Australian Government
Australian Transport Safety Bureau

ATSB TRANSPORT SAFETY REPORT
Aviation Occurrence Investigation AO-2011-045
Final

Emergency landing, VH-OTZ
7 km east of Northam, Western Australia
2 April 2011

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Abstract

During a scenic charter flight and while operating at low level, the pilot of a Kavanagh Balloons E-210 hot-air balloon, registered VH-OTZ, was unable to arrest the balloon's descent and initiate a climb in time to avoid powerlines, requiring an emergency descent and landing. The balloon landed hard in a paddock with the basket not orientated correctly to the direction of flight. It bounced, dragged and inverted along a distance of 60 m, resulting in injuries to the occupants and minor damage to the basket.

The investigation identified a minor safety issue, in that the procedural and guidance framework for commercial balloon operations generally did not provide a high level of assurance in regard to the safe conduct of low flying. Action by the Civil Aviation Safety Authority will, once in place, adequately address that safety issue. In addition, the operator of the balloon revised the content of its operations manual.

FACTUAL INFORMATION

Sequence of events

On the morning of 2 April 2011, a Kavanagh Balloons E-210 hot-air balloon (E-210), registered VH-OTZ (OTZ) was being operated on a scenic charter flight from a farm property 21 km east of Northam, Western Australia. The flight was being conducted in the company of another of the operator's balloons on the first day of the operator's 2011 flying season.

The pilot reported that the balloon had less burner output than planned because the fuel storage cylinders on both balloons had not been warmed to increase operating pressure prior to departure. However, operating pressure was still within limits. Prior to departure, the pilot briefed the eight passengers in accordance with the operator's procedures.

The balloon lifted off at 0631 Western Standard Time[1], a couple of minutes behind the other balloon, and was carried in a westerly direction over undulating farming country in the general direction of Northam. The pilot was following the preceding balloon with the intention of landing at the same location. The sky was clear, with low wind speed near the surface and higher wind strength with increasing height.

Information sourced from the pilot and passengers indicated that the first part of the flight was smooth and uneventful, with the pilot varying the height and regularly applying one or other of the two burners. Throughout the flight the pilot provided a commentary for the passengers.

The pilot recalled that, when he ascended into the faster winds to catch up with the preceding balloon, they encountered some turbulent air. For the comfort of the passengers, the pilot began a descent to a lower altitude where the balloon levelled for a period.

1 Western Standard Time (WST) was Coordinated Universal Time (UTC) + 8 hours.

According to the pilot, there was a need to follow the example of the preceding balloon and fly lower so that the balloon would be influenced by more south-easterly winds that would steer the balloon to the north of Northam. The pilot recalled that, as the balloon passed at relatively low height over paddocks that gently fell away towards a tree line that followed a water course, he allowed the balloon to descend. The burners were used to control the rate of descent.

The pilot recalled seeing powerlines from 'a mile away' and planning to initiate a climb at the tree line. Due to the balloon's height above tree level and perceived speed of 10 to 12 km/h, the pilot considered there would be plenty of time to climb over the powerlines.

By the pilot's reckoning, the balloon was about 1/2 a balloon-height over the tree line when he applied one of the burners for about 7 seconds to commence an ascent. When the balloon did not respond, and with the powerlines ahead, the pilot added the other burner. Both burners were then operated for about 10 seconds, but the balloon continued to be unresponsive and was now approaching the power lines quickly at about the same height.

The pilot considered that if the balloon didn't climb it would collide with the powerlines, so he pulled the rip line (envelope deflation line) to initiate an emergency descent, advised the passengers to get into landing position and turned the pilot lights off. A rapid descent rate and a right rotation developed such that a corner of the short side of the balloon basket contacted the ground heavily. The basket bounced and inverted while being dragged along a distance of 60 m, resulting in serious injuries to one passenger and minor injuries to the other passengers and pilot.

The occupants managed to stay within the basket during the accident sequence and evacuated after it came to a stop on its side. The property owner reported observing part of the last stages of the flight and hearing a crack that he associated with the envelope contacting the powerlines.

