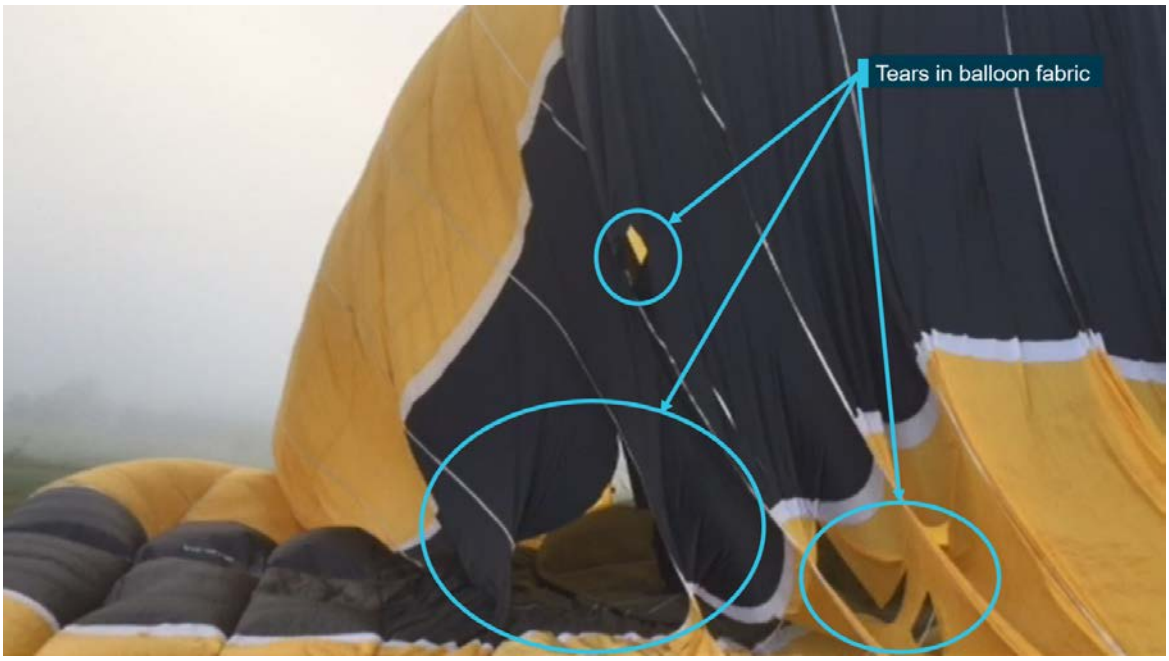
Australian Government
Australian Transport Safety Bureau

Controlled flight into terrain involving Kavanagh Balloons G-525, VH-HVW

Pokolbin, New South Wales, on 30 March 2018



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Addendum

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Safety summary

What happened

At about 0710 Eastern Daylight-saving time[1] on 30 March 2018, a Kavanagh Balloons G-525 balloon, registered VH-HVW (HVW) and operated by The International Balloon Flight Company (Australia), launched from a site near Pokolbin, New South Wales for a planned 1-hour scenic flight. HVW was one of three balloons launched by the company from the same site. After climbing through fog to about 2,000 ft and realising how far the fog layer extended, the pilot of HVW, along with the other two pilots, decided to abort the flight and descend for a landing at the nearest suitable site. On approach to land in low-visibility conditions, HVW collided with trees, which caused the basket to rotate 180 degrees. It then landed heavily, resulting in injuries to 16 of the 24 passengers, 3 of them serious. The pilot was uninjured and 74 of the balloon's panels required patching or repair.

What the ATSB found

The three pilots decided to launch despite forecast fog and the development of fog at the launch site, without an awareness of its extent. This resulted in the balloons being above a layer of fog through which they had to descend.

The descent in low-visibility conditions diminished the pilot of HVW's ability to see trees in the approach path. This, combined with a 12 kt wind at the landing site, resulted in the pilot having insufficient time to manoeuvre the balloon to climb above the trees after sighting them.

More generally, the visual flight rules permitted balloons to arrive and depart in foggy conditions without assurance that sufficient visibility existed to see and avoid obstacles.

The pilot and ground crew did not follow the operator's documented emergency procedures to not move injured passengers after the accident, increasing the risk of exacerbating their injuries.

What's been done as a result

The balloon operator amended their operations manual to include pilot actions in the event of extensive fog or low cloud forming after take-off. They also added fog as a local known hazard to their Hunter Valley operations, describing where fog is likely to occur and the best vantage point from which to assess its development.

The Civil Aviation Safety Authority (CASA) has drafted an advisory circular (AC) to provide guidance for balloon operators and pilots regarding weather assessment and low-visibility operations. CASA intends to publish the AC in 2020.

Finally, the ATSB has issued a recommendation that CASA undertake a risk assessment of the reduced visibility exemption to the visual flight rules for balloons, to determine whether it is adequately safe.

Safety message

It is vital that pilots obtain a full appreciation of the weather for the duration of the planned flight from the Bureau of Meteorology, which is the approved source of aviation meteorology products. The ultimate responsibility for a pilot's decision on whether to launch or not (go/no-go decision) rests with the pilot. This decision needs to address factors and limitations related to the pilot, balloon, environment and operation.

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

CASA has issued a Civil Aviation Advisory Publication that encourages balloon operators to train and assess ground crew members in accordance with the requirements for flight crew. This would assist operators to assure that all crewmembers meet a competency standard documented in their emergency procedures on a periodic basis.

