ACCIDENT INVESTIGATION COMMISSION

FINAL REPORT

AIC 22-1003

SIL Aviation Services

P2-SIL

BELL 206L3

Tail rotor strike during take-off

Aiyura National High School

Eastern Highlands Province

PAPUA NEW GUINEA

04 October 2022

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About the AIC

The Accident Investigation Commission (AIC) is an independent statutory agency within Papua New Guinea (PNG). The AIC is governed by a Commission and is entirely separate from the judiciary, transport regulators, policy makers and service providers. The AIC's function is to improve safety and public confidence in the aviation mode of transport through excellence in: independent investigation of aviation accidents and other safety occurrences within the aviation system; safety data recording and analysis; and fostering safety awareness, knowledge and action.

The AIC is responsible for investigating accidents and other transport safety matters involving civil aviation in PNG, as well as participating in overseas investigations involving PNG registered aircraft. A primary concern is the safety of commercial transport, with particular regard to fare-paying passenger operations.

The AIC performs its functions in accordance with the provisions of the *PNG Civil Aviation Act 2000 (As Amended),* and the *Commissions of Inquiry Act 1951*, and in accordance with *Annex 13* to the *Convention on International Civil Aviation.*

The objective of a safety investigation is to identify and reduce safety-related risk. AIC investigations determine and communicate the safety factors related to the transport safety matter being investigated.

It is not a function of the AIC to apportion blame or determine liability. At the same time, an investigation report must include relevant factual material of sufficient weight to support the analysis and findings. At all times the AIC endeavours to balance the use of material that could imply adverse comment with the need to properly explain what happened, and why it happened, in a fair and unbiased manner.

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About this Report

On 5 October 2022 at 10:15 local time (00:15 UTC), the AIC was notified by CASA PNG about an occurrence which had occurred on 4 October 2022 at 15:10 local time (05:10 UTC). The occurrence involved a Bell 206L3 helicopter owned and operated by the Summer Institute of Linguistics Aviation. The AIC immediately began gathering information pertinent to the occurrence and commenced the investigation. A team of investigators were dispatched to perform on-site activities on 07 October 2022.

This Accident *Final Report* has been produced by the PNG AIC pursuant to *ICAO Annex 13, Chapter 6, paragraph 6.5* and has been approved for public release.

The report is based on the investigation carried out by the AIC under the Papua New Guinea *Civil Aviation Act 2000 (As Amended),* and *Annex 13* to the *Convention on International Civil Aviation*. It contains information, analysis of that information, findings and contributing (causal) factors, other factors, safety actions, and safety recommendations.

Although AIC investigations explore the areas surrounding an occurrence, only those facts that are relevant to understanding how and why the accident occurred are included in the report. The report may also contain other non-contributing factors which have been identified as safety deficiencies for the purpose of improving safety.

Readers are advised that in accordance with *Annex 13* to the *Convention on International Civil Aviation*, it is not the purpose of an AIC aircraft accident investigation to apportion blame or liability. The sole objective of the investigation and the final report is the prevention of accidents and incidents (Reference: *ICAO Annex 13, Chapter 3, paragraph 3.1*). Consequently, AIC reports are confined to matters of safety significance and may be misleading if used for any other purpose.

Capt. Aria Bouraga, MBE

Acting Chief Commissioner

18 November 2023

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GLOSSARY OF ABBREVIATION

ATS	: Air Traffic Service
CPL A	: Commercial pilot license Aeroplane
CVR	: Cockpit voice recorder
ELT	: Emergency locator transmitter
ERP	: Emergency response plan
FDR	: Flight data recorder
FM	: Flight Manual
Ft	: Foot (feet)
H	: Hour(s)
HF	: High frequency (3 000 to 30 000 kHz)
HPa	: Hectopascal
IGE	In Ground Effect
Kt	: Knot(s)
M	: Metre(s)
MEL	: Minimum equipment list
MH_z	: Megahertz
NM	: Nautical Miles
OGE	Out of Ground Effect
RPM	: Revolutions per minute
SMS	: Safety management system
SOP	: Standard operating procedure(s)
UTC	: Coordinated Universal Time
VFR	: Visual flight rules
VHF	: Very high frequency (30 to 300 MHz)

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INTRODUCTION

SYNOPSIS

On 4 October 2022, at about 15:10 local time, (05:10 UTC) a Bell 206L3 helicopter, registered P2-SIL, owned and operated by Summer Institute of Linguistics (SIL) Aviation, was conducting a VFR charter flight from Aiyura National High School, in Ukarumpa, Eastern Highlands Province (EHP) to Nadzab Airport, Morobe Province, Papua New Guinea, when during its line-up for take-off, the tail rotor (TR) blades struck a powerline. The pilot subsequently landed the helicopter back onto the ground.

The accident flight had six persons on board: one pilot and five passengers.

The pilot had conducted a series of flights on the day of the accident. He flew to Lae to pick up passengers. He then flew the passenger flight to Wawen National High School and then to Aiyura National High School. Subsequent to dropping off passengers at Aiyura, the pilot flew to the Operators Aiyura base to refuel before returning to the Aiyura to pick up the passengers for the next flight.

After landing, the pilot reportedly conducted an assessment of the wind, departure area and obstacles. Among other obstacles in the area, the pilot identified a power running from East to West across the Northwestern edge of the field. The pilot incorrectly perceived the wires to be positioned away from the from the field. Due to this perception, the pilot nominated a departure position as the Northwestern edge of the field considering the weight of the aircraft and the Southerly wind direction. The investigation established that the perception was erroneous and based on an unrecognized optical illusion.

After the pilot and passengers boarded, the pilot started up, lifted off the ground as it turned toward the North, and began tracking towards the nominated departure point. During the left turn to set heading to the departure heading, the tail rotor blades struck one of the powerlines.

The investigation found that the erroneous perception was drawn from an optical illusion presented by the camouflaging background and appearance of the powerlines in reference to other environmental cues, and the significant assessment distance between the powerlines and the pilot (about 40-50 m). This distance is considered to be beyond the limit for which normal visual sight can accurately perceive distance, especially of objects as small as wires.

The pilot’s decision and subsequent actions were influenced by this perception. The pilot did not actively search for the powerlines to confirm his initial judgement. Furthermore, because of the size of the wires, the background into which the wires blended, and, likely the rotor downwash dust around the helicopter, during taxi to the departure point, the pilot did not notice at any point that the helicopter had flown directly at the powerline to within collision distance. During the left turn at the nominated departure position, the helicopter tail rotor blades struck the powerlines.

The pilot reduced the power to idle and settled the helicopter onto the ground without further event. All passengers were reported to have been evacuated safely.

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1 FACTUAL INFORMATION

1.1 History of the flight

On 4 October 2022, at about 15:10 local time, (05:10 UTC[1]) a Bell 206L3 helicopter, registered P2-SIL, owned and operated by Summer Institute of Linguistics (SIL) Aviation, was conducting a VFR[2] charter flight from Aiyura National High School, in Ukarumpa, Eastern Highlands Province (EHP) to Nadzab Airport, Morobe Province, Papua New Guinea, when during its line-up for take-off, the tail rotor (TR) blades struck a powerline. The pilot subsequently landed the helicopter back onto the ground.

There were six (6) persons onboard: one pilot and five passengers.

Figure 1. Overview departure point (accident site) and the planned destination

During an interview with AIC, the pilot stated that the helicopter had been chartered by Government officials for the day to visit two schools. The pilot arrived at the Operator's Base, Aiyura Airstrip Ukarumpa, EHP, at about 07:00, conducted the preflight actions on P2-SIL and departed for Lae, Morobe Province at 08:30.

Upon arrival in Lae, he weighed the three passengers and cargo and departed to Wawin National High School. The passengers disembarked in Wawin to attend to their planned activity while the pilot waited for them about 2 hours before the passengers returned. Two additional passengers boarded at Wawin for the flight back to Aiyura National High School.