The property owner arrived at the balloon within a few minutes of the impact and, due to unreliable mobile telephone reception in the area, went to the nearby house to call emergency services. Emergency services started arriving around 30 minutes later and attended to the occupants. Two of the passengers were airlifted to Perth for further medical care and the other passengers were taken to Northam hospital.

Pilot information

The pilot held a Commercial Pilot (Balloon) Licence (CPL) that was issued by the Civil Aviation Safety Authority (CASA) in 2000 and was endorsed for operations in up to Class 4 balloons.[2] The pilot also held the required Class 2 Aviation Medical Certificate, issued on 2 March 2010.

The pilot's total recorded balloon flying experience of 810 hours included five seasons of flying with the operator, including flying OTZ the previous year.

The pilot's last flight review was conducted in October 2010 and included a low-level segment. According to the approved testing officer who conducted the review, the pilot was competent in all aspects of the flight.

The pilot's previous flight was a private flight that was conducted in the Canberra area in a Kavanagh Balloons B-77[3] on 22 January 2011. That was preceded by flights for the operator in November 2010.

Operator records indicated that the pilot completed an emergency procedures proficiency test[4] on 31 March 2011.

The pilot reported that he woke at 0345 that morning for a 0445 arrival time at the operator's Northam office. He had been sleeping well and was feeling rested.

Balloon information

The balloon, serial number E210-407, was manufactured in Australia in 2010. It was certified with an envelope volume of 210,000 ft^3 (5,947 m^3) and a gross certificated weight (GCW)

2 Hot-air balloons with a volume greater than 260,000 ft^3 (7,362 m^3).

3 Envelope volume of 77,500 ft^3 (2,195 m^3) and certified gross weight of 760 kg.

4 This test, which was conducted annually, was a requirement under Civil Aviation Order 20.11 for a crew member of a charter or regular public transport operation.

of 1,900 kg. The overall height of the inflated balloon was about 90 ft.

The balloon was subject to periodic inspection in accordance with the balloon manufacturer's maintenance manual at intervals of 100 hours or 12 months, whichever came first. With a total time in service of 45 hours and 9 months, the balloon was not due any periodic maintenance. There were no reported defects.

The balloon envelope comprised 20 gores[5], each with 23 panels[6], which were manufactured from special nylon fabric and load-carrying polyester webbing. A *Lite Vent™* parachute vent/deflation system fitted to the balloon allowed the pilot to release air from the top of the envelope. A pull down on the red and white (candy-striped) line partially opened the vent, while a pull down on the red rip line fully collapsed the vent panel for rapid deflation. Rotation vents in the side of the envelope allowed the pilot to rotate the balloon in either direction.

The rectangular basket was of woven cane construction with a solid wood floor in a single tee configuration with capacity for 10 passengers in two compartments. Thick back-padding, side/edge padding and internal grab handles were fitted for passenger safety and comfort.

The balloon was equipped with a Cameron *Stealth/Shadow* double burner combination that was rated for envelope volumes up to 210,000 ft^3 (5,947 m^3). The burners were mounted on a frame above the basket and operated individually or together by pilot manipulation of valve handles. Fuel for the burners was liquefied petroleum gas (LPG). The burner's maximum rated power was 24 million Btu (7 MW) at 100 Psi fuel pressure. The normal operating fuel pressure range of the burners was 300 to 1,500 kPa (44 to 218 Psi), with care to be exercised if the pressure was below 550 kPa (80 Psi). To increase the operating fuel pressure and consequently, burner output, some operators warmed the cylinders prior to use.

At a total uninflated weight of 1,400 kg, the balloon was 500 kg less than the GCW and 200 kg below the performance limiting weight calculated on the planned altitudes for the flight and ambient temperature of 15 °C.

