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ATSB TRANSPORT SAFETY REPORT
Aviation Occurrence Investigation AO-2011-055
Final

Loss of control, VH-ETT
4 km south-east of Kilmore, Victoria
30 April 2011

Abstract

On 30 April 2011, the owner-pilot of a Robinson Helicopter Co. R44 helicopter, registered VH-ETT, was conducting a local flight from a private property located near Kilmore Gap, Victoria. During low-level manoeuvring at low speed around a dam, the pilot lost directional control and landed heavily in the water. The helicopter was seriously damaged; the pilot and passenger sustained minor injuries.

The investigation found that the helicopter was probably serviceable and that the loss of directional control was likely to be a result of a loss of tail rotor effectiveness.

The emergency locator transmitter (ELT) activated on impact and prompted an effective search and rescue (SAR) response through a broadcast on the 121.5 MHz frequency. However, the 406 MHz transmission that was monitored by the SAR agency did not trigger an alert or provide identification information. As a result, there was no assurance of an immediate and effective response from the SAR agency.

The investigation found that the ELT could be programmed with identification information either directly or (if fitted) by input from a component (dongle) in the ELT wiring connector. In this occurrence, the ELT had been inadvertently reprogrammed with incorrect information from the dongle.

A minor safety issue was identified in that there were only subtle cues to distinguish programmable dongles from the standard-type wiring connector. There was also variability in the conduct of post-installation ELT testing.

In response, on 6 June 2011, the Civil Aviation Safety Authority (CASA) published Airworthiness Bulletin 25-018 to alert maintenance organisations to the risk of programming dongles transferring potentially invalid details to the memory of ELTs. CASA advised that an article in *Flight Safety Australia* would also highlight the issue.

The helicopter manufacturer advised that they were introducing measures to increase awareness of programming dongles in their new helicopters.

FACTUAL INFORMATION

Sequence of events

On 30 April 2011, the owner-pilot of a Robinson Helicopter Co. R44 (R44) helicopter, registered VH-ETT (ETT), was conducting a private flight from Moorabbin Airport to a private property located near Kilmore, Victoria to position for a series of local flights. The pilot departed Moorabbin at 1020 Eastern Standard Time[1] and landed at the property airstrip at 1115.

At 1230, the pilot departed for the first sight-seeing flight in the Kilmore area. The pilot completed that and two other flights of about

1 The 24-hour clock is used this report to describe the local time of day, Eastern Standard Time (EST), as particular events occurred. Eastern Standard Time was Coordinated Universal time (UTC) + 10 hours.

10 minutes duration in succession without any problem.

On the fourth and last intended local flight, with one passenger on board, the pilot conducted a circuit and brought the helicopter to a hover on the airstrip. The pilot then turned the helicopter to the north and proceeded at low speed and low level to make a right circuit around a nearby dam to inspect recently completed earthworks.

The pilot had turned around the dam and was turning onto a southerly heading when he realised that the helicopter was not straightening up as intended. He suspected a loss of tail rotor effectiveness (LTE) and lowered the helicopter's nose in an attempt to increase airspeed and, consequently, the aerodynamic effectiveness of the helicopter's tail.[2]

The helicopter did not respond to the control inputs and the right turn continued. In an effort to avoid hitting the uneven ground around the dam, the pilot raised the collective control[3], which had the deleterious effect of increasing the rate of rotation of the helicopter. By now, the pilot was unable to maintain effective external reference and decided to put the helicopter down wherever it was at the time.

The pilot lowered the collective rapidly and heard a splash as the helicopter descended into the water of the dam (Figure 1). The engine stopped immediately and the main rotor blades hit the water and/or mud. The helicopter partially submerged before the pilot and passenger exited the helicopter and made their way to the bank of the dam. The pilot and passenger sustained minor injuries and the helicopter was seriously damaged. The pilot estimated that the accident occurred at 1305.

Pilots of a number of overflying aircraft detected the helicopter's emergency locator transmitter (ELT) transmission on frequency 121.5 MHz during routine monitoring and advised air traffic control (ATC). In turn, ATC notified the rescue coordination centre (RCC) at 1331. At 1352, the RCC tasked the crew of a search and rescue helicopter to respond. The crew homed in on the 121.5 MHz ELT signal and arrived at the accident site at 1415.

The next day, the helicopter was recovered from the dam. The tail rotor system was inspected by the helicopter owner-pilot, with no sign of any defect or anomaly existing before the accident.[4]

The pilot and passenger reported that there were no warning lights or sounds of a horn[5] before or during the event, and no apparent precursors to the loss of directional control.

Figure 1: Helicopter in the dam

Photo courtesy of the helicopter owner-pilot

Meteorological information

The area forecast that was obtained by the pilot prior to departing Moorabbin indicated that the low-level wind would be from the north at 10 kts. The pilot reported that the surface wind at the property varied between nil and 10 kts and was generally from a northerly direction.

The Bureau of Meteorology observation site at Kilmore Gap, 5 km to the south of the property, recorded the weather conditions at half-hour intervals. At 1300, the recorded wind at that site was from the north at 10 kts with no significant weather detected. The temperature was 18 °C.

