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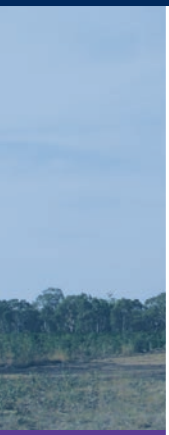

ATSB TRANSPORT SAFETY REPORT
Aviation Research and Analysis – AR-2011-028

Avoidable Accidents No. 2

Wirestrikes involving known wires: A manageable aerial agriculture hazard

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May11/ATSB49
ISBN: 978-1-74251-176-7

Introduction

Wirestrikes pose an on-going problem to aerial agricultural operations. There are 180 wirestrike accidents in the ATSB database for the period between 2001 and 2010. Of these, 100 involved agricultural flying. Research by the Australian Transport Safety Bureau (ATSB) has shown that 63 per cent of pilots were aware of the position of the wire before they struck it.[1]

This publication describes recent aerial agricultural wirestrike accidents. In all these cases, the aircraft struck a powerline that was known to the pilot. In many of these accidents, the pilot was not completely focused on the immediate task of flying due to a change in plans.

This publication also explains a number of strategies developed by the Aerial Agriculture Association of Australia (AAAA) and the ATSB to help agricultural pilots manage the on-going risk of wirestrikes during spraying operations. These include:

- ensure you are physically and mentally fit to fly
- set client expectations so that they are clear that safety comes first
- conduct a thorough briefing and study a detailed map of the area before the flight
- conduct an aerial reconnaissance before spraying and conduct an extra aerial reconnaissance before the clean-up run
- reassess the risks when plans change
- avoid unnecessary distractions and refocus when distracted
- be aware of vigilance limitations
- don't rely on your ability to react in time to avoid a wire
- actively look for and remind yourself of wires
- be aware of and manage pressures
- have a systematic approach to safely managing wires.

1 ATSB research and analysis report B2005/0055.


Source: ATSB

Clean-up run

Investigation AO-2009-017

In April 2009, two pilots were operating R44 helicopters spraying pine paddocks near Langkoop, Victoria. The first paddock was sprayed in the morning for 1.5 hours before the pilots took a 30-minute rest. From about 10 AM, the spraying of the first paddock was completed before the pilots moved onto the second paddock. The only powerline in the second paddock was in the north-east corner and partially crossed the paddock. The spraying requirements, the layout of the two paddocks, and the associated hazards were discussed between the forestry site manager and the operator's chief pilot. The chief pilot then relayed that information to both pilots. Earlier in the day, the pilots had discussed the difficulty of seeing the powerline. However, the accident pilot had not highlighted the hazards on his map.

Each pilot was responsible for a portion of the paddock and spray runs followed pre-programmed east-west-east GPS tracks. The pilot spraying the northern half of the paddock had crossed the powerline eight times during his planned spraying. Immediately prior to lunch, that pilot was tasked with two unplanned spray runs and then a clean-up run in the southern half of the paddock.

Although he was now operating in a new area of the paddock, the pilot did not conduct a reconnaissance flight to identify any hazards.

The clean-up run was firstly on the western boundary, followed by the eastern boundary travelling north. During this final run, the helicopter collided with the powerline located in the north-east corner of the paddock. The pilot was fatally injured.

The investigation found that an additional hazard identification check prior to the conduct of a clean-up run (as recommended in the AAAA manual) was not routinely practiced by all pilots or monitored by the operator.

Lessons learnt

In this case, a reconnaissance flight before the unplanned spray runs and clean-up runs could have brought the presence of the wire back into prominence among the other considerations the pilot may have been thinking about.

Source: ATSB

Change of plans

Investigation AO-2009-030

In June 2009, the pilot of a Bell 206 Jetranger was contracted to conduct agricultural spraying operations at a property near Albury, New South Wales. On arrival at the property, he conducted an aerial survey of the area with the property owner to confirm the areas to be sprayed and identify potential hazards, including any wires, within the spraying area.