Upon arrival at Aiyura National High School, the pilot landed at a landing zone at the Eastern side of the school's sports field where the passengers disembarked (refer to *Figure 2*).

After dropping off the passengers, the pilot departed from the field to the Operator's base where he refuelled and waited while the passengers attended to their activity before returning to land at the

[1] The 24-hour clock, in Coordinated Universal Time (UTC), is used in this report to describe the local time as specific events occurred. Local time in the area of the accident, Papua New Guinea Time (Pacific/Port Moresby Time) is UTC +10 hours.

[2] Visual Flight Rules.

field to pick up the passengers for their flight back to Nadzab Airport. The pilot stated that because he had low gross weight, for the flight to refuel at their base, he departed vertically climbing out Out of Ground Effect (OGE[3]) and tracked over the school buildings, East of the field.

After about 1.5 hours of waiting, the pilot then returned to the school field and landed at the same position to pick up the passengers for the flight to Nadzab Airport *(*refer *to Figure 2).*

The pilot stated that prior to commencing the accident flight out of Aiyura, he observed, from the flag adjacent to the field, the wind was blowing from the Southeast and determined the wind was about 5 to10 knots (kts).

The pilot stated that he had a power margin of 10 to 15 percent (%) which he could conduct a vertical climb OGE into the wind as this was his plan, however, due to weight considerations, he intended to position North of the field, Northwest of the parking position, to depart towards the South using in ground effect (IGE[4]).

The pilot stated that prior to conducting the flight, the pilot had to walk as far as about 20 meters (m) from the helicopters parked position to assess obstacles to the North and Northwest. He states that he observed tall trees and a soccer goal structure to the North and a powerline toward the Northwest.

From the ground assessment, the pilot concluded that the powerlines were positioned outside the field, perceiving and determined that those lines would not be a threat for his reposition to the nominated departure point at the Northwestern edge of the field and the subsequent departure.

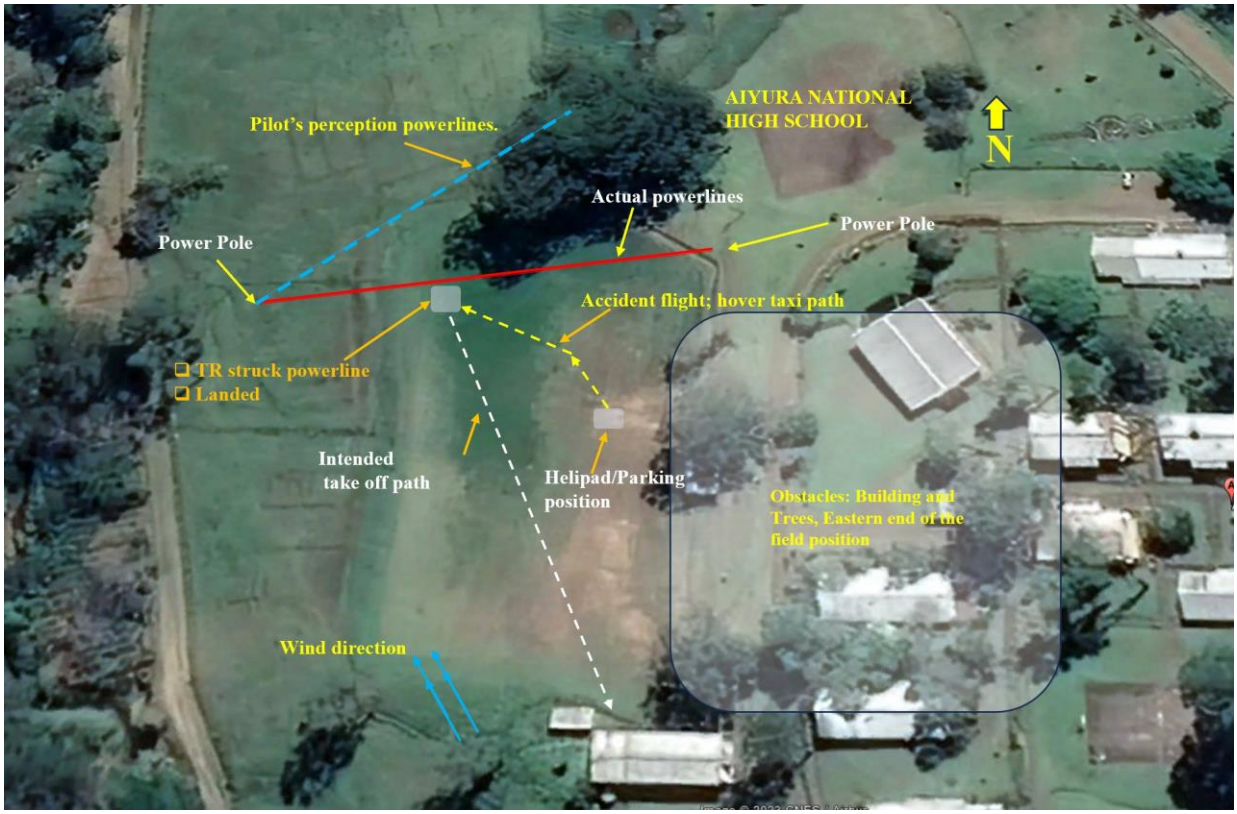


Figure 2: Depiction of Obstacles, wind direction and intended take-off path.

The pilot also stated that after the passengers boarded the helicopter, he started the helicopter, completed his after-start checks and lift-off.

[3] Out of Ground effect (OGE)-Hovering a distance greater than one disk diameter above the surface. Because induced drag is greater while hovering out of ground effect, it takes more power to achieve a hover out of ground effect *(Helicopter Flying Handbook-FAA-H-8083-21B)*

[4] In Ground effect (IGE)- Ground effect is the increased efficiency of the rotor disk caused by interference of the airflow when near the ground (*(Helicopter Flying Handbook-FAA-H-8083-21B)*

According to a video recording[5], as the helicopter lifted off the ground, it began turning towards the North of the field. About 6-7 feet (ft) from the ground and with a North-westerly heading, the helicopter began hover taxiing towards the nominated departure point. The recording showed that during the taxi, the rotor downwash blew up significant amounts of dust into the air around the helicopter.

As the helicopter reached the nominated departure point, it began turning left to line up in the direction of his planned departure path. The recording also showed that the helicopter turned through about 120 degrees before it suddenly stopped turning left and began turning right instead. It was concluded that the helicopters tail had struck a wire.

The pilot recalled that at that instant, he felt a sudden onset of vibration through the antitorque pedals and cyclic pitch control which continued until he landed. He stated that he immediately realized that he had struck a powerline.