Meteorological information

Pre-flight considerations

Meteorological information from the Bureau of Meteorology (BOM) and local automatic recording sites was sourced by the chief pilot and reviewed by the pilot at Northam, prior to departing for the launch site. A piball[7] was launched from Northam prior to the scenic flight, which indicated that the wind was coming from the south-east, through east to east-north-east with increasing height.

An advance party travelled to the provisional launch location but found that the winds were unsuitable, so another more protected site was selected. On arrival at the more protected launch site, the pilot found light winds and considered that the weather conditions were not ideal, but were reasonable and within his capability. A second piball was released and indicated suitable conditions for the launch.

Forecasts and recorded observations

The forecast for the area (ARFOR)[8] predicted the wind at 3,000 ft above mean sea level (AMSL) to be from the east-north-east at 20 kts. The closest location with an aerodrome forecast (TAF)[9] or regular report (METAR)[10] was Cunderdin, 31 km to the east of the launch site. The forecast surface wind at Cunderdin was an easterly at 12 to 20 kts. At 0700 the recorded surface wind at Cunderdin was easterly, at 10 to 14 kts.

5 A set of fabric panels that join to form a continuous and distinctive strip of fabric, extending from the bottom to top of the balloon envelope.

6 A panel is a set of fabric panels joined to form a continuous and distinctive strip of fabric that circles the balloon horizontally.

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

8 An area forecast issued for the purposes of providing aviation weather forecasts to pilots. Australia is subdivided into a number of forecast areas.

9 Aerodrome Forecasts are a statement of meteorological conditions expected for a specific period of time, in the airspace within a radius of 5 NM (9 km) of the aerodrome.

10 Routine aerodrome weather report issued at fixed times, hourly or half-hourly.

Automatic weather observation sites in the general area recorded the temperature at 0706 as just below 15 °C and the wind from the east at between 6 and 10 kts. The closest weather observation site was 20 km from the accident site.

In-flight meteorological conditions

The pilot recalled that the balloon's speed was about 10 to 12 km/h before the tree line, but increased soon after, and that the wind speed was about 25 km/h after the landing. The pilot reported experiencing turbulence at the higher altitudes and that turbulence and effects consistent with a downdraught affected the balloon over the tree line.

Overall, the passengers considered the weather to be good throughout the flight and did not notice any unusual or potentially hazardous meteorological conditions.

The pilot of the other balloon recalled that the wind speed picked up in the later stages of the flight and some turbulence and windshear was encountered that required vigilance.

Meteorological conditions commonly affecting balloons

A temperature inversion is a layer of air in which the temperature increases with height rather than decreases as is normal. A surface inversion occurs when the ground cools overnight by radiating heat, also cooling the layer of air closest to the ground. Surface inversions develop on long, calm and clear nights, and form a stable layer of air, typically a few hundred feet thick.

Windshear occurs when there is rapid change of wind speed and/or direction, typically between layers of air. Windshear can occur between the different wind velocities at the top of an inversion layer and at the base of a surface inversion when the sun heats the ground and adjacent air.

E-210 balloon meteorological limitations

The balloon's flight manual contained two meteorological limitations:

- The balloon must not be launched in winds exceeding 15 kts at ground level.
- Flights must not be conducted if there is extensive convective activity in the area, such as thunderstorms and thermals.

Global Positioning System information

A hand-held Global Positioning System receiver (GPS) was carried in the balloon to assist with navigation during the flight. The GPS recorded a number of parameters including latitude/longitude, altitude[11], groundspeed and date/time. A copy of the data was obtained from the operator for analysis.

From the recorded GPS elevation of the launch site of 650 ft, the balloon ascended to 750 ft. There was a period of level flight, then a series of climbs, descents and level periods. The average speed of the balloon in the early stages of the flight was 7 kts (13 km/h), which increased later in the flight to 24 kts (45 km/h). The maximum altitude reached was 1,447 ft.

At 0703:03, when the balloon was about 1,840 m from a projected intercept point with the powerlines, it levelled at 860 ft (about 180 ft above the highest powerlines) and maintained that altitude for 1.8 minutes at an average speed of 19 kts (35 km/h). The balloon's track throughout the last part of the flight was converging on the powerlines at an angle of 15°.