The pilot was initially following a plan to conduct spraying from higher elevations of the property down to the lower elevations, when he was contacted by the property owner via UHF radio, asking him to start spraying some of the lower elevations sooner than planned. In response, the pilot began formulating a plan to accommodate the request, while continuing to apply the current load of chemical.

There was some chemical remaining onboard when he completed the spraying required in the area he was in, so he decided to relocate and complete an additional, ad-hoc spray run. The selected area for the run crossed a powerline that was known to the pilot both from previous operations and from having been identified during the survey flight that morning.

As the pilot repositioned the helicopter and commenced the additional run, his attention was partly diverted to thinking about the amended spray plan. He was not thinking about the wire during the spray run until he observed it a short distance ahead at about eye level.

Although he quickly initiated a climb to avoid the powerline, the inherent difficulty in visually detecting the wire, combined with the operating groundspeed required for chemical application, meant that the pilot did not have sufficient time to avoid the wire. The resultant collision with the ground led to the pilot being knocked unconscious, sustaining minor injuries, and serious damage to the helicopter.

Lessons learnt

Pilots can be distracted by thoughts that are of a non-operational and personal nature, as well as by thoughts relating to more immediate operational matters. In this case, the pilot was thinking about the next spray run when he collided with a wire he had known about. Distraction, combined with the inherent difficulty in visually detecting a wire, makes wires extremely hard to avoid at the last minute.

Source: ATSB

Factors associated with wirestrikes involving known wires and strategies to manage them

Safety strategies range from an individual level, through company level and to the broader community. Not only does the individual pilot need to be committed to safety, there is also a need for clients and the company to be committed to safety.

While most of the strategies should be taken into account during the entire operation, some of these are most pertinent when there is a change of plans.

Pressures

Most agricultural pilots operate under some sort of pressure, and it is important for pilots to recognise and manage the pressures that hamper their performance. Pressures can come from external sources, such as clients and the operator, or they can be self-imposed.[2]

Client and company pressure: The agricultural pilot faces many pressures to do the job 'here and now' and to do it profitably. This may encourage the pilot to take short cuts or to absorb some of the risks by reducing planning, preparation and information gathering time.

Time pressure: The more time pressured we feel, the more likely we are to make mistakes, miss information, and take shortcuts (e.g. not conducting a reconnaissance before the clean-up run).

Self imposed pressure: Pilots may, for whatever reason, feel pressure to get the job done well and as quickly as possible, and as a result absorb or accept as much of the risks as possible in order to get the job done.

In order to minimise the possibility of client pressure, operators are encouraged to use the aerial application request form (to be completed by the client) for all application requests (available from the AAAA). This will help the operator plan the job and to get the client and the operator to start thinking about hazards and other environmental considerations in the area.

Don't be afraid to say 'no' or to ask for more information if you feel that the conditions exceed your personal minimums (see below) or if you feel some reservations about the job. A survey into agricultural wirestrike accidents, commissioned by the AAAA, found that pilots attributed their inability to say 'no' to the client when they thought safety was compromised as a factor in the accident.

2 The Aerial Application Pilots' Manual has a non-exhaustive list of pressures faced by the pilot and the sources of these pressures.

Two wirestrikes in two days

In 2010, a pilot who had a wirestrike in an Ayres Turbo-Thrush S2R aircraft the previous day (no injury and damage to aircraft) returned the next day to complete the work. The farmers assured the pilot that there would be no more wires in the paddocks; however, for the second paddock assigned to the pilot, the farmers notified, just prior to the aircraft taking off, that the paddock had a line in it. This was sprayed without incident, although the pilot was confused about whether the next paddock over was to also be sprayed, which again contained a wire. This next paddock was sprayed on the third load. After spraying most of it, the pilot reported that the task of managing stress was being done fairly poorly. At a certain point, the pilot could no longer fly under the wire and had to go over it; however, the aircraft was pulled-up too early and let down into the wire.