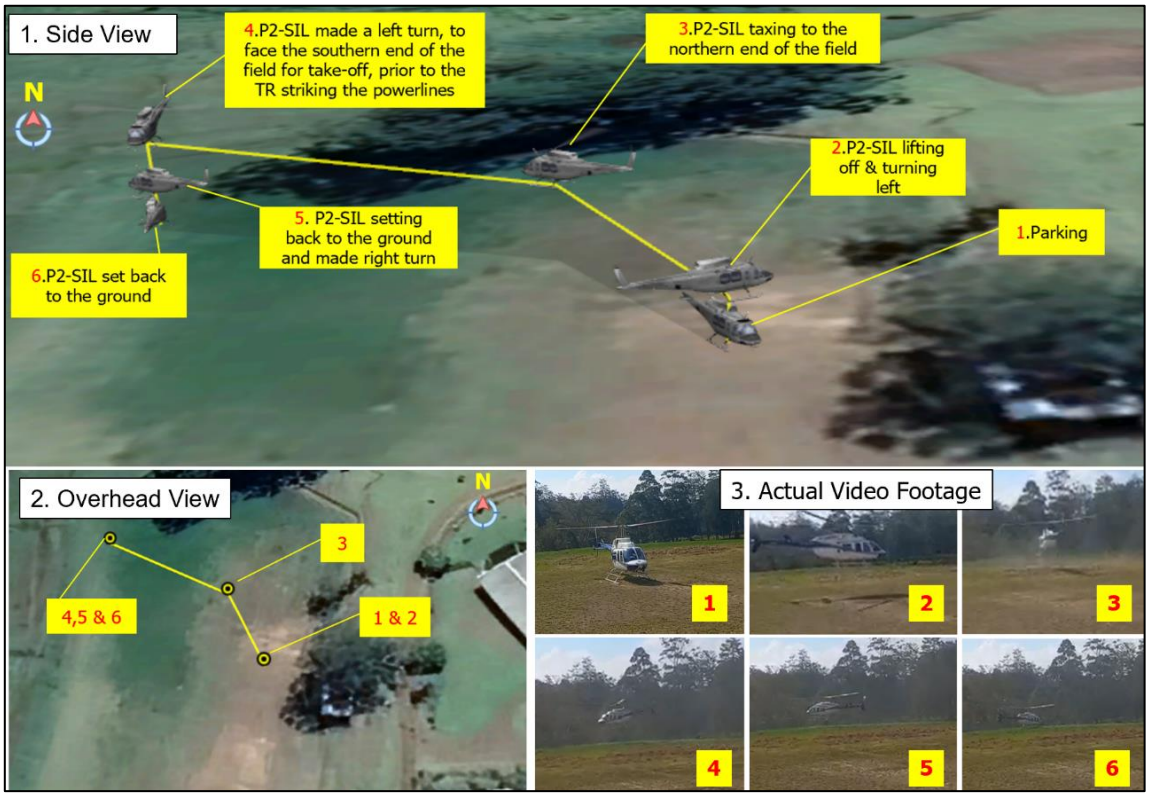


Figure 3: Overhead view of the Aiyura High School Sport fields

The pilot recalled having limited control of the helicopter due to the damage sustained to the tail rotor system and the helicopter subsequently entered an uncommanded rotation to the right. The pilot then reduced power to idle and settled the helicopter onto the grass about 5 seconds after the wire strike.

He subsequently shutdown the engine and began assisting the passengers to exit the helicopter.

There were no injuries as a result of this accident.

[5] During the investigation, the AIC received footage of a video recording taken by a witness on the ground about 15 m east of the helicopters parked position.

1.2 Injuries to passengers

Injuries	Flight crew	Passengers	Total in Aircraft	Others
Fatal	-	-	-	-
Serious	-	-	-	-
Minor	-	-	-	Not applicable
Nil Injuries	1	5	6	Not applicable
TOTAL	1	5	6	-

Table 1: Injuries to persons

1.3 Damage to aircraft

The helicopter sustained substantial damage. Refer to *Section 1.12* for detailed description of damage to relevant components of the helicopter.

1.4 Other damage

One of the powerlines snapped and dropped onto the ground.

1.5 Personnel information

1.5.1 Pilot

Age	: 45
Gender	: Male
Nationality	: United States of America
Position	: Check and Training Captain
Type of license	: PNG CPLA[6] and PNG CPLH[7] (Outdated)
Type rating	: Bell 206L3
Total flying time	: 4,628.1 hours
Total hours in command	: 4,428.2 hours
Total hours on type	: 2,534.7 hours
Total hours last 90 days on type	: 154.6 hours
Total hours last 7 days on type	: 14.5 hours
Total hours last 24 hours on type	: 4.2 hours
Medical class	: One (1)
Valid to	: 28 February 2023
Medical limitation	: Nil

[6] Commercial Pilot License Aeroplane
[7] Commercial Pilot License Helicopter

1.5.2 Training and Competency

The pilot training records provided by SIL to AIC showed that the pilot held the appropriate requirements regarding License as required by the PNG Civil Aviation Rules.

The training records showed that all general check and training requirements were in accordance with the existing Civil Aviation Rule (CAR) requirements and the Operators training programmes.

1.5.3 Pilot familiarity with Aiyura National High School Field – B206L3

The Daily Flight Record (DFR) showed that he had once landed and departed from the field on 7 October 2019. The pilot had conducted a flight out of that field with one of the Operator's other B206L3 helicopters and had total take-off weight of 1,878 Kg. The pilot informed AIC during the interview that the flight he conducted on 7 October 2019 was a maximum performance take-off [8] departure from the Eastern edge of the field to the Western edge and over the obstacles.

Although the pilot had significant experience flying helicopters and conducting different types of departures and from confined spaces, he had not conducted a departure out of the Northern area of the Aiyura School field.

The pilot was not familiar with the obstacle situation toward the North and the Northwest area of the field. He conducted an assessment and identified the powerlines but incorrectly judged their position in relation to the field.

1.6 Aircraft Information

1.6.1 Aircraft data

Aircraft Manufacturer	: Bell Helicopters
Model	: Bell 206L3
Serial Number	: 51511
Year of Manufacture	: 1991
Total Airframe Hours	: 8,049.8
Total Airframe Cycles	: 8,131
Registration	: P2-SIL
Name of the Owner	: SIL Aviation
Name of the Operator	: SIL Aviation
Certificate of Registration number	: 263
Certificate of Registration issued	: 29 July 2013
Certificate of Registration valid to	: Non-Terminating
Certificate of Airworthiness number	: 263
Certificate of Airworthiness issued	: 23 November 2013
Certificate of Airworthiness valid to	: Non-Terminating

[8] FAA Helicopter Flying Handbook: A maximum performance take-off is used to climb at a steep angle to clear barriers in the flightpath. It can be used when taking off from small areas surrounded by high obstacles.

1.6.1.1 Engine data

Engine Type	: Turboshaft
Manufacturer	: Rolls-Royce Corporation
Model	: 250-C30P
Serial Number	: PCE-50926
Year of Manufacture	: 2009
Total Time Since New	: 23,591.6 hours
Cycles Since New	: 36,328
Time Since Overhaul	: 6,197.3 hours
Cycles Since Overhaul	: 8,525

The video footage taken by a bystander and provided to AIC showed that the engine was operating as normal until the accident. The pilot also confirmed during the interview that there were no performance issues observed or experienced from engine start to the time the TR struck the powerline.

1.6.1.2 Rotor Blade

Main Rotor Blades

Manufacturer	: Bell Helicopters
Year of Manufacturer	: 2015
Part Number	: 206-015-001-119
Main Rotor Blade 1 and 2 Serial Number	: BH 215656 and BUA30860 respectively
Total Time Since New	: 976.3 hours

Tail Rotor Blades

Manufacturer	: Van Horn
Year of Manufacturer	: 2014
Tail Rotor Blade 1-2 Serial Number	: B441 and B451 respectively
Total Time Since New	: 1882.3 hours

1.6.2 Airworthiness and Maintenance.

At the time of the accident, the helicopter had a current Certificate of Airworthiness (CoA), Certificate of Registration (CoR), and was certified as being airworthy.

The maintenance records were reviewed during the investigation and identified that there were no outstanding scheduled maintenance and defects. Therefore, the helicopter was serviceable at the time of the accident.

1.6.3 Weight and Balance

The DFR of the accident flight showed that the helicopter departed with a gross weight of 1,845 kilogram (Kg).

According to *Bell 206L3 Rotorcraft Flight Manual, Section 4*, and the Summer Institute of Linguistic– PNG, *Standard Operating Procedures (SOP) Manual*, the helicopter's Maximum Internal Gross Weight Limit was 1,882 Kg.

The accident flight take-off weight was 37 Kg under the published Maximum Internal Gross Weight.

Therefore, the helicopter's take-off weight was within the permissible limits for that flight under the prevailing conditions at the field.