At 0704:52, when the balloon was about 790 m from the powerlines, it began a continuous descent at an average 162 ft/min and an average speed of 15 kts (29 km/h). During the early part of this descent, the terrain below the balloon was fairly level and up to 300 ft below the balloon.

At 0705:41, when the balloon was 370 m from the powerlines and passing over a tree line at 760 ft (about 100 ft above the highest powerlines), the terrain started to rise at an average 4% gradient.

Touchdown was at 0706:25 at an elevation of 620 ft. The GPS data was not precise enough to establish the rate of descent or speed at the point

11 GPS altitude is referenced to a simplified mathematical representation of the earth, known as an ellipsoid. Ellipsoid heights differ from heights referenced to mean sea level and, in this case, were about 90 ft lower. For simplicity and comparability, the altitudes and elevations quoted in this section are ellipsoid.

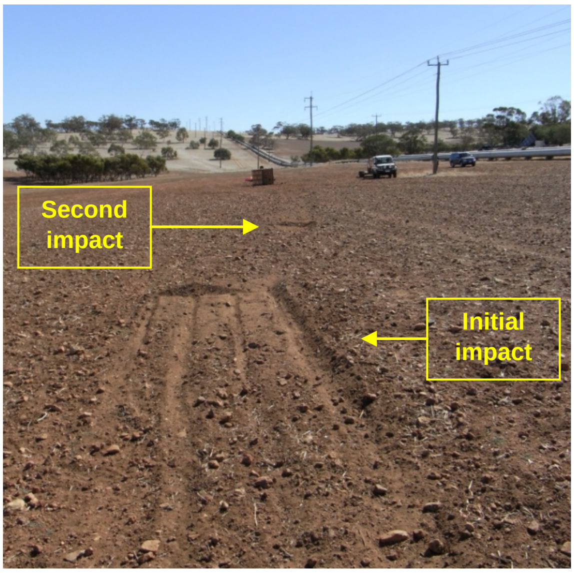
of ground impact. A depiction of the balloon's track during the last 2 minutes of the flight is at Appendix A.

Accident site information

The initial impact was located at the top of a rise in a bare paddock, 40 m from the projected point of intercept with the powerlines and 21 m laterally from the closest of three parallel powerlines (Figure 1). The closest powerline was about 8 m high and the adjacent powerline about 21 m high.

The ground marks indicated that the basket impacted the ground with the short side leading and while travelling in a westerly direction. The direction of travel subsequently changed by about 15°, taking the basket closer to the powerlines.

Figure 1: Accident site



The ground marks indicated that the basket maintained hard contact with the ground over a distance of 6 m and was then airborne for 7 m before again contacting, and then dragging along the ground for 48 m. The basket came to rest on its side (Figure 2), about 11 m from the closest powerline.

Balloon examination

The basket sustained minor damage to the wicker cane. The burner mount frame was distorted with one upright strut detached from the basket.

Figure 2: Basket assembly

One of the burners was damaged during the landing sequence. After some minor repairs, a functional test was carried out on both burners with no evidence of any defects or anomalies. There was LPG in each of the five on-board storage cylinders with a calculated total quantity of 215 L. Each burner was connected to a cylinder that was at least 60% full at impact.

The balloon envelope was holed at panel 15 (about 2/3 of envelope height) as a consequence of contacting one of the powerlines during the emergency landing sequence. All of the envelope rigging and control lines were intact.

Organisational and management information

Operational policy and procedures

Balloons operated in the aerial work or charter categories were granted a general exemption from some provisions of the *Civil Aviation Regulations 1988* including regulation 157 that addressed low flying. CASA permission was required for the operation of aerial work and charter balloon flights.

The operator was approved by CASA to conduct charter operations, subject to a number of conditions. That included a minimum height of 10 ft above the surface of the ground or water or an obstacle, except during initial launch or landing.

