Australian Government
Australian Transport Safety Bureau

Collision with terrain involving Airbus Helicopters AS350B3e, VH-SZS

60 km east of Woomera Airfield, South Australia, on 20 March 2019

ATSB Transport Safety Report
Aviation Occurrence Investigation (Systemic)
AO-2019-015
Final – 9 March 2021

Cover photo: Source: Supplied

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

Publishing information

Published by: Australian Transport Safety Bureau
Postal address: PO Box 967, Civic Square ACT 2608
Office: 62 Northbourne Avenue Canberra, ACT 2601
Telephone: 1800 020 616, from overseas +61 2 6257 2463
Accident and incident notification: 1800 011 034 (24 hours)
Email: atsbinfo@atsb.gov.au
Website: www.atsb.gov.au

Addendum

Page	Change	Date

Safety summary

What happened

On 20 March 2019, the pilot of an Airbus Helicopters AS350B3e, registered VH-SZS (SZS) was performing aerial work on Pernatty Station, South Australia, approximately 60 km east of Woomera Airfield. The task involved helicopter powerline stringing from the Mount Gunson South substation to the Carrapateena mine site, a total distance of 51 km. The stage being conducted on the morning of 20 March was from pole 159 to pole 179, a distance of 4.8 km. Stringing operations continued normally for poles 161, 162 and 163. However, while approaching pole 164, at about 1017, witnesses reported seeing the helicopter collide with the pole and impact terrain near the base of the pole. The pilot, who was the sole occupant, received fatal injuries.

What the ATSB found

The ATSB found that shortly after the pilot was trained in powerline stringing, for unknown reasons they modified the taught stringing methodology. The new methodology placed the helicopter at low level in the vicinity of the powerline poles, increasing the risk of a collision. It also exacerbated the uptake of dust which, in combination with the position of the sun and the rearward attitude of the aircraft likely reduced the pilots' visibility of pole 164 and their situational awareness of it.

These factors, combined with the short distance and large elevation gain between pole 163 and 164, led to the pilot inadvertently colliding with pole 164. It was also found that the indirect supervision provided to the newly trained pilot was ineffective in identifying that a modified stringing method was being used.

What has been done as a result

The helicopter operator has advised the ATSB that they have made the following changes to their operations manual. The changes relate specifically to the supervision and review of newly authorised pilots in specialist tasks, and includes:

- Mandated and expanded In Command Under Supervision time requirements for pilots as part of initial task training for relevant specialist tasks.
- The introduction of consolidation flight checks at key points for pilots newly authorised in relevant specialist tasks.
- The mandated extension of time that pilots newly authorised in relevant specialist tasks are mentored by an experienced pilot.

Safety message

This investigation shows that experience alone will not always prevent a pilot from having an accident. In this case the pilot was a very experienced deputy chief pilot with nearly 6,500 flight hours. The ATSB research publication AR-2012-035 provides some insight as to why experience does not always provide a safeguard:

- Experience alone can never compensate for high risk activity.
- Sound decision-making and experience do not necessarily go together.
- Using pilot experience as mitigation for potential operational risks is inadvisable. If the risks are unacceptable for a qualified and competent pilot, there should be no reason for an experienced pilot to accept them.

The investigation also highlights the value of direct supervision of pilots who have recently been trained in a new task.

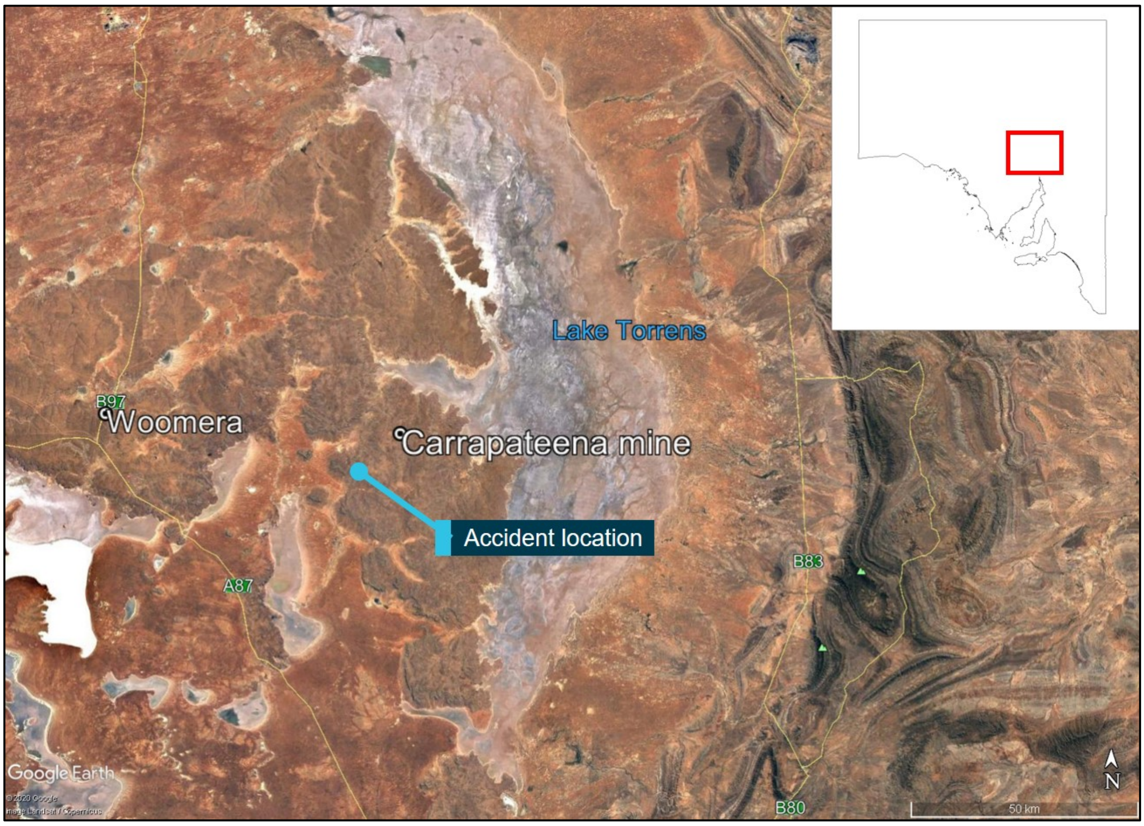
Contents

The occurrence

What happened

On 20 March 2019, the pilot of an Airbus Helicopters AS350B3e, registered VH-SZS (SZS) was performing aerial work on Pernatty Station, South Australia, approximately 60 km east of Woomera Airfield (Figure 1).

Figure 1: Accident location



Source: Google Earth, annotated by ATSB.

The helicopter operator (Aeropower) had been contracted to conduct powerline stringing operations (see the section titled *Power line stringing methodology*) for a new 132 kV electrical transmission line from the Mount Gunson South substation to the Carrapateena mine site (operated by OZ Minerals). The task involved stringing draw wire[1] and optical ground wire. The total length of the stringing operations, 51 km, was divided into twelve stages that were identified with reference to numbered transmission poles. The stage being conducted on the morning of 20 March was from pole 159 to pole 179, a distance of 4.8 km.

On the morning of the accident the Aeropower pilot and refueller rose at about 0430 Central Daylight-saving Time.[2] After breakfast, at about 0630 they attended the first of three morning briefings. The first briefing was run by Ventia, the primary contractor for the powerline operation (see the section titled *Operational information*). All workers were breath-tested for alcohol during this briefing. After the Ventia briefing, the Aeropower duo then attended the Powerlines Plus (PLP) briefing at about 0700. After the PLP briefing, at about 0730, the refueller drove the pilot to the nearby Carrapateena Airport.