The gross weight considerations were a contributing factor in the pilot's preflight assessments and decisions regarding the flight. The pilot stated that he decided to taxi to the Northern edge of the field to ensure sufficient space and obstacle clearance could be achieved for the departure.

1.6.4 Fuel information

The helicopter was refueled with JET-A1. The total fuel on board prior to departure was about 300 pounds (136 Kg). The investigation determined that the Fuel starvation or contamination was not a factor in the accident.

1.7 Meteorological information

1.7.1 PNG National Weather Service Forecast Data

The Area Forecast for Area 5 in which Aiyura National High School is situated, was issued by PNG National Weather Service on 04 October 2022, and was valid from 02:00 UTC to 14:00 UTC for the same day. The information is as follows:

Upper Winds : At 2,000ft – 120 degrees at 30 kts

Cloud : Scattered cumulonimbus at 1800ft
: Broken Stratus at 500 ft and 3000 ft in precipitation
: Scattered cumulus at 1500 ft and 15,000 ft in broken showers
: Scattered at 3000 ft and 8000ft broken in rain and drizzle

Visibility : 500 m in fog, 3000 m in thunderstorms and rain, 4000m in showers of rain and rain

Weather : Fog, Thunderstorms, Showers of rain, Rain drizzle

Freezing level : 15,000 ft

Area QNH : 1009 hPa

1.7.2 Weather on the accident day.

During the interview, the pilot informed AIC that it was a clear sunny day and the wind was blowing from the Southeast end of the field.

The video recording provided by the witness showed that it was a clear day at the field. The visibility was more than 10 Kilometers (km). However, during the taxi to reposition, there was a substantial amount of dust blown into the air by the rotor downwash which was considered by the investigation as a factor which may have contributed temporary deterioration to visibility. This was observed from the point of view of the witnesses recording. The dust did not settle until after the accident.

1.8 Aids to navigation

Navigational aids and their serviceability were not a factor in this accident.

1.9 Communication

Communication between Air Traffic Services (ATS) and the crew and the serviceability of radio equipment were not factors in this accident.

1.10 Aerodrome information

Aiyura National High School is located in the Ukarumpa Area, Eastern Highlands Province at an elevation of 5,300 ft above mean sea level (AMSL), The area is about Nautical Miles (34 NM) Southeast of Goroka Town.

The Aiyura High School field is an open clear flat-surfaced sporting field, about 100 m long and 50 m wide. During the onsite investigation, the investigators observed trees as tall as 100 ft surrounding the field, except the Western side. The powerline that was struck by the helicopter TR blade ran over the Northern edge of the field, oriented East to West at a height of about 20 ft. The field was observed to be about 10 ft higher than the Western Pole was at a lower elevation than the field and the other pole on the Eastern. The suspended powerlines would therefore be closer to the ground over the field. Furthermore, the powerlines naturally hang lowest around the centre section. At the time of the accident, the centre section of the powerline was positioned over the field. The ground clearance of the powerline at the point the helicopter struck it would be no more than 10 ft.

Figure 4. Aiyura National High School field after the accident. ***Photo: Drone footage from the Operator.***

1.11 Flight recorders

The helicopter was not equipped with a flight data recorder or a cockpit voice recorder, neither were required by PNG Civil Aviation Rules.

1.12 Wreckage and impact information

At the Northern edge of the field, there are three powerlines running from the Eastern end to Western end. While the helicopter was hovering and initiating the left turn at the Northern end, simultaneously its tail rotor began travelling towards the powerline. As the helicopter continued the turn, the margin between the powerline and tail rotor blade reduced and subsequently the TR blade struck the powerline.

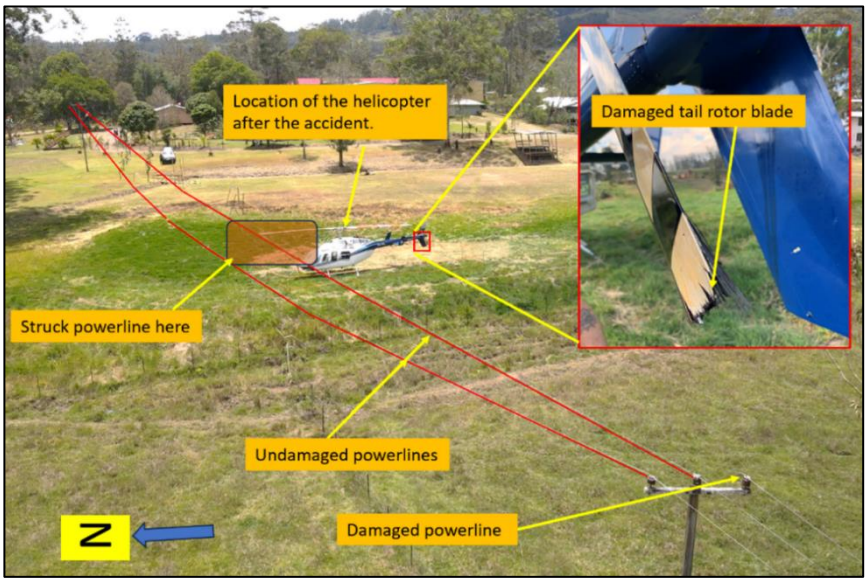


Figure 5. Damage sustained to the TR blade by the powerlines.

On 7 October 2022, the AIC conducted examinations on the damage sustained to the helicopter tail boom, TR shaft, TR gearbox and tail rotor blades at the Operator's Base. It was noted that there was significant damage to the TR gearbox and mounting structure of the helicopter, typical of a sudden TR blade strike.

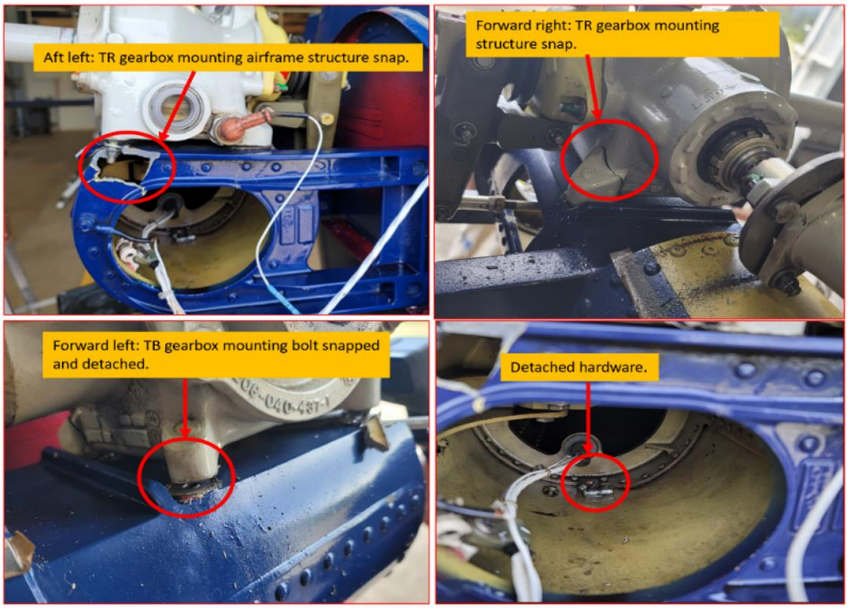


Figure 6. Damaged sustained to the TR gear box mounting structure.

1.13 Medical and pathological information

No medical or pathological investigations were conducted as a result of this occurrence, nor were they required.

1.14 Fire

There was no evidence of pre- or post-impact fire.

1.15 Survival aspects

According to the pilot, he assisted the passengers through the main exit door and away from the helicopter without any injuries.

1.16. Tests and Research

No tests or research were required to be conducted as a result of this accident.

