Australian Government

Australian Transport Safety Bureau

Hard landing involving Kavanagh Balloon B-425, VH-OKX

4 km south of Greta, New South Wales, 13 January 2018

ATSB Transport Safety Report
Aviation Occurrence Investigation
AO-2018-004
Final – 23 January 2019

Released in accordance with section 25 of the *Transport Safety Investigation Act 2003*

Publishing information

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Addendum

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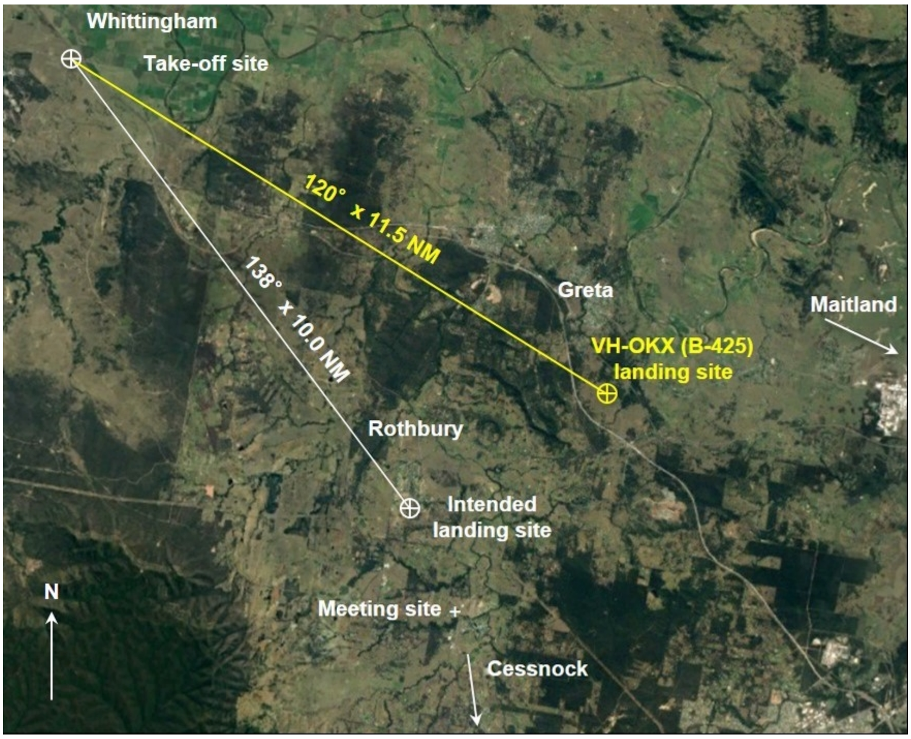
Hard landing of Kavanagh Balloon B-425, VH-OKX

What happened

On the morning of 13 January 2018, the International Balloon Flight Company (Australia) prepared to conduct morning scenic charter flights in the Hunter Valley, New South Wales, utilising four of the operator's balloons. The operator stated that on the evening of 12 January 2018 he reviewed several weather websites to assess the conditions the following morning. The weather websites reportedly indicated light surface winds with a sharp increase in surface wind speed from 1100 Eastern Daylight-saving Time.[1] He stated he made a further check at 0330 on 13 January 2018, which showed the weather conditions were unchanged. Based on the assessed conditions, a decision was made to continue with the morning's four simultaneous balloon flights. The operator reported that the forecast surface winds were light at the planned launch time of about 0540.

The four pilots and the ground crew met at a location about 7 km north of Cessnock. They assessed the local conditions and decided on the take-off and landing site. The balloon ground crews launched a piball[2] at the meeting location and surface winds were assessed as being about 5 kt.[3] As it ascended, the piball initially went in a northerly direction and then veered to steady on a heading of about 140° T. Based on the local assessment, the pilots decided to take off from the most northerly take-off site, at Whittingham, which was of a similar elevation to the meeting location. The intended landing site was in a paddock, 19 km to the south-east near Rothbury (Figure 1).