Contents

The occurrence

What happened

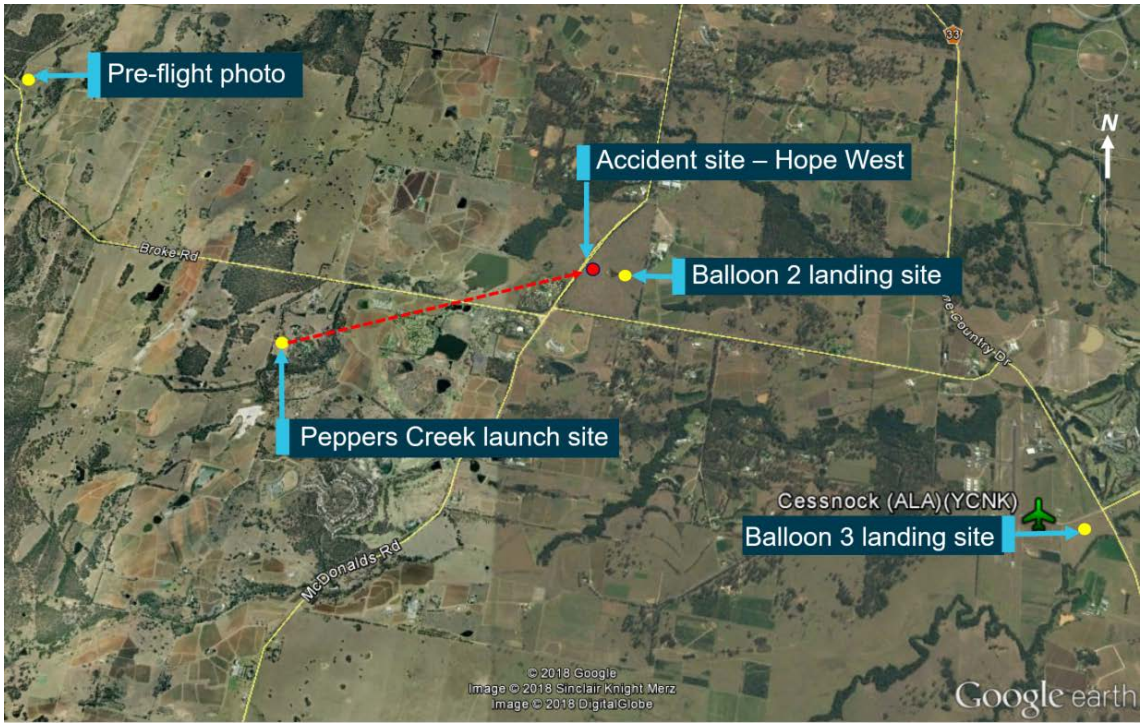
Early on the morning of 30 March 2018, the senior base pilot, acting as the duty pilot of The International Balloon Flight Company's Hunter Valley operation, prepared for the morning's operations. The senior pilot was to conduct a 1-hour scenic balloon flight together with two other balloons operated by company pilots.

The pilots reported reviewing the forecast and actual weather conditions from three different sources and assessed the conditions as suitable for the flight. The pilot of one of the balloons, a Kavanagh Balloons G-525, registered VH-HVW (HVW), reported noting at the time that the temperature and dewpoint[2] were very close, which can be conducive to the formation of fog.

At about 0500 Eastern Daylight-saving Time,[3] the pilots met and briefed their passengers in Pokolbin, New South Wales. There were 24 passengers for HVW, and 19 and 20 passengers each for the other two balloons. A pibal[4] was launched to assess the wind direction and strength, and the visibility. All three pilots reported that the sky was clear at that time.

The pilots and passengers were then transported by bus to a possible launch site, where a second pibal was launched. Based on the wind conditions, the pilots elected to continue to a third site (Peppers Creek) and after launching a third pibal, decided they would launch the balloons from there (Figure 1). At Peppers Creek, the pilots completed their briefing of the passengers. This included a demonstration of the position to be adopted for landing. The passengers were then required to demonstrate that they could assume the correct position.

Figure 1: Map of the area showing launch and landing sites



Source: Google Earth annotated by ATSB

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2 Dewpoint: the temperature at which water vapour in the air starts to condense as the air cools. It is used, among other things, to monitor the risk of aircraft carburettor icing or the likelihood of fog.

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

4 A pibal is a pilot balloon filled with helium, which has an LED light attached. It is used to indicate wind direction and speed and visibility.

The pilots reported that the sky was still clear at Peppers Creek when they started to inflate the balloons, but that some light mist was rolling in. The senior base pilot drove to a location about 3.5 km to the north-west to assess the conditions in the area. He took a photo (Figure 2), which he sent to the other two pilots showing it was 'clear'. Following receipt of this, and on the senior base pilot's experience of the weather in the area, they elected to launch the three balloons from Peppers Creek.

Figure 2: Photos taken by senior base pilot prior to launch

Source: Provided to ATSB

At about 0704, HVW lifted off and the other two balloons followed soon after. The pilot of HVW reported that there was a thin layer of low cloud but the visibility was adequate. Photos provided by the passengers showed fog in the area during and just after launch (Figures 3a and 3b).

Figure 3a: View of company balloons from VH-HVW, airborne at about 0704

Figure 3b: View from VH-HVW shortly after take-off

Source: Provided to ATSB

The balloons climbed above the fog to about 2,000 ft above mean sea level (AMSL). The pilot of HVW reported that the low-level cloud was rolling in from the north and getting thicker. About 10 to 15 minutes after take-off, the senior base pilot radioed the other two pilots to advise them to abort the flight. All three pilots decided to land as soon as practicable, as the conditions were worsening.

The pilot of HVW commenced descent, aiming to land at a landing site known as Hope West, at an elevation of about 300 ft AMSL. At 0717, as the balloon descended, the pilot received a phone

call from the pilot of another local balloon operator asking whether the conditions were suitable for flight. He responded in the negative and the other pilot elected not to launch.

As HVW descended below about 900 ft AMSL, it entered cloud. The pilot was unable to see the ground and used the map on his iPad to locate his planned landing site. During this time, he reported maintaining a descent rate of about 100 ft per minute with reference to the balloon's vertical speed indicator. He sighted the ground when about 100 ft above it, and levelled the balloon out. The pilot could see a tank, which was also represented on the iPad map. From this, he was able to determine that the clearing he was aiming for was about 100 m ahead, across a road bordered by trees.

The pilot estimated that his visibility at that stage was about 5 m and that the balloon was travelling at about 12 kt. He also reported finding the motion of the cloud very disorientating. He reported by this point he had briefed passengers to pack away equipment and get into the landing position they had been previously shown on the ground.

