STATE COMMISSION ON AIRCRAFT ACCIDENT INVESTIGATION

FINAL REPORT

ACCIDENT

Occurrence No: 970/13

Aircraft: hot air balloon

Thunder & Colt 240 A; SP-BAM

3 July 2013 – Troks near Olkusz

This Report is a document presenting the position of the State Commission on Aircraft Accident Investigation concerning circumstances of the air occurrence, its causes and safety recommendations. The Report is the result of the investigation carried out in accordance with the applicable domestic and international legal provisions for prevention purposes only. The investigation was conducted without the need of application of legal evidential procedure. In connection with the provisions of the Regulation (EU) No 996/2010 of the European Parliament and of the Council on the investigation and prevention of accidents and incidents in civil aviation and repealing Directive 94/56/EC (EU Journal of Laws L. 2010.295.35), the wording used in this Report may not be considered as an indication of a person guilty or responsible for the occurrence. The Commission does not apportion blame or liability. In connection with the above, any form of use of this Report for any purpose other than air accidents and serious incidents prevention, can lead to wrong conclusions and interpretations. This Report was drawn up in the Polish language. Other language versions may be drawn up for information purposes only.

Warsaw 2014

TABLE OF CONTENTS

GENERAL INFORMATION

Type of occurrence :	**ACCIDENT**
Type and model of aircraft:	**balloon: Thunder & Colt 240 A**
Aircraft registration marks:	**SP-BAM**
Aircraft Commander:	**balloon pilot**
Flight organizer:	**private**
Aircraft user:	**private**
Aircraft owner:	**PHU NOVO-OIL Wojciech Noga**
Place of occurrence :	**Troks near Olkusz**
Date and time of occurrence:	**3 July 2013; 20:45 hrs. LMT**
Damage to the aircraft:	**none**
Injuries to persons:	**2 passengers – serious injuries**

SYNOPSIS

The pilot performed a flight with seven passengers. After about 40 minute flight, during the landing approach the balloon began to descend at a rate higher than intended by the pilot. Pilot attempted to reduce the rate of descent by using all burners. Before touchdown the pilot opened the parachute valve and Velcro rip panel. After the first touchdown the basket again bounced off the ground twice and came to rest about 50 meters from the first touchdown place. During the touchdown two passengers suffered serious injuries.

Investigation into the occurrence was conducted by the SCAAI Investigating Team in the following composition:

Tomasz Kuchciński - Investigator-in-Charge,
Dariusz Frątczak - Team Member,
Jarosław Olędzki - Team Member - SCAAI expert.

<u>During the investigation SCAAI determined the following cause of the air accident:</u>
Touchdown of the balloon performed with too high descent rate, probably due to downdraft.

<u>Contributing factor:</u>
Imprecise upwind orientation of the basket long side, which contributed to the collisions among passengers resulting in serious injuries.

After closing the investigation SCAAI has not proposed any safety recommendations.

1. FACTUAL INFORMATION

1.1. History of the flight.

On 3 July 2013, the pilot planned a balloon flight with seven passengers. He met with the passengers around 18:00 hrs. According to the pilot's statement, while waiting for the anticipated reduction in wind speed he briefed the passengers on the proper behavior during the flight and landing. The balloon took off from a meadow in Wielmoża village, at approx. 20:05 hrs. LMT (18:05 hrs. UTC). The flight was carried out with a North-Western heading in the class G airspace at an altitude of about 300 m relative to the take-off place. During the flight the passengers were again briefed by the pilot to adopt the correct body position during landing i.e. to bend their knees, stand back to the direction of flight and hold on to the handles inside the basket.
At the beginning, for the initial 20 - 25 minutes the flight proceeded normally. Then the pilot repeatedly felt the gusts of wind which caused unintended descent of the balloon. To level the flight he used two or three burners. The loss of altitude was about 20 meters. After about 40 minute flight the pilot decided to land in a meadow in the Troks village near Olkusz. According to the pilot, on the final approach the horizontal speed of the balloon was 2 – 2, 5 m/s and the vertical one 0,2 – 0,5 m/s. During descent the pilot used the turning vent to orientate the long side of the basket upwind. During rotation of the balloon at a height of approximately 10-15 m, the pilot again felt a gust of wind that caused increased descent rate of the balloon. He immediately used three burners to reduce the descent rate. When the pilot realized that he was not able to sufficiently reduce the descent rate prior to touchdown, he instructed the passengers to firmly hold on to the handles. He closed main valves and pilot lights of the burners, fully opened the parachute valve and Velcro rip panel. The balloon touchdown took place approximately 25 m in front of the chosen meadow, with a deviation of the long side of the basket by about 25° from the upwind direction. After the first touchdown the basket again bounced off the ground twice and came to rest on the long side about 50 meters from the first touchdown place.