Figure 1: Take-off site, intended and actual flight paths and landing sites



Source: Google earth, modified by the ATSB

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1 Eastern Daylight-saving Time (EDT): Coordinated Universal Time (UTC) + 11 hours.

2 An abbreviation of 'pilot balloon', which is a small, helium-filled free balloon with a light that is released and visually tracked to determine the wind at different altitudes.

3 One knot, or one nautical mile per hour, equals 1.852 kilometres per hour.

The crew and passengers then travelled to the launch site. At the launch site, the ground crew inflated another piball and reportedly observed similar conditions to the meeting site. Each of the four balloon pilots then conducted a safety briefing with their passengers. The briefings included the passengers' positions in the basket and a demonstration of the brace landing position, in accordance with the operator's procedures.

At 0540, a Kavanagh B-425 balloon registered VH-OKX, with 15 passengers and one pilot onboard, lifted off in conditions that were reported to be a light north-westerly wind, at about 5 kt. The operator's other balloons launched soon after OKX.

OKX maintained 40 ft above ground level (AGL) for about 5 minutes, then climbed to about 2,500 ft AGL. The balloon was then carried in an east-south-easterly direction over undulating country in the general direction of Maitland. The pilot stated the wind direction changed and the speed increased at about 0600, which was significantly earlier than he expected.

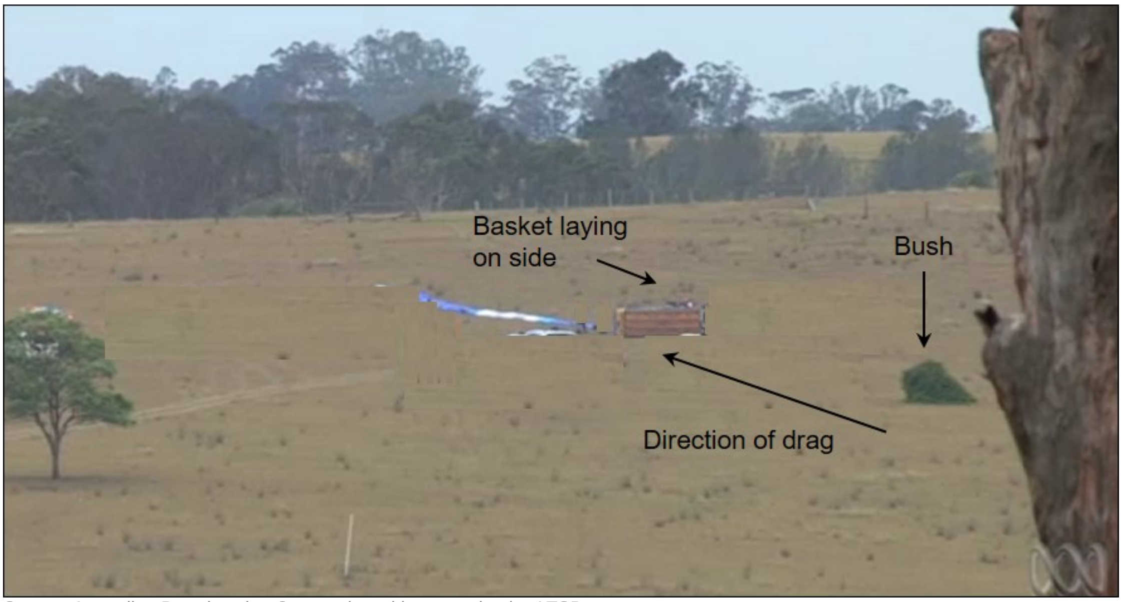
The balloon pilots communicated with each other regarding the wind speed and decided to land at the first suitable site. The predetermined landing areas were no longer available to them, as the wind change had taken them further east than they had planned. The area selected was a large open field that was not one of their normal landing areas.