[1] The draw wire is thinner (13 mm) and lighter (0.55 kg/m) than the conductor wire (31.5 mm, 1.96 kg/m). After the helicopter strings the draw wire, a ground-based winch is used to pull the conductor wire through.

[2] Central Daylight-saving Time (CDT): Coordinated Universal Time (UTC) +10.5 hours.

At 0842 the pilot took-off from Carrapateena Airport. After about two minutes of flight, the pilot returned the aircraft to the airport due to what was later described as a warning light in the cockpit. After about seven minutes on the ground, the pilot took-off again and flew to pole 179 (the last pole of the stage) for a radio check with the stringing team ground-crew. The pilot then flew the length of the stage to the start point (pole 159) for a fly-by inspection of the job site. The pilot then flew to the refuelling point, nick-named the 'Turkey's nest', landing at about 0858 (Figure 2). Here the pilot rendezvoused with the refueler and the stringing team for the last pre-start briefing for those workers directly involved with the helicopter operations.

During this meeting the pilot briefed one of the ground crew, supplied by the powerline company, on how to hook-up the draw wire to the helicopter as they had not performed this task previously. The aircraft was also refuelled. Afterward, the stringing team proceeded to their assigned work positions and at about 1000 the pilot took off and proceeded to pole 159 to commence stringing operations.

Figure 2: ADS-B[3] derived flight data for VH-SZS on 20 March 2019.

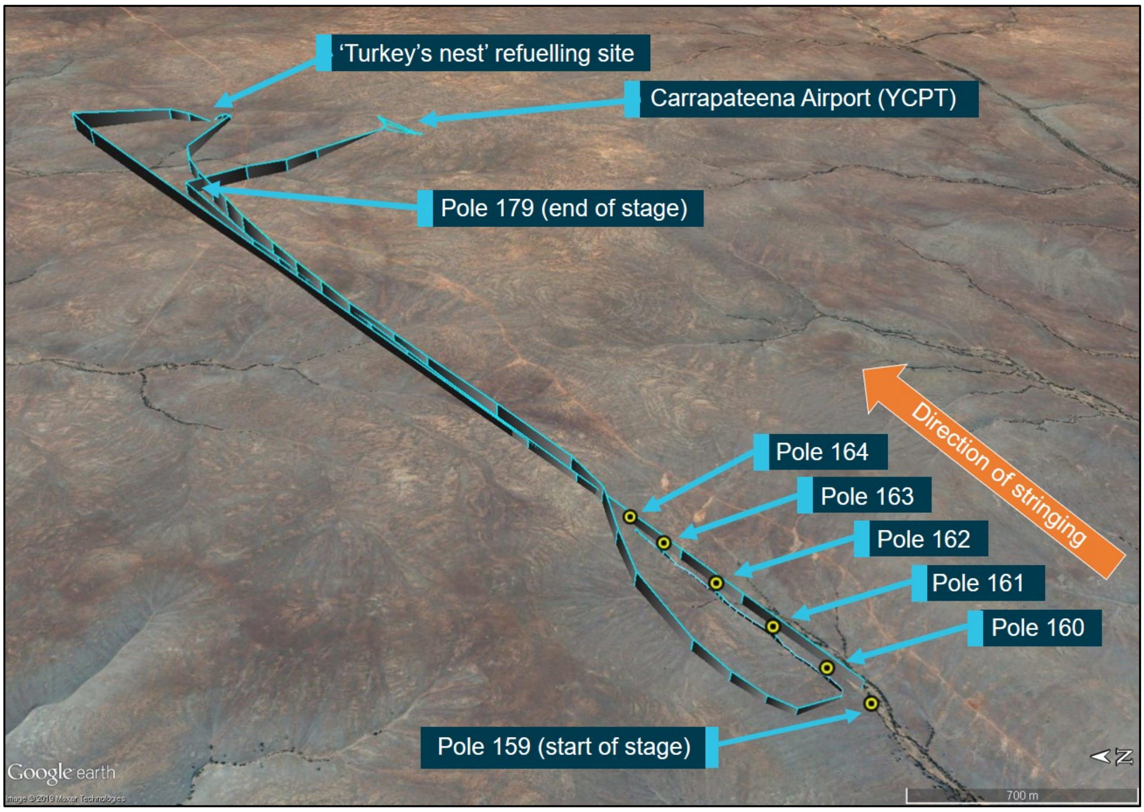


Figure 2 Shows the ADS-B flight data for VH-SZS on the day of the accident.
Source: FlightRadar24 and Google Earth, annotated by ATSB.

In preparation for helicopter stringing operations, the draw wire had previously been strung to a pulley on pole 159 using an elevated work platform. Just after 1000, when SZS reached pole 159, ground crew attached the draw wire to a remote hook fitted to the helicopter at the end of a 30 ft longline. SZS then pulled the draw wire out from a Tesmec S.p.A.[4] (Tesmec) stringing machine and proceeded to pole 160 to clip the draw wire into the pulley. Stringing operations continued normally for poles 161, 162 and 163.

3 ADS-B: Automatic Dependent Surveillance–Broadcast is a surveillance technology in which an aircraft determines its position via satellite navigation and periodically broadcasts it, enabling it to be tracked.

4 Tesmec S.p.A. are an Italian manufacturer of stringing machines. In this case, a diesel-powered hydraulic winch/brake, provides tension while the helicopter is drawing wire out and then acts as a winch to pull the final conductor wire back though.

While approaching pole 164 at about 1017, witnesses reported seeing the helicopter collide with the pole and impact terrain near the base of the pole. Several ground crew from the stringing team that were near the helicopter came to assist. They extinguished a small post-impact fire and removed the pilot from the aircraft to a safe distance. A short time later emergency services and paramedics from the mine site attended the scene and confirmed that the pilot, who was the sole occupant, had received fatal injuries.

Context

Pilot information

General information

The pilot held commercial pilot licences for both aeroplanes and helicopters, issued on 17 November 2000 and 20 November 2009 respectively. The pilot was rated for both single- and multi-engine fixed wing aircraft, as well as single-engine helicopters. Design feature endorsements that the pilot held included manual propeller pitch control, tail wheel, gas turbine and retractable undercarriage endorsements. Additionally, the pilot had a low-level endorsement for helicopter sling operations issued on 17 November 2009 and an aeroplane aerobatic endorsement, issued on 8 January 1998. The pilot was also a licenced aircraft maintenance engineer.

A review of the pilot's Air Maestro[5] logbook showed that at the time of the accident the pilot had accumulated a total flying experience of approximately 6,370 hours. About 45 of those hours were in the previous 30 days and about 77 hours were in the last 3 months. Most the pilot's flying experience (5,280 hours) was in helicopters, and the majority of that (4,537 hours) was in the MD500, a single-engine light utility helicopter. The pilot had 240 hours on the AS350, the same type flown on the day of the accident, with about 49 hours in the last 3 months on that type. The pilot's licence book indicated that the pilot had last completed a single-engine helicopter flight review on 24 Jan 2019 that was valid for 12 months.

Powerline stringing training

The pilot, who was the deputy chief pilot (DCP) for Aeropower Pty. Ltd., had been with the company since the late 1990s. In that time, the pilot had accrued about 2,400 hours in powerline operations. This included about 1,343 hours in powerline patrol and inspection, 643 hours insulator washing and nearly 400 hours in platform work.

The DCP had observed powerline stringing operations in December 2018, on a job in Wollongong, New South Wales. However, all the DCPs formal powerline stringing training was conducted during the three days of the first tour at Carrapateena.