1.2. Injuries to persons.

Injuries	Crew	Passengers	Others
Fatal	-	-	-
Serious	-	2	-
Minor	1	5	-

1.3. Damage to aircraft.

None.

1.4. Other damage.

None.

1.5. Personnel information.

The pilot – male, aged 43, holder of the Balloon Pilot License (BPL) with Class C rating. The License and the rating were valid on the day of the accident. Flight time as Commander on hot air balloons: 214 hrs. In 2003 he received the first license issued in accordance with the requirements of ICAO Annex 1. On 30 March 2013 he passed the practical exam required for the License in accordance with the requriments of Part FCL, piloting the balloon on which the accident occurred.
The pilot had Class 2 Aeromedical Certificate valid on the day of the accident.

1.6. Aircraft information.

Hot air balloon Thunder & Colt with classic envelope type Colt 240 A of 6797 m^3 (210 000 ft^3) volume, equipped with a parachute vent, Velcro rip panel and turning vents. Basket with „T" partition. Quad burner Colt MK III T (Magnum) type consisting of three main burners and one separate whisper burner (Commercial Liquid Fire). During the flight there were three Thunder & Colt fuel cylinders V30 type in the basket. Analogue board instruments: altimeter, variometer, thermometer and IC-A23 radiotelephone.

Year of manufacture	Manufacturer	Envelope Serial No	Registration marks	Register Number	Register date
1993	Thunder & Colt Ltd	2320	SP-BAM	154	18.08.2004

Airworthiness Review Certificate valid until	5 August 2013
Envelope total flight time since new	669 hrs. 10 min
Total number of flights since new	389
Last Airworthiness Review date	15 January 2013

Fuel (gas) quantity prior to the flight:

fuel: propane-butane	84 kg;

The fuel (gas) quantity was sufficient to complete the planned flight.

Balloon loading (mass data):

empty balloon mass:	463 kg
fuel mass (with cylinders)	144 kg
estimated crew mass (pilot + 7 passengers)	640 kg
estimated equipment mass	10 kg
Total:	**1257 kg**

Balloon loading for take-off:

Take-off weight: taking into account the ambient temperature: +23ºC, elevation of take-off place: 410 m AMSL and the intended altitude not exceeding 700 m AMSL:

- maximum permissible 1600 kg
- actual 1257 kg

Take-off weight of the balloon was within the limits specified in the Flight Manual.

Basket occupancy:

Eight persons flew the balloon. There were three persons in the first passenger compartment, four in the other and the pilot in his compartment. There were also three gas cylinders Thunder & Colt V-30 type.

The basket measurements and calculations showed that each person flying the balloon had more than the required 0,25 m^2 surface of the basket floor.

Technical documentation of the balloon:

During documentation check it was found lack of Supplement 8.22 (Out of Production Burner Models) - applicable to the Colt MK III T burner mounted in the balloon - in the Flight Manual (Issue 10, change 11).

Technical condition of the balloon:

The pilot stated that prior to the accident the balloon was airworthy. The visual inspection of the balloon conducted by the Investigating Team did not show any damage caused by the accident. However, during the inspection it was found that three fuel cylinder straps other than those approved by the manufacturer were used. Two of the four burners showed symptoms of excessive wear. In one of the burners it was found melted top part of the pilot light burner (Photo 1), and in the other non-standard gap in the upper part of the pilot light burner and lack of one of the main burner jets (Photo 2). In addition, there was found corrosion on the crossflow ball valves of the burner gas installation (Photo 3). However, in the Commission opinion the above abnormalities had no influence on the accident occurrence.