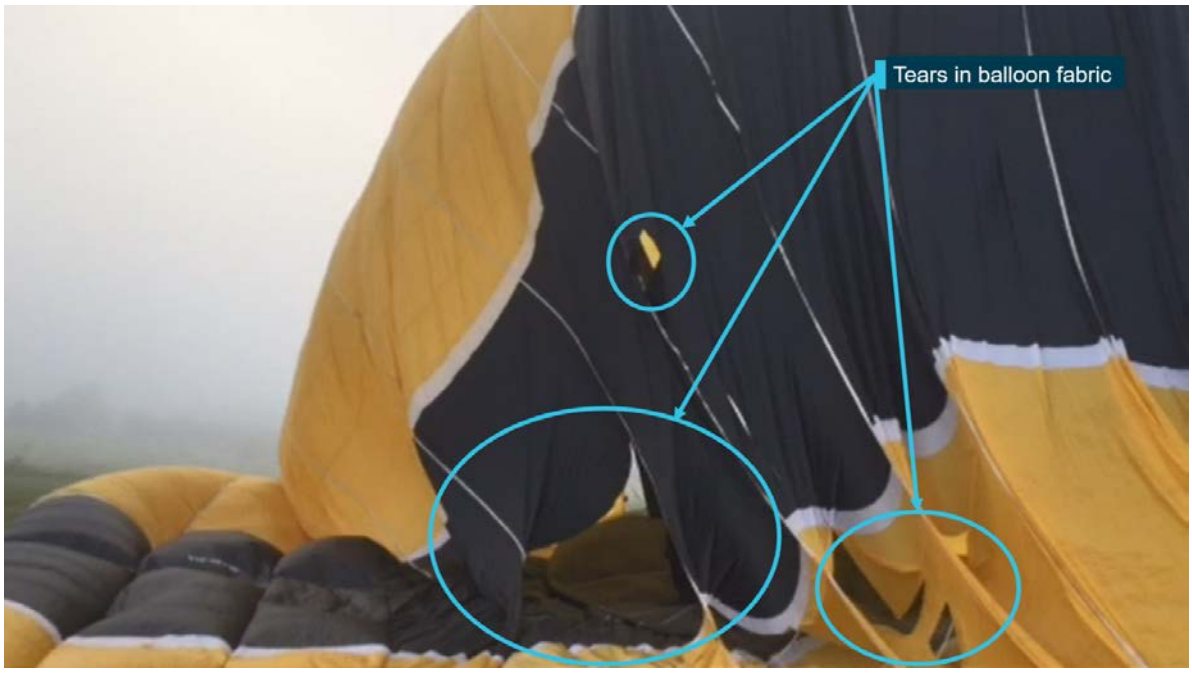
At about 50 ft above the ground, a number of passengers sighted a road and trees ahead and called out a warning to the pilot. The pilot saw the trees and reported activating full burners to try to climb above them, however he was unable to prevent a collision. The collision resulted in several large tears to multiple panels of the balloon fabric in the lower section of the balloon envelope. The impact with the trees also resulted in the basket rotating 180 degrees.

The pilot called out to the passengers to brace for landing. At about 0728, the balloon landed heavily, beyond the trees with the basket upright. All of the occupants were facing forwards in the direction of travel as the balloon contacted the ground, instead of the normal rearwards-facing landing position.

Sixteen passengers were injured in the landing, three of them seriously. The balloon was substantially damaged, requiring repairs to the fabric of the balloon envelope (Figure 4).

The second company balloon landed without incident, about 10 minutes later in the same clearing, but a few hundred metres beyond HVW. The senior base pilot landed his balloon, also without incident, near Cessnock Airport.

Figure 4: Damage to balloon VH-HVW



Source: Provided to ATSB

Post-accident actions

After landing, the pilot and ground crewmember reported that they assessed the passengers, and as they were walking around, determined that no one was seriously injured and there was no need to call an ambulance. The ground crewmember also reported that they offered to call an ambulance but that passengers declined. However, passengers reported having requested an ambulance, but that one had not been called.

Passengers also reported that the balloon basket had to be laid on its side to aid an injured passenger who was unable to exit the basket themselves. One of the passengers, who was a medical doctor, tended to a passenger with an injured ankle, and had also been aware of another passenger with a sore back who had walked to the ground crew car.

The ground crewmember transported three passengers to Cessnock Hospital (district hospital) in the ground crew car. Two of those had sustained spinal injuries and were transferred to John Hunter Hospital (a major hospital).

The company took the remaining passengers who were not transported in the ground crew car to the breakfast location by bus. Following arrival at this location, some passengers chose to drive themselves to seek medical assistance. In addition, venue and balloon company staff provided first aid to other passengers at the breakfast venue.

Context

Pilot information

The pilot held a commercial pilot licence (balloon) issued in 1997 and a Class 2 medical certificate valid until August 2020. He had accrued a total of 3,120 balloon flying hours. The pilot had moved to the Hunter Valley to work for the operator 6 months prior to the accident, having previously operated in Central Australia. After commencing in the Hunter Valley, the pilot had accrued a total of 25 hours on the balloon type, 15 of those 25 had occurred in the 90 days prior to the accident.

Operator information

The International Balloon Flight Company operated 11 balloons from three locations – Hunter Valley, Mudgee and Camden, NSW. The company operated under the names Balloon Safaris, Hunter Valley Ballooning and Balloon Aloft (Hunter Valley and Camden).

The balloons operated by the company include Kavanagh 84, 105, 240, 350, 400 and a G-525. About 14,000 passengers were carried in the 12 months prior to the occurrence, which had increased from 8,000-9,000 per year previously.

The chief pilot for the Hunter Valley operation was also the chief pilot for the Sydney base. The Hunter Valley operation was supervised by the senior base pilot, who was also the company director.

Balloon information

VH-HVW was a Kavanagh Balloons G-525 balloon (Figure 5). It had a volume of 14,866 cubic metres (525,000 cubic feet) and the capacity to carry a pilot and 24 passengers. The basket was a double tee basket (Figure 6), 1.6 m by 5.6 m in dimension. The operator's first recorded flight in the balloon was on 10 December 2017. The balloon had a total of 48.8 flight hours.

The balloon had a *Lite Vent* deflation system and rotation vents. Rotation vent lines enable the pilot to open rotation vents that rotate the balloon in either direction. Using the vent lines, the pilot can orientate the long side of the basket across the direction of travel for landing, with the passengers facing rearwards.

Figure 5: VH-HVW

Figure 6: Double tee basket

Source: Kavanagh Balloons

Aircraft equipment requirements

Civil Aviation Order 20.18 Appendix X contained the list of equipment required for manned free balloons operated under the visual flight rules. The relevant mandatory flight and navigational instruments for the accident flight included:

- an altimeter
- a time piece (a watch was considered acceptable)
- a vertical speed indicator
- a free air temperature indicator and an envelope temperature indicator
- a magnetic compass
- maps and charts
- VHF radio communication.

