AIRCRAFT ACCIDENT

FINAL REPORT

A 01/25

Air Accident Investigation Bureau (AAIB)

Ministry of Transport, Malaysia

Rotary Wing Helicopter Bell 206L4, Registration PK-ZUV

near Kg. Janda, Bentong, Pahang

on 06 February 2025

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FINAL REPORT A 01/25

AIR ACCIDENT INVESTIGATION BUREAU (AAIB)
MALAYSIA

REPORT NO.: A 01/25

OPERATOR	**: PT. ZAVERYNA UTAMA**
AIRCRAFT TYPE	**: BELL 206L4**
NATIONALITY	**: INDONESIA**
REGISTRATION	**: PK-ZUV**
PLACE OF OCCURRENCE	**: NEAR KG. JANDA, BENTONG, PAHANG, MALAYSIA**
DATE AND TIME	**: 06 FEBRUARY 2025 AT 1020LT**

The sole objective of the investigation is the prevention of accidents and incidents. In accordance with Annex 13 to the Convention on International Civil Aviation, it is not the purpose of this investigation to apportion blame or liability.

All times in this report are Local Time (LT) unless stated otherwise. LT is UTC +8 hours.

INTRODUCTION

Air Accident Investigation Bureau of Malaysia

The Air Accident Investigation Bureau (AAIB) is the air accident and serious incident investigation authority in Malaysia and is responsible to the Minister of Transport. Its mission is to promote aviation safety through the conduct of independent and objective investigations into air accidents and serious incidents.

The AAIB conducts these investigations in accordance with Annex 13 to the Chicago Convention, the Civil Aviation Act of Malaysia 1969, and the Civil Aviation Regulations of Malaysia 2016.

It is inappropriate that AAIB reports should be used to assign fault or blame or determine liability since neither the investigations nor the reporting processes have been undertaken for that purpose.

In accordance with ICAO Annex 13 paragraph 4.1, notification of the accident was sent out on 07 February 2025 to the National Transportation Safety Committee (NTSC) Indonesia as the State of Registration and the State of Operator, to the Transportation Safety Board of Canada (TSB) and the National Transportation Safety Board (NTSB) of the United States of America as the State of Design and Manufacture, and to the International Civil Aviation Organization (ICAO). A copy of the Preliminary Report was subsequently submitted to the NTSC, TSB and ICAO on 06 March 2025.

In accordance with ICAO Annex 13 paragraph 6.3, a copy of the Draft Final Report was sent on 31 October 2025 to CAAM, NTSC, TSB, the Lessor, and the Lessee inviting their significant and substantiated comments on the report.

Unless otherwise indicated, recommendations in this report are addressed to the investigating or regulatory authorities of the State having responsibility for the matters with which the recommendations are concerned. It is for those authorities to decide what action is to be taken.

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ABBREVIATIONS

AAIB	Air Accident Investigation Bureau
ATC	Air Traffic Controller
BAC	Blood Alcohol Concentration
CAAM	Civil Aviation Authority of Malaysia
C of A	Certificate of Airworthiness
C of R	Certificate of Registration
CPL	Commercial Pilot License
CVR	Cockpit Voice Recorder
FDR	Flight Data Recorder
HLS	Helicopter Landing Site
hrs	hours
LT	Local Time
mins	minutes
MOR	Mandatory Occurrence Reporting
PIC	Pilot in Command
Sdn Bhd	Sendirian Berhad
SWP	Safe Working Procedure
TNB	Tenaga Nasional Berhad

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SYNOPSIS

On 06 February 2025, a Bell 206L4 helicopter bearing registration number PK-ZUV operated by PT. Zaveryna Utama crashed while attempting to land in Bentong, Pahang, Malaysia. The accident occurred at approximately 1020 LT near a hot spring pool at Kg. Janda along the old Kuala Lumpur-Bentong road.

