Australian Government
Australian Transport Safety Bureau

Wirestrike and collision with terrain involving Robinson R22, VH-KLY

75 km west-north-west of Hay, New South Wales on 26 May 2021

ATSB Transport Safety Report
Aviation Occurrence Investigation (Short)
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Addendum

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Safety summary

What happened

On 26 May 2021, the pilot of a Robinson R22 Beta helicopter, registered VH-KLY and operated by Stock & Station Aviation, was conducting mustering operations on a property 75 km west-north-west of Hay, New South Wales. The pilot was the only person on board. As the helicopter was flown towards cattle yards, it struck a powerline and collided with terrain. The pilot was fatally injured.

What the ATSB found

The ATSB found that, as it was not originally planned for the pilot to muster cattle to the yard, they did not do an aerial inspection and the hazards at the yard were likely not considered. During a turn most likely associated with an approach to land, the helicopter contacted a single wire earth return line, which was very difficult to detect. Control was subsequently lost, and the helicopter collided with terrain.

The ATSB also found the emergency locator transmitter (ELT) did not activate as the transmitter was selected to OFF. As the accident was witnessed, this did not affect the response.

Safety message

Mustering operations around yards and buildings are inherently dangerous due to low-level hazards including powerlines. According to the ATSB's Avoidable Accidents Low-level flying research report, about 63% of pilots involved in wirestrike accidents reported they were aware of the powerlines but had forgotten about them before they were struck.

As such, the Aerial Application Association of Australia has been working with landowners and energy suppliers to install markers on powerlines through their Powerline Safety Program. In addition, a number of power companies are making these markers available at reduced cost.

In addition, the ATSB *Avoidable Accidents No. 2 Wirestrikes involving known wires: A manageable aerial agricultural hazard* advises pilots that in order to manage the on-going risk of wirestrikes, if their plan changes, they should reassess the risks to the flight.

Operators are also reminded of the importance of regularly conducting a self-test of the emergency locator transmitter (ELT) system. Having a working ELT increases the likelihood that an aircraft and its occupants will be located quickly in the event of an accident.

The investigation

Decisions regarding whether to conduct an investigation, and the scope of an investigation, are based on many factors, including the level of resource required to obtain a safety benefit from an investigation. For this occurrence, a limited-scope investigation was conducted in order to produce a short investigation report and allow for greater industry awareness of findings that affect safety and potential learning opportunities.

The occurrence

On Wednesday 26 May 2021, the pilot of a Robinson Helicopter Company R22 Beta helicopter (Figure 1), registered VH-KLY (KLY) and operated by Stock & Station Aviation, was conducting mustering operations on a property 75 km west-north-west of Hay, New South Wales. The pilot was the only person on board.

Figure 1: Exemplar R22 helicopter

Source: Archangel12. Used under the Creative Commons Attribution 2.0 Generic license. Registration and company branding removed.

The pilot had arrived at the property on the preceding Sunday afternoon, to assist with a wild goat muster. This was to be conducted over a number of days, during which the mustering crew were staying at a house on the property. The goats were to be mustered to a set of temporary yards.

The muster began on the Monday and, during the day, the pilot observed a small herd of cattle, which were required to be removed after the completion of the goat muster. The following day, the weather deteriorated during the morning and the muster was called off early, with the pilot returning to the house at about lunchtime.

On Wednesday the muster re-commenced and, at approximately 0707 Eastern Standard Time,[1] the pilot flew to the temporary yards, landed the helicopter and shutdown. The goats were being drafted[2] before being loaded on to trucks and the helicopter was not required for that work.

After a few hours, the pilot had a brief discussion with the lead contractor and a stockperson, following which the contractor instructed the pilot to find the previously detected cattle and direct the stockperson to them. The pilot was then to return to their accommodation, before beginning another muster on a different area of the property. The stockperson was instructed to move the

1 Eastern Standard Time (EST): Coordinated Universal Time (UTC) + 10 hours.
2 Drafting: separation of animals into different enclosures.

cattle to the main yards on the property. Prior to this, there had been no plan to use these yards during the muster.