These provided limited aids to a pilot in non-visual conditions. Each of the three company pilots who flew on the accident morning carried a personal electronic device with a moving map application. This provided a line depicting the balloon's track and a Google Earth image. It is possible for a pilot to overlay known powerlines on the application, but the pilot of HVW had not done so.

There was, however, no requirement for a pilot to carry a moving map application. Nor was there any training or assessment of a pilot's capability to use these tools. The senior base pilot was very experienced at using the application to operate in low visibility conditions and had reportedly trained the other company pilot in doing so, but not the pilot of HVW.

Weather and environmental information

Forecast conditions

The pilot of HVW reported using three different 'weather models' to assess the conditions prior to launch: Weatherzone, Windyty and the Bureau of Meteorology, and that fog had not been forecast. The senior base pilot also stated that the area forecast did not show fog in their area. He had met the other pilots at about 0430 but had not subsequently confirmed what time the weather forecast was obtained that morning. The pilot of HVW had noted the temperature and dewpoint were 'getting very close' and they had had quite a bit of rain so there was moisture on the ground, which 'could have been an indicator'.[5]

In discussing preparation for flight, the Airservices Australia Aeronautical information publication, *En Route 1.10 Flight planning, Flight plan preparation*, stated:

> 1. Before beginning a flight, the pilot in command must study all available information appropriate to the intended operation, and, in the cases of flights away from the vicinity of an aerodrome…must make careful study of:
>
>   a. current weather reports and forecasts for the route to be followed and at aerodromes to be used…

The minimum information required was a graphical area forecast and a grid point wind and temperature forecast.

[5] A decrease in the temperature/dewpoint spread to 0 °C indicates increasing fog density or likeliness of fog.

The Bureau of Meteorology graphical area forecast, issued at 0322 on 30 March and valid from 0400 to 1000, included visibility reducing to 500 m in scattered[6] fog over land, and broken[7] stratus clouds with bases at 1,500 ft above mean sea level (AMSL) and tops at 4,500 ft.

The grid point wind and temperature forecast valid at the time of the flight for 1,000 ft AMSL included north-north-easterly winds at 6 kt and temperature 20 °C, and at 2,000 ft, north-easterly winds at 5 kt and temperature 21 °C.

The aerodrome forecast (TAF)[8] for Williamtown, 49 km east of the accident site, current at the time of launch included scattered cloud at 1,500 ft above ground level (AGL), north-westerly wind at 5 kt, a temperature of 19 °C and a 30 per cent probability of fog with broken cloud at 200 ft AGL between 0500 and 0900.

The TAF for Maitland, 18 km east-north-east of the accident site, current at the time of launch, included variable wind at 3 kt, fog with visibility 500 m and broken cloud at 200 ft AGL, with the wind becoming west-north-westerly at 5 kt and scattered cloud with base at 2,500 ft AGL between 0700 and 0900.

Recorded weather observations

At 0700, the meteorological observation for Cessnock aerodrome was nil wind, temperature and dewpoint 15 °C and for Maitland was nil wind, overcast at 400 ft AGL and temperature and dewpoint 19 °C. Special Reports (SPECIs) rather than routine reports (METAR) [9] had been issued for Maitland (at least every half hour from 0300 to 1100 EDT), Williamtown (from 0612 to 1100) and Merriwa (from 0431 to 0945) aerodromes because visibility and/or cloud were below specified criteria.

Satellite imagery showed low cloud and fog developing from 0200 in a south-easterly band from Scone to Williamtown and becoming more extensive until it started to dissipate after 0900. Figure 7 shows the fog and low cloud in the area at 0700.

The Bureau of Meteorology reported that ‘the relevant forecasts were consistent with the likely weather conditions in the area of the incident.

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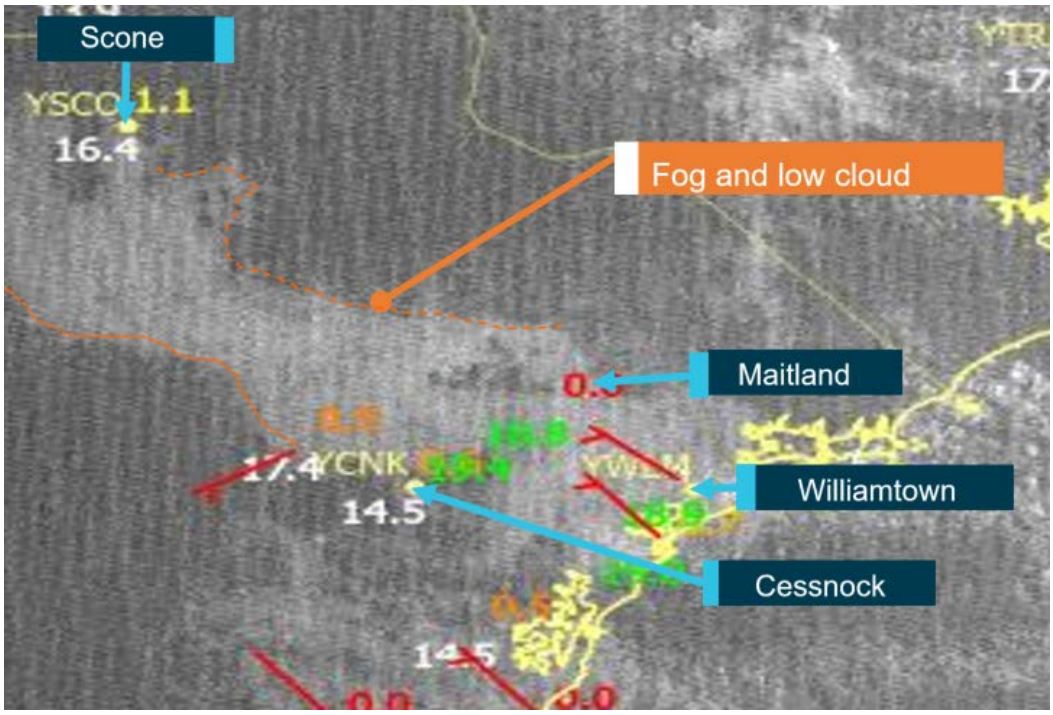
6 Weather coverage amount (for all phenomena except thunderstorms): In aviation, an area of weather should be considered Scattered if, it consists of well separated features which affect, or are forecast to affect, an area with a maximum spatial coverage greater than 50 per cent but not more than 75 per cent.