The helicopter had been engaged in aerial work for Tenaga Nasional Berhad (TNB) and had been operating in the area since 21 January 2025. On the day of the accident, it was returning to the landing site for refuelling when it lost control while hovering just above the ground. The aircraft's skid partially made contact with the landing surface, causing it to topple and catch fire.

A member of the ground crew was tragically struck by the helicopter's rotor blades and instantly perished. Despite minor injuries, the pilot survived the crash.

The Aircraft Operator submitted a Mandatory Occurrence Report (MOR) to the Civil Aviation Authority of Malaysia (CAAM), followed by a notification of the occurrence submission to the Air Accident Investigation Bureau, Malaysia (AAIB), and an investigation team was dispatched to the crash site on the same day.

1.0 FACTUAL INFORMATION

1.1 History of the Flight

On 06 February 2025, a Bell 206L4 helicopter (PK-ZUV), wet-leased[1] by MHS Aviation Berhad (will be referred to as the Lessee) and operated by PT. Zaveryna Utama (will be referred to as the Lessor/aircraft operator) was scheduled for an aerial work flight near Bentong, Pahang, Malaysia.

At 0800 LT, the aircraft operator crew arrived at the Helicopter Landing Site 1 (HLS 1) for their daily briefing, which was scheduled at 0830 LT. The aerial operation involved transporting cargo loads to a designated drop zone, with each flight cycle taking approximately 25-30 minutes. On that day, PK-ZUV was assigned to cover Zone Foxtrot.

Below are the flight operations timeline and the flight tracks from PK-ZUV as depicted in Figure 1:

0850 LT: PK-ZUV started up at HLS 2 (Bentong Fruit Farm).

0855 LT: Take-off from HLS 2 to HLS 1 for cargo pickup.

0857 LT: Picked up the first load (405 kg) and departed for the drop zone.

0925 LT: Returned to HLS 1.

0926 LT: Picked up the second load (405 kg) and departed.

0954 LT: Returned to HLS 1.

0955 LT: Picked up the third load (405 kg) and departed.

1025 LT: Returned to HLS 2 and made the last radio transmission: *"Landing at HLS 2 for refuel, then will call again before take-off."*

Total Flight Time: 1 hour 35 minutes

Total Load Transported: 1,215 kg

[1] ***Wet Lease*** is an agreement between air operators pursuant to which the aircraft is operated under the AOC of the lessor. It is normally a lease of an aircraft with crew, operated under the commercial control of the lessee and using the lessee's designator code and traffic rights.

Figure 1: PK-ZUV flight tracks on the day of the accident
(Source: Spidertracks)

Upon arrival at HLS 2 for refuelling, PK-ZUV descended to approximately 20 meters above the ground to release the cargo net sling. After releasing the sling, the pilot attempted to manoeuvre backwards to realign the helicopter with the fuel drum barrels, which had been placed on the ground by the engineer. At this point, the helicopter was approximately 20 meters away from the fuel drums, which were positioned to its right with the engineer standing behind the fuel drums.

Realising the distance, the pilot attempted to adjust the position of the helicopter by air taxi sideways to the right. During this low-level lateral hover to reposition closer to the fuel drums, the pilot inadvertently applied excessive control input, causing the right skid to contact the ground surface, resulting in a loss of control. Despite the pilot's attempts to recover, the helicopter tilted, rolled over, and came to rest on the ground, immediately engulfed in fire, causing total damage.

During the helicopter roll over, the main rotor blades struck the engineer, resulting in fatal injury. However, the pilot escaped the accident with minor injuries and was taken to the hospital for further treatment.

1.2 Injuries to Persons

Injuries	Crew	Passengers	Others	Total
Fatal	NIL	NIL	01	01
Serious	NIL	NIL	NIL	NIL
Minor	01	NIL	NIL	01
None	NIL	NIL	NIL	NIL

1.3 Damage to Aircraft

The tail boom section of the helicopter remained intact; however, the rest of the helicopter was destroyed by post-impact fire (Refer to Figure 2).

