT 111, minimum sector alert warning, climb, are you climbing to
FL 110?
RFT111: Yes sir I’ll slowly climbing FL 110

Time 14:09:13
APP Bucuresti: Ok RFT111, contact radar 122.025
RFT111: 122.025 thank you
Conversations transcription – 122,025 MHz – KONEL sector, ACC

Bucharest

Time 14:09:45
PIL: Bună ziua, RFT111
CTA: Good day, RFT111, Radar contact, continue climb FL110

Time 14:34:31
PIL: Bucuresști, RFT111, trebuie să coborâm la 100 din cauza givrajului
CTA: RFT111, Roger.
PIL: Încercăm să menținem 100-105 din cauza givrajului, nu poate mai sus.
CTA: Confirm.
PIL: Mulțumesc

Time 14:35:59
CTA: RFT111....
PIL: Vă ascultăm.
CTA: Vă informez că AMA în această zonă este 10500 picioare.
PIL: Vă dați seama că stim, vă dați seama ca ne străduim.
CTA: QNH1006.
PIL: Mulțumim mult.

Time 14:42:03
PIL: Bucharest, RFT111, o să coborâm la 80 și intraăm pe 129,4.
CTA: Bucharest confirm.
PIL: Mulțumim.

Conversations transcription – 129,4 MHz – Bucharest Information

Time 14:42:10
PIL: RFT111, de la Băneasa la Oradea și a trebuit să părăsim nivel 110 din cauza givrajului, coborâm la 8000 picioare, după 1007. Oradea estimăm la 16:35 local.
PIL: Avem 4036A și estimăm Oradea la 16:35 local.
CTA: Confirmați A4036, destinație Oradea și 16:35.
PIL: Confirm

Time 14:45:05
CTA: RFT111, Bucharest informare

PIL: Ascult...
CTA: RFT111, Bucharest informare...
PIL: Recepție...
CTA: Vă rog să îmi dați o estimă de Sibiu, pentru că bănuiesc că traversați CTR-ul Sibiu.
PIL: 10 minute.
CTA: Confirm.Și v-aș ruga să intrați și cu ei din timp.
PIL: Da,întrâm și cu ei.