7 Cloud cover: in aviation, cloud cover is reported using words that denote the extent of the cover – few indicates that up to a quarter of the sky is covered, scattered indicates that cloud is covering between a quarter and a half of the sky, broken indicates that more than half to almost all the sky is covered, and overcast indicates that all the sky is covered.

8 A TAF is a coded statement of meteorological conditions expected at an aerodrome and within a radius of five nautical miles of the aerodrome reference point.

9 Aerodrome weather reports of visibility, weather and cloud observations at an aerodrome issued half hourly or when conditions change.

Figure 7: Satellite imagery showing a band of fog and low cloud at 0700



Source: Bureau of Meteorology annotated by ATSB

Pilot weather observations

The pilot reported that the cloud/fog layer was about 350-400 ft thick and about 40-50 ft beneath it was clear above the ground. The senior base pilot reported descending through cloud between 1,000 ft and 500 ft, with the cloud base about 500 ft AMSL. Once he got below 500 ft AMSL, his visibility was 'pretty good' and he flew on for another 15 minutes. He then landed near Cessnock Airport, which was 100-150 ft lower in elevation than HVW's landing site, and he had about 300 ft visibility below the cloud base. He did not communicate this as a better landing option with the other pilots.

The pilot of HVW estimated the low-level wind was about 10-12 kt on landing. Although he had a GPS and an iPad on board, these reportedly did not record the flight, so the speed on landing could not be verified. The senior base pilot estimated that the wind was about 11 kt when he landed.

Weather decision-making

Interpretation of weather conditions expected for a flight is important for a pilot's go/no-go decision making.

> Without a complete picture of the weather, a pilot may make an ill-advised decision to launch that may result in injury, damage to the balloon, or worse. It is imperative that a pilot use as many resources as he can, understanding the variables potentially affecting flight, and making an informed decision to conduct a safe flight.[10]

The International Balloon Flight Company operations manual A 1.6 stated that the pilot in command (PIC) 'for any flight shall have the absolute discretion as to whether he will fly or not.' Section C 4.6 stated that: 'Prior to any flight the PIC must obtain the relevant weather information for the period of the flight from the [Bureau of Meteorology] BoM' and that they 'shall use this information together with his own test balloon, local knowledge and general observations to make the go/no-go decision.'

[10] United States Federal Aviation Authority's Balloon Flying Handbook Chapter 4.

The criteria for no-go decision in the operations manual were:

- Balloons must not be flown free or tethered in winds greater than 15 knots (surface) nor if there is any extensive thermic or cumulonimbus activity...No flight is permitted if thunderstorms are present.
- Operations shall normally only be conducted in [visual meteorological conditions] VMC or special VMC as specified for balloons in the [aeronautical information publication] AIP. In the event that conditions deteriorate below VMC during flight a landing shall be made as soon as it is possible to do so safely.

Visibility requirements

Visual flight rules require flights to be conducted in visual meteorological conditions. These conditions were specified in Airservices Australia Aeronautical Information Publication (AIP). In Class G airspace these were:

- for aircraft operating below 10,000 ft AMSL, flight visibility of 5,000 m, and 1,000 ft vertically and 1,500 m horizontally from cloud
- at or below the higher of 3,000 ft AMSL or 1,000 ft AGL, flight visibility of 5,000 m, and the aircraft was required to remain clear of cloud and in sight of ground or water.

There were exemptions for helicopters operating below 700 ft and two exemptions for balloons. The exemptions for balloons were:

- Below 1,500 ft above ground or water, 5,000 m flight visibility was required, and the balloon was to remain clear of cloud. However, no vertical clearance from cloud below the balloon was required, provided that the top of the cloud was at or below 500 ft above ground or water, and the balloon was at least 10 NM from an aerodrome with an approved instrument approach procedure.
- Below 500 ft above ground or water, the minimum flight visibility required was 100 m and no distance from cloud was specified, and the balloon was required to be at least 10 NM from an aerodrome with an approved instrument approach procedure.
- Relevant to the accident flight, the launch site at Peppers Creek was about 11 NM from Maitland Airport, which had an instrument approach procedure, and the landing site was about 10 NM from Maitland Airport. Cessnock Airport, although closer, did not have an instrument approach.

There were no similar exemptions to visual flight rules for balloons in New Zealand, the United Kingdom (UK), United States or Europe. The UK Civil Aviation Authority advised that 'All balloons in the UK, including commercial balloons fly within VFR, there is no exemption for balloons to have a reduction in visibility when compared to other aircraft. Standardised European Rules of the Air apply.'

The ATSB asked the Civil Aviation Safety Authority (CASA) to provide historical documentation relating to the exemption to the VFR and associated risk assessment. In response, CASA provided documentation that showed the exemption appeared in the AIP in 1999, which was the oldest archived AIP. CASA advised that there was ‘some reference to a process in 1996 and 1992, but no documents to support any rationale for the exemption being created.’

CASA further advised that balloon operators should make an assessment as to whether 100 m visibility was safe for the proposed balloon flight. However, that was not a stated VMC condition.

Balloon climb performance

The Kavanagh G-525 balloon was certified in accordance with the British Civil Airworthiness Requirements Part 31 – *Manned free balloons*. Included in these requirements were:

> 31.17 **Performance: climb**
>
> a) Each balloon must be capable of climbing at least 300 feet in the first minute after take-off with a steady rate of climb. Compliance with the requirements of this paragraph must be shown at each altitude and ambient temperature for which approval is sought.
>
> b) Compliance with the requirements of paragraph a) of this section must be shown at the maximum weight with a weight tolerance of +5%.

and

> 31.20 **Controllability**
>
> The applicant must show that the balloon is safely controllable and manoeuvrable during take-off, ascent, descent, and landing without requiring exceptional piloting skill.

The flight test report for a G-525 balloon included climb performance results for three tests. All tests demonstrated that the balloon met the specified criteria and climbed to 300 ft between 42.8-48.5 seconds. The climbs were initiated from 'neutral buoyancy' (vertically stationary) using all four available burners. All three tests demonstrated that for about the first 10 seconds, no climb was achieved and the balloon climbed to 100 ft in 27-30 seconds from full burner activation.

For comparison, Kavanagh also provided the flight test report for an EX-77 (77,000 cubic feet volume) high performance sport balloon. In the flight testing, as for the G-525 balloon, it took about 10 seconds before any altitude gain occurred and about 30 seconds for the balloon to climb 100 ft from full burner activation.