1.17 Organisational and Management Information

1.17.1 Aircraft Operator: SIL Aviation

SIL Aviation is a general aviation company based at Aiyura, Eastern Highlands Province, Papua New Guinea. The company has an Air Operator Certificate (AOC) issued pursuant to Section 47 (3) and 49 of the Civil Aviation Act 2000 (As Amended) and Part 119.9 and is authorised to perform commercial air operations in accordance with its exposition and Parts 135 and 136.

It operates non-scheduled passengers and cargo flights. SIL Aviation is also authorised to maintain and release to service aircraft and aircraft components as defined in the organisation's exposition and Part 145.

1.17.1.1 Operator's Helicopter Operation Manual

The AIC reviewed the Operators *Helicopter Line Operations Manual*. The following provisions were noted:

Section 6.1. '*Pre takeoff briefing*' states;

6.1.2. The following items shall be reviewed in a pre-takeoff check.

6.1.3. Wind strength and direction

6.1.3.1. Obstacles - ensure that the area all around and above the helicopter are clear, paying particular attention to the tail rotor area.

Section 6.3 'Helicopter Taxi Procedures' states;

6.3.8. SIL helicopters are normally taxied at a 5 ft skid height to avoid obstacles.

6.3.9. Normally, the PIC shall ensure that the helicopter is pointing in the direction of travel while hover taxiing. For short pre-positioning, the helicopter may need to be taxied sidewards or rearward.

6.3.9.3 Prior to hover turns, the PIC shall visually check that the direction towards which the tail rotor is travelling is clear.

8.7.5. Landing site assessment. On arrival at the landing area, the PIC shall conduct a reconnaissance of the landing site, consisting of the following as appropriate (dictated by the complexity of the LZ.)

NOTE

A Landing Site Recon is a dynamic process where the PIC gathers and processes a large variety of information. The gathered information will have to be reconfirmed and assessed throughout the process all the way to landing and shut down or departure from the LZ. The PIC should be willing and ready to abort the landing at any time.

8.9.3. For improved situational awareness and ease of monitoring of clearances it is recommended that whenever possible, the obstacle posing the biggest threat be positioned in direct view of the pilot. It is the PIC's responsibility to monitor and keep track of threats, people and obstacles in the vicinity of the helicopter at all times. In the event that the PIC loses situational awareness of different threats, people and obstacles identified during the high, low and overshoot reconnaissance, the operation shall be aborted immediately.

8.9.4.1. For any LZ at which regular service is expected, the following requirements shall be used:

b. Outer Pad Area - A circle with a diameter equal to twice the overall length of the helicopter. This area shall be free of obstructions likely to interfere with the manoeuvring of the helicopter such as wires, poles, trees, and loose objects;

During the interview, the pilot stated that he was aware of the powerlines toward the North to Northeast from the field, however, he incorrectly perceived their position in relation to the field during his assessment.

1.17.1.2 Hazard Identification and Risk Management

The Operator has existing standard Safety Management System which includes the Safey Risk Management (SRM) procedure. The SRM as per the Operator's *Safety and Quality Manual* encompasses Hazard Identification, Risk Analysis and assessment, Risk control and mitigation and Risk monitoring.

The Operator's *'QA Risk Assessment Log Spreadsheet'* listed 122 hazards spanning from 2012 to July of 2022. The log integrates identified aircraft operation related hazards as well as organizational management and workplace hazards.

The investigation reviewed Hazard No. 87 (see *Figure 7*) dated October 28, 2015. Although the risk level was classified as *'Acceptable'* which according to the *Operators Safety and Quality Manual section 5.3.4* is where there is little to no risk involved in the operation and the activities will be considered appropriate to do with no further control or mitigation considerations necessary. However, the AIC noted mitigation actions under the risk mitigation/comment column which were implemented by the Operator and evidence of implementation provided upon request from the AIC. The AIC reviewed the *Helicopter Line Operations Manual* and found that Landing Requirements procedure and Unfamiliar confines areas procedure are stated in sections 8.9 and 8.7 respectively and not in 9.10 and 12.5 as per the risk mitigation on the log.

According to the pilots Competency check conducted on 22 May 2022, the pilot was checked on *Advance Landing Site* which includes *confined area.* However, the AIC did not obtain evidence to show a new training module focusing on *landing in unimproved LZ's* and replacement of the *Helipad 'Check Out' requirements*.

The AIC observed that the Risk Assessment log did not indicate clearly if the risk level on the table shows residual risk or risk level before mitigating actions were carried out.

The Risk assessment log spreadsheet did not contain any specific hazards for the Aiyura landing zone/helipad or other landing zones the operator operates to.

Date	Tracking No.	Hazard	Undesired Event	Risk Probability	Risk Severity	Risk Hazard	Risk Mitigation/Comment
March 30, 2014	81	Possible ground contact of the strakes (tail strike) @ Efogi	Aircraft damage	2 - Unlikely	C - Major	Tolerable	INITIAL REVIEW: MAR 2016 Action: SOP changes to address this hazard
October 28, 2015	87	Heli confined landing sites	Serious incident	1 - Highly Unlikely	B - Hazardous	Acceptable - 4	Added paragraphs 9.10 LZ requirements & 12.5 Unfamiliar Confined areas plus pilot training: proximity training, further airborne/hover proximity training, line check requirements, new training module focusing on landing in unimproved LZ's, proposed plan to replace the "Helipad Check Out" requirements and renewed emphasis will be place to verify the existence of a fully developed and appropriate PIC mentality in the trainee during all Checking and Training events.

Figure 7. Extract of the Operator's Risk Assessment Log spreadsheet

1.17.2 CASA PNG

Civil Aviation Safety Authority of Papua New Guinea (CASA) PNG is a statutory body with a legal mandate to promote aviation safety and security through effective safety regulation of the civil aviation industry, with particular emphasis on preventing aviation accidents and incidents within the civil aviation system in Papua New Guinea.

CASA PNG is responsible for monitoring and auditing compliance of Operators with the Civil Aviation Rules made by the Minister from time to time.

1.17.2.1 CAR Part 61 Pilot License and Rating

According to CAR Part 61, subpart 61.1 *Purpose* states;

This purpose prescribes the requirements for-

1. *the issue of a pilot license and rating in accordance with section 49 of the Act; and*
2. *the issue of a rating in accordance with this Part; and*
3. *the condition under which a pilot license and rating is required; and*
4. *the privileges and limitations of a pilot license and ratings*

SUBPART 61.6 *Specifications for Licences* states;

Pilot Licences issued under this Part must contain:

1) *Name of the issuing State; and*
2) *Title of licence; and*
3) *Licence number; and*
4) *Full name of the licence holder; and*
5) *Licence holder's date of birth; and*
6) *Licence holder's address; and*
7) *Licence holder's nationality; and*
8) *Signature of the licence holder; and*
9) *Authority and conditions under which the licence is issued; and*
10) *Certification concerning validity and authorization for holder to exercise privileges; and*
11) *Signature of the Officer issuing the licence and the date of such issue; and*
12) *Seal or stamp of Authority issuing the licence; and*
13) *Ratings and endorsements; and*

The pilot's records provided by the Operator showed that the accident pilot had a PNG CPL (H) License issued on 20 March 2006 and a PNG CPL (A) issued on 13 November 2008.

All items required under CAR Part 61, subpart 61.6 as listed above were contained in the pilot's PNG License except for item 13, ratings and endorsements, refer to *5.1 Appendix A.*

On 9 February 2023, the AIC requested the Operator to provide any additional pages of the accident pilot licence that may contain additional information as required under Part 61. The Operator replied that there were no additional pages. The Operator also stated that the type ratings were not a requirement at that time when the pilot licence was issued.

On 3 April 2023, the AIC requested CASA PNG for the accident pilot records. CASA PNG provided his records including his license on 5 April 2023. The AIC noted that the license provided by CASA was the same as the one provided by Operator.