The training involved the:

- DCP observing the chief pilot (CP) from the ground
- DCP observing in the aircraft
- CP observing the DCP while flying dual
- DCP stringing solo with the CP observing from the ground.

The DCP was deemed satisfactory in all requirements and on 7 February 2019 the CP signed-off the DCP for powerline stringing operations. The training comprised a total 7.2 hours with 1.4 hours of those with the DCP in command. At the time of the accident the pilot had a total of 25 hours experience in powerline stringing.

Medical information

The pilot held a Class 1 Aviation Medical Certificate that was valid until 2 Oct 2019 with no restrictions. The pilot was reported to be very fit and active and displayed normal behaviour on the morning of the flight and was well-rested. He was not reported to be taking any prescription medications and had no reported medical condition that could have affected his ability to operate an aircraft that day.

---

[5] Air Maestro is a cloud-based Pilot Management Software which includes an electronic pilot's logbook.

A post-mortem examination identified no significant background natural disease, which could have contributed to the accident. Toxicological analysis concluded that the toxicology was also non-contributory to either the accident or cause of death.

Aircraft information

Overview

VH-SZS (SZS) (Figure 3) was an Airbus Helicopters[6] AS350B3e Écureuil (Squirrel) light utility helicopter manufactured in 2012. The aircraft was a single-engine helicopter with six seats in the basic configuration. The primary structure of the aircraft was constructed of sheet metal, while the canopy, underside access cowling, transmission and engine cowlings were made of composite materials. The cabin area was accessible through four doors, two hinged pilot doors and two sliding rear doors.

Figure 3: Image showing VH-SZS

Figure 3 shows VH-SZS, a single turboshaft-powered Airbus Helicopters AS350B3e Squirrel.
Source: Supplied

Engine and rotors

The main rotor system comprised of three composite main rotor blades constructed of a fiberglass spar with a composite skin over a foam core. The blades were attached to a composite semi-rigid, bearingless starflex hub. The two-blade tail rotor was also manufactured of composite materials moulded onto a fibreglass spar. The tail rotor was mounted to a lightweight sheet metal tail boom. All flight controls were hydraulically boosted, with hydraulic power supplied by a single hydraulic pump which was belt driven by the engine-to-transmission driveshaft. SZS was powered by a

6 Since the helicopter was manufactured, the type certificate of the helicopter was changed from Eurocopter to Airbus Helicopters.

Turbomeca Arriel 2D engine, which was a free turbine[7] turboshaft engine. The engine was controlled by a dual-channel, full authority digital engine control (FADEC) system.

Engine Data recorder

The aircraft was fitted with a Sensorex Engine Data Recorder (EDR). The EDR was a light recorder that exclusively records data sent by the FADEC system for maintenance purposes. For both FADEC channels, engine parameters and failure flags were recorded. Engine parameters were recorded continuously at a sample rate of 1 second and at a sample rate of 20 ms for a limited duration when a failure occurs.

Maintenance

The helicopter was built in 2012 and operated in New Zealand before being imported to Australia in 2016. A Certificate of Airworthiness inspection was completed 11 March 2016 and the certificate of registration was transferred to the current owner on 13 December 2018. SZS had a current maintenance release, issued on 19 October 2018 which was valid for a period of 150 hours or 12 months, whichever was sooner. At the time of the accident the aircraft had accrued 100.4 hours since the maintenance release. The maintenance release was not in the helicopter, as required, it was located in the pilot's belongings in the accommodation area.

The helicopter was maintained in accordance with the manufacturer's documentation. At the time of the accident, there were no known maintenance deficiencies with the helicopter.

Aircraft weight and Balance

A weight and balance was performed on 16 January 2019 with an expiry date of 15 January 2022. Additionally, weight and balance calculations indicated that the aircraft was below maximum take-off weight and within the centre of gravity limits for the duration of the flight

Mack Pull

To facilitate stringing operations, the helicopter was fitted with a Mack Innovations (Australia) Pty Ltd (Mack Pull) bidirectional line stringing system. The Mack Pull provides a hard point located under the belly and to the side of the aircraft that is designed to carry a standard cargo hook. It assists with aerial work applications that require sideways flight and was specifically designed for power cable stringing work as it helps to keep the cable within the pilots' field of vision.

A 30 ft longline was attached to the cargo hook on the Mack Pull and a Mechanical Specialties 301 remote hook was attached to the other end of the 30 ft longline. A cockpit mounted load meter gave a visual indication to the pilot of the load placed on the system. The load rating on both the remote hook and the 30 ft longline was 3,000 lbs (1,360 kg).

Flight recorders

The aircraft was not fitted with a flight data recorder or a cockpit voice recorder, nor was either required by regulations.

Meteorological information

Graphical Area Forecasts (GAF)[8] for the area of operations, as well as aerodrome forecasts (TAF), meteorological aerodrome report (METAR)[9] and Automatic Weather Station (AWS) reports from Woomera Airfield were obtained from the Bureau of Meteorology. The forecasts (GAF and

[7] A free-turbine turboshaft is a form of turboshaft or turboprop gas turbine engine where the power is extracted from the exhaust stream of a gas turbine by an independent turbine, downstream of the gas turbine and is not connected to the gas turbine

[8] Following requests from the aviation industry, the Bureau of Meteorology changed the format of Area Forecasts (ARFORs) from text based to graphical on 9 November 2017. The new format is known as a Graphical Area Forecast (GAF). More information regarding GAFs is available from the Bureau of Meteorology.

[9] A METAR is a routine report of meteorological conditions at an aerodrome.

TAF) predicted no significant weather in the area of operations for the duration of the accident flight.

The METARs for Woomera Airfield (about 60 km west of the accident site) at 0930 indicated that the surface wind was 160° (True) at 9 kt. At 1000 the wind was 170° at 10 kt and at 1030 the wind was 160° at 9 kt. For all times the QNH[10] was 1015 hPa and the conditions were CAVOK.[11]

At the time of the accident the Woomera AWS recorded the temperature at 24.4 °C, 8 knots of wind (with maximum gusts of 10 kt) from 166°, and a QNH of 1015.8.

Weather data measured at the Carrapateena mine showed that at 1010 (about 7 minutes before the accident) the temperature was 27.5 °C and the wind was 1.7 kt from 128°. There were no significant changes in those conditions on the morning leading up to the accident.

On-site observations

Observations of the conditions on the day were consistent with the meteorological reports. It was reported that during the last pre-flight briefing the pilot commented that the conditions were good for flying . Other witnesses described the conditions as sunny and a little bit windy. Several witnesses noted both the strength and position of the sun, which was reported to be in the direction that the aircraft was travelling. Geoscience Australia data showed that at the time of the accident the azimuth[12] of the sun was 65° and its altitude was 35°. The bearing from pole 163 to pole 164 was 49°.

Additionally, the presence of a large amount of dust in the vicinity of the aircraft was noted by several witnesses. This can be seen in Figure 4, which shows a sequence of images of the aircraft traversing from pole 163 to pole 164.

Figure 4: VH-SZS traversing between pole 163 and 164.

Figure 4 shows VH-SZS traversing between pole 163 and 164. Pole 163 is visible in the image, while pole 164 is out of the frame to the right. The direction of travel is from left to right in this image.
Source: Witness

10 QNH: the altimeter barometric pressure subscale setting used to indicate the height above mean seal level.

11 Ceiling and visibility okay (CAVOK): visibility, cloud and present weather are better than prescribed conditions. For an aerodrome weather report, those conditions are visibility 10 km or more, no significant cloud below 5,000 ft, no cumulonimbus cloud and no other significant weather.