Conversations transcription – 122.7 MHz – TWR Sibiu

14:46:14 RFT 111: Sibiu, bună ziua, RFT 111
14:46:20 CTA EXE: RFT 111, tare și clar de la Turnul Sibiu, continuați
14:46:25 RFT 111: Cu 90 acum catre Oradea, vom intra în zona dumneavoastră, din cauza givrajului nu mai putem să urcăm
14:46:53 RFT 111: Sibiul dacă ne-ati auzit?
14:46:58 CTA EXE : RFT 111 tare și clar de la Turnul Sibiu, cum mă receptionați?
14:47:04 RFT 111: Acuma bine, întrâm și noi în zona dumneavoastră, cu 90 din cauza givrajului, încercăm să ajungem la Oradea
14:47:11 CTA EXE: RFT 111 se aprobă intrarea în zonă, la Sibiu deocamdată zona liberă de trafic, QNH 1006 hPa
14:48:03 RFT 111: Copiat, mulțumim
14:48:05 RFT 111: Cum e actualul de Sibiu ?
14:48:11 CTA EXE: RFT 111, ultimul METAR la Sibiu, vantul variabil 2 kt, vizibilitate 10 km sau mai mult, nori Scatterd la 6600 de picioare, temperatura 13 grade, punct de rouă 6 grade, QNH-ul 1006 hPa
14:48:27 RFT 111: Copiat, mulțumim frumos
14:56:59 CTA EXE: RFT 111 poziția și altitudinea dumneavoastră
14:57:05 RFT 111: Noi avem 80 și suntem la 15 mile de Sibiu, inbound
14:57:15 CTA EXE: Confirm. Să procedați direct pe cap de Oradea și să mă anunțați cu axul liber
14:57:20 RFT 111: Confirm, așa facem
14:58:02 CTA EXE: RFT 111 puteți urca la 90 ?
14:58:06 RFT 111: încercăm
14:58:10 CTA EXE: Confirm, să urcați vă rog, să mă anunțați când vă apropiatia de 90. O să avem un Dash 8, în aproximativ 7 minute, maxim, la UREKI și încercăm să-l coborăm sub dumneavoastră, să nu mai fie nici o problemă pentru aterizare.
14:58:27 RFT 111: Mulțumim, încercăm să urcăm la 90
15:00:00 CTA EXE: RFT 111, procedați inițial către Sibiu, de la Sibiu direct Oradea
15:00:06 RFT 111: Da, noi așa facem, așa suntem
15:00:16 CTA EXE: Să-mi spuneți vă rog altitudinea dumneavoastră în momentul de față
15:00:20 RFT 111: 8600
15:00:23 CTA EXE: Confirm, mulțumesc. Să mă anunțați când atingeți 90
15:00:25 RFT 111: Vă anunțăm
15:02:47 AUA 785J: Sibiu Tower, good afternoon, Austrian 785 J inbound UREKI, maintaining 80
15:02:52 CTA EXE: Guten Tag Austrian 785 J, inbound SIB NDB continue descend 6400 ft by QNH 1006 HPa, expect an ILS approach runway 27
15:03:04 AUA 785J: Continue descend 6400 ft QNH 1006 inbound SIB NDB and ready to copy latest weather report
15:03:16 CTA EXE: Austrian 785 J, last met report at Sibiu, wind from 010 dergrees 4 kt, variable between 290 degrees and 020 degrees, visibility 10 kilometers and more, clouds FEW at 6900 feet, temperature 13 degrees, dew point 6 degrees, QNH 1006 hPa, transition at 60, runway 27 is dry and clear braking action good
15:03:40 AUA 785J: Thank you, that`s copied Austrian 785 J
15:03:44 CTA EXE: Austrian 785 J, for your information we have a VFR flight at your 12 o`clock at 20 miles, at 8600 ft climbing at 9000 ft
15:03:57 AUA 785J: Yeah thank you, that`s copied and we`ve got the runway in sight, we would appreciate a visual approach for runway 09.
15:04:03 CTA EXE: Do you have ground contact sir?
15:04:05 AUA 785J: Affirm, we have the runway in sight
15:04:09 CTA EXE: Roger sir, with ground contact and runway in sight clear for visual approach runway 09, and if you`re too high, you make, you may do a 360 on your left
15:04:18 AUA 785J: Ok that`s copied and cleared visual approach 09 and call you Austrian 785J
15:04:27 RFT 111: Sibiu, 111, approach, dacă este, am depașit oricum axul pistei, coborâți la 80, că e imposibil să facem mai mult de atât
15:04:40 CTA EXE: RFT 111, coborăți la 80, și mă anunțați când atingeți. Acum traficul IFR prin 5000 de picioare
15:04:51 RFT 111: Confirm
15:06:18 CTA EXE: Austrian 785 J, I have you in sight, wind from 010 degrees 4 knots, runway 09 clear to land
15:06:24 AUA 785J: Clear to land 09 and we don`t have to perform a 360, Austrian 785J go straight in
15:06:33 CTA EXE: Roger sir, also caution birds in the proximity of the runway
15:06:35 AUA 785J: Copied
15:07:35 CTA EXE: RFT 111 să mă anunțați la ieșirea din zonă
15:07:41 RFT 111: Vă anunțăm
15:09:10 CTA EXE: Austrian 785J for parking follow marshallar signals, vacate via Echo, see you later
15:09:17 AUA 785J: Echo to the apron, see you Austrian 785 J
15:13:27 CTA EXE: RFT 111 se apropă ieșirea din zonă, în continuare monitorizați frecvența Bucharest Infomare pe 136.575 sau 136.225
15:13:37 RFT 111: 136.575 ?
15:13:41 CTA EXE: Afirmativ
15:13:43 RFT 111: Să cealalta ?
15:13:47 CTA EXE: 136.225
15:13:50 RFT 111: N-avem noi cu 136 la stațiile asta. Rămâne cu 129.4
15:14:01 CTA EXE: Confirm, monitorizați 129.4, zbore placut, ia re.
15:16:16 RFT 111: Sibiu, 111 din nou cu dumneavoastră
15:16:20 CTA EXE: Continuați
15:16:21 RFT 111: Cât are Bucharest în zona astă, București radar, că 129.4, suntem prea jos și nu ne aude
15:16:37 CTA EXE: Două momente vă rog
15:17:52 CTA EXE: RFT 111 puteți urca mai sus ?
15:17:57 RFT 111: încercăm, dar nu prea putem
15:18:02 CTA EXE: Confirm, că singura variantă ar fi 129.4
15:18:07 RFT 111: Să un radar e 124.1 cumva?
15:18:13 CTA EXE: Aradul e 124.1
15:18:23 CTA EXE: Ar fi unul dintre sectoare 127 cu 075
15:18:28 RFT 111: Confirm încercăm și pe ăla
15:18:36 CTA EXE: RFT 111 dacă zburati VFR s-ar putea să nu vă vectorizeze
15:19:38 CTA EXE: RFT 111 Turnul Sibiu