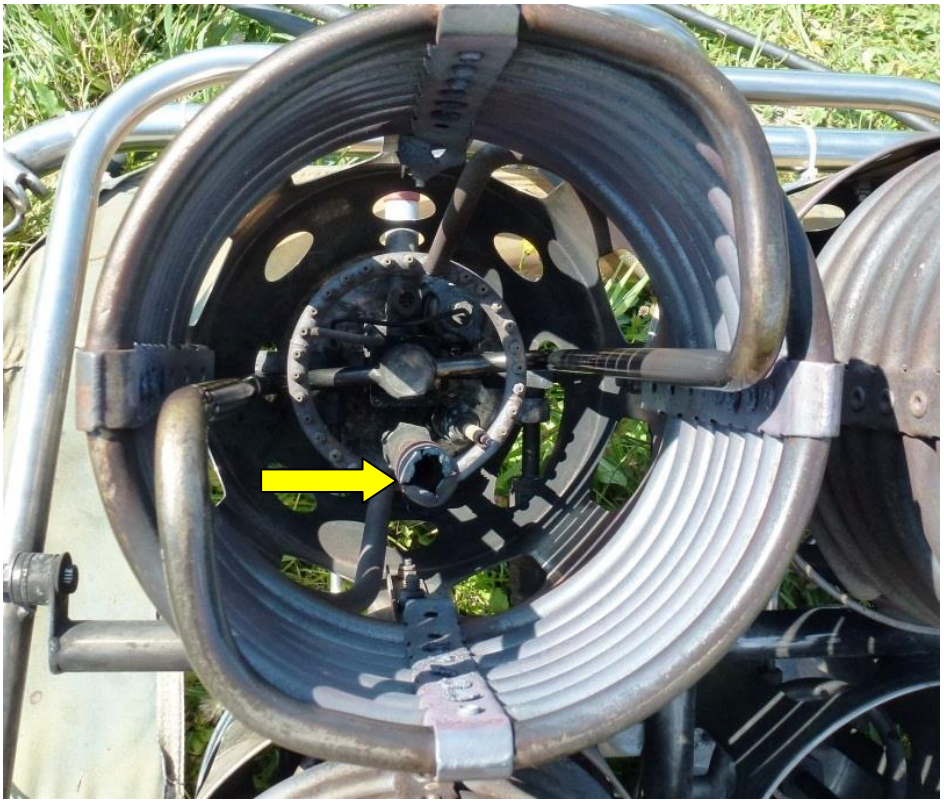

Photo 1. The yellow arrow indicates melted top part of the pilot light burner. Photo: SCAAI

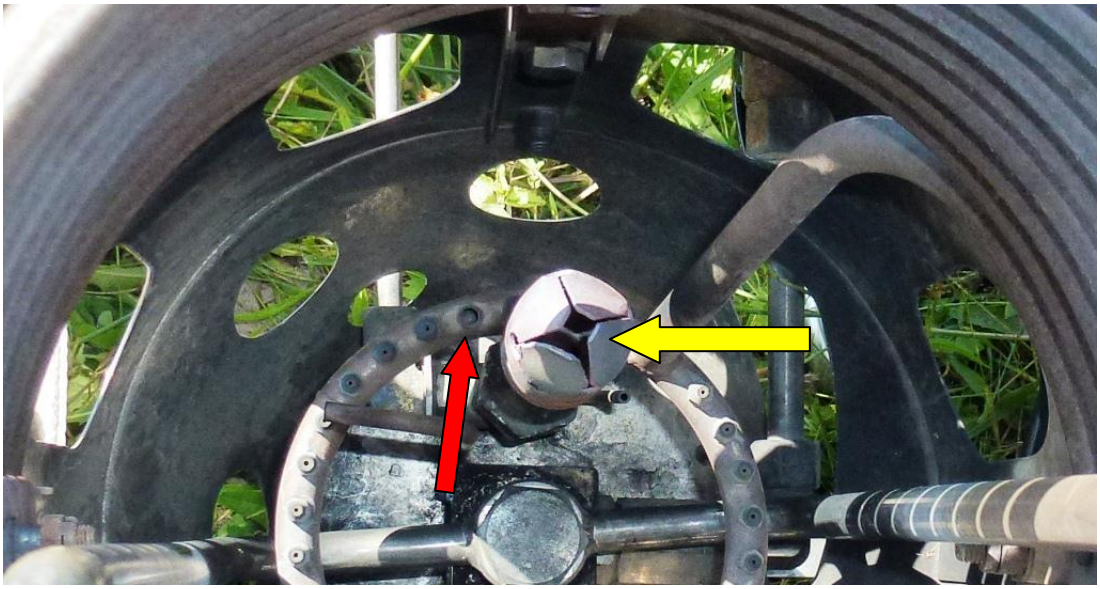

Photo 2. The yellow arrow indicates non-standard gap in the upper part of the pilot light burner. The red arrow indicates place of the missing jet of the main burner. Photo: SCAAI