2 Airflow from forward speed, from a headwind or from a combination of both improves a helicopter's directional stability.

3 Raising the collective increases the pitch of the main rotor blades and increases the main rotor thrust (effectively lift) produced by the main rotor.

4 The investigation team did not attend on-site.

5 The helicopter was equipped with a low main rotor RPM warning light and horn that were designed to activate when the main rotor RPM reduced below 97%.

Pilot information

The pilot held a Commercial Pilot (Helicopter) Licence that was issued on 28 September 2009 and an R44 endorsement. All of the pilot's helicopter flight time of 152 hours was conducted in R44 helicopters.

The pilot also held a Commercial Pilot (Aeroplane) Licence with about 2,600 hours total aeroplane flying time.

Helicopter information

The helicopter was manufactured in the United States (US) in 2008 and was imported to Australia as a new aircraft. Since that time it had been operated for about 200 hours with about 30 hours since the last 100-hour/annual maintenance inspection. There were no reports or record of any helicopter defects.

The pilot calculated that the helicopter's weight was 158 kg below the maximum gross weight and that the centre of gravity was within limits.

Loss of tail rotor effectiveness[6]

The thrust generated by the tail rotor of a helicopter counteracts the torque reaction produced by the rotation of the main rotor blades. Pilot control of tail rotor blade pitch allows variation in the tail rotor thrust and provides directional control. In helicopters with a single main rotor that rotates counter-clockwise (as in the R44), any loss of tail rotor effectiveness (LTE) results in an uncommanded yaw to the right (nose to the right). In simple terms, that yaw is a product of proportionally less tail rotor thrust (relative to main rotor torque) resulting primarily from disruption to the airflow over the tail rotor. Factors that increase the risk of the onset LTE are:

- high all-up weight
- out of ground effect hover[7]
- low forward airspeed (less than 30 kts)
- high power settings
- a wind direction from the left or rear of the helicopter
- turns to the right.

The recommended recovery technique is to simultaneously apply full left pedal and to move the cyclic forward to increase speed. If altitude permits, power should be reduced. If a pilot's response to the onset of LTE is incorrect or slow, the yaw rate may rapidly increase to a point where recovery is not possible.

LTE has been identified as a contributing factor in a number of previous helicopter accidents and incidents in Australia (for example, see ATSB transport safety reports 200003293, 200600738, 200606570 and AO-2008-043).

Emergency locator transmitter operation

System description

The helicopter was equipped with a fixed ELT that was approved for aircraft use. Impact forces automatically activated the ELT, which then transmitted on 121.5 MHz and 406 MHz. Since February 2009, the satellite system used by the RCC no longer received alerts on 121.5 MHz. Detection of transmissions on 121.5 MHz relied on reception and notification by crews of overflying aircraft.

When installed in an aircraft, an ELT must have been programmed (encoded) with a unique digital identification number. All these ELTs are registered with the organisation with overall responsibility for search and rescue in Australia, the Australian Maritime Safety Authority (AMSA). In the event of ELT activation, the unique identification number enables AMSA's RCC to quickly establish the identification of the aircraft and owner, facilitating the search and rescue response.

The ELT can be directly programmed before its installation by an approved maintenance organisation. It can also be programmed during its installation on an aircraft by a programming dongle that already contains the unique digital identification number. These dongles are an optional component that can be incorporated into the ELT wiring connector.

6 Adapted from the US Department of Transportation Federal Aviation Administration (FAA) publication FAA-H-8083-21 *Rotorcraft Flying Handbook* and ATSB investigation report AO-2008-043 (available at www.atsb.gov.au).

7 Helicopters require less power to hover close to the ground due to a cushioning effect created by the main rotor downwash striking the ground.

In the case of an aircraft fitted with a programming dongle, it is the dongle that should be programmed with the unique digital identification number, rather than the ELT. That facility allows any ELT that might be installed in the aircraft to be automatically and correctly programmed.

An approved avionics workshop had correctly programmed the ELT through the direct method and correctly registered the aircraft and owner details with AMSA.

Activation and detection of the 406 MHz signal

The Cospas-Sarsat satellite system detected the ELT 406 MHz transmission from the helicopter. That transmission indicated the position of the ELT (to within 5 km), but was coded with the ELT manufacturer's test protocol and so did not generate an alert. The RCC received advice of the ELT activation at 1350.

AMSA advised that the unique digital identification number received from the ELT was not in the registration database of Australian 406 MHz beacons. As a SAR response had already been initiated in response to the 121.5 MHz signal that was reported in the Kilmore area, a separate response was not considered necessary.

Anomalous operation of the ELT

Investigation of the anomalous operation of the ELT determined that when it was installed in the helicopter, the wiring connector, with its integral programming dongle, modified the ELT's previous programming. The unintended reprogramming of the ELT installed a different and unregistered digital identification number: the factory test protocol for the ELT.

The maintenance organisation that installed the ELT reported that at the time they were unaware that new helicopters, such as involved in this occurrence, were being supplied with an integral programming dongle in the wiring connector. Apart from slightly different part numbers, the programming dongle looked identical to the standard-type connector.