The helicopter took off at 1032 and, as the pilot was locating the cattle, they detected a second larger herd. The pilot advised the stockperson over the UHF radio and directed them to these cattle. The pilot then advised the stockperson that they would locate and move the original small herd to the main yards using the helicopter.

The pilot subsequently located the cattle and began moving them along a fence line toward the yards. They then flew ahead to open the gates to the yard. At about 1150, a witness located near the yards, observed the helicopter as it passed (Figure 2). The pilot landed the helicopter, exited and opened the first gate at the entrance to the yards.

Figure 2: Last section of flight from recorded GPS data

Source: Google Earth with data from onboard GPS, annotated by ATSB

A short time later, the witness heard the helicopter take-off and, very soon after, heard a loud bang. Suspecting that the helicopter had crashed, they drove initially to the front of the yards and, when they did not find it, they then drove around to the back of the yards and found the helicopter on its side. Shortly after, two more people arrived and first aid was rendered, however the pilot sustained fatal injuries. The helicopter was substantially damaged, with indications that it had sustained a wirestrike.

Context

Pilot information

The pilot held a Commercial Pilot Licence (Helicopter) and a class 1 aviation medical certificate, with no restrictions. They also held a single-engine helicopter rating with grade 3 instructor rating, an aerial application rating with fire endorsement, and a low-level rating with sling and mustering endorsements.

An assessment of their logbook revealed the pilot had accrued approximately 3,017 flying hours with 2,525 on the Robinson R22. They had flown approximately 128 hours in the previous 90 days and 30 hours in the previous 30 days.

The pilot had completed a crew resource management, hazards and human factors course with the Aerial Application Association of Australia in 2018. This course covered the hazards involved in low level flying, including operations around powerlines.

The pilot was reported to be fit and healthy and there was no indication they were experiencing a level of fatigue known to affect performance.

Medical and pathological informational

The forensic pathologist who conducted the post-mortem examination concluded that the pilot succumbed to injuries sustained during the accident sequence. At the time of publication of this report, the finalised post-mortem and toxicology report were unavailable to the ATSB.

Aircraft Information

VH-KLY (KLY) was a two-seat Robinson Helicopter Company (RHC) R22 Beta helicopter, serial number 4424, and was powered by a Textron Lycoming O-360-J2A, four-cylinder piston engine. It was manufactured in 2009 and registered in Australia the same year. It was purchased by Stock & Station Aviation in July 2017 and had been maintained by the same maintenance organisation since that time.

The helicopter was maintained in accordance with the manufacturers' maintenance schedule, which required a periodic inspection every 100 hours or 12 months, whichever came first. A periodic inspection was completed on 13 May 2021 and a review of the maintenance release issued at that time indicated no outstanding maintenance requirements or serviceability issues. KLY had accrued 2,633.4 total time in service.

The helicopter did not have wirestrike protection equipment fitted, nor was it available for this helicopter type due to a lack of securing structure. In addition, KLY was being operated with the doors removed.[3]

Flight data

The helicopter had a Garmin 660 GPS unit and a TracPlus surveillance system installed. TracPlus provided real-time tracking through a satellite or mobile phone network. It reported position, altitude, and speed at set time periods, in this case every 15 seconds.

Analysis of the recorded flight data indicated KLY took off from the first gate at the yards and flew in a southerly direction, towards the second gate, at between 16–33 ft (5–10 m) above ground level (AGL) (Figure 3). The recorded groundspeed was about 22 kt, slowing to 15 kt[4] as the helicopter turned towards a closed gate adjacent to the accident site. This gate was required to be opened to allow the cattle access to the yards.