The operator required passengers to be briefed pre-flight on the actions in the event of hard landings and emergencies. That included the use of the handgrips and of the appropriate positioning during landing.

The operator's operations manual included a section on low flying, which stated that:

> A constant watch must be made for power lines at all times.

The operator's emergency procedures checklist in the case of contact with powerlines included the instruction:

> IN ALL INSTANCES *IF IN DOUBT – RIP OUT*

In the specific aircraft operating procedures section of the operations manual, the operator provided guidance in regard to the avoidance of dangerous obstacles at low level. That guidance included the advice that the pilot must decide whether to climb or make an emergency landing, and that emergency landings can be made by opening the deflation vent at heights of 50 ft or less.

Further guidance was provided in regard to preparation for a heavy landing. In that case, the passengers were to be briefed to brace and to hold on firmly to the basket internal handles while in a crouching position. In addition, the pilot was to shut the fuel off and, if time permitted, empty the line to the burners and extinguish the pilot light.

Pilot training and experience

The training and qualification of commercial balloon pilots was administered by CASA. The aeronautical knowledge training syllabus included the topics of inertia, momentum and false lift. It also included the considerations for the recognition and avoidance of powerlines and the actions to be taken in the event of a probable powerlines contact.

The flying training syllabus included the demonstration of competence in controlled ascents and descents in windshear and inversions. It also addressed the assessment of wind velocity and weather and determining appropriate action in response.

A CPL was not issued unless the applicant had held a private pilot certificate (balloon) for at least 1 year and had completed 8 hours of flight training. The minimum flight experience for the issue of a CPL was 75 hours as pilot in command of a balloon, including 60 hours of free flight time and 5 hours of tethered flight time.

The ongoing pilot training requirements included a flight review at intervals not exceeding 2 years and an emergency procedures proficiency test annually. The operator's test was conducted as a desktop exercise and included 'low level avoidance of obstacles' and 'preparation for a hard landing' items.

There was an ongoing pilot experience requirement prior to conducting a charter flight of one flight within the previous 90 days.

The operation of manned free balloons and airships for recreational purposes was administered by the Australian Ballooning Federation Inc (ABF). The ABF produced a pilot training manual that did not specifically address low flying, but did provide advice regarding powerline emergencies. It stated that, as a guide, wires should be cleared by at least the height of the poles with the safe clearance in each instance affected by factors such as wind speed, air stability and balloon control response.

Additional information

Balloon principles of flight

An inflated balloon envelope displaces a proportional 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 burner(s). That decreases the air density within the envelope such that the balloon's mass becomes relatively less than the lift created by the displaced air. In other words, it becomes lighter-than-air and can ascend while the temperature/density differential exists. To descend, the pilot allows the air in the envelope to cool naturally, or opens vents in the envelope to release the hot air therein.

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 exactly 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.

As a result of its substantial mass, a balloon such as the E-210 has considerable inertia that contributes to a delayed response to pilot inputs. That delay will increase with an increase in balloon speed and a reduction in burner power. Balloon response to burner application during the flight was reported by the pilot and passengers to be typically 5 to 10 seconds.

Controllability of a balloon can be compromised by unstable atmospheric conditions. In such conditions, any vertical movement of air will tend to carry the balloon with it, requiring timely use of the controls to avoid or counteract any undesired effect.

Balloon performance and controllability can be affected by 'false lift'. False lift is the aerodynamic lift created by airflow over the curved upper surface of the balloon envelope. In flight, false lift occurs when the upper part of the balloon is in faster moving airflow than the lower part of the balloon. False lift can mask a decay in buoyancy such that a subsequent change in conditions can result in the loss of that lift and an unanticipated descent.

Landing is normally carried out with the long side of the basket across the direction of travel and with the passengers facing opposite to the direction of flight.

Balloon flying season

Commercial ballooning in the Northam area was generally conducted between the end of March and the end of November each year. Weather conditions in that period were usually more stable and the relatively cooler ambient temperatures provided adequate buoyancy. The operator explained that they did not start flying until early April each year to allow weather conditions to improve further.