Conversations transcription – 127,075 MHz –NAPOC sector, ACC Bucharest

Time 15:18:41
PIL: Bună ziua, Bucharest, RFT111
CTA: RFT111, continuați
PIL: Am trecut de Sibiu, 20 mile aproximativ, către Oradea, avem 85 nivel din cauza de givraj și Bucharest informare pe 129,4 nu ne aude. Am apelat la dumneavoastră.
CTA: RFT111, rămâneți pe frecvența noastră.
PIL: Oricum suntem și pe 129,4 cu cealaltă stație.

Time 15:27:48
CTA: RFT111, contactați Bucharest, 124,1
PIL: 124,1, numai bine.
Conversations transcription – 124,1 MHz – BUDOP sector, ACC Bucharest

**Time 15:32:32**

PIL: Bucharest, bună seara, RFT111  
CTA: Bună ziua, confirm RFT111  
PIL: ... cu nivel 80... (înterupere)

**Time 15:32:50**

CTA: RFT111, Bucharest  
PIL: RFT... (neinteligibil)

**Time 15:33:11**

CTA: RFT111, do you read me

**Time 15:33:17**

CTA: RFT111, do you read me  
PIL: ...(neinteligibil)...

**Time 15:33:28**

CTA: RFT111 do you read me

**Time 15:34:51**

BMS215B: RFT, this is BMS215B, how do you read?  
RFT111: 52 de mile inbound Rosia, cu 80, continuați...  
BMS215B: confirmat

**Time 15:35:07**

BMS215B: Bucharest, BMS215B  
CTA: BMS215B, vă mulțumesc, da  
BMS215B: 52 de mile inbound Rosia, cu nivel 80, de la RFT111  
CTA: Vă mulțumesc

**Time 15:45:34**

CTA: RFT111, Bucharest radar, do you read me?

**Time 16:00:40**
CTA: RFT111, Bucharest radar

Time 16:01:47

CTA: RFT111, Bucharest radar

Time 16:02:25

CTA: RFT111, Bucharest radar

Time 16:02:50

CTA: RFT111, Bucharest radar

Time 16:04:08

CTA: RFT111, Bucharest radar

Time 16:04:22

CTA: RFT111, Bucharest radar

Time 16:04:56

CTA: THY5KW
PIL: go ahead

CTA: Would you be so kind a relay with RFT111, if he will read you, to estimate ORA
PIL: I am sorry, I don't understand

CTA: THY5KW, please make a relay with RFT111, it is a VFR flight which is flying on low altitude and he can't read us and I want to estimate time for arrival for ORADEA.
ANNEX 3

RELEVANT WEATHER INFORMATION FORM DISPATCHER’S FILE
ANNEX 4
RELEVANT WEATHER INFORMATION FOUND IN THE PILOT’S IN COMMAND FILE ON BOARD OF THE AIRCRAFT

>>> LRBS (BUCURESTI / BANEASA-AUREL VLĂI) <<<
METAR 2010302 04007KT 010V070 0600 R07/P2000 R25/1200V1900U FG SCT001 BKN002 06/05 Q1011 0719//95 BECMG 1500 BR

TAF AMD 200910Z 2009/2106 06008KT 0300 FG OVC001 BECMG 2010/2012
0800 OVC003 TEMPO 2012/2015 2000 BR BKN005 BECMG 2016/2018
0300 FG OVC001 BECMG 2104/2106 1500 BR OVC005