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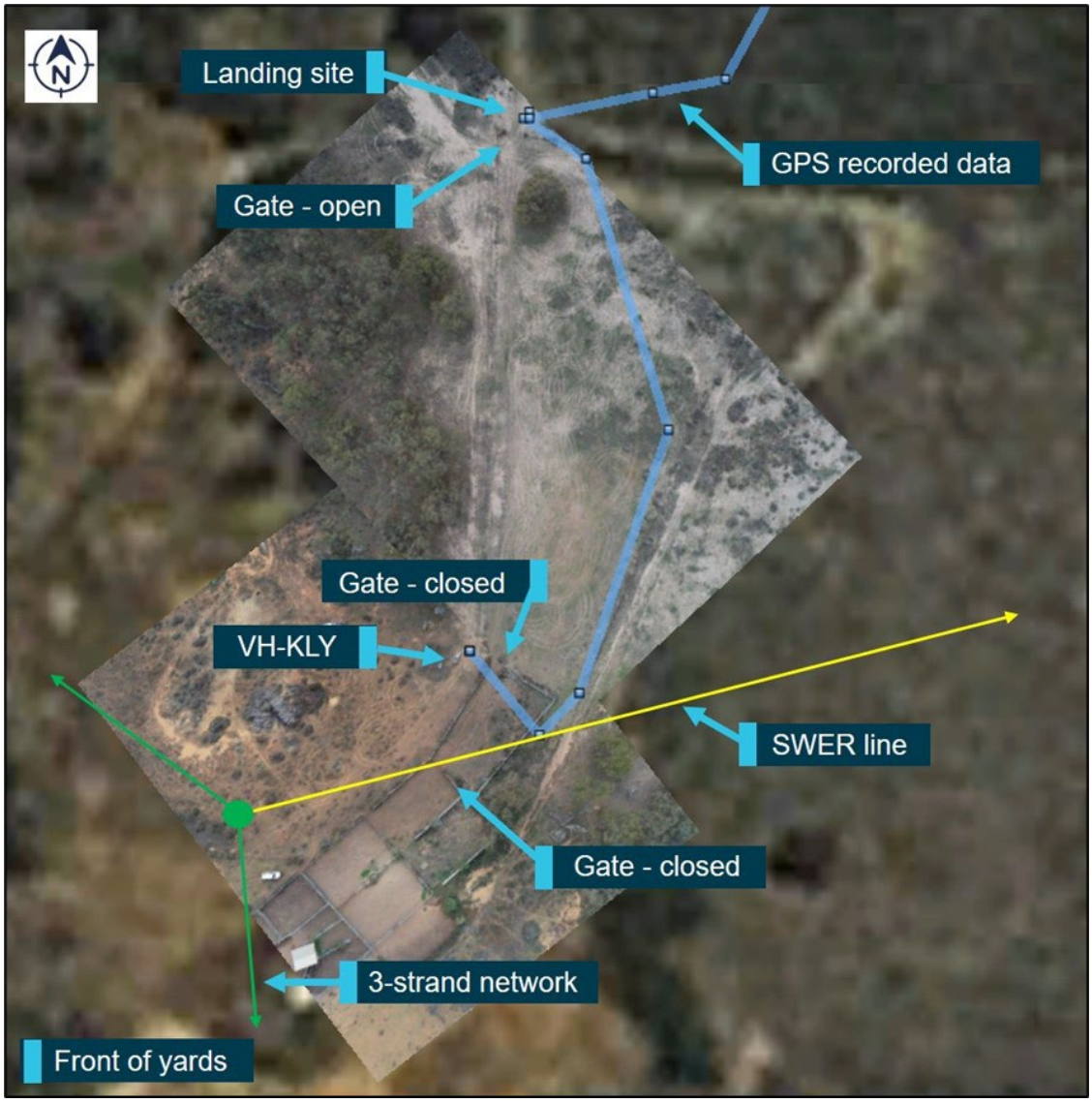
[3] The R22 pilot operating handbook authorised doors-off operation, where there were no loose articles in the cabin, and changes to weight and balance had been considered.

[4] The speed recorded by the Garmin GPS and TracPlus was calculated between fixed points and did not take into account any manoeuvring between the points.

Analysis of the flight tracks flown during the previous days identified that the helicopter flew past the main yards once on the first day. On that flight, they flew in a northerly direction about 370 m east-south-east of the yards, passing over a single wire earth return (SWER) line (see the following section titled *Powerline information*) at approximately 280 ft AGL and at a speed of approximately 65 kt.