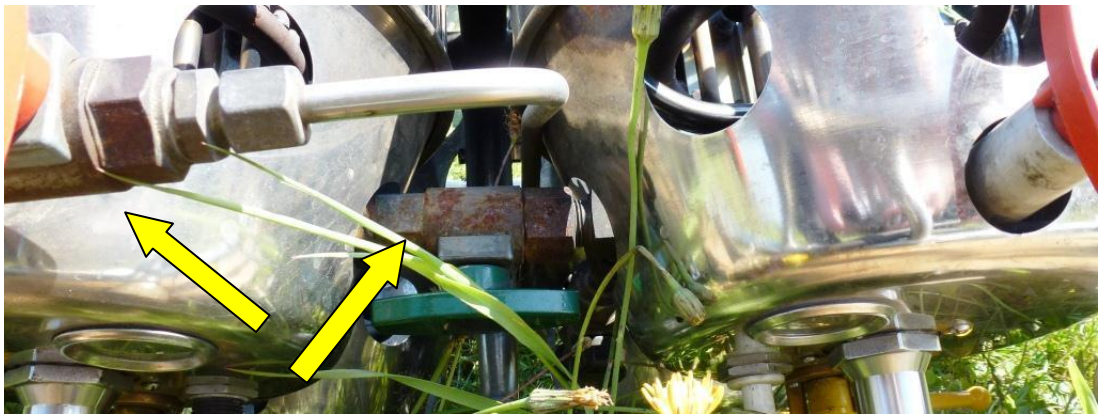

Photo 3. Arrows indicate corrosion on the burner crossflow ball valves. Photo: SCAAI

1.7. Meteorological information.

Weather in the area of the flight: the sky cloudless; visibility over 10 km; no dangerous weather phenomena; the air temperature: 22-23°C with a decreasing trend; QNH: 1015hPa showing an increasing trend; surface wind speed: 4 kt (2 – 2,5 m/s), from the direction of 100° - 110°.
Meteorological conditions were adequate to perform a balloon flight.

1.8. Aids to navigation.

Not applicable.

1.9. Communications.

The pilot established the radio communication with Sector Kraków FIS.

1.10. Place of the occurrence information.

a. Meadow a size of about 80 x 40 m.
b. Geographical coordinates: N 50° 18’ 00.1” / E 019° 37’ 51.9”.
Elevation: 390 m AMSL.