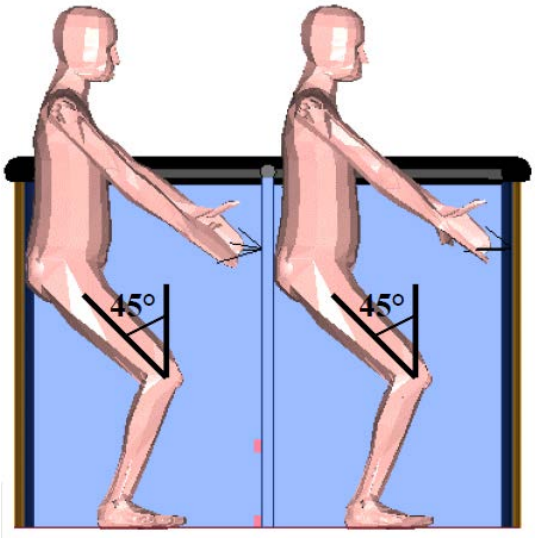
Kavanagh advised that these results were consistent for balloons of all volumes and there was always a period of about 10 seconds with very little altitude gain. Additionally, if the balloon is in a descent rather than in neutral buoyancy, then initiation of the climb will be significantly delayed.

If there is a wind, a balloon may drift unavoidably towards an obstacle. Based on taking 30 seconds to linearly climb to 100 ft (with no climb for the first 10 seconds), if an obstacle 50 ft high (consistent with obstacle consideration for aeroplane approach and departure) is sighted 100 m away while the balloon is close to the ground and a climb commenced to avoid it, the balloon will not clear that obstacle if the wind is greater than about 10 kt. In a descending balloon, as the lag before any climb starts is approximately doubled, a wind speed above about 6.5 kt will result in collision with a 50 ft obstacle. As balloons actually climb to 100 ft at an accelerating rate, in practice initiation of a climb from low level in wind strengths below these values could still result in collision with a 50 ft obstacle. The time taken to react and initiate the climb will also aggravate the situation.

Landing position and injuries

The landing position briefed to the passengers was the position recommended by the United Kingdom Civil Aviation Authority (Figure 8). From the research conducted to support this recommendation, any position other than the recommended position, with all occupants facing backwards, is likely to increase the risk of injuries.

Figure 8: Landing position – knees bent and holding onto handles



Source: Kavanagh Balloons

Emergency procedures

The company's general emergency management procedures, which applied to pilots and ground crew, required them to call an ambulance while administering first aid, if anyone was injured during the balloon flight. It stated that passengers were not to be transported to medical facilities in ground crew vehicles.

Related occurrences

On 13 January 2018, during landing in windy conditions, a Kavanagh Balloons B425, VH-OKX, also operated by The International Balloon Flight Company (Australia), landed hard and struck vegetation, resulting in a serious injury to one passenger.

The ATSB investigation into that occurrence (AO-2018-004) found that '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 wind and temperature forecast. Consequently, the balloon deviated from its intended flight path and landing area.' The safety message highlighted the importance of studying available weather information when preparing for a flight.

The operator advised the ATSB that the following lessons were learnt from that occurrence. These had not been incorporated in the operations manual at the time of the March 2018 accident, but were not relevant to that 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.

Post-accident surveillance

The CASA conducted surveillance of the balloon operator after the accident on 30 March 2018. They found that there was a 'Lack of operational guidance material for the operational bases including having minimum weather criteria for departure. The guidance needs to include wind,

visibility and cloud base. Guidance is also required for operating within the vicinity of 10 nm of aerodromes with a published instrument approach.'

Safety analysis

Introduction

Adequate weather planning is essential for safe ballooning operations, including to ensure the pilot is able to see and avoid obstacles during landing. Balloon pilots must ensure weather conditions are compatible with the limitations of balloon manoeuvrability. This analysis details the pilots' decision to conduct the flight based on the assessment of the forecasts they obtained, and the observed weather conditions. Additionally, the effects of the impact with trees on the passenger injuries will be considered.

Pre-launch weather assessment

The company pilots reported using several weather models to assess the conditions prior to the launch. They did not identify any fog forecast, although the pilot of VH-HVW (HVW) noted that the conditions could be conducive to fog formation. This differed from the Bureau of Meteorology forecast of scattered fog with visibility of 500 m from 2 hours prior to the time of the launch. Conditions conducive to the formation and increasing density of fog were also forecast, and observations at the time from three aerodromes in the area included reduced visibility and low cloud. It was not possible to reconcile the differences between the pilots' recollection of the forecast and the Bureau of Meteorology forecast.

After assessing the conditions at the proposed launch site, the senior base pilot travelled to a location north-west of the launch site to assess the weather and visibility. Following this assessment and on the senior base pilot's experience of the weather in the area, the pilots elected to go ahead with the launch. Fog was present at the time of the launch and the balloons climbed through the fog layer. The fog extended eastwards to the coast, without the breaks that could be expected based on the forecast 'scattered' fog, however, the pilots were not aware of its extent when they launched.

Despite fog and visibility of about 100 m at the launch site, the pilot of HVW, along with the two other company pilots, decided to launch their balloons, resulting in a climb through a layer of fog, unaware how far it extended.

Descent and approach to landing site

Having climbed above the layer of fog, the pilot of HVW realised its extent and, along with the advice from the senior base pilot to abort the flight, decided to land as soon as possible at the nearest known landing site. The pilot assessed that the selected landing site was his best option, due to the extent of the fog and in the direction of the wind. A second pilot also elected to land in the same field, while the senior base pilot continued on for about 10 minutes to land near Cessnock Airport, where the ground was lower and there was more clearance between the ground and the cloud base.

With almost zero visibility, the pilot of HVW conducted the descent with reference to the balloon instruments to control the rate of descent, and used a map on his iPad to locate the approach to the landing site. However, he was unable to assess the balloon's height above ground level (AGL) because the balloon's altimeter displayed its height above mean sea level (AMSL) and he did not have the reference height of the landing site AMSL.

Approaching the site, the balloon encountered a wind strength of about 12 kt. While the pilot applied full burners when he sighted the trees, due to the limited manoeuvrability of the balloon, it was too late to climb above the trees. The low-level wind and low visibility diminished the pilot's ability to see, and act with sufficient time, to avoid obstacles.