Personal safety standards

Know your personal minimums. These are your set of rules and criteria for deciding if and under what conditions to fly or to continue flying based on your knowledge, skills and experience. They act as a 'safety buffer' between the demands of the situation and the extent of your skill.

Discuss your personal minimums with a more experienced pilot. Have the discipline to stick to your personal minimums in spite of self-imposed and external pressures. Treat your personal minimums as a line in the sand over which you will not cross.

Set client expectations

Agricultural pilots, like everyone else, have the right to expect a safe working environment that complies with OH&S standards. If you do not feel that your employer/client has provided you with that, speak up and try to work out a way to improve the conditions.

Setting safety expectations beforehand will take the pressure off continuing with the flight if the conditions exceed your personal minimums. Before each job, brief clients on the possibility of changes to the flight or spraying pattern due to changes in weather, lighting conditions or aircraft performance so that they are clear that safety comes first.

For aerial application pilots, a safe working environment involves the initial identification of wires and other hazards as described below, and then putting in place mechanisms to manage their impact on safety. Pilots should make it clear to property owners that the property owner must tell the pilot about any wires they know about.

Wire markings can enhance the visibility of wires. Australian Standard 3891.2—2008[3] states that 'Markers should be installed where regular low-level flying operations take place.' It also states that the 'person requesting planned low-level flying operations (for example, the land owner) is responsible for requesting installation of markers' and that the 'pilot or the pilot's delegate should be satisfied as to the need for and effectiveness of markers prior to commencing low-level operations.'

Further, the Australian Standard 3891.1—2008[4] requires any wire to be marked if the section of cable has a height greater than 90 m and a continuous span greater than 50 m. However, even in cases where the criteria of AS 3891.1 do not apply, there may be an obligation on the owner of the wire to mark the wire. This could be the case if there is a high level of risk in the particular circumstances associated with the visibility of the wire. If you consider that a wire creates an unacceptable level of risk you should tell the owner of the wire (and the property owner if they are not the same).

Duty of care

A 2007 judgement by the NSW Court of Appeal found that the owner (an energy company) of a wire that was struck by an aircraft had a duty of care to ensure the wire was adequately marked. At the time the aircraft struck the wire, the wire was unmarked and particularly difficult to see (the poles were a significant distance apart and there was no clearing of the tree line to suggest the existence of the power line). Further, prior to the accident, the energy company had been advised the wire posed a risk to low flying aircraft.

This case highlights the responsibility on the owner of a wire to take into account any risk that the wire may pose to low flying aircraft when considering the need to use markings to mitigate the risk. While each case will be dependent on its own circumstances, it is important that you raise any concerns you may have about the visibility of a wire.

3 Australian Standard 3891.2, 2008, Part 2: *Marking of overhead cables for planned low level flying operations*.

4 Australian Standard 3891.1, 2008, Part 1: *Permanent marking of overhead cables and their supporting structures for other than planned low level flying.*

Source: QLD Police

Fitness to fly

Fatigue can arise from short-term sleep deprivation, disturbed sleep, or from chronic sleep deprivation. Fatigue can also arise from other factors such as changes in the circadian rhythm, the time spent on the task, health issues, task and environmental factors (such as noise and vibration from the cockpit, boredom/monotony, and temperature) as well as drugs and alcohol.

When we are fatigued, our performance is adversely affected. For example, short term memory is reduced, reaction time is slower, vigilance and alertness levels are reduced, focus of attention is narrowed, and we tend to experience visual and task fixation.

Scientific studies have shown that taking a nap can be beneficial. Keep in mind to limit your nap to between 20 and 40 minutes and wait 30 minutes after a nap to ensure you are fully awake before you fly. Also, having proper nutrition and drinking plenty of water helps keep you alert; don't rely on caffeine (coffee, energy drinks) as they only provide short-term relief from the effects of fatigue.

For more information on managing fatigue in aerial work flying see the ATSB fact sheet *Pilot fatigue a major risk in combating plague locusts.*

The United States Federal Aviation Administration's (FAA's) Pilots Handbook of Aeronautical Knowledge (2003) recommends that pilots personally use its Illness Medication Stress Alcohol Fatigue Eating (IMSAFE) checklist before flight to make a self-evaluation of their own physiological and psychological fitness. The FAA recommends that if a pilot answers 'yes' to any of the questions below, then they should consider not flying.