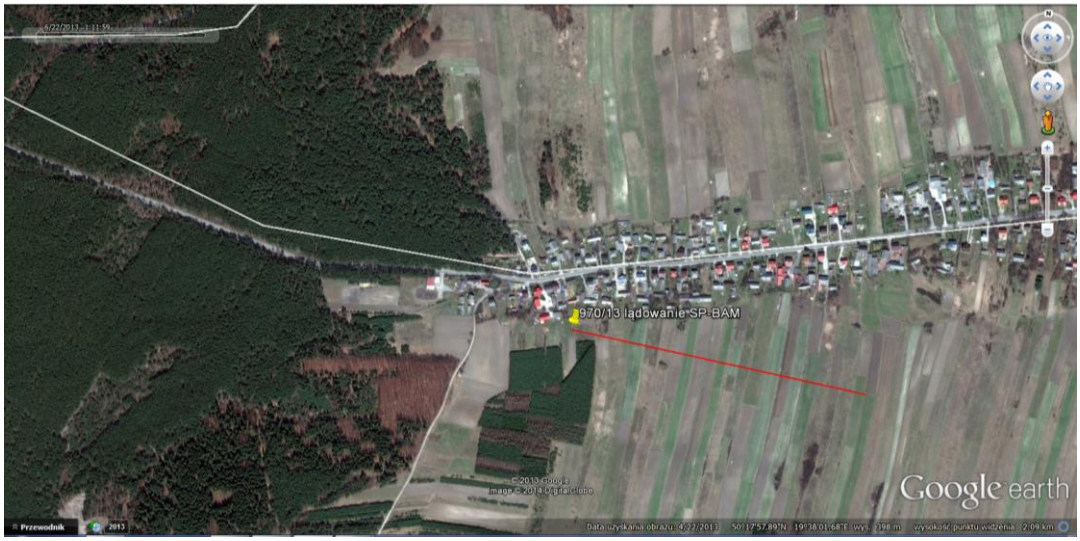

Fig. 1. View of the balloon landing area. The red line indicates approximate direction of the last phase of the flight. The yellow sign indicates location of the basket stop. Map source: Google earth.

c. Characteristics of the area: rolling terrain at the skirts of arable land, meadows and forests.

d. The landing site was located near Troks village buildings.

1.11. Flight recorders.

The balloon was not equipped with flight recorders.

1.12. Wreckage and impact information.

The landing was carried out in the direction of 280°. After the first contact with the ground the basket bounced and again contacted with the ground about 5,5 meters further. Then the basket bounced again and third contact with the ground took place about 9,4 m from the first track, then the basket moved along the ground to the rest place located about 50 m from the first track.
The landing took place at a rate of descent higher than intended by the pilot. The long side of the basket was orientated about 25° to the right from the upwind direction. The horizontal speed during landing was estimated by the pilot for 2 - 2,5m/s.

1.13. Medical and pathological information.

a. During the touchdown two passengers suffered serious injuries.
b. The pilot was not under the influence of alcohol.

1.14. Fire.

Fire did not occur.

1.15. Survival aspects.

a. All passengers had access to a sufficient number of handles inside the basket. The passengers stated that prior to the touchdown they adopted positions required by the pilot, i.e. they were turned back to the direction of flight, stood on bent legs and held on to the handles.

b. One of the injured persons left the basket unaided. The other injured person was removed from the basket after disassembling the burner. Due to injuries suffered by the passengers an ambulance was called to the landing site. The ground crew of the balloon arrived at the scene earlier than the ambulance. A member of the ground crew (paramedic) offered the first aid to the victims. They refused to accept the first aid. The ambulance transported three persons to the hospital. One of them, who suffered only bruises left the hospital after medical examination. The other two persons who suffered serious injuries were hospitalized.

1.16. Tests and research.

Visual inspection of the occurrence site and the balloon was carried out. The pilot and balloon records were analyzed. Meteorological expert opinion was prepared. The pilot statement was acquired. The materials made available to the Commission by Police were analyzed. The flight description given by the pilot was consistent with the

circumstances of the accident determined by the Commission. Despite the fact that the course of events could not be objectively verified (no GPS or video recording) the Commission considered the sequence of events given by the pilot as very probable.

1.17. Organizational and management information.

The balloon owner who was the flight organizer agreed with the passengers that they would pay a predetermined sum of money to an account of a foundation. Neither the balloon owner nor the foundation had the air operator certificate (AOC). The pilot stated that he was not to receive remuneration for the flight. The passengers did not make the agreed payment.

1.18. Additional information.

The pilot – balloon owner and the Aircraft Accidents Investigation Branch were informed that they had the right to become acquainted with the Draft Final Report.

1.19. Useful or effective investigation techniques.

Standard investigation techniques were applied.

2. ANALYSIS

The flight proceeded properly from takeoff to approach to landing. According to the pilot statement, in the final phase of the approach to landing, at an altitude of 10 - 15 m, the balloon began to descend at a rate higher than intended. To explain this, the specificity of the area over which the balloon was flying should be taken into account. The approach to landing was performed over cultivated areas (meadows, crops), near a large forest and on the leeward of a small, gentle hill.

Fig.2. Landing area. The red line indicates the approximate direction of the last phase of the flight. There was downslope of about 40 meters at the distance of about 800 m. There was a forest on the Eastern side of the landing site. Map source: GPMapa TOPO 2009.

