Australian Ballooning Federation Inc

Pilots' Circular

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Balloon Accident in the US – Collision with Terrain

Synopsis

At about 0615 hours on the 13th April 2005 at Marana, Arizona in the US, a Cameron A-210 hot air balloon became airborne in VMC for a local area sightseeing tour. 30 minutes later the balloon collided with boulders located atop foothills to the west. The two pilots, one a trainee, and five passengers sustained minor injuries. Three passengers sustained serious injuries and one passenger was fatally injured. The balloon was substantially damaged.

Background

The accident was investigated by the National Transportation Safety Board (NTSB) and this document is based on its report. The findings reaffirm the imperative that pilots be well versed in the skills and knowledge relevant to low level and contour flying, and to the conditions that most affect this phase of flight, specifically to meteorological phenomena such as curl-over, wind rotors, thermal and mechanical turbulence, venturi effect and temperature variations. Lift and performance theory also come under the spotlight.

Using the publicly available NTSB report (http://www.ntsb.gov/aviation/aviation.htm) this article examines the accident, but it delves into not just what the pilots did wrong which the report rightly highlights, but a little deeper looking into possible underlying issues that may have existed for some time lying in wait to precipitate an adverse event. These latter areas are explored using the ICAO-endorsed James Reason method of analysis.

The accident bears resemblance to what is called in airline crash investigations 'controlled flight into terrain' (CFIT). On this occasion with the pilot at the controls the balloon collided at speed with rocks on a hill. In dealing with operational issues such as pre-flight planning, commercial pressures and the vagaries of weather while training a new pilot, the pilot-in-command appears to have displayed deficiencies in knowledge application, decision making and technique.

Accident Analysis

An NTSB investigator was assigned to examine the accident and the resulting report and findings are a thorough treatment. In addition to speaking to the pilot, the investigator interviewed the other crew member, passengers, and a local resident.

In a written statement the pilot reported that after departure the balloon ascended to about 500 feet AGL. About 5 minutes into the flight he transferred control to the other crewmember, a private pilot who was under training and gaining commercial experience. About 1 km before reaching rising terrain the crewmember ascended to about 1,000 feet AGL where the speed increased to about 15 knots. The balloon was then approximately 100 feet higher than the peak of the upcoming hill. Though attempting to maintain level flight the crewmember could not prevent the balloon going into a gradual descent. The pilot said that he resumed control and activated both burners but the balloon continued to descend. The basket then heavily impacted the rising terrain twice.

The crewmember in his report described the company's standard passenger flight as consisting of a departure from Marana, followed by an ascent over the foothills located to the west. After clearing the terrain there is a tour of the valley, and pending wind conditions, the pilot may then land. This particular flight departed in light wind conditions, ascended after lift-off at about 300 feet/minute until reaching about 600 feet AGL where the pilot levelled off. The crewmember added that due to the residential neighbourhood below, a minimum altitude of 500 feet AGL was maintained until reaching the unpopulated foothills about 1½ kms to the west.

The crewmember said that while he was in control everything seemed normal as the balloon continued toward the hills. At close proximity to the hilly terrain the pilot resumed control activating both burners, presumably for maximum lift, but the balloon did not climb. The balloon then impacted a rock on top of a hill, which 'offset the basket from the envelope'. The basket collided with an additional rock causing injuries to himself and other occupants. The balloon floated to the west side of the hill where the pilot landed.

A passenger reported that after departure, as the balloon continued to gain altitude, he kept his attention fixed on the scenery below. About 2½ minutes prior to impact he recalled a passenger asking the pilot their altitude. The pilot reported 2,500 feet after consulting his handheld GPS. 30 seconds passed and another passenger queried the pilot as to altitude, and the pilot again reported 2,500 feet. The passenger went on to say that seconds before impact the pilot instructed the other crewmember to 'turn on both burners'.

The passenger noted that in the 2 minutes prior to impact the balloon did not appear to increase in altitude and he assumed the pilot was going to attempt to manoeuvre around the approaching peak. He stated that during the flight's duration only one burner was operating at a given time except in the few seconds before the impact when he noted two burners operating. He added that, though the flight path consisted of a continuous ascent up the mountain, the balloon's altitude did not appear to reach higher than the peak.

The investigator spoke to a local resident, also a pilot. She had observed the operator conducting company sightseeing flights on many previous occasions. The operator had regularly manoeuvred over her house at an altitude of 50 feet before reaching the foothills to the west. There the balloon would either ascend over the mountain if enough altitude was gained, or continue through a pass in the hills. On numerous occasions she had observed the balloon landing on fields below the hill which she thought was a result of the balloon not obtaining enough altitude prior to reaching the rising terrain.