12 Bearing of celestial body measured clockwise from true north.

Wreckage and accident site information

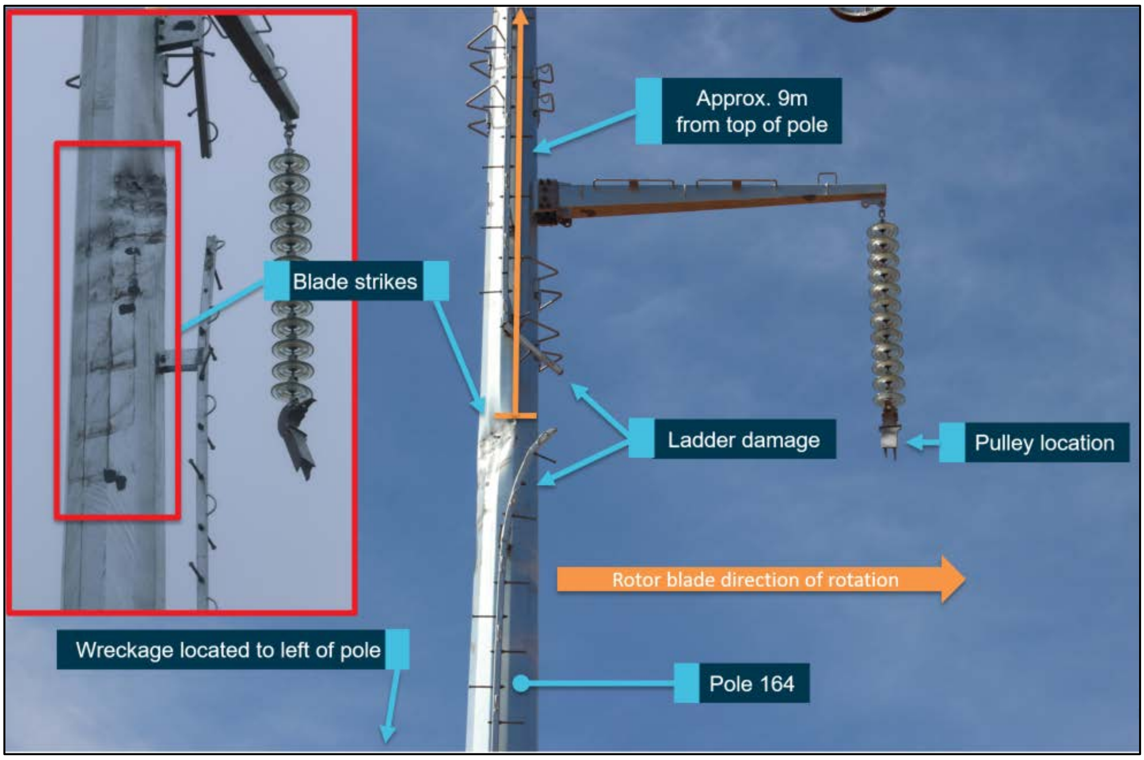
Accident site

The accident site was located about 60 km east of Woomera South Australia, on the OZ Minerals Carrapateena mine site (Figure 1). The mine is located on Pernatty Station, a 2,147 km^2 livestock station about 136 km north of Port Augusta. The start of the stringing stage (pole 159) was about 5 km south west of Carrapateena Airport and the aircraft had traversed about 1 km to pole 164.

Wreckage examination

Site and wreckage examination did not identify any aircraft defects or anomalies that might have contributed to the accident. Markings on pole 164 (Figure 5) indicated that the helicopter collided with the pole about 17 m above the ground. The main rotor blade (MRB) contacted the pulley mounted on the insulator, the ladder and pole during the accident sequence. The pulley fractured from its mounting bracket and came to rest on the access road, 15 m from the pole. The ladder was struck and bent toward the direction of the pulley, consistent with the direction of rotation of the MRBs. The pole had a number of MRB strikes, which progressed in a downward direction as the helicopter descended (inset in Figure 5).

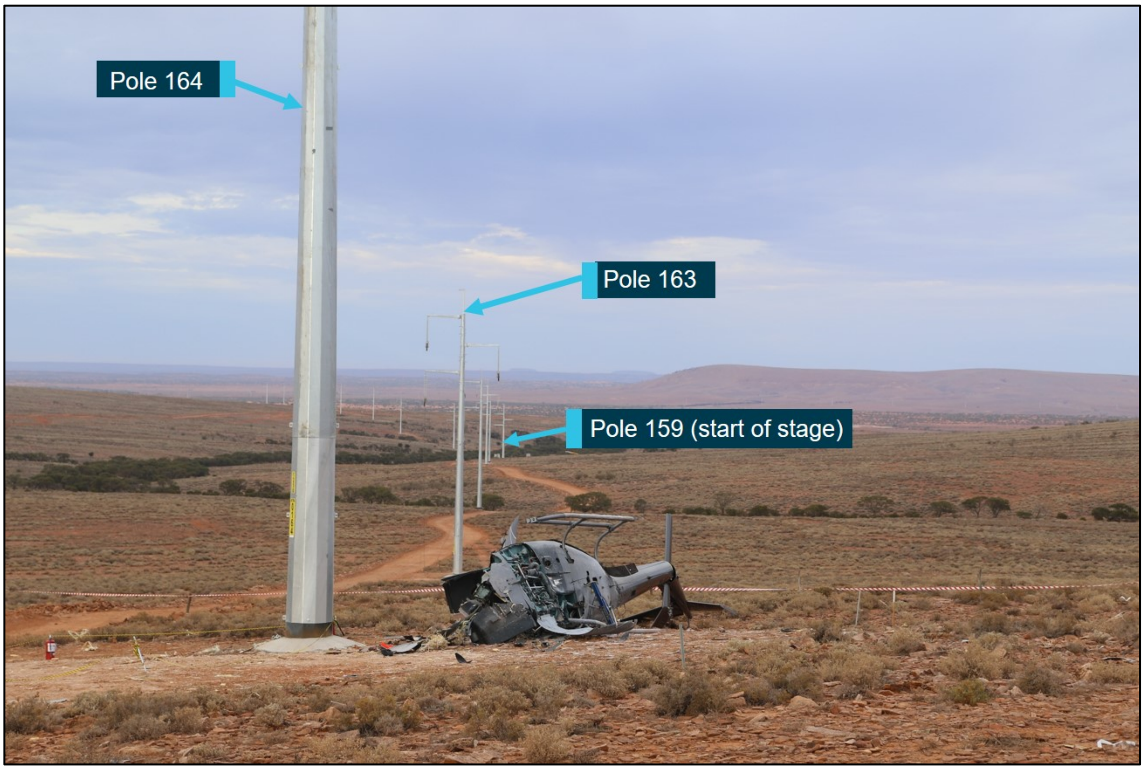
Figure 5: Impact marks and damage to pole 164.



Source: ATSB

After impacting the pole, the helicopter came to rest on its right side approximately 2 m from the base of the pole (Figure 6). The aircraft had rotated approximately 90° to the left of its direction of travel.

Figure 6: The accident site near pole 164. The direction of travel of the helicopter was from pole 163 to pole 164.



Source: ATSB

The cockpit and fuselage roof were substantially disrupted from impact forces. The tail boom had almost entirely detached at the fuselage junction and fractured forward of the horizontal stabiliser, due to ground impact. Two of the MRBs had separated from the rotor head and came to rest side-by-side next to the fuselage. The third blade remained attached and had become entangled around the main rotor gearbox.