In such a diverse terrain updrafts and downdrafts might have occurred despite the imminent sunset. This is due to the fact that during the day such areas as meadows and fields with crops are heated by the sun faster than, for example wood. Areas that quickly heat up, also cool down quickly. Areas which slowly heat up also cool down slowly.

In the evening unstable equilibrium of the air created during a sunny day was replaced by the constant equilibrium but only over the places which quickly heated up and quickly cooled down. In contrast, the unstable equilibrium persisted over the areas which heated up and cooled down slower. This caused the air to rise up from these places. This resulted in the situation that the air rising from above the forest descended on adjacent areas cooled down faster, causing a local downdraft. It should be noted that descent of the air does not occur in the same place continuously. For this reason, it was difficult to be predicted by the pilot. In addition, the balloon landing was made on the leeward of the hill, where the air also descended. According to the Commission, the balloon descent faster than intended by the pilot during the approach to landing was probably due to accumulation of the two factors described above: to a greater extent by the downdraft and to a lesser extent by the descending air on the leeward of the hill.

Landing on a relatively small meadow of approximately 80 x 40 m required precise piloting but could have been safely carried out even on the leeward of a small and gentle hill with the wind speed of 2 – 2,5 m/s.

When at the height of 10 - 15 m the pilot was carrying out the final approach to landing he was surprised by an increased rate of descent. According to the Commission, the pilot acting in the deficit of time and altitude, made the right decision to first reduce the rate of descent using all burners. When it turned out that he would have failed to stop the descent of the balloon, just above the ground he closed all the burner valves and opened the parachute valve and Velcro rip panel. These were the correct actions, otherwise besides many strong bounces off the ground the landing could have taken place beyond the selected meadow and even end in a collision with buildings. As a result, the first touchdown of the balloon took place about 25 m in front of the selected meadow and with imprecise orientation of the basket long side which should be upwind.

The pilot briefed his passengers on the desired behavior during the flight and the correct position which they should have adopted during landing. The landing instruction was repeated during approach to landing. Just before the touchdown the pilot warned passengers to firmly hold on. Before the touchdown passengers adopted the prescribed positions – they stood on bent legs, back to the direction of flight and held on to the handles.