The ELT manufacturer advised that the user and installation manual required a self-test after ELT installation, followed by a recommended monthly self-test. That test will detect the factory test protocol and display an error code.

With the appropriate equipment, it is possible to conduct a 406 MHz transmission test after ELT installation to detect any programming anomalies. There was no record of such a test being carried out on the helicopter, nor was there any requirement for such a test.

ANALYSIS

Loss of control

Given the apparent absence of any helicopter unserviceability prior to the pilot's loss of directional control, the accident was probably related to the pilot's handling of the helicopter in the local environmental conditions.

The helicopter was being operated at slow speed and out of ground effect, probably with a crosswind from the left, when the pilot was ready to make a right turn to return to the airstrip. In those conditions, the helicopter was susceptible to loss of tail rotor effectiveness (LTE) and the ensuing behaviour of the helicopter was symptomatic of deepening LTE.

This accident highlights the insidious nature of LTE and the difficulty in recovering from it at low altitude. The action by the pilot in putting the helicopter down when he did probably reduced the severity of the outcome.

Emergency locator transmitter

Activation of the emergency locator transmitter (ELT) on impact and transmission of the 121.5 MHz signal that was received by overflying flight crews alerted rescue coordination centre personnel, who initiated the search and rescue (SAR) response. However, the 406 MHz transmission in test protocol did not generate an alert and did not provide assurance of an immediate response from the SAR agency. The anomaly also prevented the SAR agency accessing the registered details for the aircraft and owner. Access to that data by the SAR agency could have enhanced the effectiveness of the SAR response. In other circumstances, with less frequent overflying aircraft and serious occupant injuries, any delay to a SAR response has the potential to be critical.

The automatic and, on this occasion, unintended reprogramming of the ELT by the dongle during the installation of the ELT was of concern, because there were only subtle cues to the existence of programmable dongles in the ELT wiring connector. Furthermore, there was variability in the conduct of post-installation testing. Therefore, there was a risk that ELTs on other aircraft with programmable dongles could be inadvertently reprogrammed and, on activation, not transmit the applicable digital identification number.

FINDINGS

From the evidence available, the following findings are made with respect to the loss of control that occurred 4 km south-east of Kilmore, Victoria on 30 April 2011 and involved Robinson Helicopter Co. R44 helicopter, registered VH-ETT. They should not be read as apportioning blame or liability to any particular organisation or individual.

Contributing safety factor

- During low-level manoeuvring at low airspeed, the pilot lost directional control of the helicopter and landed heavily, probably as a result of loss of tail rotor effectiveness.

Other safety factors

- The emergency locator transmitter activated on impact, but the 406 MHz transmission was in test protocol, which did not provide assurance of an immediate response from the search and rescue (SAR) agency and prevented SAR agency access to the aircraft and owner details that could have enhanced the effectiveness of the SAR response.
- There were only subtle cues to the optional fitment of programming dongles in aircraft and variability in the conduct of post-installation testing, increasing the risk of inadvertent and undetected emergency locator transmitter reprogramming and a less effective search and rescue response. *[Minor safety issue]*

Other key findings

- The action by the pilot in putting the helicopter down when he did probably reduced the severity of the outcome.

SAFETY ACTION

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

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

Emergency locator transmitter programming

Minor safety issue

There were only subtle cues to the optional fitment of programming dongles in aircraft and variability in the conduct of post–installation testing, increasing the risk of inadvertent and undetected emergency locator transmitter (ELT) re-programming and a less effective search and rescue response.

Action taken by the Civil Aviation Safety Authority

On 6 June 2011, the Civil Aviation Safety Authority (CASA) published Airworthiness Bulletin 25-018 to alert maintenance organisations to the risk of programming dongles transferring potentially invalid details to the memory of ELTs. In addition, an article was planned for inclusion in CASA's *Flight Safety Australia* magazine to highlight this issue.

ATSB assessment of action

The ATSB is satisfied that the action taken and proposed by CASA will adequately address the safety issue.

Action taken by the helicopter manufacturer

The helicopter manufacturer advised of the commencement of a design revision to add a

decal to the ELT mounting bracket to warn that the dongle must be programmed, rather than the ELT. Where applicable, instructions regarding the need to program the dongle rather than the ELT were being added to the paperwork package for new helicopters.

ATSB assessment of action

The ATSB is satisfied that the action proposed by the helicopter manufacturer will adequately address the safety issue.

SOURCES AND SUBMISSIONS

Sources of Information

The sources of information during the investigation included the:

- pilot and passenger of VH-ETT (ETT)
- current and former maintainers of ETT
- avionics maintenance organisation
- Australian Maritime Safety Authority
- emergency locator transmitter manufacturer
- helicopter manufacturer.

References

Federal Aviation Administration, *Rotorcraft Flying Handbook*, FAA-H-8083-21, 2000

Submissions

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

A draft of this report was provided to the pilot and maintainer of ETT, the helicopter manufacturer, AMSA, the Civil Aviation Safety Authority (CASA) and the ELT manufacturer.

Submissions were received from the helicopter and ELT manufacturers and CASA. The submissions were reviewed and, where considered appropriate, the text of the report was amended accordingly.