Figure 3: Flight track and powerline



Source: Google Earth, annotated by ATSB

Note: GPS data was recorded every 15 seconds so the line between track points was not necessarily representative of the actual flight path.

Powerline information

A power pole (green dot in Figure 3) was located about 75 m west-south-west of the accident site. It had one network consisting of 3-strands, which ran along the front of the yards. Above this, a SWER network ran across the northern side of the yards. The single strand was attached at the top of the pole at 10.48 m (34.4 ft) above the ground.

A SWER line is a single line of intertwined narrow-gauge steel wires. It spanned approximately 351 m to the next pole in the network. The minimum ground clearance of the SWER line was 7.23 m (23.7 ft). There were no markers or other devices installed on the powerline to enhance its visibility, nor was there a requirement to install such devices.

The power company advised there were no interruptions or surges reported in the electricity system at the time of the accident.

Visual cues during low-level flying

A key influence on the risk of a wirestrike when flying at low level is a pilot's visual acuity in the given environmental conditions. According to Veillette (2015), the near invisibility of wires results from a number of factors including the:

- size of the wire
- viewing angle
- sun position
- condition of the aircraft's transparencies (windscreen)
- camouflaging effect of nearby vegetation.

Visibility of the powerline

Using a remotely piloted aircraft system (RPAS), the ATSB recreated the approximate flight path of the helicopter at about the time of day the accident occurred. The RPAS was flown at a similar speed and height above the ground to provide an appreciation of the pilot's perspective (Figure 4).

