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ATSB TRANSPORT SAFETY REPORT
Aviation Occurrence Investigation AO-2008-078
Preliminary

Wire Strike – 13 km north of Murray Bridge, SA 19 November 2008

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Abstract

At about 1115 Central Daylight-saving Time on 19 November 2008, a pilot and two linesmen were operating a McDonnell Douglas 369D helicopter, registered VH-PLJ, to test a high-voltage powerline between Mannum and Mobilong, SA. While manoeuvring to test a conductor joint, the helicopter's main rotors struck a conductor and impacted the ground. One linesman was fatally injured and the other sustained minor injuries, while the pilot sustained serious injuries. The investigation is continuing.

FACTUAL INFORMATION

The information contained in this preliminary report is derived from initial investigation of the occurrence. Readers are cautioned that there is the possibility that new evidence may become available that alters the circumstances as depicted in this report.

Sequence of events

At about 1115 Central Daylight-saving Time[1] on 19 November 2008, a pilot and two linesmen were operating a McDonnell Douglas 369D helicopter, registered VH-PLJ, to test a high-voltage powerline between Mannum and Mobilong, SA. During the final stages of manoeuvring to test a conductor joint[2], the helicopter's main rotors struck a conductor and impacted the ground (Figure 1). One linesman was fatally injured and the other sustained minor injuries, while the pilot sustained serious injuries.

The helicopter operator had been contracted by a utilities operator to conduct joint resistance testing of live high-voltage electricity transmission line joints throughout South Australia. Due to the weather conditions at the time, it was decided that operations would be done on the Mannum to Mobilong section of the line commencing at the Mannum substation.

The utilities operator supplied information to the aircraft operator on known tower specifications, conductor joint positions and 'no-fly' areas along the route. The aircraft operator then compiled computer aided drawings, which gave minimum clearance distances from the conductors to the helicopter and other briefing material that was then given to the crew before the task began. In this case, the crew had been given information that there were three joints between towers 31 and 32, but their exact locations were unknown.

Figure 1: Accident site

The operation was supported by ground refuelling personnel who met the helicopter at pre-determined points along the line to be surveyed.

1 The 24-hour clock is used in this report to describe the local time of day, Central Daylight saving Time (CDST), as particular events occurred. Central Daylight saving Time was Coordinated Universal Time (UTC) + 10:30 hours.

2 A join in the cable that readily conducts electricity.

Refuelling took place every 20-30 minutes. This kept the helicopter weight as low as possible to maximise helicopter performance.

The crew consisted of one pilot who was seated in the left front position of the cabin, and two linesmen. One linesman sat in the right front seat of the cabin next to the pilot and the other on a platform attached to the helicopter's landing skids.

The linesman on the platform had test equipment to be placed at the joint (Figure 2). His role was to extend a 4.5 m pole (a hot stick) horizontally from the platform to a predetermined length. The pole had a sensor and a remote camera attached at its end nearest the conductor. The pilot manoeuvred the helicopter to enable the sensor to be placed on either side of the joint to take resistance measurements. Those resistance measurements were transmitted to a laptop computer used by the linesman in the cabin to record the readings. That process normally took less than 20 seconds. If the equipment did not read correctly or the reading was irregular, further readings were taken to ensure their accuracy. The platform operator then withdrew the probe and the pilot manoeuvred the helicopter clear of the powerlines before proceeding to the next joint.

Figure 2: Helicopter and probe in position

Operations had started earlier that morning when the pilot flew the helicopter from Parafield Airfield, SA to a predetermined refuelling point at Mannum. The platform was fitted there and line inspection duties commenced. The crew had difficulties identifying the correct conductor that was to be checked, so the helicopter was landed at the Mannum substation, were the correct conductor was identified. The operation then continued as planned and after testing joints between towers 29 and 30, the pilot flew the helicopter to where the refuelling vehicle was positioned on a nearby road. Fuel was added and the helicopter took off to resume the inspection from tower 31 towards tower 32. That section included a 'transposition' in the span (Figure 3). The refuelling personnel moved off towards the next refuelling point.

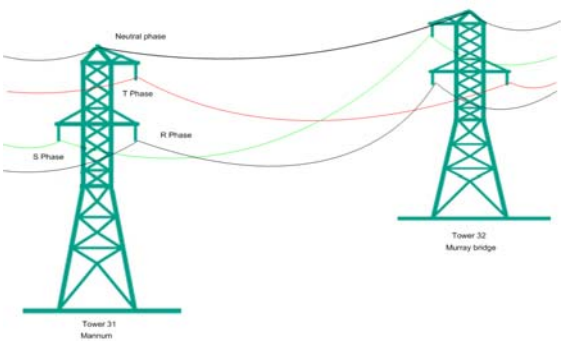
A witness travelling north along the Murray Bridge to Mannum Road saw the helicopter flying adjacent to the powerline and, while continuing to drive, intermittently watched its progress. The witness reported that the helicopter was at about the same level as the conductors when it 'wobbled', before rolling right and impacting the ground. The witness observed an object thrown from the helicopter before it struck the ground.

The helicopter came to rest on its left side, pointing towards tower 30. The helicopter's engine continued to operate after the accident until the fuel supply was shut off by the pilot.

Powerline transposition

Whenever electricity is transmitted through conductors, an electromagnetic field or 'flux' is created around those conductors. Depending on the configuration of the power conductors and the towers, there may be an imbalance of forces within the power transmission system. This can lead to loss of conductor efficiency or large heat build up. To counteract this effect, the power conductors have their relative positions transposed (their relative positions to each other changed). This can be done in a number of ways, either electronically at a substation, or by cable switching at the tower itself or, as in this case, as a mid-span (between two towers) transposition. Mid-span transpositions occur at irregular intervals.