Figure 2: Pictures of the destroyed helicopter

1.4 Other Damage

One of the two fuel drum barrels, with its cap already open, was damaged by the post-impact fire.

1.5 Personnel Information

1.5.1 Pilot

Status	Pilot in Command (PIC)
Nationality	Indonesian
Age	44 years old

Gender	Male
License Type	CPL
License Validity	Valid (31 January 2026)
Aircraft Rating	BELL 206
Total Hours on Type	1010hrs
Total Flying Hours	4003hrs 50mins
Rest Period Since Last Flight	More than 8hrs
Medical Certificate Class	1
Limitations	Holder shall possess glasses that correct for near vision
Medical Expiry Date	27 May 2025

The pilot joined PT Zaveryna Utama in 2019 and had landed several times at HLS 2 since the project started in January 2025. Duly qualified and authorised to conduct the flight in accordance with existing regulations. In the morning, before the flight, as required by the company's Operation Manual Part A, Chapter 7.2, the pilot performed a medical check, which included a blood pressure check and an alcohol test. The result of the check was within the limitations for blood pressure and 0% for alcohol. Additionally, the pilot was medically fit and sufficiently rested to operate the aircraft.

The pilot had a prior accident in 2019 involving the same type of helicopter with another aircraft operator. The helicopter crashed near Lombok International Airport in Kawo Village, Central Lombok, Indonesia. The accident occurred while returning from a tour in Labuan Bajo, East Nusa Tenggara, following a suspected engine failure at approximately 500 meters in altitude.

The investigation team attempted to obtain the final report of the aforementioned accident from the relevant investigative authority; however, the report has yet to be completed.

After experiencing two major accidents, the investigation team remains attentive to the pilot’s health and well-being. As a precautionary measure, it has been recommended that the company facilitate the pilot’s consultation with an aviation medical professional to conduct a comprehensive mental and physical health evaluation, ensuring the pilot is fully fit to resume flying duties.

1.5.2 Engineer

Status	Engineer
Nationality	Indonesian
Age	27 years old
Gender	Male
AME License	Aircraft Maintenance Engineer
Date of Issue	02 April 2024
Type Rating	BELL 206 Series
Initial Date of Issue	02 April 2024

The ground engineer was duly qualified and authorised to conduct the ground duties in accordance with existing regulations. Joined PT Zaveryna Utama in November 2024 and have been working as an engineer for approximately five years. Been assigned to the operation in Bentong since 21 January 2025 until the date of occurrence.

In the morning before the flight, as required by the company's Operation Manual Part A Chapter 7.2, the engineer performed a medical check that consisted of a blood pressure check and an alcohol test. The result of the check was 0%.

1.6 Aircraft Information

Aircraft Type	Bell 206L4
Manufacturer	Bell Helicopter Textron
Year of Manufacturer	1995
Aircraft Owner	PT. Zaveryna Utama
Aircraft Operator	PT. Zaveryna Utama
Registration No.	PK-ZUV
Aircraft Serial No.	52151
C of R Validity Period	25 July 2025
C of A Validity Period	07 November 2025
Insurance Validity Period	07 November 2025
Total Flying Hours	7067 Hrs
Engine Type and Model	Rolls-Royce Allison 250-C30 Series

Engine Serial No.	CAE-895821
Total Engine Cycle	8376 Cycle

The aircraft had a valid C of R and C of A, and it had been maintained in compliance with the regulations. The maintenance records indicated that the aircraft was equipped and maintained in accordance with existing regulations and approved procedures.

1.7 Meteorological Information

The weather was fine when the accident happened. Nevertheless, the weather conditions on that day did not contribute to the occurrence of the event.

1.8 Aids to Navigation

Not applicable.

1.9 Communications

All communication frequencies were operating normally.

1.10 Aerodrome Information

There is no specific information regarding the aerodrome; however, the accident occurred on a designated landing site known as HLS 2. Given the presence of multiple helicopters and the associated operational hazards, the main contractor implemented a Safe Working Procedure (SWP) to ensure a secure and controlled working environment.