TWY A STOP BAR LGTS U/S
PARKING STAND 1 CLSD
HELICOPTER ALIGHTING AREA H3 CLSD
WARNING FOR BIRD HAZARD: BIRD CONCENTRATION IN THE AD AREA

RWY HOLDING POSITIONS ( AIRCRAFT PARKING/DOCKING CHART AD 2.4-22 ) ARE SUSPENDED.
TWY E CLSD DUE TO TECHNICAL REASONS
ACFT STANDS 19 AND 20 CLSD
ALL CONVENTIONAL SID AND STAR AT LRBS (AIP PAGES AD 2.4-30/31/32/33) ARE SUSPENDED.
NON-PNAV AIRCRAFT WILL BE VECTORED.

>>> LROP (BUCURESTI / HENRI COANDA) <<<
METAR 2010302 06009KT 0800 R08R/1100V1500U R26L/1100N R08L/1200V1700U R26R/1100V1500N FG BKN001 OVC002 06/05 Q1010 8829//95 BECMG 1500 BR BKN002

TAF AMD 200910Z 2009/2106 06008KT 0300 FG OVC001 BECMG 2010/2012
0800 OVC003 TEMPO 2012/2015 2000 BR BKN005 BECMG 2016/2018
0300 FG OVC001 BECMG 2104/2106 1500 BR OVC005
TWY C CENTERLINE LIGHTS ARE SPACED 120M BTN ACFT STANDS 204-205
AND 90M BTN ACFT STANDS 217-219. IN LVO ACFT WILL BE GUIDED
BY FOLLOW ME CAR. IN NORMAL OPS CONDITION FOLLOW ME CAR
ASSISTANCE WILL BE PROVIDED AT PILOTS REQUEST.  NOTAM LR/A0106/14

SAFEGATE STAND 113 APRON 1 U/S. GUIDANCE BY MARSHALLER
INSTRUCTIONS NOTAM LR/A3011/13

HEL ALIGHTING AREA WITH COORD 443425.16N0260554.88E CLSD
NOTAM LR/A3006/13

WARNING FOR BIRD HAZARD. BIRD CONCENTRATION IN THE AD AREA.
NOTAM LR/A3007/13

ALL CONVENTIONAL SID AND STAR AT LROP
(AIP PAGES AD 2.5-30/31/32/33) ARE SUSPENDED.
NON-PNAV AIRCRAFT WILL BE VECTORED. NOTAM LR/A2551/13

>>> LRCD (GRADEA) <<<

METAR 2010302 16006KT CAVOK 13/08 Q1005 0125//95
TAF 2008002 2009/2018 10008KT CAVOK BECMG 2010/2012 18010KT

OPERATIONAL HOURS OF METEOROLOGICAL INFORMATION PROVIDED BY
AD MET OFFICE ARE TEMPORARY CHANGED AS FOLW:
MON. TUE, WED, THU, FRI: 0300-2030
SAT: 0300-1900
SUN: 0500-2030
NOTAM LR/A0007/14

PAPI RWY 01 AND RWY 19 U/S
NOTAM LR/A3247/13

BIRD HAZARD: AERODROME BIRD CONCENTRATION
NOTAM LR/A3042/13

FUEL TH JET A1 NOT AVBL
NOTAM LR/A3041/13

WIP ON STRIP RWY 01/19 AT 100M L/R FROM RWY CENTERLINE
NOTAM LR/A2971/13

>>> LRGB (SIBIU) <<<

METAR 2010302 14012KT 9999 FEW036 SCT076 12/05 Q1006 2715//95
TAF 2005002 2006/2106 15008KT 9999 SCT045 BECMG 2006/2011
5000 -RA BR BECMG 2016/2018 5000 BR BECMG 2020/2022 3000 BR
BRN010 BECMG 2100/2106 1500 BR BRN005

APP SIBIU TOWER - RADAR SERVICE 122.700 MHZ U/S
NOTAM LR/A3092/13

ACFT STANDS 01 CLSD
NOTAM LR/A2927/13

AERODROME BIRD CONCENTRATION
NOTAM LR/A2596/13

>>> END-OF-BULLETIN <<<