1.18 Additional information

1.18.1 Situational Awareness and Decision Making

According to CASA Australia *Safety Behaviours: Human Factors for Pilots 2nd Edition*: *Resource Booklet 6 'Situational Awareness'* (SA);

> *One of the leading researchers on situational awareness, Dr Mica Endsley's, formal definition of situational awareness is:*
>
> - *the perception of the elements in the environment within a volume of time and space*
> - *the comprehension of their meaning*
> - *the projection of their status in the near future*
>
> *Simply put, the three key processes of SA, therefore, are:*
>
> *1. perception (scanning, gathering data) of what is happening (level 1)*
>
> *2. understanding what has been perceived (comprehension) (level 2)*
>
> *3. using what has been understood to think ahead (projection) (level 3)*
>
> *Understanding the situation triggers decision making, action and review.*
>
> *Situational Awareness precedes decision making because pilots must understand their environment before they make a decision and act upon it.*

According to CASA Australia *Safety Behaviours: Human Factors for Pilots 2nd Edition: Resource Booklet 7 Decision making;*

> *Decision making is the act of choosing between alternatives under conditions of uncertainty. We consider the circumstances and reach a judgment or choose an option or action depending on the situation.*

The AIC determined that the pilot was aware of obstacles in the Northwest of the field. According to the pilot, he scanned the whole area and walked out towards the edge of the helipad within about 20 m of the edge of the helipad just right in the middle of the field. He assessed the wires and looked like they were upward and away from the field, so he considered that he had plenty of space to maneuver in that direction to maximize his distance to take off into the wind.

1.18.2 Visual Illusions

According to CASA Australia *Safety Behaviors: Human Factors for Pilots 2nd Edition: Resource Booklet 9 'Human Information Processing';*

> *Perception is the way in which the brain understands information acquired through the senses. It makes the connection between external events (such as objects, people, movement, sounds and smells) and our thoughts about them.* Misperception *is when we get this wrong.*
>
> *Illusions are defined as misperceptions of reality when our senses are 'tricked' so that what we think we see, or feel is not what is really happening.*
>
> *The performance limitations of our sensory organs mean that we also don't always perceive things accurately. This is mainly because of the way the brain reconstructs data. We can be fooled into believing, or literally feeling, a false interpretation of the outside world.*
>
> *We are all susceptible to misperceptions caused by sensory limitations, and we generally* experience *these misperceptions in the same way. However, as individuals with different experiences and personalities, these experiences can* affect *us in markedly different ways.*
>
> *Understanding perception is important for all pilots, as it directly influences the decisions we make and the actions we take in response to our perceived situation. We need to understand how to manage the misperceptions and illusions caused by our sensory limitations and subjectivity.*
>
> *Some visual misperceptions are due to physiological limitations of the eye, such as blind spots and colour blindness, as well as an inability of our eyes to detect objects in very low light conditions (night) or at the other extreme in very bright conditions (looking directly at the sun).*

According to the interview, the pilot stated that visual illusion 'tricked' his eyes to think that the powerlines and pole were further away. He stated that he walked about 20 m to the edge of the helipad in the middle of the field to scan for obstacles and when he looked at the powerlines which are on the North side of the field, it looked like it was going upward and away from the field. With the sun being at a 3 o'clock position[9] the wires looked like they were going out in the direction

[9] The clock position, or clock bearing, is the direction of an object observed from a vehicle, typically a vessel or an aircraft, relative to the orientation of the aircraft to the observer.3 o'clock means directly to the right.

away from the field and so he considered he had plenty of space to maneuver over in the direction of the power line and maximize his distance to take off into the wind. He also stated that he did not thoroughly look over to see that the power lines were right over the edge of the field.

According to the Operator's *Internal Preliminary report*, wires are no more than thin lines when viewed against a bright sky. Their location is difficult to perceive when viewed on their own. Standing beneath the lines, tracing the path between support poles, noting shadows, and comparing the line to its position relative to the ground can increase situational awareness.

1.19 Useful or effective investigation techniques

The investigation was conducted in accordance with the *Papua New Guinea Civil Aviation Act 2000* (*As Amended*), and the Accident Investigation Commission's approved policies and procedures, and in accordance with the Standards and Recommended Practices of *Annex 13* to the *Chicago Convention on International Civil Aviation*

2 ANALYSIS

2.1 General

The analysis of this report discusses the circumstances considered relevant to the accident. the powerline strike at Aiyura National High School field, Eastern Highlands Province.

Wire strikes make up for a large number of helicopter accidents. In most circumstances, it is found to be due to pilots being unable to see the suspended wire and avoiding contact.

In the case of this accident, the pilot confirmed that he had seen the wire during ground assessment, prior to flight. However, the pilot also confirmed that he perceived the wire to be well away from his planned departure point.

During taxi to his nominated departure point, the pilot did not see the wire which resulted in the pilot turning within close proximity of the wire resulting in the wire strike.

This Section further discusses some of the circumstances and conditions which contributed or may have contributed to the accident.

2.2 Flight Operations

2.2.1 Preflight Obstacle Assessment

The pilot conducted an area and obstacle assessment from within 20 m of the helicopter. The pilot spotted the suspended powerline from this point. The pilot did not proceed further toward the powerline to confirm the accuracy of his judgement. The investigation concluded that the distance, of no less than 40 m, was too far for the normal human eye to perceive distance, especially when an object as thin as a powerline.

During the lift off and hover, the pilot observed a power margin of 10 to 15%, which he stated would have been sufficient power to conduct vertical climb departure. The pilot did not replan as there was no alternative cues that suggested a reassessment and replan. As far as the pilot had perceived, there was no obstacles in the way of his repositioning and departure, giving the helicopter in the departure path would allow for a safer landing if engine issues were encountered.

2.2.2 Pilot Qualification

The pilot's PNG CPL did not contain the prerequisite information required under CAR Part 61. The investigation observed that the licence had been issued in accordance with PNG Civil Aviation Regulations in 2006 and this was common with most pilots who had been issued licences prior to the inclusion of CAR PART 61, subpart 61.6 (13).

The AIC reviewed the pilots flight logs and training records which show that contrary to the representation of the outdated licence, the pilot was actually trained and qualified to conduct operations in the B206 helicopters.

The pilot also holds a valid USA pilot licence and specified that the pilot was qualified to operate helicopters as a commercial pilot and to act as a flight instructor on helicopters. The USA licence did not contain aircraft type ratings to be specified in the licence and it was not required.

The pilot was issued an Instrument of Approval (IOA) to conduct Flight Instruction and Flight Examiner on the B206 Helicopters. There was no evidence of assessment of the Pilots licence being reviewed and updated to meet the current CAR Part 61, subpart 61.6 (13) requirements.

Pilot qualification was not considered a contributing factor to the accident. The pilot was found to be properly qualified and trained for helicopter operations that he was carrying out. However, these qualifications were not reflected on the pilot license as required.

2.2.3 Operation of the Helicopter

Initially departure was to conduct a vertical climb out of ground effect into wind because of the power margin of 10 to 15% established in the hover. The pilot elected to depart from the Northwest edge of the field to give the helicopter sufficient clearance from the obstacles in the departure path.

The AIC believes considering the circumstances that under the observed and reported circumstances, had the pilot conducted the same departure from the middle of the field, the helicopter would have been able to remain clear of the obstacles in the path.

The pilot taxied to the edge of the field to the nominated departure point where during the turn, the TR blades struck one of the wires. The pilot did not notice the wires which were right ahead of the helicopter because they were camouflaged by the background trees and would have been difficult to notice. There was also rotor downwash blowing dust into the air around the helicopter.

The AIC believes that the circumstances were such that the pilot would probably have had chance to detect the wires during the taxi if the pilot was actively looking out and searching for them.

The departure point was decided on the basis of a misperception of the position of the powerlines in reference to the field. The decision and perception were not later investigated by the pilot to confirm the accuracy of his perception.