The pilot of OKX reported that the balloon descended gradually over the next 15 to 20 minutes, and the balloon's speed increased. He briefed the passengers for landing and advised them to rest their backs on the basket padding and hold on to the internal grab handles as per their previous briefing. The passengers maintained that position for the duration of the landing. The balloon approached the landing site about 4 km south of Greta, with a ground speed of about 20 kt.

As the balloon descended into the centre of the clearing (several feet above the surface), the pilot turned off the gas to the burners and opened the envelope deflation system. The balloon landed lightly with the basket upright, then the basket laid over onto its side and was dragged across the field by the balloon envelope acting as a sail in the wind.

The pilot stated that following the landing, the balloon changed direction slightly and was dragged about 40 m towards a large bush in the centre of the field. The basket subsequently contacted the bush, lifted up rapidly on its right side and landed back down heavily. It was then dragged a further 50-60 m before coming to rest (Figure 2). Due to the significant ground impact forces, one passenger was seriously injured and three others sustained minor injuries. All four passengers were taken to hospital for examination, with three being discharged on the same day.

Figure 2: Landing site terrain with the deflated balloon, basket and the bush it contacted



Source: Australian Broadcasting Corporation with annotation by ATSB

Two of the other three company balloons were landed in the same open area, laid over and dragged for a short distance with no occupant injuries or damage. The third balloon continued flying for about half an hour and landed safely, but the balloon's envelope was damaged by contact with foliage.

Other occurrences

A search of the ATSB occurrence database found that over the period from January 2007 to January 2018 there were 46 other balloon inadvertent hard landings, contact with obstacles or collision with terrain. Most occurrences were reported to be associated with changing weather conditions.

Weather forecasts

The operator stated he reviewed several weather websites to obtain weather models for the intended flight on 13 January 2018. Bureau of Meteorology (BoM) forecasts were reportedly reviewed, but as the forecasts were for the general area, the operator stated that he preferred local weather models for specific areas. He stated that these models indicated surface winds of 7 kt at 0500 and 5-6 kt at 0800, with a sharp increase at 1100. He advised that he knew the upper winds were stronger but was confident with the weather model.

In discussing preparation for flight, the Aeronautical Information Publication (AIP) ENR 1 – GENERAL RULES AND PROCEDURES, Section 1.10 - FLIGHT PLANNING, paragraph 1 - FLIGHT PLAN PREPARATION, sub-paragraph 1.1 stated:

> Before beginning a flight, a pilot in command must study all available information appropriate to the intended operation and, in the case of flights away from the vicinity of an aerodrome…must make a careful study of:
>
> a. current weather reports and forecasts for the route to be flown and the aerodromes to be used;
>
> …

Further, sub-paragraph 1.2.1 required that:

> Forecast information must include:
>
> …
>
> b. one of the following:
>
> (I). a flight forecast; or
>
> (II). a GAF [graphical area forecast[4]] (at or below A100)…
>
> …
>
> c. a wind and temperature forecast
>
> For a flight to a destination for which a prescribed approach procedure does not exist, the minimum requirement is a GAF.

The BoM graphical area forecast (GAF) valid for the intended flight indicated broken cloud and isolated showers with severe turbulence forecast below 7,000 ft from 0400 on 13 January 2018. Additionally, a forecast for moderate turbulence that affected the intended flight area had been in place since 0000 on 13 January 2018.

The grid point wind and temperature (GPWT)[5] forecast (Table 1) indicated wind speeds that were consistent with the forecast severe turbulence. At 0200, the GPWT forecast indicated a steady increase in wind speed from 1,000 - 5,000 ft. At 0500, the wind speed was forecast to significantly

4 Information about GAFs is provided by BoM on its website.

5 Information about GPWT charts is provided by BoM on its website.

increase with altitude. The air temperature was forecast to remain steady at about 30°C at 2,000 ft and below.