On the morning of the accident she again saw the balloon cross over her house at about 50 feet, whereupon she ran outside to communicate to the pilot that he was flying too low. She thought the low operations were an invasion of her privacy, as balloon occupants could look through her windows. She added that several months prior to the accident she contacted government authorities to lodge a complaint against the operator but no action had been taken.

Analysis details show that take off elevation was approximately 2,000 feet AMSL. Using recovered GPS information the investigator estimated the first impact point occurred at an altitude of 2,465 feet AMSL.

An attempt was made to establish the actual met conditions prevailing at the time, however observations for the immediate local area were not available. The nearest observation point was located a distant 40 kms to the southeast where at 0655 hrs winds were from 140° at 9 knots. The pilot stated that during the accident the wind was 120° at 10 knots, gusting to 15 knots, with a downdraft present.

A representative from Cameron Balloons examined the wreckage. He performed functional tests and inspections of all the components. He stated that the entire balloon appeared to be in good condition with no anomalies or discrepancies with the envelope, basket or burners.

FAA regulations require a pilot to fly at an altitude that will allow for a power unit failure and/or emergency landing without undue hazards to persons or property. Further, regulations restrict private pilots from being pilot-in-command during commercial operations with passengers except where the commercial pilot is providing instruction.

In finalising its report the NTSB cited the probable causes of the accident as:

- the failure of the flying pilot (ie: the pilot under training) to attain a proper climb rate and maintain an adequate clearance from rising terrain, and
- the inadequate flight supervision and delayed remedial action by the pilot-in-command.

Accident Analysis Method

The above findings are both pertinent and supported. However like many accident reports, aviation or otherwise, they address only what occurred during the last few minutes of the activity and what the operators (pilots) did wrong.

ICAO countries almost universally now use the James Reason accident analysis method which provides for a holistic consideration of the event. An investigator is obliged to examine not merely the actions of the operator at the time of the accident but to consider the operating system as a whole. This introduces a much broader range of issues. In the Reason method these are tiered under the following headings:

- Organisational issues – deficiencies in the systems, processes and decisions developed at the management level such as safety management, training and resourcing.
- Task/environment – error and violation producing conditions on the day such as task pressure, task complexity and adverse weather. Human Factors issues such as information processing, medical standard, fitness, fatigue, stress and so on need to be considered.
- Individual's actions/inactions from start to end of the activity in question such as flight planning, load checks, crew supervision, hand-over/take-over protocols, skill/knowledge errors.
- Failed/absent defences that are or should have been in place for the operation such as pre-flight risk assessment, qualification/experience/currency standards, thorough briefing, and so on.

The value in this approach, now well proven, is that it uncovers within the system latent failures that go beyond those related merely to the operator at the coal face. By examining underlying causes, which may at first appear remote from the accident, subsequent recommendations address the root problems and so become far more effective in reducing the risk of future similar accidents.

The method also addresses error, violation, blame and culpability. Investigators must focus on whether the operator committed an error or a violation. Errors are unintentional and are generally blameless whereas violations are intentional and perpetrators are therefore culpable.

The need to blame is an irresistible trait in human beings. As humans we are all prone to error but to blame and punish someone for doing something they had no intention of doing, while personally satisfying for us who sit in judgement, in no way guarantees that the person will not err in future. Indeed blaming can actually subvert desired safety outcomes, as people become scared to speak up for fear of retribution. A biblical saying comes to mind here: 'Let he who is without sin (error) cast the first stone.'

Applying this analysis method leads to a consideration of the balloon company's entire operating system. What follows is a list of issues the modern investigator might consider. They are neither conclusive nor definitive but are merely subjects that spring to mind given the accident facts and the witness statements. Indeed some may be found to have no substance and to lead to a dead end, but to be discounted they must first be examined.

Organisational: Were Federal Aviation Administration (FAA) rules and regulatory oversight adequate? What about company safety culture issues such as: management safety commitment and safety statement, existence of safety and risk management systems, resourcing, level of supervision, training and operating standards, tendency for risk-taking and violation, past history? Some of these are directly supported by the NTSB analysis, for example questionable training and supervision techniques; the apparent regular low over-flight of populous areas in contravention of FAA regulations.

Task/environment: The task included training a new pilot. Was there an undue urgency to get him qualified? Was his training/experience level appropriate given the conditions on the day? A brisk breeze towards the ridgeline combined with venturi effect would likely have caused a wind speed increase, mechanical turbulence and an increase in balloon inertia. With the wind blowing towards rising terrain, if anything there should have been an updraft effect. This would have aided balloon ascent over the ridgeline. Why then the downdraft and the descent? One can speculate that the balloon encountered very localised unpredictable mechanical turbulence which at the exact location of the balloon comprised a downdraft.

The PIC himself reported a wind speed 10 kts gusting to 15 with a downdraft present. He stated that he 'activated both burners but the balloon continued to descend'. These were challenging conditions for an experienced pilot let alone a trainee.