HLS 1, located at the Bentong Store, has limited capacity and is unsuitable for accommodating more than one helicopter at a time. Due to spatial constraints and the potential risk of collision, the SWP proposed an alternative site approximately 800 meters from HLS 1, which site then identified and designated as HLS 2 to facilitate the operation of additional helicopters. However, only 1 helicopter shall be allowed to take off and land at a time. No simultaneous activities allowed at HLS 2.

An aerial view illustrating the locations of HLS 1 and HLS 2 is provided in Figure 3 below.

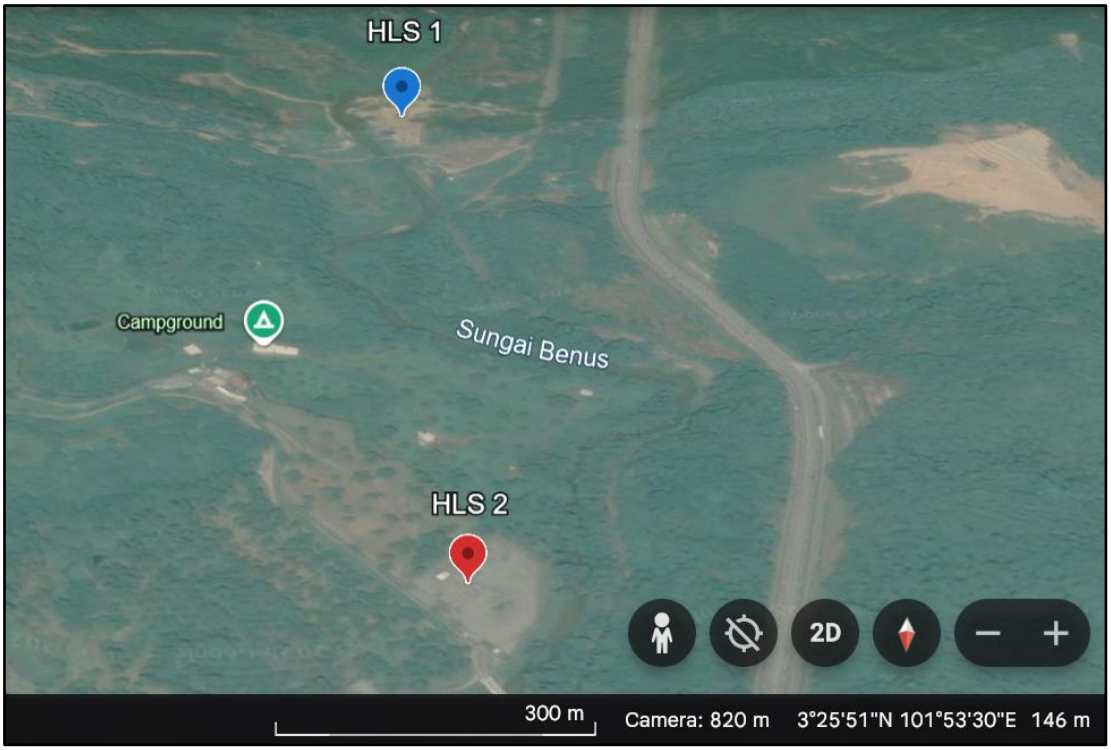


Figure 3: Location of HLS 1 and HLS 2
(Source: Google Earth)

1.11 Flight Recorders

The helicopter was not equipped with a Flight Data Recorder (FDR) or a Cockpit Voice Recorder (CVR). However, it was found that the helicopter was installed with a Garmin GTN 6xx series unit (refer to Figure 4), which includes a memory card that may contain stored data.

Figure 4: PK-ZUV Garmin GTN 6xx series unit

1.12 Wreckage and Impact Information

Figure 5 below provides a general description of the site, the helicopter wreckage location, the last location of the victim, and the location of the underslung cargo net. The ‘broken yellow line circle’ indicates the helicopter wreckage location, the ‘red X’ is the last location of the victim (deceased), and the ‘broken orange line circle’ illustrates the location of the underslung cargo net, which was released on the ground earlier on prior to refuelling.