Impact sequence

The balloon basket was designed with handles on one side and padding on the other to provide support for passengers on landing. The impact with the trees resulted in the basket rotating 180°, and the pilot was unable to turn the basket back to the correct position before the balloon landed hard. Landing facing the wrong way affected the passengers' ability to brace and therefore likely contributed to the extent of injuries they sustained. This is consistent with the research from the United Kingdom Civil Aviation Authority, which showed the safest landing position was to have passengers' backs toward the direction of travel.

Visual meteorological conditions for balloons

Under an exemption to the visual flight rules, balloons were permitted to operate in visual meteorological conditions with a minimum of 100 m visibility below 500 ft above ground level, providing certain criteria were met. While this exemption had been in place in Australia for over 20 years, the ATSB found no similar rule in other International Civil Aviation Organisation States and the Civil Aviation Safety Authority was unable to provide any documented assessment of the collision risk associated with this exemption, despite it permitting approach and departure in fog.

The rule permitted the pilots to launch the balloons in the conditions experienced prior to the accident flight. The senior base pilot's assessment that the visibility was legal at the time of the launch, indicates that the rule may have influenced their decision to launch.

When the pilot of HVW approached to land, the visibility, in combination with the 12 kt wind, was insufficient to manoeuvre the balloon from descent to out-climb trees about 100 ft high.

More generally, analysis of balloon climb performance indicated that 100 m visibility is unlikely to be adequate to manoeuvre a balloon to avoid obstacles if they are sighted from that distance at low level, except in light wind conditions. While fog formation is generally associated with light winds, on this occasion the wind strength was assessed to be 12 kt (within the operating limits of the balloon). Additionally, while helicopters are also permitted to operate in reduced visibility conditions, in those circumstances they are also required to maintain a forward speed that allows obstacle avoidance. No such collision risk control is possible in a balloon.

Therefore, the 100 m visibility rule permitted balloons to operate in conditions that did not assure sufficient visibility existed to see and avoid obstacles.

Emergency procedures and handling of passengers

The operator's emergency procedures required ground crew or pilots to contact emergency services if anyone was injured, but in this case this did not occur. Despite their injuries, the passengers were all able to walk. This probably influenced the ground crew's decision to drive three injured passengers and their support people to hospital in the ground crew vehicle, rather than call to request an ambulance.

The emergency procedures also stated that no person with an injury should be transported to hospital by the ground crew. Two of these injured passengers were later diagnosed with spinal fractures. Moving a patient with suspected spinal injuries can worsen their condition. In this occurrence there was no evidence that passenger injuries were affected by the actions following this accident.

Findings

From the evidence available, the following findings are made with respect to the controlled flight into terrain involving Kavanagh Balloons G-525, registered VH-HVW that occurred in Pokolbin, New South Wales, on 30 March 2018. These findings should not be read as apportioning blame or liability to any particular organisation or individual.

Safety issues, or system problems, are highlighted in bold to emphasise their importance. A safety issue is an event or condition that increases safety risk and (a) can reasonably be regarded as having the potential to adversely affect the safety of future operations, and (b) is a characteristic of an organisation or a system, rather than a characteristic of a specific individual, or characteristic of an operating environment at a specific point in time.

Contributing factors

- The decision to launch the balloons, including VH-HVW, in developing low-visibility conditions resulted in the balloons being above a layer of widespread fog, through which they had to descend.
- While on descent to land, the balloon encountered low-visibility conditions that reduced the pilot's ability to see and avoid obstacles. This, combined with the low-level wind, meant the pilot had insufficient time to avoid impacting the trees.

Other factors that increased risk

- **The visual flight rules permitted balloons to arrive and depart in foggy conditions without assurance that sufficient visibility existed to see and avoid obstacles. [Safety issue]**
- The pilot and ground crew did not follow the operator's documented emergency procedures after the accident, increasing the risk of exacerbating passenger injuries.

Safety issues and actions

The safety issue identified during this investigation is listed in the Findings and Safety issues and actions sections of this report. The ATSB expects that all safety issues identified by the investigation should be addressed by the relevant organisation(s). In addressing those issues, the ATSB prefers to encourage relevant organisation(s) to proactively initiate safety action, rather than to issue formal safety recommendations or safety advisory notices.

Depending on the level of risk of the safety issue, the extent of corrective action taken by the relevant organisation, or the desirability of directing a broad safety message to the aviation industry, the ATSB may issue safety recommendations or safety advisory notices as part of the final report.

The initial public version of these safety issues and actions are repeated separately on the ATSB website to facilitate monitoring by interested parties. Where relevant the safety issues and actions will be updated on the ATSB website as information comes to hand.

Balloon visual meteorological conditions

Number:	AO-2018-027-SI-01
Issue owner:	Civil Aviation Safety Authority
Operation affected:	Aviation: Charter – balloons
Who it affects:	All balloon operators of charter flights

Safety issue description:

The visual flight rules permitted balloons to arrive and depart in foggy conditions without assurance that sufficient visibility existed to see and avoid obstacles.

Response to safety issue and/or Proactive safety action taken by the Civil Aviation Safety Authority

In May 2020, in response to the draft ATSB report, the Civil Aviation Safety Authority (CASA) stated:

> CASA expects operators conducting operations in reduced visibility to have procedures to assess whether the conditions are safe in the planned operational area.
>
> CASA advised that it is currently drafting the [Civil Aviation Safety Regulations] Part 131 [Manual of Standards] MOS and related Advisory Circular (AC). The MOS will prescribe the requirements for flight preparation and weather conditions. As a Safety Issue has been identified, the AC will further support the MOS with recommendations on Operational Procedures for these special conditions.

CASA subsequently provided the ATSB with an extract of the draft AC, titled *Flight preparation – weather assessment,* which they intend to publish in 2020, prior to the implementation of Part 131. Regarding the reduced visibility rule, the draft AC stated:

> Pilots preparing to conduct a flight in areas and in conditions where fog limiting visibility is present, or which may form later, should conduct a risk assessment for the planned flight.

Further, it stated that:

> it is highly recommended that pilots and operators exercise this permission with appropriate caution and only where sufficient flight preparation has taken place.

The draft AC included the warning that ‘landing in fog can…be very dangerous and is not recommended’ and that there is ‘a long history of pilots and operators being caught out by changes in the fog that were not predicted.’