2.2.4 Standard Operating Procedures

The Operator's *Helicopter Line Operations Manual* specifies the need to conduct an obstacle assessment for Landing Zones. The Manual generalizes obstacles and risks to all obstacles. From the investigation, it was apparent that the Manual does not provide minimum specifications for conducting LZ and/or obstacle assessments. The manual does not adequately discuss risks associated with LZ or obstacle assessments.

The investigation found that the Operators Helicopter Line Operations Manual does not contain adequate guidance, standards, or specifications to ensure that assessments are correctly accurately done and reduce the likelihood of errors or misperception.

The Operator's *Helicopter Line Operations Manual* recommends that during operations, pilots had to position the obstacle posing the biggest threat in direct view of the pilot for improved situational awareness and ease of monitoring of clearances. Unfortunately, prior to boarding the helicopter, the pilot had already decided that the wires were the least of the obstacles concern.

The Manual requires that any information gathered during an assessment will be reconfirmed and assessed during landing or departure from the LZ. The PIC did not actively reconfirm or reassess the information he had gathered during his ground assessment. This was due to a strong assertion and confidence in his initial perception which had been drawn from unrecognized optical illusion.

2.2.5 Obstacle assessment

The pilot conducted a reconnaissance during arrival at the field prior to landing at the field as required by the *Helicopter Line Operations Manual*. From the evidence, it was apparent that the pilot did not identify the powerlines during that aerial reconnaissance. The pilot's second landing after refuelling, he was not able to detect the powerline as well.

For this assessment, the investigation believes that it would be difficult to identify powerlines with the ground behind them.

During the ground assessment, prior to the passenger flight, the pilot walked out to about 20 m from the helicopters parked position and identified and assessed a number of obstacles toward the North and Northwest. He observed a soccer goal structure, trees and suspended powerlines around that area.

Based on his assessment, the pilot concluded that the powerlines were positioned beyond the edge of the field and the area which he had nominated as his departure point. It was later confirmed after the accident that the perception that the pilot had made his situational awareness and influenced decisions erroneous.

The AIC believes that the distance at which he viewed the powerlines from the ground was too far for the normal human eyes to accurately judge their distance. Unlike other larger obstacles, the powerlines are thin and difficult to see.

Furthermore, if a misperceived object, such as a tree, building or other larger objects, is misperceived from a distance, the error in judgement is easier to detect as the helicopter flies towards it as it will easily draw a pilot's attention because of its size. However, for smaller or thin objects, typically powerlines, it is difficult due to human optical senses limitation and/or the manner in which the information is presented in the environment.

If the pilot had walked further toward to Nort or Northwest edge, he would have been able to accurately determine the position of the powerlines over the field with a closer observation.

2.2.6 Familiarity with Landing Zone

The AIC reviewed the pilots flight history and found that apart from the flights on the day of the accident, the pilot had only once in 2019 landed and taken off from that field. The next flight flown into the field was the passengers' arrival flight earlier on the day of the accident and departed to refuel at the Operator's base. The pilot confirmed that neither of those departures were conducted out of the North.

The accident flight was his first planned departure out of the Northwestern edge of the field. The pilot conducted an obstacle assessment from the ground prior to the flight. However, he conducted this obstacle assessment from a distance of about 20 m from the parked helicopter which would mean that he was about 40 to 50 m away from the Northwest edge of the field.

The pilot incorrectly perceived the position of the powerline from the ground. However, at the time, it did not appear to consider any risks that would generally be associated with and contribute to an erroneous perception.

The Operator's *Helicopter Flight Operation Manual* provides general requirements for the assessment of obstacles. However, there was no specific guidance or requirements for the conduct of obstacle assessment and associated risks.

There was no evidence to show that the pilot's likelihood of misjudgement, the pilot did not pay any attention to, or search for the powerlines to confirm his perception.

The investigation determined that the pilot did not have adequate knowledge of the field and surrounding obstacles, particularly the position of the powerlines suspended North of the field.

2.3 Human Factors

2.3.1 Optical Illusion and Perception

The pilot confirmed that he saw the powerlines during his pre-flight area and obstacle assessment. From the position he made his observation, he perceived the powerlines to be positioned further away and clear of his planned operation area. The misjudgement of the distance was found to be due to an optical illusion.

There were a number of factors that were considered to have created the condition for this optical illusion. Firstly, the pilot was at least 40 m from the powerlines which the investigation considered too far for the normal human eye to judge distance and position in space, especially objects as small as powerlines. Secondly, the appearance of the powerlines against the surrounding environment (background) were such that from where the pilot was standing, he was assured that the powerlines was outside of his nominated departure area.

The erroneous perception on the ground which would later lead to an unsafe situation was a result of an optical illusion. The pilot did not consider that he may have been misled by an optical illusion.

As he commenced the flight and proceeded toward the nominated departure point, the powerlines were right ahead of the helicopter. However, being thin and dark, they were easily blended into and were camouflaged by the background trees and difficult to see. If there were any chance to spot the powerlines in flight, that would have had to be if the pilot was looking out for them. However, due to the initial erroneous perception on the ground, the pilot was self-assured that the powerlines would not be a threat to the helicopter during the departure. The investigation also found that there was significant dust blown into the air by the rotor downwash during taxi. Dust can reduce visibility. If dust had any bearing, it would have made spotting small objects even more difficult.

2.3.2 Situational Awareness

The investigation found that the pilot had a misled sense of situational awareness which came from an erroneous perception. Because he was self-assured that he had properly assessed the area and discerned the powerlines, he did not consider the powerlines to be a threat to his operation.

The pilot did not pay attention to the powerlines during taxi and the turn. The investigation believes that the decremented vigilance was due to exhaustion and the false sense of self-assurance that the powerlines were not a factor to consider as a threat. The pilot confirmed that he focused on other references and did not scan the area for the powerlines to confirm his initial perception of the powerlines.

The AIC concluded that the pilot did not continue fully assessing the environment to confirm the accuracy of his initial perception to correct or to maintain proper situational awareness.

2.3.3 Workload

The investigation reviewed the flights and the activities that the pilot conducted on the day. The AIC's assessment of the day's activities drew the view of a high workload for the pilot. The single pilot operations base at 07:00 and began duty. He conducted flights throughout the day on a sunny day. The pilot completed 3 legs on the day with a waiting period of about 2 hours at Wawin National High School. There were long waiting periods in between flights and at the Operator's base during and after refuelling. The pilot operating as a single pilot also conducted weight and balance calculations, pre-flight activities including area assessments.

Although within the regulated daily flight and duty times, the pilot conducted a full day's activities from before 07:00 as a single pilot until the time the accident occurred at 15:10. There were also outstanding flights to be completed by the pilot that day to Nadzab and back to base in Aiyura.

The AIC considered acute fatigue as one of the factors that may have contributed to the reduced attentiveness and vigilance during the planning and flight on the day, resulting in reduced effective judgement and decision making.

3 CONCLUSIONS

3.1 Findings

3.1.1 Helicopter

a) The helicopter was certified, equipped and maintained in accordance with existing PNG rules and approved procedures.

b) The helicopter had a valid Certificate of Airworthiness and had been maintained in compliance with the Rules.

c) The helicopter was airworthy when dispatched for the flight.

d) There was no evidence of any defect or malfunction prior to the accident.

e) There was no evidence of airframe failure or system malfunction prior to the accident.

f) The helicopter was structurally intact prior to impact.

g) All control surfaces were accounted for and all damage to the aircraft was attributed to the tail rotor striking the powerlines.

3.1.2 Pilot

a) The pilot's licence does not contain all the prerequisite information required by CAR Part 61.

b) The pilot was medically fit and adequately rested to operate the flight.

c) The pilot was in compliance with the flight and duty time regulations.

d) The pilot did not have adequate situational awareness of the obstacle at the Aiyura National High School field, particularly, the position of the powerline.

e) The pilot's actions and statements indicated that his knowledge and understanding of the aircraft systems was adequate.