ANALYSIS

Emergency landing

In this occurrence, the balloon probably would have collided with powerlines if the pilot had not conducted an emergency descent and landing. That action was in accordance with the operator's procedures and likely reduced the severity of the consequences as intended.

The emergency landing was required because the balloon did not climb in response to burner application while at low level and tracking towards powerlines. Although balloons naturally take some time to respond to burner application, in this case, the judged response was too long to assure a safe climb over the lines.

The responsiveness of a balloon to burner application is primarily affected by its inertia, residual buoyancy/lift, local environmental effects and burner output. In this case, the balloon's inertia as a function of its mass would not have varied significantly during the flight; nor was it outside the specified limitations. As a result, it was not considered to have directly contributed to the development of the occurrence.

Residual buoyancy or lift at any particular time is difficult to quantify, but the descent before the tree line is symptomatic of a negative buoyancy trend. Although the pilot reported that he applied burner during that descent, for a climb to occur, that trend needed to be arrested then reversed by burner output, which took more time in this case than was available.

Balloons are particularly susceptible to local environmental effects. Those effects can sometimes be difficult for a pilot to perceive because the weather being experienced in the basket can be different to that affecting the upper envelope some 100 ft above.

On the day, the 3,000 ft forecast wind of 20 kts was suppressed near the ground, probably by a surface inversion. That was demonstrated by the increasing speed of the balloon with increasing height as shown in the Global Positioning System data. During the flight there were indications that the inversion layer was starting to break up and dissipate. In the flight's latter stages, the turbulence at higher altitudes and the increasing ground speeds with reported turbulence at lower altitudes were symptomatic of that process. Some influence of the sun warming the ground and reducing low-level air density with an associated decrease in balloon buoyancy could not be ruled out.

The burner combination was paired with the largest possible balloon envelope. In that context, the lack of pre-flight cylinder warming reduced burner output and required increased pilot anticipation. Nevertheless, the operating pressure was within limits with no indication of malfunction, and after 40 minutes of flying, the pilot could be expected to be familiar with burner/balloon performance. In that case burner performance, though not optimal, was not considered to have directly contributed to the development of the occurrence.

To summarise, it is likely that balloon inertia, low residual buoyancy/lift, local environmental effects and comparatively reduced burner output all played some part in reducing balloon performance capability. However, there was insufficient evidence to be conclusive and no evidence that those factors were outside the range of normal operations.

At low level, the timing and method of burner application will have a significant effect on obstacle clearance. Complicating the pilot's visual assessment of distance and height could have been the small angle of intercept with the powerlines and the undulating terrain. In an operational context requiring careful observation skills and anticipation, the pilot's lack of recent experience, though compliant, might have reduced his proficiency.

Due to a lack of time for the pilot to reorientate the basket before ground impact, the emergency landing was carried out with the basket not orientated correctly to the direction of flight. As a consequence, the passengers were side-on to the direction of flight. That reduced the effectiveness of the basket handholds in preventing passenger movement and negated much of the benefit of the basket padding and the passenger crouch position. In addition, the pilot had to 'rip out' or emergency vent the envelope at or about the maximum recommended height of 50 ft, resulting in a high rate of descent and force of impact.

The tenacity with which the occupants held onto the handholds during the emergency landing sequence reduced the risk of further injury and demonstrated the benefit of the passenger briefings.

Risk management

Commercial ballooning operations were exempt from a number of the regulations that applied to other aircraft. That allowed balloon operators to operate below 500 ft over non-populous areas and in this operator's case, down to 10 ft above the ground and obstacles.

While balloons travel at much slower speeds than other aircraft, they are exposed to the same low-flying risks. Those risks are: reduced height (and time) in which to recover from compromised control or performance, and the reduced margin for clearance from the ground or water and obstacles. In addition, balloons are more susceptible to environmental effects on their performance and control.