ATSB comment

The ATSB appreciates CASA's efforts in drafting the AC extract and notes that it contains useful information on the hazards of low visibility balloon operations. However, the ATSB is concerned that the value of the contained information may be limited as an AC is guidance material and not required to be read or followed by the balloon sector.

Additionally, while the draft AC highlights the inherent risk of low-visibility operations and advises individuals and operators to assess and manage that risk, there is limited detail on how to conduct such an assessment.

Additionally, balloon operators are not required to have a safety manager or safety management system, and will not be required to do so under the initial implementation of the proposed Part 131 regulations. Therefore, the emphasis in the draft AC on operators and pilots to conduct risk assessments, is not supported by a requirement to have appropriately-trained personnel and safety management practices.

Fundamentally, the ATSB remains concerned that, given the climb performance/profile of balloons, the current visual meteorological criteria for operation below 500 ft above ground level does not provide assurance that sufficient visibility exists to see and avoid obstacles.

This contrasts with all other current VMC criteria, which provide this assurance without any further required assessment or mitigation.

ATSB safety recommendation to the Civil Aviation Safety Authority

Action number: AO-2018-027-SR-044

Action status: Released

The Australian Transport Safety Bureau recommends that the Civil Aviation Safety Authority (CASA) undertake a risk assessment of the reduced visibility exemption to the visual flight rules for balloons, to determine whether it assures an adequate level of safety. Furthermore, that CASA publishes any required mitigating factors identified from the risk assessment that are necessary to operate safely in the reduced visibility conditions.

General details

Occurrence details

Date and time:	30 March 2018 – 0728 EDT	
Occurrence category:	Accident	
Primary occurrence type:	Controlled flight into terrain	
Location:	near Cessnock Aerodrome (Pokolbin), New South Wales	
	Latitude: 32° 47.25’ S	Longitude: 151° 20.5' E

Pilot details

Licence details:	Commercial Pilot (Balloon) Licence – issued August 1997
Endorsements:	Class 1-4 balloon
Ratings:	Night VFR
Medical certificate:	Class 2 – valid until August 2020
Aeronautical experience:	3,120 hours
Last flight review:	December 2017

Aircraft details

Manufacturer and model:	Kavanagh Balloons G-525	
Registration:	VH-HVW	
Operator:	International Balloon Flight Company	
Serial number:	G525-535	
Type of operation:	Charter – passenger	
Departure:	Peppers Creek, New South Wales	
Destination:	near Pokolbin, New South Wales	
Persons on board:	Crew – 1	Passengers – 24
Injuries:	Crew – 0	Passengers – 3 Serious, 13 Minor
Aircraft damage:	Substantial	

Sources and submissions

Sources of information

The sources of information during the investigation included the:

- pilot and passengers
- balloon operator and manufacturer
- Civil Aviation Safety Authority
- Bureau of Meteorology
- United Kingdom Air Accidents Investigation Branch.

References

Meijer R, Dalenoort A and Mordaka J 2011, Evaluation of and possible improvements to current methods for protecting hot-air balloon passengers during landings, CAA Paper No. 2006/06.

Submissions

Under Part 4, Division 2 (Investigation Reports), Section 26 of the *Transport Safety Investigation Act 2003* (the Act), the Australian Transport Safety Bureau (ATSB) may provide a draft report, on a confidential basis, to any person whom the ATSB considers appropriate. Section 26 (1) (a) of the Act allows a person receiving a draft report to make submissions to the ATSB about the draft report.

A draft of this report was provided to the pilot, passengers, balloon operator, balloon manufacturer, Civil Aviation Safety Authority, Bureau of Meteorology and the United Kingdom Air Accidents Investigation Branch.

Submissions were received from the Bureau of Meteorology, United Kingdom Air Accidents Investigation Branch and the Civil Aviation Safety Authority. The submissions were reviewed and, where considered appropriate, the text of the report was amended accordingly.

Australian Transport Safety Bureau

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; 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 the ATSB's 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.

Purpose of safety investigations

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

Developing safety action

Central to the ATSB's investigation of transport safety matters is the early identification of safety issues in the transport environment. The ATSB prefers to encourage the relevant organisation(s) to initiate proactive safety action that addresses safety issues. Nevertheless, the ATSB may use its power to make a formal safety recommendation either during or at the end of an investigation, depending on the level of risk associated with a safety issue and the extent of corrective action undertaken by the relevant organisation.

When safety recommendations are issued, they focus on clearly describing the safety issue of concern, rather than providing instructions or opinions on a preferred method of corrective action. As with equivalent overseas organisations, the ATSB has no power to enforce the implementation of its recommendations. It is a matter for the body to which an ATSB recommendation is directed to assess the costs and benefits of any particular means of addressing a safety issue.

When the ATSB issues a safety recommendation to a person, organisation or agency, they must provide a written response within 90 days. That response must indicate whether they accept the recommendation, any reasons for not accepting part or all of the recommendation, and details of any proposed safety action to give effect to the recommendation.

The ATSB can also issue safety advisory notices suggesting that an organisation or an industry sector consider a safety issue and take action where it believes it appropriate. There is no requirement for a formal response to an advisory notice, although the ATSB will publish any response it receives.

Terminology used in this report

Occurrence: accident or incident.

Safety factor: an event or condition that increases safety risk. In other words, it is something that, if it occurred in the future, would increase the likelihood of an occurrence, and/or the severity of the adverse consequences associated with an occurrence. Safety factors include the occurrence events (e.g. engine failure, signal passed at danger, grounding), individual actions (e.g. errors and violations), local conditions, current risk controls and organisational influences.

Contributing factor: a factor that, had it not occurred or existed at the time of an occurrence, then either:

(a) the occurrence would probably not have occurred; or

(b) the adverse consequences associated with the occurrence would probably not have occurred or have been as serious, or

(c) another contributing factor would probably not have occurred or existed.

Other factors that increased risk: a safety factor identified during an occurrence investigation, which did not meet the definition of contributing factor but was still considered to be important to communicate in an investigation report in the interest of improved transport safety.

Other findings: any finding, other than that associated with safety factors, considered important to include in an investigation report. Such findings may resolve ambiguity or controversy, describe possible scenarios or safety factors when firm safety factor findings were not able to be made, or note events or conditions which ‘saved the day’ or played an important role in reducing the risk associated with an occurrence.