Figure 4: Image taken by RPAS along approximate helicopter flight path

Image source: ATSB

Figure 5: Approximate helicopter flight path perspective with the SWER marked

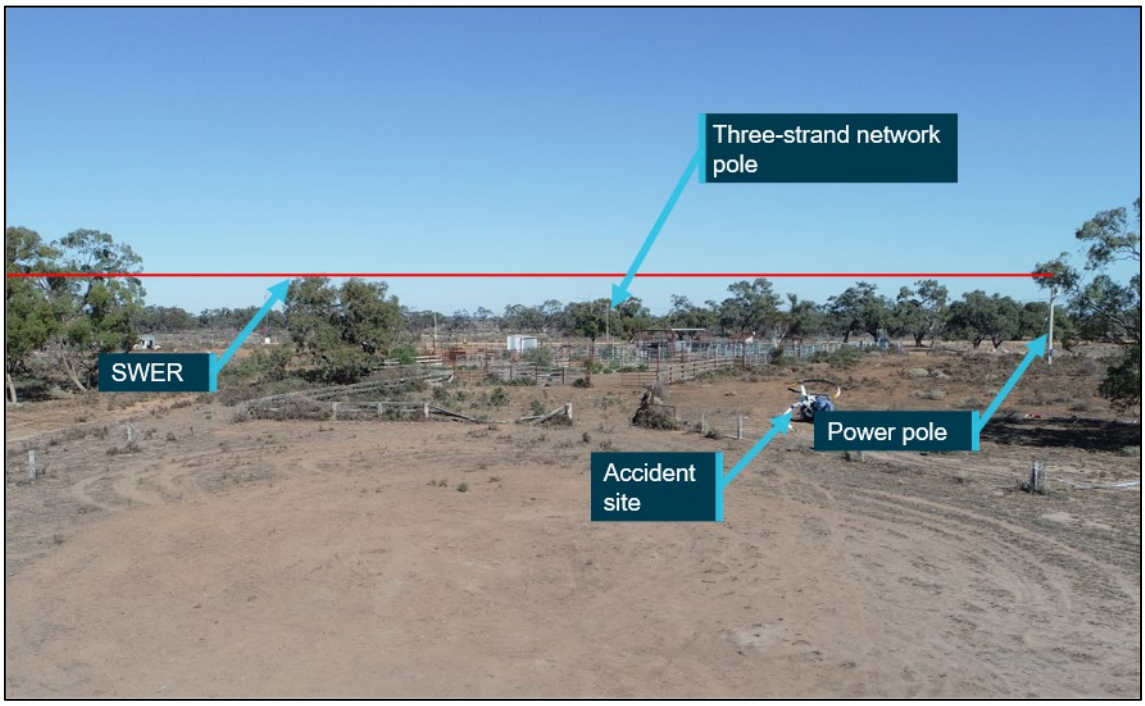


Image source: ATSB

Weather and sun position

The Bureau of Meteorology graphical area forecast for NSW–West valid at the time of the occurrence indicated that from 1200, the forecast visibility was greater than 10 km with scattered[5] cloud between 4,000 and 8,000 ft. The relevant grid point wind and temperature chart valid at the time, forecast a wind from 250° at 31 km/h (17 kt). Witnesses reported that there was no cloud cover and very little wind at the time of the accident.

At 1200 that day, the altitude[6] of the sun was about 34° and its azimuth[7] was about 005°. During the flight, the pilot was wearing an aviation helmet, fitted with a retractable sun visor, designed to reduce glare. It was reported the pilot was not using the visor however, given the position of the sun, there was minimal potential for it to have been a factor in the wirestrike.

Previous operations at the yards

It was reported that the pilot had first worked at the property in May 2020. Prior to beginning that muster, the pilot and the lead contractor flew over the yards noting the hazards, including both sets of powerlines. They had then mustered cattle to the yards over the following days, reportedly flying in from multiple directions.

The pilot had worked at the yards again in February 2021, mustering cattle to the yards over 3-4 days. It was reported that during that muster, the pilot had been reminded of the SWER line while cattle were being mustered in the same direction as the accident flight.

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5 Cloud cover: in aviation, cloud cover is reported using words that denote the extent of the cover – 'scattered' indicates that cloud is covering between a quarter and a half of the sky.

6 Altitude: the vertical angle from an ideal horizon to the sun.

7 Azimuth: the clockwise horizontal angle from true north to the sun.

Wreckage and impact information

The wreckage was located on a dirt access road, just outside the fence at the north-west corner of the main yards. The area was clear flat ground with little grass and small shrubs (Figure 3). There was no evidence of a tree or bird strike, either on the helicopter, nor in the surrounding area.

All components of the helicopter were identified at the accident site. Examination of the site and wreckage indicated the helicopter collided with terrain largely inverted. Damage to the right side of the landing gear was consistent with a significant secondary impact, right side low and slightly nose up, before the helicopter came to rest on its right side, about 6 m from the initial impact point. The wreckage was located about 17 m from the SWER line.

Examination of the site and wreckage identified:

- dirt embedded in the main rotor head assembly, the top and leading edge of one blade and the trailing edge of the second blade, along with ground scars consistent with the main rotor head and blades
- the main rotor pitch links had failed in overstress
- main rotor blade strike to the tail cone
- no pre-existing defects with the rotors, drivetrain or flight controls that would have prevented normal flight
- several indicators that the engine was providing power at the point of impact
- the left skid, forward of the crosstube, had marks consistent with a wirestrike.[8] The marks indicated that the relative contact had been both towards, and away from, the front crosstube (Figure 7)
- the right skid had collapsed under the fuselage.

The windshield was noted to be clean and in good condition, thereby not hindering the pilot's view. In addition, it was noted that the ELT transmitter was selected to the 'OFF' position (see the section titled *Emergency locator transmitter*).