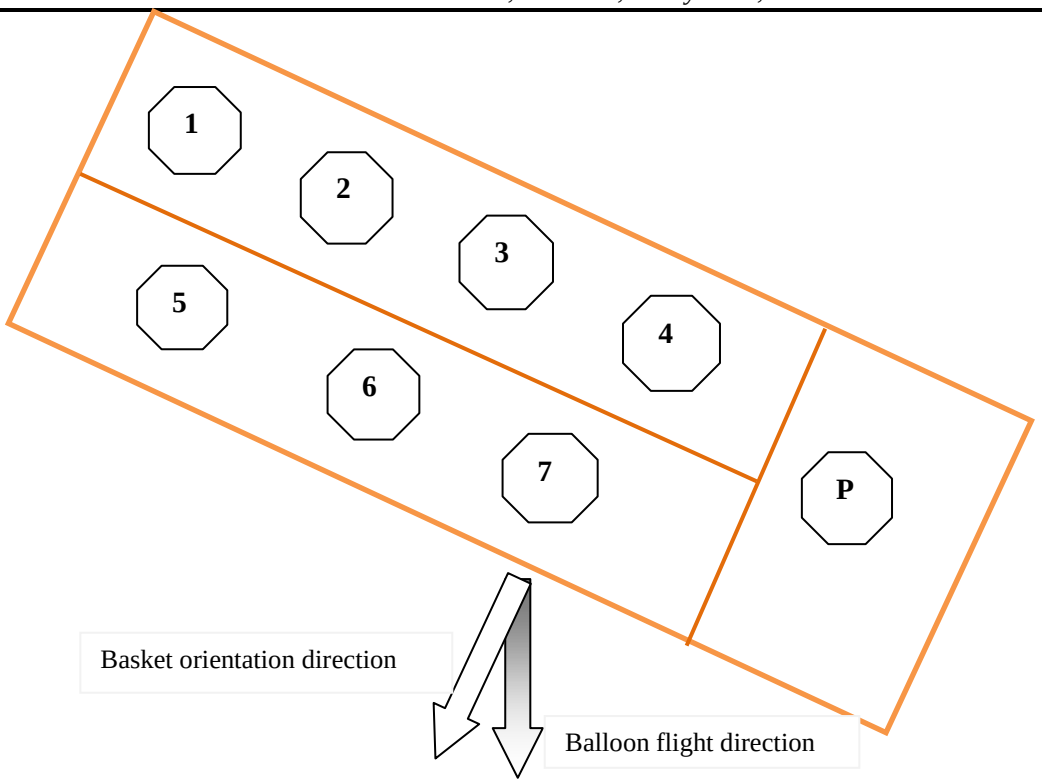

Fig.3. Placement of passengers and the pilot in the balloon basket and basket orientation relative to the direction of flight during the first touchdown. The passengers marked with numbers from 1 to 7. The letter "P" indicates the pilot.

There were seven passengers and the pilot in the basket of the balloon. Only passengers marked with “1” and “2” suffered serious injuries during the landing. The passenger number “2” claimed that during landing all the time she was holding to the handles. However, according to the passenger number “3”, after the second contact of the basket with the ground the passengers number “1” and “2” fell at each other and at him or he fell at passengers number “1” and “2”. In the Commission opinion, the nature of injuries of the passengers “1” and “2” indicates that they resulted from falling persons on each other and not from hitting the side or floor of the basket. As described above, the balloon touchdown occurred at a rate of descent higher than planned by the pilot. Tracks of landing indicate that during the first contact with the ground the long side of the basket was orientated about 25° to the right from the upwind direction. During touchdown, probably the second contact of the basket with the ground caused sudden rotation of the basket to the left of about 25 degrees. In the Commission opinion, it had an influence on the movement of passengers “2” and “3” who fell on the passenger “1”. The fact that the other passengers did not fall on each other indicates that they held on to the handles more firmly and the resultant of the vertical and horizontal speed during landing was not too high. This is also indicated by the fact that the passenger number “7”, who held on to the handle with just one hand neither fall on the passenger number “6” nor was thrown out of the basket .

In summary, during landing approach on the leeward side of the small and gentle hill the balloon probably flew into a downdraft which caused a rate of descent higher than

planned by the pilot. Despite using all three burners, the rate of descent was not reduced to the planned by the pilot value which was about 0,5 m/s. The need to operate three burners and open the parachute valve and Velcro rip panel prior to touchdown made it impossible for the pilot to orientate the basket long side exactly upwind. Imprecise orientation of the basket and touchdown with a rate of descent higher than planned caused that two passengers suffered serious injuries.

3. CONCLUSIONS.

3.1. Commission findings.

a. The pilot had adequate and valid ratings to fly a balloon with an envelope volume of 6797 m^3 (210 000 ft^3);

b. The balloon documentation was in accordance with the applicable requirements except for the lack of Supplement 8.22 (Out of Production Burner Models) - applicable to the Colt MK III T burner mounted in the balloon - in the Flight Manual (Issue 10, change 11). Lack of supplement did not affect occurrence of the accident;

c. The pilot stated that the balloon was airworthy at the time of flight;

d. The Commission found that three fuel cylinder straps other than those approved by the manufacturer were used and the burner showed symptoms of excessive wear. It did not affect the occurrence of the accident;

e. Loading of the balloon was within the limits specified in the Flight Manual;

f. Quantity of gas in the balloon cylinders was sufficient to complete the planned flight;

g. The passengers and the pilot had adequate space and access to handles in the basket, according to the requirements specified in the Flight Manual;

h. The pilot was not under the influence of alcohol;

i. The weather conditions were suitable for the balloon flight. However, during approach to landing a local downdraft caused a rate of descent higher than planned by the pilot;

j. Despite using by the pilot full power of all three burners, the rate of descent was not sufficiently reduced prior to touchdown;

k. During touchdown the long side of the basket was not orientated exactly upwind;

l. During the touchdown two passengers suffered serious injuries.

3.2. Cause of the accident

Touchdown of the balloon performed with too high descent rate, probably due to downdraft.

Contributing factor:

Imprecise upwind orientation of the basket long side, which contributed to the collisions among passengers resulting in serious injuries.

4. SAFETY RECOMMENDATIONS.

Having become acquainted with the materials gathered during the investigation the State Commission on Aircraft Accident Investigation has not proposed any safety recommendations.

THE END

Investigator-in-Charge

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