Table 1: The grid point wind and temperature forecast at 0200 and 0500 EDT, 13 January 2018

0200 EDT				0500 EDT			
Altitude (ft)	**Wind direction (° True)**	**Wind speed (kt)**	**Air temperature (°C)**	**Altitude (ft)**	**Wind direction (° True)**	**Wind speed (kt)**	**Air temperature (°C)**
5,000	320	36	25	**5,000**	310	52	24
2,000	340	23	32	**2,000**	300	30	30
1,000	010	15	28	**1,000**	300	17	31

Source: Bureau of Meteorology

Meteorological conditions commonly affecting balloons

An inflated balloon envelope displaces a proportionate volume of air and in the process creates lift equivalent to the weight of the displaced air. For a balloon to start rising, its buoyancy needs to be increased by heating the air within the envelope with a gas-powered burner(s). Heating decreases the air density within the envelope such that the balloon's mass becomes relatively less than the lift created by the displaced air. To descend, the pilot allows the air in the envelope to cool naturally. For a given air temperature/density within the balloon envelope, buoyancy is reduced by increased altitude, increased outside air temperature and increased humidity.

In stable flight, a balloon flies at the same speed and direction as the wind at that altitude. A degree of directional control is achieved by climbing or descending to levels with the desired wind direction.

Safety analysis

Weather conditions on the day of the incident

The operator advised that they relied on weather models for the local area and that when the balloons launched at about 0540, the surface temperature was 22°C. The pilot of OKX stated that at about 0600, and 2,500 ft, some 20 minutes after the balloons launched, the air temperature measured from the balloon basket increased to 29°C. The operator assessed that, as a consequence, the sudden increase in temperature near the surface penetrated an inversion layer. He further concluded that situation resulted in the mixing of wind layers above and below the balloon, resulting in turbulence, and a rapid change in wind speed and direction.

However, a review of the GPWT and GAF forecasts for the area indicated that the air temperature was forecast to be about 30°C, at 2000 ft, at the time of the flight. The temperature was consistent with the balloon pilot's observed air temperature, when OKX was at 2,500 ft. Further, the GPWT forecast at 0200 and 0500 showed winds speeds increasing over time and with altitude. Based on the forecast conditions, the ATSB concluded that the encountered turbulence was probably the result of mechanical effects associated with strong winds rather than the result of penetrating an inversion layer.

More significantly, a review of the forecast weather conditions, consistent with the AIP requirements, would have identified the likelihood of the flight encountering strong winds and severe turbulence. In that context, the ATSB considers that the exposure of the pilots and passengers to hazardous weather conditions during the flight, and the injuries sustained during the landing, were avoidable.

Layover landings in strong winds

In light winds, the basket normally remains upright on landing. However, in winds greater than about 10 kt, layover landings can occur. During these landings the basket tips onto its side and is dragged until the balloon envelope deflates. The baskets are designed to withstand these type of events and have padding and grab handles on the inside of the basket for occupant protection and support. Layover landings, although undesirable, are not unusual and should not significantly increase risk, provided they are prepared for and executed appropriately in a suitable landing area.

OKX landed at a ground speed of about 20 kt. At that speed the pilot needed an approximate clearing of about 200 m to land the balloon safely, allowing for a significant stopping distance. Based on the safe landings executed by two other company balloons, the clearing selected was suitable with the exception of the large bush that was struck by the basket.

As the basket landed, the balloon envelope started to drag the basket (on its side) across the terrain (Figure 2). Between the vent outlet and top of the balloon, a 5-6 m bubble of hot air remained, and the balloon envelope started to act like a sail, further dragging the basket. This also changed the direction of the basket and it was dragged towards a bush. The right hand side of the basket struck the bush, bouncing it forcefully back into the air. It subsequently came down on one corner and was dragged a further 50-60 m before coming to rest.

The landing site was largely cleared and the pilot had landed the balloon with clear ground in the direction of travel. However, the direction of drag changed, which resulted in the collision with the bush. When the basket collided with the bush and became airborne, the subsequent ground impact resulted in four injuries.