IMSAFE Checklist

Illness	Do I have any symptoms?
Medication	Have I been taking prescription or over-the counter drugs?
Stress	Am I under psychological pressure from the job? Do I have money, health, or family problems?
Alcohol	Have I been drinking within 8 hours? Within 24 hours?
Fatigue	Am I tired and not adequately rested?
Eating	Have I eaten enough of the proper foods to keep adequately nourished during the entire flight?

Initial identification of wires

Have an up-to-date and detailed map with powerlines and other hazards clearly marked. Some power companies have coverage maps available to the public - contact the power company responsible for the powerlines in the area for up-to-date maps. Pilots of some wirestrike accidents reported to the ATSB that the maps they received from clients did not have powerlines clearly marked on the map.

Don't rely entirely on these maps – they only tell part of the story. Conduct a thorough briefing with the property owner, local residents or other operators with experience in the area about the known hazards of the area.

Also, identify any hazards just outside the area of operation (create a buffer zone) in case you need to fly outside the area of operation (in an emergency).

Conduct an aerial reconnaissance

While it is an important first step to have a detailed map and a thorough briefing, do not rely entirely on the briefing (no matter how thorough) and the map (no matter how detailed) – always conduct an aerial reconnaissance to confirm wire locations and other hazards for yourself. An aerial reconnaissance will give you a better idea of the location and orientation of the powerlines and what they look like from different angles, as wires often can't be seen from certain directions.

An AAAA survey of pilots who have had wirestrike accidents cited complacency and a reliance on verbal communication from the operator, loaders and customers about hazards as significant factors in their accident.

Be aware that during the reconnaissance, you may miss spotting some wires as the visual cues are not always reliable or available. For example, power poles often blend into background vegetation, making them difficult to see. Also, don't rely entirely on the presence of poles or other cues as indicators of wires. If you can see the wire, follow the wire itself to confirm its placement.

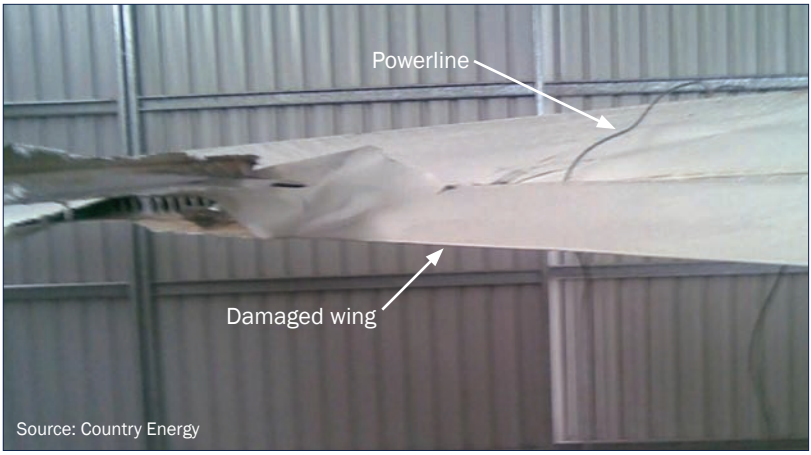
Change of plan

Reassess the risks when things change

Treat any changes in your plan as a 'red flag' – that is, treat it as something you should consider and assess before going any further. For example, a change in weather may affect the visibly of wires, so a reassessment of the risks is required.

If you are given an unplanned spray run, you must conduct a new risk assessment and this includes a reconnaissance of the area, even though you may be spraying the same general area. This is because the powerlines you identified earlier in your reconnaissance may now look different, may be harder to see, or may be obscured as you are now approaching them at a different angle/direction.

Clean-up runs are similar to an unplanned spray run and so also require a reconnaissance before commencing.