Figure 3: Transposition of powerline conductor



On a typical, non-transposed span, individual conductors are strung between insulators occupying the same position on consecutive towers. In a transposition, a conductor can be connected to insulators on the other side or at different levels of a subsequent tower.

The powerline to be checked consisted of three conductors suspended between towers approximately 30 m high and 440 m apart. The powerline also had an earth conductor located along the top of each tower.

The crew were attempting to take measurements from a joint on one of the conductors when the accident occurred.

Injuries to persons

The linesman on the platform received critical injuries. That linesman was trapped between the helicopter and the platform. He subsequently died in hospital 2 days after the accident. The pilot received serious injuries to his left arm, pelvis, and back. The linesman in the cabin received minor injuries and was able to exit the cabin without assistance.

Damage to the helicopter

The helicopter fuselage came to rest on the left side facing north-north-west, opposite to the direction of flight.

The tail boom had separated from the fuselage during the impact sequence and was about 10 m from the main wreckage. One of the main rotor blades was 126 m north-east of the main wreckage and the damper from that blade was found 147 m east of the main wreckage. The four other main rotor blades remained attached to the hub, but exhibited significant damage consistent with contacting the ground while under power. Witness marks near the tips of two of the blades were consistent with them having contacted a conductor.

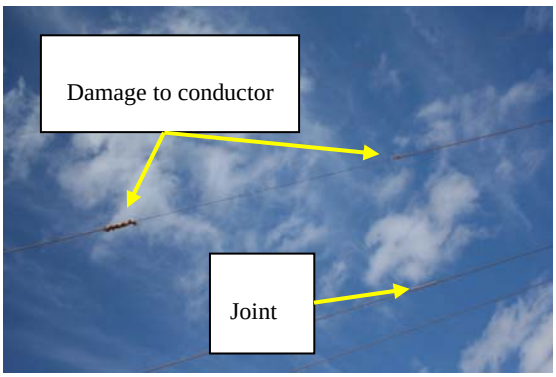
The outside working platform was buckled in an 'S' shape and had partially detached from the landing skids.

Examination of the wreckage indicated that the helicopter was operating normally at the time of the accident and that damage was consistent with impact damage.

Damage to the powerline

Examination of the powerline near the accident site revealed joints in close proximity to each other in all three conductors above the position where the helicopter cabin section came to rest and one of the conductors was damaged (Figure 4).

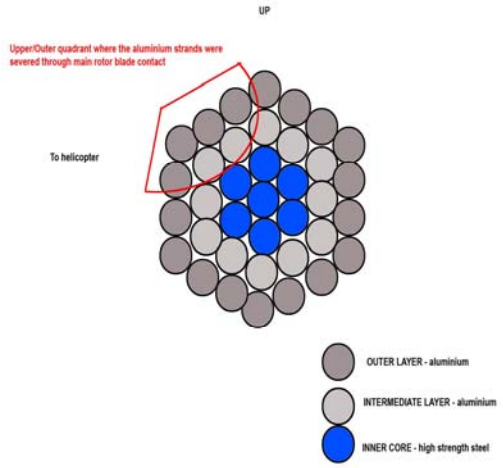
Figure 4: Damaged conductor



ATSB examination of damaged conductor

After the powerline had been repaired, the ATSB took possession of the damaged section of conductor. Examination of that section revealed that the conductor was comprised of an outer and intermediate layer of counter-woven aluminium alloy (18 and 12 wire strands respectively), and an inner core of high-strength steel (seven wire strands). The aluminium wires were used for their electrical conductivity properties while the steel wires comprising the inner core provided the strength necessary for suspension between transmission towers.

Figure 5: Conductor cross section



Approximately 8 m of the conductor had been damaged and the majority of the damage had occurred to the outer and intermediate layers of aluminium wire near the top section of the conductor. The aluminium wires at the Mobilong end had been severed and splayed outward from the main weave, while the Mannum end had been bunched into a loosely coiled 1 m length.

Two distinct failure modes for the aluminium wires were identified at the point of initial contact. Fourteen of the aluminium wires had been cleanly severed while the remaining 16 wires had failed from tensile overload.

Personnel information

The pilot held a Commercial Pilot (Helicopter) Licence since July 2005. He had also held a grade 1 helicopter instructor rating since April 2005.

The pilot's total flying experience was 3,744.2 hrs, of which 3,624.6 hrs was on helicopters. The pilot's total experience on the McDonnell Douglas 369D helicopter was 1,374.6 hrs.

He had worked for the operator for 4.5 years. He had conducted powerline inspections, helicopter instruction, and tower maintenance and insulator washing tasks. On 18 November 2008, the operator's chief pilot had demonstrated the joint testing procedure to the pilot and then sat in the helicopter while the pilot flew a number of simulated joint tests. The pilot was reported to have completed those exercises competently. The joint resistance testing on the day of the accident was the first occasion he had conducted that type of operation.

Both linesmen on board the helicopter were experienced in the joint testing role.

Background information

The operator has provided this type of service to the national power generation and supply industry since 1992 and has also provided this service internationally.

Ongoing investigation activities

The investigation is continuing and will include:

- the extent of information provided to the crew
- the operator's training system
- risk assessment procedures
- survivability aspects of the accident.