The longline, which had separated from the Mack Pull, was found a short distance away toward Pole 163. The draw wire was also found to have separated from the remote hook on the longline. The ATSB recovered a number of components from the accident site for further examination.

Engine

The engine assembly was examined and found to be complete with no evidence of pre-accident defects. All engine plumbing and wiring looms were connected to their respective components. The chip detector and magnetic plugs were examined and found to be clear of particles. The engine fuel and oil filters were examined and found to be clear of contaminants.

Recorded engine data

The engine data recorder (EDR) was shipped to France and downloaded by the of Bureau d'Enquêtes et d'Analyses (BEA). The BEA analysed the data in consultation with the aircraft manufacturer (Airbus Helicopters) and the engine manufacturer (Safran Helicopters Engines). The analysis showed that the engine was performing in a satisfactory manner until contact with the pole, when the EDR recorded a torque overlimit. The BEA report concluded that;

> No anomaly was found prior the impact with the ground/pylon.

Fuel

SZS was fully fuelled on the morning of the flight from an intermediate bulk container (IBC), which was owned and maintained by the operator. The amount of Jet A1 taken aboard was 315 litres, which was sufficient to carry out the planned work for that morning.

A fuel sample was taken from the aircraft post-accident and from the IBC. Both series of testing indicated that the fuel was clean and clear of any contaminants.

Instruments and Avionics

The instrument panel fitted to SZS was the basic panel with added turn and slip and glideslope indicators. An air conditioning control panel and hour meter was also installed.

Emergency Locator Transmitter (ELT)

SZS was fitted with a KANNARD 406 AF-H ELT. The ELT, with part number S1822502-02 and serial number LX1100019317, had an expiry date of November 2024. The ELT activated automatically during the accident sequence and was deactivated by an attending police officer.

Flight controls

All flight controls were examined, and control continuity was established for both main and tail rotor systems. A number of control tubes displayed bending damage due to contacting the surrounding structure during the accident sequence.

Mack Pull and longline

An examination of the Mack Pull and cargo hook did not reveal any defects. Company standard practice was to install the longline with a shackle at both ends however, the draw wire did not have a shackle fitted for the connection to the remote hook. The upper end connected to the helicopter hook did have the shackle installed as required.

The remote hook and longline detached from the aircraft cargo hook during the accident and were located a short distance from SZS, drawn backwards by the retracting load of the draw wire. It could not be determined how it unhooked from the Mack Pull cargo hook. After detaching from the Mack Pull, the remote hook struck a large rock, indicated by orange paint transfer from the hooks' outer cage. The hook then bounced to another location, shown by a ground scar. The draw wire was found detached from the remote hook. On-site testing indicated it was likely the uncoupling of the draw wire occurred during the impact with the rock.

Post impact fire

A small post impact fire occurred at the engine exhaust. Responders used hand-held fire extinguishers to prevent the spread of fire to the airframe. The resulting damage was minimal and did not show evidence of a fire outside of the engine exhaust.

Additional information

Operational information

The pilot, who was the deputy chief pilot (DCP) for Aeropower and the chief pilot (CP) mobilised to Adelaide on 31 January 2019 in preparation for operations at Carrapateena. The intention was that the CP would use this job as an opportunity to train the DCP in powerline stringing operations, then once signed-off, the DCP would complete the rest of the job solo. On 3 February both pilots mobilised to Port August and arrived at Carrapateena on 4 February for an all-stakeholder briefing for the stringing operation. The key stakeholders present were:

- OZ Minerals – the mine site operator
- Ventia – Principal contractor
- ElectraNet – Contracted to build, own, operate and maintain the powerline infrastructure
- Powerlines Plus (PLP) – sub-contracted by Ventia to build the powerline
- Aeropower – contracted by PLP for the helicopter stringing operations.

Later that day the Aeropower pilots were audited by an independent safety auditor contracted by ElectraNet to assess their capability to safely undertake the job. At this point Aeropower were already contracted to do the work. The next day, 5 February, flying operations began.

Summary of stringing operations

Tour 1 of the helicopter powerline stringing operations started on 5 February and continued until 7 February. During these 3 days, stages 5 and 6 were completed. Stage 5 comprised 22 poles while stage 6 comprised 21 poles. Each stage was completed thrice, once for each of the three wires suspended by the poles. At the end of tour 1, on 7 February, the DCP was signed-off on powerline stringing and the CP departed the site.

Stringing for tour 2 started on 18 February and was conducted by the DCP solo, without the CP on-site. Stage 7 (15 poles), was completed on 18 February and stage 8 was completed on 19 February (19 poles). Again, all stages were conducted three times.

Tour 3 stringing operations commenced on 10 March with the 20 poles of stage 4. This was followed the next day with stage 9 (21 poles). Again, all stages were completed three times by the DCP flying solo. Tour 4 started 9 days later, on 20 March. Including the 4 poles strung on the morning of the accident, the pilot had strung 122 poles, all but the last 4 were strung 3 times.

Accident span gradient

The span width between poles 163 and 164 (the accident span) was 174 m, one of the shortest the pilot had undertaken at Carrapateena. Indeed, of the 122 spans that the pilot had strung at Carrapateena, only 4 were shorter than the accident span. In addition, the elevation gain between pole 163 and 164 was 12.86 m. This was the largest elevation gain of any span the pilot had undertaken at Carrapateena. As a result of the span length and elevation gain, the accident span between pole 163 and 164 had the greatest gradient of any span the pilot had conducted at Carrapateena.

Use of load rings

In response to an ATSB investigation (ATSB report 200300011), the Civil Aviation Safety Authority (CASA) airworthiness bulletin AWB 25-006 was issued (and has since been revised). The bulletin applies to all rotorcraft engaged in underslung load / non-human external cargo. It highlights the importance of using a primary load ring and shackle on cargo hooks to prevent both an inadvertent release or a jammed hook.

The Aeropower operations manual was consistent with this regulatory guidance, with sections 9.1.3 and 9.1.4 stating;

> 9.1.3. DO NOT put a rope of any kind directly onto the cargo hook. It can twist and hang up preventing release if required.
>
> 9.1.4. DO use a shackle or primary load ring to attach directly to the hook to ensure smooth release. Make sure it is large enough to fall free without becoming trapped by the dropping tongue of the hook.

On the day of the accident a Powerlines Plus ground staff was assigned to hook up the draw wire to the helicopter. As they had not performed the task before, during the pre-flight briefing, the pilot instructed the ground staff on the procedure. It was reported that the use of a load ring or shackle was not mentioned, and that the instruction given was to connect the draw wire directly to the remote hook. Other ground staff reported never seeing a load ring or shackle between the draw wire and the remote hook at any time during the Carrapateena operations.

Power line stringing methodology

The purpose of powerline stringing is to attach electrical conductor wire to pulleys that are suspended on towers (or poles). Light-weight conductor wire on smaller poles can be strung using an elevated work platform (‘cherry-picker’) and pulled through with a small winch. While heavier gauge wires, such as that used at Carrapateena, necessitates the use of heavy machinery to pull the conductor between towers. Helicopters can also be used for powerline stringing. The advantage of using helicopters are;

- Much faster than pulling a conductor wire with a bulldozer.
- Minimised disruption to ecologically or culturally sensitive land (the Carrapateena site had cultural sensitivities).
- The ability to traverse rugged terrain that would be inaccessible to ground-based heavy machinery.