Figure 6: VH-KLY

Source: ATSB

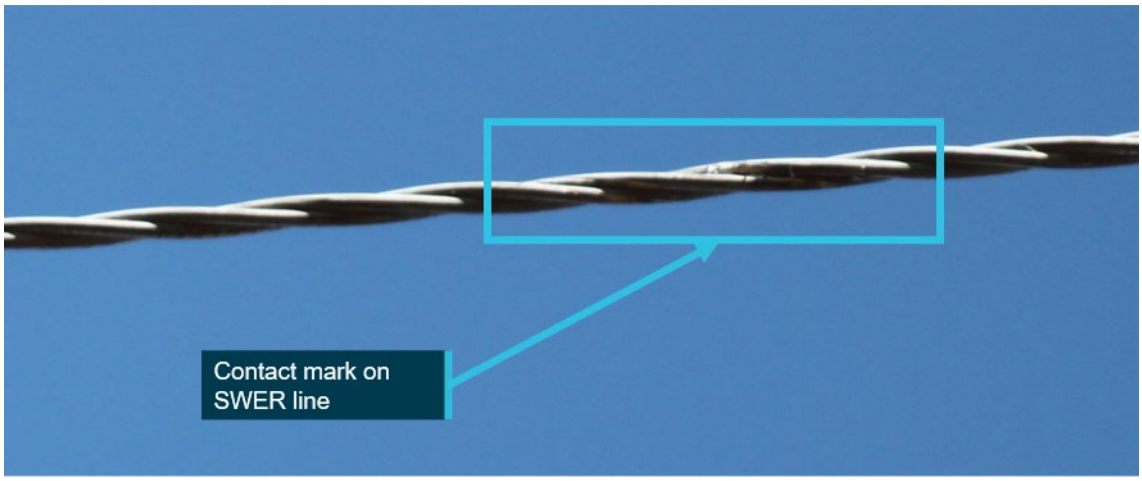
[8] The ATSB was advised that these marks were not on the skid prior to the accident.

Figure 7: Landing gear front left skid

Source: ATSB

The SWER line was found intact and the insulators on the power poles at either end of the span were undamaged. A polished area was observed on the SWER line in the approximate location of the flight path, consistent with it being contacted (Figure 8). Equipment available to the ATSB during the initial site visit was not sufficient to enable a close inspection of the wire. This mark was not visible when the ATSB returned to the accident site approximately 4 weeks later.

Figure 8: Contact mark on SWER line



Source: ATSB

Survival aspects

The survivable space within the helicopter cabin was maintained throughout the accident sequence (Figure 6). The right (pilot) seat displayed minor creasing on the right side. The storage under the right seat was filled to the volumetric capacity,[9] however, as the helicopter was inverted when it collided with terrain, this was not considered to have contributed to the pilot's injuries.

The pilot was wearing a three-point harness and aviation helmet, both of which were reported to have been fastened correctly.

[9] The pilot operating handbook advised 'avoid placing objects in compartments which could injure occupant if seat collapses during a hard landing'.

There was evidence that the pilot may not been fully restrained within the structure of the helicopter during the accident sequence. The ATSB examined the pilot's helmet at its Canberra technical facility and determined that it was structurally intact with no sign of cracking or fracturing of the composite outer shell and no damage to the inner shell. Dirt was identified on the back of the helmet with scratch marks which appeared to be recent, however it could not be established how or when they occurred.

Emergency locator transmitter

The optional emergency locator transmitter (ELT) fitted to the helicopter consisted of the transmitter, located in the main transmission bay and a remote switch/annunciator, which was located in the cabin, left of the cyclic. The ELT transmitter is normally selected to 'ARM'.[10] With the transmitter selected to ARM, the three-position remote switch/annunciator, with indicator light, operated as follows:

- ON – ELT activated
- ARM – permitted ELT activation when subjected to high 'G' load
- Test/RESET – allowed brief functional testing of the ELT or reset in case of inadvertent activation
- Light – red light illuminated when the ELT was transmitting.

RHC recommended following the ELT manufacturer's documentation for installation, operation and maintenance. The ELT manufacturer recommended a self-test 'once a month but not more than once a week'. The ELT transmitter battery was to be replaced every 6 years, with the unit subject to specialised inspection and testing at the same time. The RHC periodic inspection included, 'ELT (if installed): inspect condition and verify security'.

The maintenance organisation acknowledged that the ELT should be checked routinely during a maintenance inspection. They advised that they normally checked the security of the unit, battery expiry date, and conduct a self-test of the system. For reasons that could not be determined, the ELT had not been inspected by the maintenance organisation during the time they had maintained the helicopter.

Wreckage examination identified the remote switch/annunciator was in the ARM position and the transmitter was selected OFF. The position and orientation of the transmitter meant the switch position was unlikely to be discovered without performing a self-test. While it could not be determined if the pilot performed a self-test, it is most likely they did not as the test would have failed.