Currently, commercial balloon operators and pilots are required to manage operational risk through elements such as:

- pilot training, qualification and experience
- recurrent flight review
- a 90-day recency period
- emergency procedures proficiency testing
- operator policy and procedures.

Those risk controls included knowledge of aerostatics and meteorology, and procedures for obstacle avoidance. However, there was no evidence of operator or regulatory requirements for procedures and guidance that applied specifically to low flying. There was no assurance that such measures would have prevented the accident, but given the inherent risks of low flying, it would be prudent for balloon operators to implement additional low-flying risk controls.

FINDINGS

From the evidence available, the following findings are made with respect to the emergency landing that occurred near Northam, Western Australia on 2 April 2011 and involved Kavanagh Balloons E-210, registered VH-OTZ. They should not be read as apportioning blame or liability to any particular organisation or individual.

Contributing safety factors

- An emergency descent and landing was required after the pilot recognised that he was unable to sufficiently arrest the balloon's rate of descent then initiate a climb in time to avoid powerlines.
- The balloon landed hard with the basket not orientated correctly to the direction of flight and bounced, dragged, and inverted along a distance of 60 m, resulting in injuries to the occupants and damage to the basket.

Other safety factors

- The procedural and guidance framework for commercial balloon operations generally, did not provide a high level of assurance in regard to the safe conduct of low flying. *[Minor safety issue]*

Other key findings

- The pilot's initiation of the emergency descent and landing probably avoided an airborne collision with powerlines.

SAFETY ACTION

The safety issues identified during this investigation are listed in the Findings and Safety Actions sections of this report. The Australian Transport Safety Bureau (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.

All of the responsible organisations for the safety issues identified during this investigation were given a draft report and invited to provide submissions. As part of that process, each organisation was asked to communicate what safety actions, if any, they had carried out or were planning to carry out in relation to each safety issue relevant to their organisation.

Low-flying policy and procedures

Minor safety issue

The procedural and guidance framework for commercial balloon operations generally did not provide a high level of assurance in regard to the safe conduct of low flying.

Civil Aviation Safety Authority response

The Civil Aviation Safety Authority (CASA) advised that:

> ...the proposed Part 131 of the Civil Aviation Safety Regulations (CASR) 1998, presently entering legal drafting at Attorney General's Department, requires balloon AOC [Air Operator's Certificate] holders to have a safety management system.

and that:

> CASA expects that the new legislation will require operators to address all risks within their organisation (not just low flying risks) in an organised manner, and maintain an ongoing review of risk within the organisation.

ATSB assessment

The ATSB is satisfied that the proposed Part 131 of the CASR will, once in place, adequately address the safety issue.

Balloon operator proactive safety action

The balloon operator did not believe that the operations manual content related to low flying was inferior to that provided by other operators. However, since the occurrence, the low-flying section of the operations manual was amended to read:

> As per the CAR 259 permit low flying below 10 feet is not permitted except in the initial stages of launch and the final stages of landing. Whilst low flying is a necessary procedure in order to correctly and safely navigate a hot air balloon, flight below 500 feet AGL should be conducted with extreme concentration, care and vigilance. When flying below 500 feet AGL pilots should observe the following:
>
> - A constant watch must be made for power lines at all times and where ever possible low flying in the vicinity of power lines shall be avoided.
>
> - When operating in conditions of low level turbulence sufficient height should be maintained in order to allow for adequate clearance of all obstacles in the flight path of the balloon.
>
> - Pilots should where ever possible attempt to rotate the balloon and basket into the correct orientation for landing of the balloon.

SOURCES AND SUBMISSIONS

Sources of Information

The sources of information during the investigation included the:

- balloon pilot and passengers
- balloon operator
- Bureau of Meteorology
- Australian Balloon Federation (ABF)
- Civil Aviation Safety Authority (CASA).

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 balloon operator and pilot, the ABF and to CASA.

Submissions were received from all of the parties and, where considered appropriate, the text of the report was amended accordingly.

APPENDIX A: DEPICTION OF RECORDED DATA – BALLOON TRACK