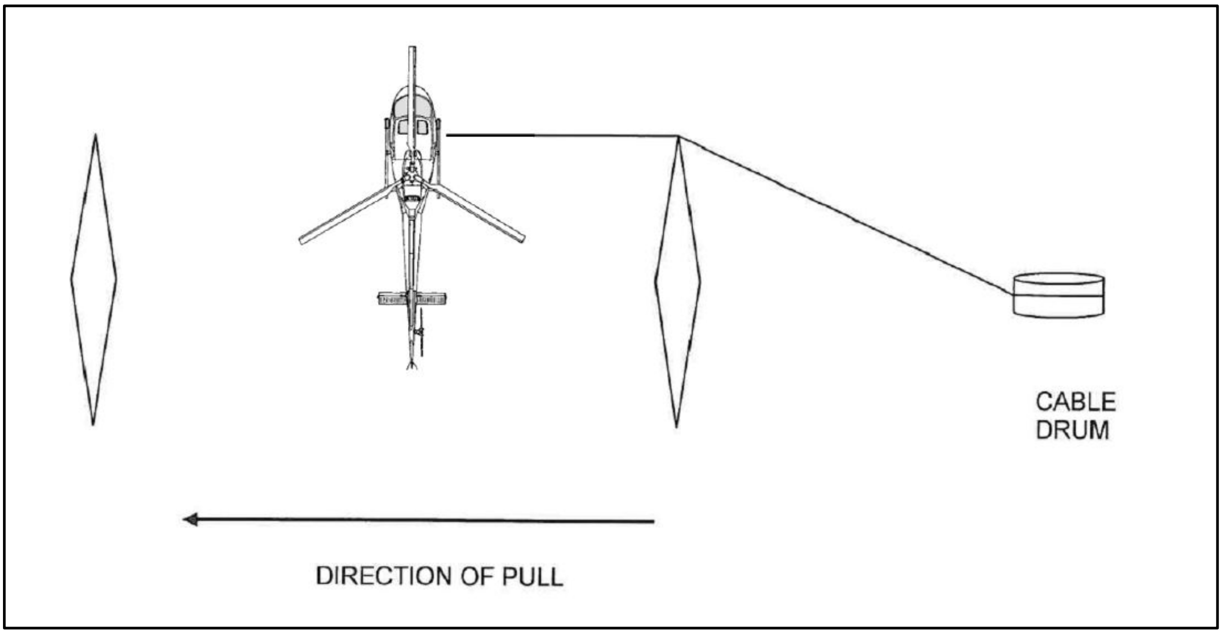
One of the limitations of using a helicopter is the weight carrying capacity of the aircraft. For jobs that require a heavy conductor wire, a lighter weight draw wire is strung by the helicopter. Then, a fixed position ground-based winch uses the draw wire to pull the heavier conductor wire back through the pulleys.

Taught methodology

Between 5 and 7 February 2019, the DCP received instruction in helicopter powerline stringing methodology. The stringing method taught by the CP had several key features, these included:

- A straight-line flight path is maintained between each pole.
- The helicopter hovers and traverses at an angle of about 90° (sideways) to the path of the wire. This ensures that visibility of both poles in maintained. The strung pole should be visible through the right cockpit door/window and the target pole should be visible through either the left cockpit door/window or the open rear left door (Figure 7).

Figure 7: Orientation of helicopter relative to path of travel during stringing operations.



Source: Aeropower work instruction AS350 – Mack Pull

- After clipping in the draw wire to the pulley, height is maintained for a short distance to ensure there is enough weight in the line to hold it down on the pulley.
- As the helicopter traverses to the next pole, altitude is gained to a height greater than that of the next pole.
- The helicopter traverses directly over the top of the target pole. Visibility of the pole is maintained by use of aircraft mounted mirrors.
- Once clear on the other side of the pole, the helicopter descends to the height of the target pulley to clip the wire in.
- The process continues until the stage is complete.

Observed methodology

The DCP was deemed competent in the stringing method and signed-off by the CP at the end of tour 1 on 7 February 2019. All subsequent stringing operations were conducted by the DCP solo.

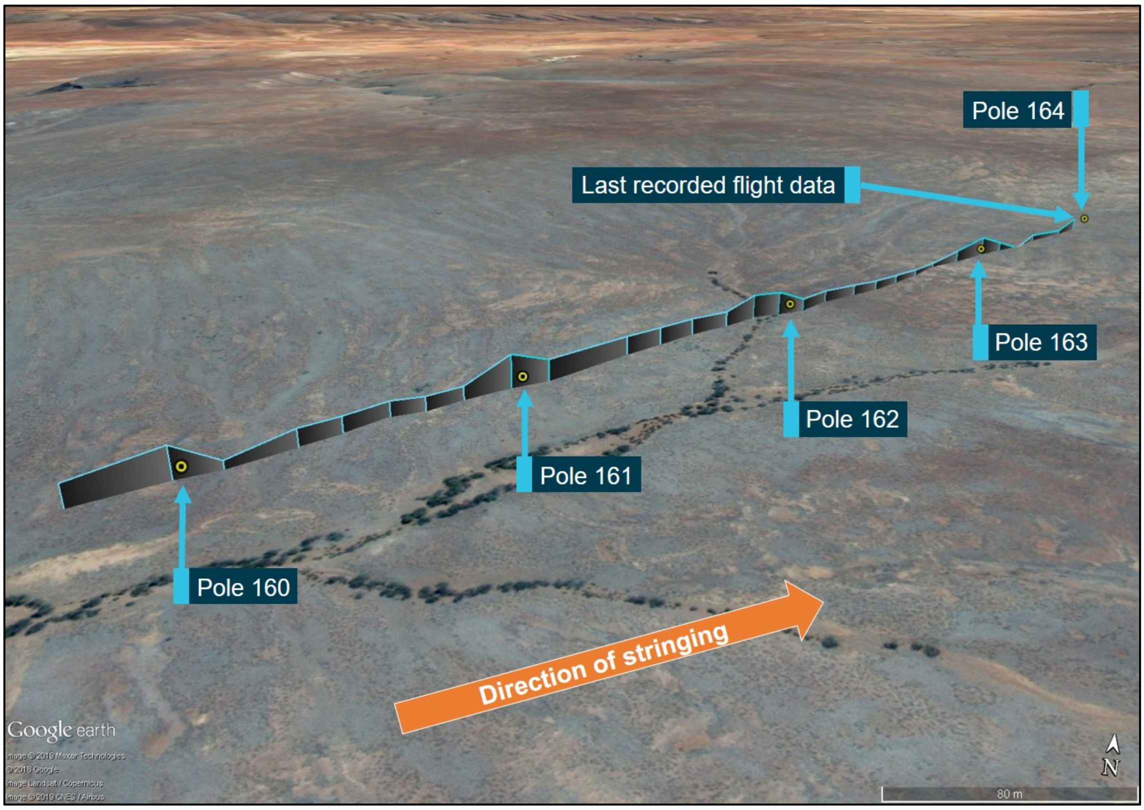
Nothing unusual or untoward was observed regarding the stringing methodology during the two days of flight operations of the second tour. However, the Aeropower refueller, who was experienced in stringing operations, never observed the stringing operations due to the location of the refuelling site. During the third tour a different Aeropower refueller was on-site and took photographs and video of the stringing operations. Some of the key points observed were;

- After clipping in the draw wire to the pulley the helicopter traversed out to the side (left side relative to direction of travel) en-route to the target pole.
- The aircraft did not gain altitude while traversing in-between poles.
- The helicopter pulled the draw wire in a pronounced tail-back attitude, with respect to the direction of the pull (Figure 4).
- Rather than traversing directly over the target pole, the helicopter came back in from the left side and came over and around the pole.