Testing of the ELT at the ATSB technical facilities, determined it was capable of activation and transmission. However, it was also determined that due to the angle the helicopter collided with terrain, it was possible the ELT would not have activated.

In 2013, the ATSB published A review of the effectiveness of emergency locator transmitters in aviation accidents, and found that even in a high deceleration impact the ELT only activated 40-60 per cent of the time in the ARM mode.

Loading and performance

Calculations by the ATSB indicated the helicopter was within the prescribed weight and balance limits for the flight.

[10] Selecting the ELT transmitter to OFF is only recommended for maintenance, storage and shipment. The ELT can also be activated by selecting the transmitter to ON

Related occurrences

A review of the ATSB database identified that, between 1 January 2010 and 31 December 2020 there were 350 reports of aircraft collisions with powerlines. Of these 12 resulted in fatal accidents, with an additional 25 accidents resulting in serious injuries.

Significantly, analysis of wirestrike accidents reported to the ATSB between 2001-2010, showed that 63 per cent of the time pilots were aware of the presence of the wire before they struck it but had momentarily forgotten about it. Two such examples are detailed below.

ATSB investigation AO-2019-011

On 13 March 2019, a Robinson R44 helicopter, registered VH-ZWK, was conducting aerial spraying operations at Bool Lagoon, around 20 km south of Naracoorte, South Australia. While spraying along a drainage channel, the pilot momentarily lost awareness of the powerline while manoeuvring over a bridge. Nearby vegetation, which reduced the pilot's ability to see the power poles and visually identify the powerline, probably reduced the pilot's ability to maintain this awareness. The helicopter was destroyed and the pilot sustained minor injuries.

ATSB investigation AO-2016-013

On the morning of 20 February 2016, the pilot of a Robinson R22 helicopter, registered VH-LYW, was conducting aerial cattle mustering operations on a property about 88 km north-east of Roma, Queensland. The pilot had mustered in that paddock several times previously and was aware of a set of high voltage transmission wires that had been erected across the property in the previous 12 months.

Prior to commencing mustering, the pilot overflew the paddock, sighted the powerlines and formed a plan to muster the cattle from north to south, giving due consideration to the wires running east-west. The pilot then mustered the mob from north to south, and the helicopter remained above the wires during that time. The pilot then saw another vegetated area near the dam, where cattle may have been hidden from view, and flew the helicopter towards it. While the pilot's focus was on searching for cattle in the scrub below, the helicopter neared the powerlines. The pilot's attention suddenly returned to the wires, sighting them close in front at the same level. The pilot attempted to avoid the wires however, the tail rotor struck the earth wire. The helicopter sustained substantial damage and the pilot was seriously injured.

These investigations, and others, highlight the dangers posed by powerlines during low-level operations. They emphasise importance of pre-flight planning and continual reassessment of where an aircraft is in relation to the wires.

Safety analysis

The pilot had been tasked to direct a stockperson to a small herd of cattle and then return to base. However, during the flight, the pilot changed this plan due to the identification of further cattle and decided they would muster the original herd to the main yards. The ATSB *Avoidable accidents No.2 - wirestrikes involving known wires: A manageable aerial agricultural hazard* advised pilots to reassess risks when plans are changed.

The pilot was aware of the powerline locations at the main yards from their previous operations however, that was a significant period of time before so their presence is unlikely to have been front of mind for the pilot as they flew towards the yard. Additionally, while the recorded flight data showed that the helicopter had passed the yards once in the previous days, it is considered unlikely that the pilot was assessing the hazards as there was no plan to use the yards during this muster and the helicopter overflew at a height significantly above the wire. Further, there was no indication of any subsequent flights over, or around, the yards that may have provided an opportunity to reassess known hazards, including during the accident flight.