Findings

These findings should not be read as apportioning blame or liability to any particular organisation or individual.

- Shortly after take-off, the balloon experienced strong winds and turbulent conditions, as predicted in the Bureau of Meteorology graphical area forecast and grid point winds and temperature forecast. Consequently, the balloon deviated from its intended flight path and landing area. Due to the adverse conditions, the pilot decided to land at the first suitable site, which was a clearing that was unfamiliar to him.
- Due to the wind conditions, the balloon landed with a significant forward velocity and was dragged for a considerable distance on its side by the balloon's partially deflated envelope. As the basket was being dragged, it struck a large bush, forcing it upwards before impacting the ground with considerable force that resulted in injuries to four of the passengers.

Safety action

Whether or not the ATSB identifies safety issues in the course of an investigation, relevant organisations may proactively initiate safety action in order to reduce their safety risk. The ATSB has been advised of the following operator safety actions in response to this occurrence.

Operator actions

The operator advised the ATSB that the following lessons were learnt from this occurrence:

- Future flights at Whittingham will need another weather check to be carried out at a more elevated location to gain a better perspective of surface winds and temperature changes.
- Pressure dropping to 1,000 hPa and below is an indication of changing weather conditions and should be taken into strong consideration when making a decision to fly.
- The area south of Greta was the first large open area to land. Another very large landing area at a lower elevation has been identified for use should there be another weather event.

- Elderly passengers will be positioned in compartments with more people to restrict the potential for flail-type injuries.

Safety message

This accident highlights the importance of studying all available weather information when preparing for a flight. In this instance the aviation-specific products generated by the Bureau of Meteorology clearly identified the presence of weather that was hazardous to balloon operations.

General details

Occurrence details

Date and time:	13 January 2018, 0620 EDT	
Occurrence category:	Accident	
Primary occurrence type:	Hard landing	
Location:	4 km south of Greta, New South Wales	
	Latitude: 32° 42.7' S	Longitude: 151° 23.0' E

Aircraft details

Manufacturer and model:	Kavanagh B-425	
Registration:	VH-OKX	
Operator:	International Balloon Flight Company	
Type of operation:	Commercial	
Persons on board:	Crew – 1	Passengers – 15
Injuries:	Crew – 0	Passengers – 4
Aircraft damage:	Nil	

About the ATSB

The ATSB is an independent Commonwealth Government statutory agency. The ATSB is governed by a Commission and is entirely separate from transport regulators, policy makers and service providers. The ATSB's function is to improve safety and public confidence in the aviation, marine and rail modes of transport through excellence in: independent investigation of transport accidents and other safety occurrences; safety data recording, analysis and research; and fostering safety awareness, knowledge and action.

The ATSB is responsible for investigating accidents and other transport safety matters involving civil aviation, marine and rail operations in Australia that fall within Commonwealth jurisdiction, as well as participating in overseas investigations involving Australian registered aircraft and ships. A primary concern is the safety of commercial transport, with particular regard to operations involving the travelling public.

The ATSB performs its functions in accordance with the provisions of the *Transport Safety Investigation Act 2003* and Regulations and, where applicable, relevant international agreements.

The object of a safety investigation is to identify and reduce safety-related risk. ATSB investigations determine and communicate the safety factors related to the transport safety matter being investigated.

It is not a function of the ATSB to apportion blame or determine liability. At the same time, an investigation report must include factual material of sufficient weight to support the analysis and findings. At all times the ATSB endeavours to balance the use of material that could imply adverse comment with the need to properly explain what happened, and why, in a fair and unbiased manner.

About this report

Decisions regarding whether to conduct an investigation, and the scope of an investigation, are based on many factors, including the level of safety benefit likely to be obtained from an investigation. For this occurrence, a limited-scope, fact-gathering investigation was conducted in order to produce a short summary report, and allow for greater industry awareness of potential safety issues and possible safety actions.