This modified technique continued into tour 4 and was observed by a number of witnesses on the day of the accident. Witnesses stated that the helicopter never came above the height of pole 164 before colliding with it.

ADS-B data (Figure 8) from the day of the accident shows a flight path consistent with what was described by witnesses. The data shows that the aircraft maintained a low altitude between poles. Only once in close proximity to the next pole did the aircraft rise above the height of the pole. The data also shows the aircraft tracking to the left of the direct path and traversing around the pole rather than directly over it.

Figure 8: ADS-B data of the flight path from pole 159 to 164



Source: FlightRadar24 and Google Earth, annotated by ATSB

Regulatory oversight

Other than the low level and sling operations endorsements, there are no other specific Civil Aviation Safety Authority (CASA) requirements for undertaking powerline stringing operations. Additionally, there are no recommendations or requirements from CASA regarding the training requirements for operators training pilots in powerline stringing. Nor are there any requirements for any supervision post-training. It is up to the individual operators to provide what they determine to be an appropriate syllabus of training and supervision.

The pilot was provided the training required by Aeropower procedures and satisfied all CASA and Aeropower requirements to conduct powerline stringing. Although there was no requirement in Aeropower procedures for post-training supervision, the CP did try to provide indirect supervision after they had left Carrapateena. The CP stated they were in regular contact with the DCP during tours 2 and 3 to check up on how the DCP was going. It was reported that the DCP did not raise any concerns regarding the job or the stringing methodology.

Related occurrences

A review of the ATSB's national aviation occurrence database revealed only one other occurrence reported to the ATSB in the 20 years between 2000 and 2019 involving helicopter powerline stringing operations. That accident, also involving an Aeropower aircraft, was investigated by the ATSB (Investigation report AO-2008-025). A summary is below.

> On 9 April 2008, the crew of a McDonnell Douglas Helicopter Company MD369ER helicopter registered VH-PLU, experienced a substantial loss of engine power while conducting low-level powerline stringing operations. The helicopter impacted the ground and was seriously damaged. The two occupants were seriously injured.
>
> The investigation determined that the pilot in command was operating the helicopter with a fuel tank quantity that did not guarantee continuous operation of the engine at the flight attitudes experienced during the powerline stringing operation.
>
> As a result of the accident, the operator revised its fuel management procedures for powerline stringing operations.

In the same 20-year period Aeropower was involved in the following five accidents that were investigated by the ATSB (this includes AO-2008-025, previously mentioned):

- 200505332: Loss of tail rotor authority – 9 km north of Warwick Queensland, VH-SUV
- AO-2008-025: (Summarised above) Fuel-related event 16 km south-east of Townsville Airport, Queensland 9 April 2008
- AO-2008-078: Wirestrike - McDonnell Douglas 369D, VH-PLJ, 13 km north of Murray Bridge, South Australia, 19 November 2008
- AO-2012-082: Collision with terrain - Schweizer 269C-1 helicopter, VH-LTO, Redcliffe Aerodrome, Queensland, 18 June12
- AO-2016-078: Fuel exhaustion and collision with terrain involving McDonnell Douglas Corporation 369, VH-PLY, 36 km north-west of Hawker, South Australia, on 17 July 2016

Of note, the wirestrike fatal accident in 2008 (AO-2008-078) involved a pilot that was recently instructed in a new task (platform work – joint-testing). The accident occurred the day after training had completed on the pilot's first unsupervised joint-testing job. Although experienced, with 3,744.2 total flight hours, at the time of the accident the pilot had a total of about 27 hours on platform work.

The report stated:

> Had the chief pilot been able to supervise the task on the day of the occurrence as planned, it was possible that he may have detected one or more of the earlier mid-span transpositions and alerted the crew to the hazard. That would probably have forewarned the crew to anticipate other mid-span transpositions along the line, and increased the likelihood that they would detect the transposition between towers STR0031 and STR0032.

One of the safety factors identified by the investigation was;

> There was no direct supervision of the joint-testing operations [Minor Safety issue].

Safety analysis

Introduction

While stringing powerlines to the Carrapateena mine about 60km east of Woomera Airfield, South Australia, Airbus Helicopters AS350B3e Écureuil (Squirrel) registered VH-SZS, pulled draw wire towards pole 164. Witnesses observed the aircraft traverse slowly up the gradient of rising terrain towards the pole in a near backwards attitude toward the morning sun and in the presence of substantial dust. As the aircraft approached the pole it was observed to continue to fly in a controlled manner until it collided with the pole and fell to the ground.

Site and wreckage examination did not identify any aircraft defects or anomalies that might have contributed to the accident. The recorded engine data also showed no anomalies with the engine prior the impact with the pole. Additionally, no evidence was found to suggest any medical, fatigue related or physiological issues that would have affected the pilot's performance on the day of the flight. Therefore, this analysis will focus on the operational and environmental factors that led to an experienced helicopter pilot inadvertently colliding with a known obstacle.

Development of the accident

Altered methodology

The pilot received 7.2 hours of training in helicopter powerline stringing in the 3 days of the first tour between 5 February and 7 February 2019. By the third tour (March 10-11) video and photographs taken of the stringing operations showed that the pilot had altered the methodology from that which was taught. Witnesses on the day of the accident also described the same modified method being used. The new method placed the helicopter at a lower operating height above the ground, in a tail-rear attitude, while tracking out to one side before climbing around the pole.

It is not known when exactly the pilot began altering the stringing method, only that it was in use during the third tour and on the accident day. It is therefore likely that the pilot had successfully strung dozens of poles using the new method before the accident, possibly re-enforcing the validity of the method to the pilot.

Span length

By 20 March, the pilot had strung 122 poles (almost all of which were strung 3 times). The length of these spans varied from 156 m to 351 m. The vast majority (85 per cent) of the spans were between 200-300 m in length, with the average being about 250 m. The accident span was 174 m, one of the shortest of the 122 the pilot had done. Only 4 spans were shorter, and they were all strung on March 10, 10 days prior to the accident. Additionally, the span immediately prior to the accident was 253 m. The accident span was nearly 80 m shorter than the average span, and 79 m shorter than the penultimate span. Based on the pilot's previous experience, it is possible the pilot's expectation was that pole 164 was still some distance away at the time on the collision. Compounding this risk was the gradient of the accident span. With an elevation gain of 12.86 m, the span between poles 163 and 164 had the greatest gradient of any the pilot had flown at Carrapateena.

Visibility of pole 164

A feature of the taught stringing method was that both the recently strung pole and the next target pole are both visible at all times. Maintaining a straight-line path between the poles with the aircraft at 90° (sideways) to the relative track ensures visibility of both poles is maintained. The method also places the aircraft at an altitude higher than the target pole, therefore safeguarding against collision. The pilot's altered methodology placed the helicopter both at lower altitude and in a pronounced tail-rear attitude.

The low altitude exacerbated the amount of dust in the air around the helicopter. Witnesses described a plume of dust higher than the nearby poles. Although the perspective of observers on the ground may not accurately represent that of the pilot, it is clear from observations and photographs taken on the day (Figure 4), that there was significant dust in the vicinity of the helicopter as it approached pole 164.

Analysis of the sun position and observations made on site indicated that the sun would have been in the general direction of the pilot's vision of pole 164. Although the pilot was wearing a helmet mounted visor at the time of the accident, sun glare, particularly in combination with dust, may have reduced visibility of the pole.