On the accident flight, the pilot flew in a southerly direction from the entrance of the yards, most likely with the intention of landing and opening a second gate to allow cattle to enter the yard. The SWER line, which crossed the yard, was very difficult to detect due to the:

- lack of contrast to the background
- next power pole in the SWER network being outside the pilot's normal field of view in the direction of flight
- absence of markers on the SWER line to increase the line's visibility.

In addition, the power poles from the 3-strand network were in the pilot's forward view. While also difficult to detect, if the pilot had seen them, it may have given them a false assurance that the powerlines were not in their immediate operating area.

The direction of the marks on the left skid indicate that the left skid contacted the SWER line on an oblique angle. The marks indicated the wire had rubbed along the skid toward the front crosstube, and then away from the tube. This, and the relatively low forward airspeed, likely contributed to the SWER line not being severed. It could not be determined if the pilot had observed the wire prior to contact and was trying to avoid it, or if they reacted as the wirestrike occurred.

After contacting the wire, the helicopter collided with terrain in an inverted position. It then rolled over with the front of the right skid collapsing under the fuselage while coming to a rest on its right side.

The ELT remote switch in the cabin was in the ARMED position and, as such, it is likely the pilot would have believed the system was operational, unaware the transmitter was selected to OFF. Why the transmitter was deactivated, and not detected via periodic self-testing, could not be determined. In this instance however, there was no effect to the outcome as wreckage was located quickly due to the nearby witness.

Findings

ATSB investigation report findings focus on safety factors (that is, events and conditions that increase risk). Safety factors include 'contributing factors' and 'other factors that increased risk' (that is, factors that did not meet the definition of a contributing factor for this occurrence but were still considered important to include in the report for the purpose of increasing awareness and enhancing safety). In addition 'other findings' may be included to provide important information about topics other than safety factors.

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

From the evidence available, the following findings are made with respect to the wirestrike and collision with terrain involving Robinson Helicopter Company R22, VH-KLY, 75 km west-north-west of Hay, New South Wales on 26 May 2021.

Contributing factors

- The helicopter struck a powerline which was very difficult to detect, resulting in a loss of control and collision with terrain.
- As there was no plan for the pilot to muster cattle to the main yard and they did not conduct an aerial inspection, it is likely the hazards around the yard had not been considered.

Sources and submissions

Sources of information

The sources of information during the investigation included:

- the lead contractor for the muster
- Stock and Station Aviation Pty Ltd

- Robinson Helicopter Company
- the maintenance organisation for VH-KLY
- Civil Aviation Safety Authority
- New South Wales Police Force
- witnesses
- recorded data from the helicopter.

References

Gibb, R., Scharff, L. and Gray, R., 2010. *Aviation Visual Perception: Research, Misperception and Mishaps (Ashgate studies in human factors for flight operations)*. Ashgate Publishing Group.

Veillette, P., 2015. Wire wary: what you don't see can kill, and does. *Business and commercial aviation*.

Submissions

Under section 26 of the *Transport Safety Investigation Act 2003*, the ATSB may provide a draft report, on a confidential basis, to any person whom the ATSB considers appropriate. That section 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 following directly involved parties:

- the operator
- lead contractor for the muster
- Civil Aviation Safety Authority
- Robinson Helicopter Company
- United States National Transportation Safety Board.

A response was received from the Robinson Helicopter Company. The submission was reviewed and, where considered appropriate, the text of the report was amended accordingly.

General details

Occurrence details

Date and time:	26 May 2021 – 1152 EST	
Occurrence class:	Accident	
Occurrence categories:	Wirestrike	
Location:	75 km west-north-west of Hay, New South Wales	
	Latitude: 34º 19.031' S	Longitude: 144º 03.376' E

Aircraft details

Manufacturer and model:	Robinson Helicopter Company R22 Beta	
Registration:	VH-KLY	
Operator:	Stock and Station Aviation Pty Ltd	
Serial number:	4424	
Type of operation:	Aerial Work	
Activity:	Agricultural	
Departure:	Boyong Station, New South Wales	
Destination:	Boyong Station, New South Wales	
Persons on board:	Crew – 1	Passengers – 0
Injuries:	Crew – 1 Fatal	Passengers – N/A
Aircraft damage:	Substantial	