Source: Country Energy

Distractions

Dividing your attention can be a routine part of flying, especially during low-level operations. However, focusing attention on non-operational tasks or focussing on operational tasks at the wrong time can affect your hazard avoidance, detection and reaction times. This is particularly pertinent to agricultural spraying operations where multitasking in a fast-paced environment is a part of the job. Note that all pilots are vulnerable to distraction - experienced pilots also get distracted.

Criss-crossing wires

Spraying a paddock containing three wires going in different directions, the pilot reported that as he flew over a wire on the eastern end of the paddock, he was focused on another wire that he was approaching and momentarily forgot about the wire on the diagonal. When he spotted the diagonal wire and pulled up, it was too late.

The pilot escaped uninjured but the Air Tractor 502 sustained damage to the spray boom and propeller.

The sources of pilot distraction are diverse and there are a number of ways an agricultural pilot can become distracted:

- thinking of the next spray job or a technical problem
- personal events or fatigue
- task fixation, such as when you are absorbed in performing one task (for example spraying crop) at the exclusion of other tasks such as keeping an eye out for hazards
- excessive communication or inopportune communication with ground crew
  - ask your ground crew to call you during turns
- operating a mobile phone
- birds and other wildlife
- people near the treatment area
- checking up on equipment (for example spray equipment, GPS)
- calculating loads while flying.

Distracted with the GPS

The pilot reported that he struck a wire because he was distracted with his GPS.

He was spraying the last run and wanted to line up his Gippsland GA-200 correctly using the GPS marker system. He became 'tied up with that' and forgot about the wire.

If he had his time again, the pilot said he would have lined up the marker further out and then checked the paddock for wires before commencing the last spray run. He would have also maintained height until he was well over the wire and then descend.

Focus only on operational tasks

To help you stay focused on the job at hand, have a ritual to focus only on operational tasks. For example, the simple act of closing the cockpit door behind you signifies that you will deal only with operational tasks/thoughts, and non-operational issues will be dealt with after you have landed.

Sports psychology and refocussing

The AAAA likens agricultural pilots to elite athletes and much like a tournament, agricultural flying requires discipline and focus. It takes training to recognise quickly when your mind is drifting to non-essential thoughts, and sports psychology offers some tips on how to refocus when you are distracted.

- Have physical cues to remind you to refocus and watch for wires. For example, have a note or an object or sticker on the instrument panel reminding you to watch for wires.
- The AAAA suggests that to help you refocus, ask yourself:
  - Where is the wire/hazard now?
  - What do I do about it?
  - Where am I in the paddock?

'I knew it was there'

Before commencing his spraying run, the pilot of an Ayres Turbo-Thrush S2R had a detailed map showing the hazards in the spraying area. He also researched the area using Google Earth and conducted a pre-spray inspection of the area.

While he was on his last run of the spray load, the pilot noticed that two vehicles had driven close to the operation area. Once he confirmed that the vehicles were not going to be near his flight path, he started the run into the field. There was a small area of tea to spray, then a patch of bush, and then onto the main treatment area. On pulling out of the small area into the main area, the aircraft struck the power line that ran out of the bush and across the gully.

The pilot reported that 'I knew it [the wire] was there but due to the distraction [of the vehicles], I momentarily forgot it'.


Source: ATSB

Actively look for and remind yourself of wires

Remind yourself of the position of the wires at the top of every turn, and actively look for wires when flying the spray run.

Studies into 'inattentional blindness' have shown that we fail to perceive unexpected objects (even if they appear in the field of vision) if we are not paying attention to them (for example, focusing on another object or task). Without attention, there is no perception. Thus, you are unlikely to notice an approaching wire if you are not looking for it even if you were previously aware of it. Add to this the inherent difficulty of visually spotting wires, the likelihood of hitting a wire is increased.

Vigilance limitations

The amount of time spent on a monotonous task will affect a person's ability to remain attentive. As a result, the chance of detecting hazards, and the time taken to detect hazards, will decrease greatly after the first 30 minutes of many aerial spraying tasks.