Additionally, several witnesses, as well as photographs, show that the helicopter was being flown in a near backwards attitude as it traversed towards pole 164. Although it is difficult to determine the exact proportional effect of each element in isolation, it is likely that in combination, the near backwards attitude of the aircraft, significant dust and the position of the sun would have led to a reduction of the pilot's visibility of pole 164 and the ground. In the absence of visual cues of the pole it is likely that the pilot's situational awareness of pole 164 was degraded leading to the pilot inadvertently colliding with it.

Supervision

The operator did not have any documented requirements for supervision after the pilot was signed-off for powerline stringing, nor were they required to by regulations. Despite this, after the chief pilot left Carrapateena on 7 February 2019, they were in contact with the deputy chief pilot by telephone several times to check-in and see how the job, and the pilot, were going. Unfortunately, this indirect supervision relied either on the pilot being aware there was a problem with their methodology, or the pilot disclosing that they had intentionally altered the methodology.

The investigation could not determine why the pilot modified the stringing methodology. It is possible it was a result of an unperceived degradation of a newly taught skill, or the intentional modification of the technique. In either case, it is highly likely that ongoing supervision by an experienced powerline stringing operator would have identified the modified methodology and the associated risks.

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.

Safety issues are highlighted in bold to emphasise their importance. A safety issue is a safety factor that (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.

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 Collision with terrain involving Airbus Helicopters AS350B3e,VH-SZS 60 km east of Woomera Airfield, South Australia, on 20 March 2019.

Contributing factors

- The pilot was using a stringing technique that was different to that instructed by the chief pilot. The modified method resulted in the aircraft operating at a lower height above the ground, which led to the pilot colliding with pole 164.
- Due to a combination of the attitude of the aircraft, dust and the position of the sun, it is likely that the pilot lost situational awareness of pole 164, leading to the collision with it.

Other factors that increased risk

- **There were no requirements in Aeropower procedures to provide any post-training supervision for powerline operations. What supervision was provided was ineffective in identifying that a modified stringing method was being used by the pilot. [Safety issue]**

Safety issues and actions

Central to the ATSB's investigation of transport safety matters is the early identification of safety issues. The ATSB expects relevant organisations will address all safety issues an investigation identifies.

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

All of the directly involved parties are invited to provide submissions to this draft report. As part of that process, each organisation is asked to communicate what safety actions, if any, they have carried out or are planning to carry out in relation to each safety issue relevant to their organisation.

The initial public version of these safety issues and actions will be provided separately on the ATSB website on release of the final investigation report, to facilitate monitoring by interested parties. Where relevant, the safety issues and actions will be updated on the ATSB website after the release of the final report as further information about safety action comes to hand.

Aeropower post-training supervision

Safety issue description

There were no requirements in Aeropower procedures to provide any post-training supervision for powerline operations. What supervision was provided was ineffective in identifying that a modified stringing method was being used by the pilot.

Issue number:	AO-2019-015-SI-01
Issue owner:	Aeropower Pty. Ltd.
Transport function:	Aviation: General aviation
Current issue status:	Closed-Adequately addressed
Issue status justification:	The actions taken by the operator address the key concern of the safety issue, that being the supervision of pilots recently trained/authorised in a new specialist task. The mandated extension of command under supervision time, the introduction of periodic consolidation flight checks and the mandated extension of mentoring time are all expected help better prepare newly trained pilots for solo operations and provide them with additional defences to the hazards associated with specialist flight tasks.

Proactive safety action taken by Aeropower Pty. Ltd.

Action number:	AO-2019-015-NSA-044
Action organisation:	Aeropower Pty. Ltd.
Action date:	4 November 2020
Action status:	Closed

On 4 November 2020, the ATSB were advised that Aeropower had taken the following proactive safety actions:

> Specifically relating to the supervision and review of newly authorised pilots in specialist tasks, Aeropower has made the following amendments to our procedures:
>
> 1. Mandated and expanded In Command Under Supervision (ICUS) time requirements for pilots as part of initial task training for relevant specialist tasks.
>
> 2. The introduction of consolidation flight checks at key points for pilots newly authorised in relevant specialist tasks. These have been identified as primary, secondary, and tertiary checks.

3. The introduction of a requirement for pilots newly authorised in relevant specialist tasks to be rostered with an experienced pilot to act as a mentor for their first tasking as PIC on the specialist task.

For cable stringing, the new requirements include 2,500 hours minimum as pilot in command, 100 hours on type, 200 hours low level flying, 200 hours on other powerline operations. Additional supervision requirements include;

- 10 hours in command under supervision (ICUS)
- Primary consolidation check at 1-20 hours
- Secondary consolidation check at 30-50 hours
- Tertiary consolidation check at 75-100 hours
- Operational proficiency checks pre tasking.

General details

Occurrence details

Date and time:	20 March 2019 – 1017 CDT	
Occurrence category:	Accident	
Primary occurrence type:	Collision with terrain	
Location:	60 km east of Woomera Airfield, South Australia	
	Latitude: 31° 18.82" S	Longitude: 137° 24.9'E

Aircraft details

Manufacturer and model:	Airbus Helicopters AS350B3e Écureuil (Squirrel)	
Registration:	VH-SZS	
Operator:	Aeropower Pty. Ltd.	
Serial number:	7421	
Type of operation:	Aerial work	
Activity:	General aviation > Aerial work – Construction – sling loads	
Departure:	Carrapateena Airport	
Destination:	Carrapateena Airport	
Persons on board:	Crew – 1	Passengers – nil
Injuries:	Crew – fatal	Passengers – nil
Aircraft damage:	Substantial	

Sources and submissions

Sources of information

The sources of information during the investigation included the:

- Aeropower Pty. Ltd.
- OZ Minerals
- ElectraNet
- Civil Aviation Safety Authority
- South Australian Police Service
- Bureau of Meteorology.
- Airservices Australia
- accident witnesses
- video footage and photographs of the accident flight and other photographs and videos taken on the day of the accident and prior to the accident.
- recorded data from the Engine Data Recorder unit on the aircraft.

References

Aeropower work instruction AP-WI 2653 – Cable Stringing – AS350 – Mack Pull

Aeropower operations manual AP-OM 0610 – Powerline stringing (Electrical pylon cable laying)

ATSB investigation report (200300011)

Civil Aviation Safety Authority (CASA) airworthiness bulletin AWB 25-006

ATSB research publication AR-2012-035

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:

- Civil Aviation Safety Authority
- Aeropower Pty. Ltd.
- The chief pilot
- OZ Minerals
- Ventia
- Powerlines Plus
- ElectraNet
- BEA

Submissions were received from the Civil Aviation Safety Authority, Aeropower, the chief pilot and OZ Minerals. The submissions were reviewed and where considered appropriate, the text of the report was amended accordingly.

Australian Transport Safety Bureau

About the ATSB

The ATSB is an independent Commonwealth Government statutory agency. It is governed by a Commission and is entirely separate from transport regulators, policy makers and service providers.

The ATSB's purpose is to improve the safety of, and public confidence in, aviation, rail and marine transport through:

- 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, as well as participating in overseas investigations involving Australian-registered aircraft and ships. It prioritises investigations that have the potential to deliver the greatest public benefit through improvements to transport safety.

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

Purpose of safety investigations

The objective of a safety investigation is to enhance transport safety. This is done through:

- identifying safety issues and facilitating safety action to address those issues
- providing information about occurrences and their associated safety factors to facilitate learning within the transport industry.

It is not a function of the ATSB to apportion blame or provide a means for determining 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. The ATSB does not investigate for the purpose of taking administrative, regulatory or criminal action.

Terminology

An explanation of terminology used in ATSB investigation reports is available on the ATSB website. This includes terms such as occurrence, contributing factor, other factor that increased risk, and safety issue.