3.1.3 Flight operations

a) The flight was conducted in accordance with the procedures in the company Operations Manual.

b) The impact force exerted on the TR blades subsequently damaged the TR gear box mounting structure and the airframe structure as well.

c) The helicopter landed back on the ground without further event.

3.1.4 Operator

a) The Operator had a valid AOC and MOC at the time of the accident.

b) The Operators manuals do not adequately specify minimum standards and specifications for pilots to meet when conducting Landing Zone and obstacle assessment.

3.1.5 Landing Zone

a) The field was suitable for normal take-off and Landing and had sufficient space.

3.1.6 Flight Recorders

a) The aircraft was not equipped with a FDR or a CVR; neither was required by the regulation.

3.1.7 Medical

a) There was no evidence that incapacitation or physiological factors affected the pilot performance.

b) There was no evidence that the pilot suffered any sudden illness or incapacity which might have affected his ability to control the aircraft.

3.1.8 Survivability

a) The accident was survivable due to the low level of severity of impact.

b) The pilot and the passengers egressed the aircraft without injuries and external assistance.

3.1.9 Safety Oversight

a) The pilot's licence did not contain information about ratings and endorsement required to be displayed on pilot licences issued under CAR Part 61.

b) The CASA PNG did not update nor require an update to the pilot license to ensure full comply with CAR Part 61.

c) The pilot was not operating on a Validation Certificate issued under CAR Part 61.

3.2 Causes [Contributing factors]

- The pilot taxied to his nominated departure position which was unbeknownst to him. Within collision proximity of suspended powerlines where during a turn to line up for departure, the tail rotor blades struck one of the powerlines.
- The distance at which the pilot was assessing the powerlines was considered too far to accurately judge distance.
- The powerlines, with the surrounding environment, presented an optical illusion which caused the pilot, at the distance from which he was observing the powerlines, to perceive.
- The erroneous perception resulted in misguided decisions.
- The high workload on the day would have caused a reduction in attentiveness and vigilance.
- The reduced effectiveness of the pilot' scan and continued verification of initial perceptions made it difficult to detect perception of the powerlines were further away than they actually were.
- The departure position was selected by the pilot during pre-flight obstacle assessment following the erroneous perception of the observed powerlines position.
- The pilot perceived the suspended powerlines to be further away from the field than they were. The pilot assessed the powerlines and judged the powerlines distance from a distance that the normal human eyes are considered not reliable for accurately determining distance.
- The pilot was not aware of the actual environment and his cognitive limitation which led to a strong sense of full situational awareness. This affected the pilot's ability to maintain a vigilant look out to verify the environment for any unsafe situations.
- The investigation considers that the fact that the pilot worked through a full day with activities still ahead, the pilot may have been fatigued and reduced vigilance and attention.

3.3 Other factors

The investigation found non-contributing safety deficiencies. These are addressed in the factual sections and in the Safety Recommendations.

4 RECOMMENDATIONS

4.1 Recommendations

As a result of the investigation into the accident involving P2-SIL, the Papua New Guinea Accident Investigation Commission issued the following recommendations to address concerns identified in this report.

4.1.1 Recommendation number AIC 23-R15/22-1003 to SIL Aviation.

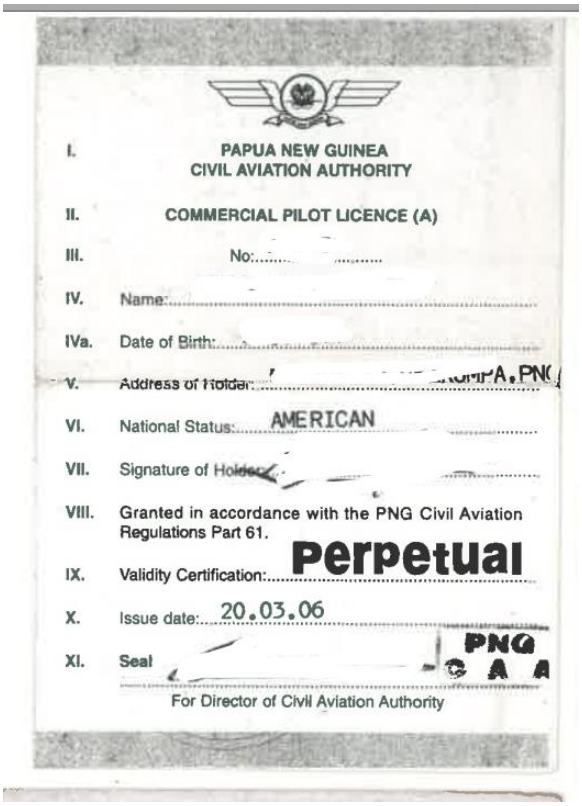
The AIC recommends that the SIL Aviation should ensure its pilots are made aware associated with perceptions of existing obstacles such as powerlines and other smaller objects, which could easily be influenced by the surrounding environment or circumstances, when conducting pre-landing and pre-flight assessments and during flight manoeuvrers.

4.1.2 Recommendation number AIC 23-R16/22-1003 to CASA PNG.

The AIC recommends that CASA PNG should ensure that all valid pilot licences, including those issued under the CAA, show the appropriate information pursuant to the licence requirements and specifications listed under CAR Part61.

5 APPENDICES

5.1 Appendix A: Pilot Licence Issued by CAA



I. PAPUA NEW GUINEA
CIVIL AVIATION AUTHORITY

II. COMMERCIAL PILOT LICENCE (A)

III. No:

IV. Name:

IVa. Date of Birth:

V. Address of Holder:

VI. National Status: AMERICAN

VII. Signature of Holder:

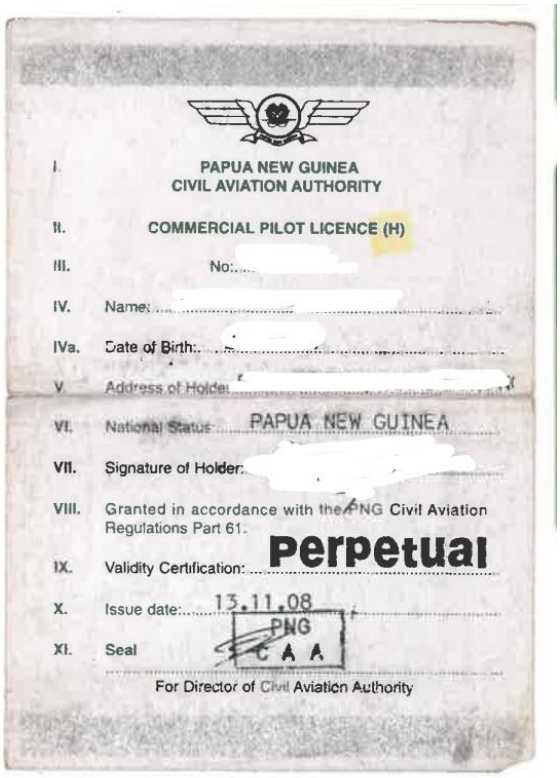
VIII. Granted in accordance with the PNG Civil Aviation Regulations Part 61.

IX. Validity Certification: Perpetual

X. Issue date: 20.03.06

XI. Seal PNG C A A

For Director of Civil Aviation Authority



I. PAPUA NEW GUINEA
CIVIL AVIATION AUTHORITY

II. COMMERCIAL PILOT LICENCE (H)

III. No:

IV. Name:

IVa. Date of Birth:

V Address of Holder:

VI. National Status: PAPUA NEW GUINEA

VII. Signature of Holder:

VIII. Granted in accordance with the PNG Civil Aviation Regulations Part 61.

IX. Validity Certification: Perpetual

X. Issue date: 13.11.08

XI. Seal PNG C A A

For Director of Civil Aviation Authority