Human Factors issues need to be considered. Expectation due to familiarity and repetition is a common information processing issue. Did the PIC fall victim to this? Other HF issues might include medical standard, fitness, fatigue, stress?

Individual's Actions/Inactions: The two NTSB findings mentioned earlier are pertinent here. Considerations might also include Gross Lift – a rough calculation for a 210 balloon shows a possibility that, depending on temperature, the balloon was overloaded. There is some support for this in the local resident's statement that: 'On numerous occasions the balloon landed on fields below the hill which she thought was a result of the balloon not obtaining enough altitude prior to reaching the rising terrain.' The pilot appears to have used his GPS for altitude information. GPS systems are extremely accurate in plan mode but lack this accuracy in elevation unless additional supplementary information, as provided by say an air data system, is available.

Absent/Failed Defences: Was there a risk management strategy for this task? Was it used? Did the pilot have a personal plan of action in case of adverse conditions? If so, why did it let him down? Did he adequately prepare for the flight? To what degree did the Chief Pilot provide supervision/briefing? Were crew qualification, experience and currency standards adequate for the level of operations? Were the crew and passenger briefings adequate?

Summing Up

The accident seems to raise many issues worthy of consideration. This article, while providing a description, has also been an introduction to the type of thorough investigation that results from using the broadly accepted James Reason accident analysis method. The additional findings proposed suggest that while piloting errors were made, it's possible the more serious causes may have stemmed from latent, underlying problems that may have existed for some time within the system as a whole. If this was the case and the problems remain unaddressed, pilots are destined to make similar mistakes in the future.

When you do read about an accident, any accident, note whether blaming the operator is the primary focus. Is there a tendency to point the finger solely at the person at the end of the accident chain? In almost all cases there will be underlying systemic problems that if addressed, will vastly improve findings and recommendations so enhancing the lessons learned and ultimately safety of the operation.

Ops Manual Amendment – Use of Pilot Light/s

An amendment to the ABF Operations Manual regarding use of pilot lights is currently being processed. Due to an on-going series of adverse events due to the pilot light/s being left on during landing the operations staff have decided that a prescriptive approach is required.

The amendment will state that it is a requirement for normal approach and landing (which is the vast majority of the time) the pilot lights must be turned OFF just prior to touch-down. This of course is to safeguard against fire should (1) a valve or gas line malfunction on landing, or (2) a lay-over landing occur where an ignition source increases the risk of fire either in or outside the basket.

A flow-on is that pilots <u>must</u> pay particular attention to their overshoot options. In tight situations the pilot must be prepared to either overshoot early or to immediately relight the pilots. It does I know, add to the complexity of the approach and landing (which of course is complex enough!) but consider the alternative. We have enough evidence to suggest that it is riskier to land with the pilot lights on than off. In the end it's up to you as we won't be there to monitor.

Installation of a Tall Structure Near Coleraine, Vic

Origin Energy, Vic has advised that have errected a Meteorological Monitoring Mast. The mast was erected during the week beginning Monday 15th February 2010 and may be in place for up to three years. This mast is a single tubular structure 65 meteres in height and supported by four sets of guy wires. The outer guy wires in each set (4) will be marked with 300mm diameter Orange Aviation Marker balls approximately 5 metres from the top of the structure. See below for details.

CONTACT DETAILS

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Phone:	9652 5200	FAX:	9819 0120

LOCATION AND DESCRIPTION OF STRUCTURE

Type of Structure:	Meteorological Monitoring Mast
Location:	Coleraine, Victoria
Locality or Feature name:	Dundas Tablelands
Description of Structure:	Tubular mast supported by four sets of guy wires
Owner of Structure:	Origin Energy Power
Is structure temporary?	Yes (up to 3 years)

SURVEY DATA (metres)

GPS location: WGS84 Zone 54.

UTM Grid reference: **Easting: 0559077 Northing: 5852381**

Lat/Long*: **Latitude: -37 ° 28 ' 414 " Longitude: 141 ° 40 ' 087 "**

(*Calculated using http://www.ga.gov.au/geodesy/datums/redfearn_grid_to_geo.jsp)

Height of Obstruction: **65m**

Ground base elevation: **310m**

Elevation top of Structure: **375m**

STRUCTURE MARKING

Obstacle marking: 4 x 300mm Orange Aviation marker balls located on outer guy-wires approximately 5 metres from top of structure. Lower 2 metres of guy wires are marked with 25 mm orange plastic tubing. Lighting Nil.

Pilots' Circular (PC) is produced by the Australian Ballooning Federation Inc. It contains operational and safety information for all ABF balloonists. All members – from the newest student to the most experienced pilot – are invited to contribute to PC either on issues they feel are important or to raise questions for which they would like information. Thanks in anticipation to all members who contribute.
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