In addition, defences are often lowered at the end of a job and pilots may start to think about the next job or the impending break. It is at this time you need to restore your vigilance for wires to the same level as when you started. To do this, you should treat the reconnaissance before the clean-up run as if you are seeing the paddock and wires for the first time. This puts your frame of mind back into the task at hand and acts as a reminder of the powerlines and their locations.

Although listening to music while conducting a spray run may appear to reduce the monotony of a spraying task, be aware that it can be detrimental to your short-term memory.

Don't rely on your reaction time

Don't rely on your ability to visually detect an unmarked wire - many pilots report that it is almost impossible to see a wire by itself.

Research has shown that it takes between 5.5 and 12.5 seconds for an object to be detected, recognised as a hazard, a decision made on an action, then for that action to be initiated, and the aircraft to respond to that action. Thus, given the inherent difficulty in visually detecting a powerline and the travelling speed of the aircraft, in most cases you will not have enough time to avoid a powerline by the time it can be seen.

The ability of pilots to detect powerlines depends on the physical aspects of the wire, such as the spacing of power poles and the sag of the wire, the orientation of the wire, and the effect of weather (especially visibility). In many cases, the powerline and/or the power pole will blend into the background vegetation or will be obscured by trees etc.

Beware of sagging lines

Spraying a paddock that contained several different powerlines, the pilot had been flying under various spans of the powerlines during spraying. On a subsequent load, he was spraying underneath a two-wire powerline when the lowest earth wire hit the top of the windscreen and cracked it as the wire cutter in his Ag Wagon severed the wire.

The pilot probably misjudged the height of the wire as he said that the particular span was hanging slightly lower than rest of the powerline.

Source: Essential Energy

Systems approach to safely managing wires

It is important that all pilots in an organisation know how to plan for and look for wires and to do it in a systematic way. This means operators need to give their pilots appropriate training and resources to operate in aerial agriculture (particularly, operating around wires), as well as having tools and systems in place to help pilots plan for the spray operation and also in identifying hazards.

The AAAA has introduced an integrated management system for aerial application companies. The Aerial Application Management System (AAMS) program includes a safety management system (SMS) that directly addresses wire risk and also covers topics such as product stewardship, logistics, OH&S, human resources and management. The program is based on an International Organization for Standardization (ISO) style approach and encompasses the relevant Australian standards for risk management. The AAMS has, so far, more than a third of the industry signed on. Most of these companies have received their initial training and started detailed implementation of the program. The AAAA anticipates that accreditations will start to be issued in 2011. For more information, see Further reading and resources.

AAAA six steps to managing wires

1. Am I fit? Consider your medical and mental airworthiness.
2. Find the wires – planning and assessment.
3. Picture all the wires.
4. Remember all the wires – refresh your memory/refocus.
5. Don't relax until you are out of the danger box (see below).
6. Rehearse your refocusing plan.

AAAA tips for remembering wires

- Create a 'danger box' around the treatment area – be on edge every time you enter it.
- Engine and wire check at top of each turn.
- Develop a short check for the run in. For example, check wind and wires when wings are level.
- Set a break-off point on the run in if you haven't identified the wire.
- Plan for each run – stick with the plan.
- Do you have 'the (bigger) picture' in your mind?
- Manage your workload. Plan the job so that the busier you are, the less you have to remember.
- Have a wire reminder in the cockpit. For example, have a watch for wires reminder sticker.

Further reading and resources

Reading

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Wire risk management training

AAAA and other organisations conduct training in wirestrikes risk management.

For more details, contact the AAAA: www.aerialag.com.au

AAAA Aerial Application Management System (AAMS)

For more details, contact the AAAA: www.aerialag.com.au

Online video

Helicopter Association International (HAI) - *Surviving the wire environment.*

While this educational video is from the HAI, the general safety guidelines on operating near powerlines are just as applicable to pilots of fixed-wing aircraft.

www.rotor.com/Publications/HAIVideosLibrary/SurvivingtheWiresEnvironment.aspx

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May11/ATSB49