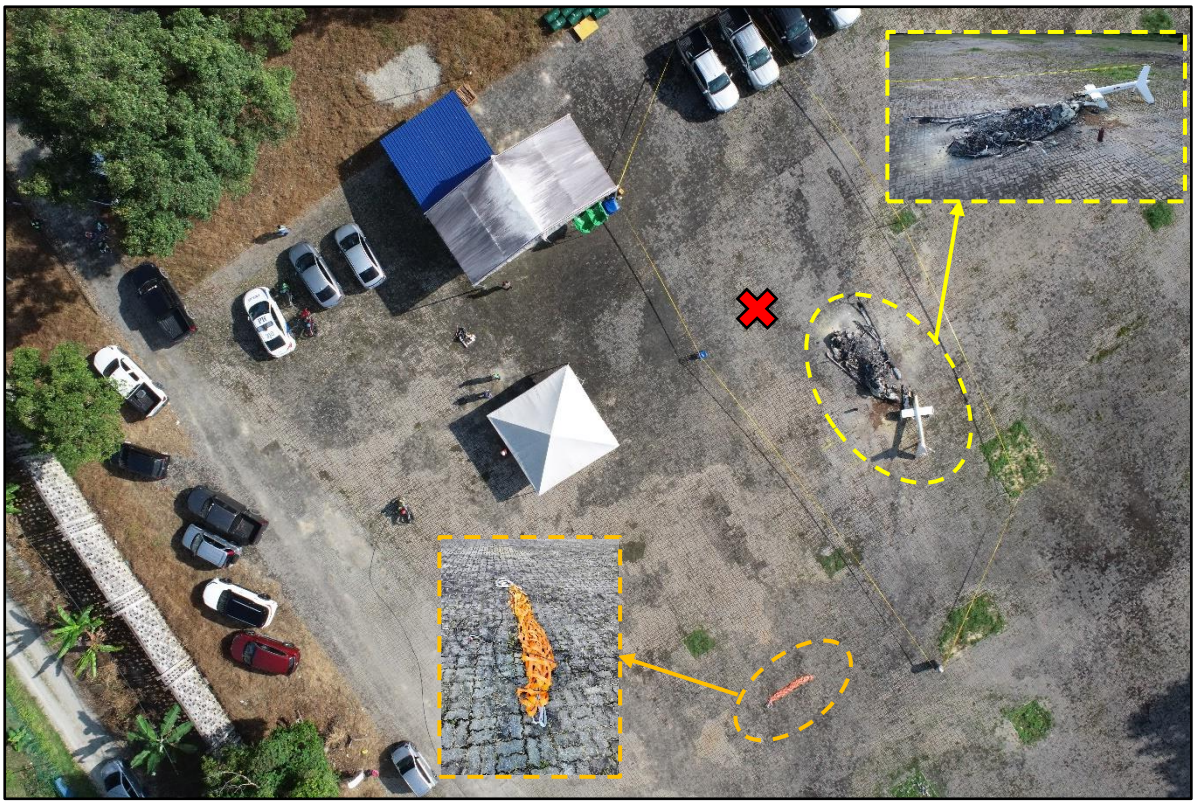


Figure 5: PK-ZUV general description map of the accident site and wreckage location

1.12.1 HLS 2 landing area surface conditions

Upon arriving at the accident site, the investigation team deployed a drone to capture aerial photographs and map the surrounding area. Equipped with a Pix4D mapping system, the drone documented the ground features and surface conditions of the HLS 2 area. The collected data were subsequently brought to the AAIB flight laboratory in STRIDE for detailed processing and analysis.

The processed data output provided a clearer understanding of the ground features and surface conditions in the HLS 2 area. It included valuable information such as ground contours, slope profiles with vertical gradients, and precise measurements of those gradients (refer to Figure 6).

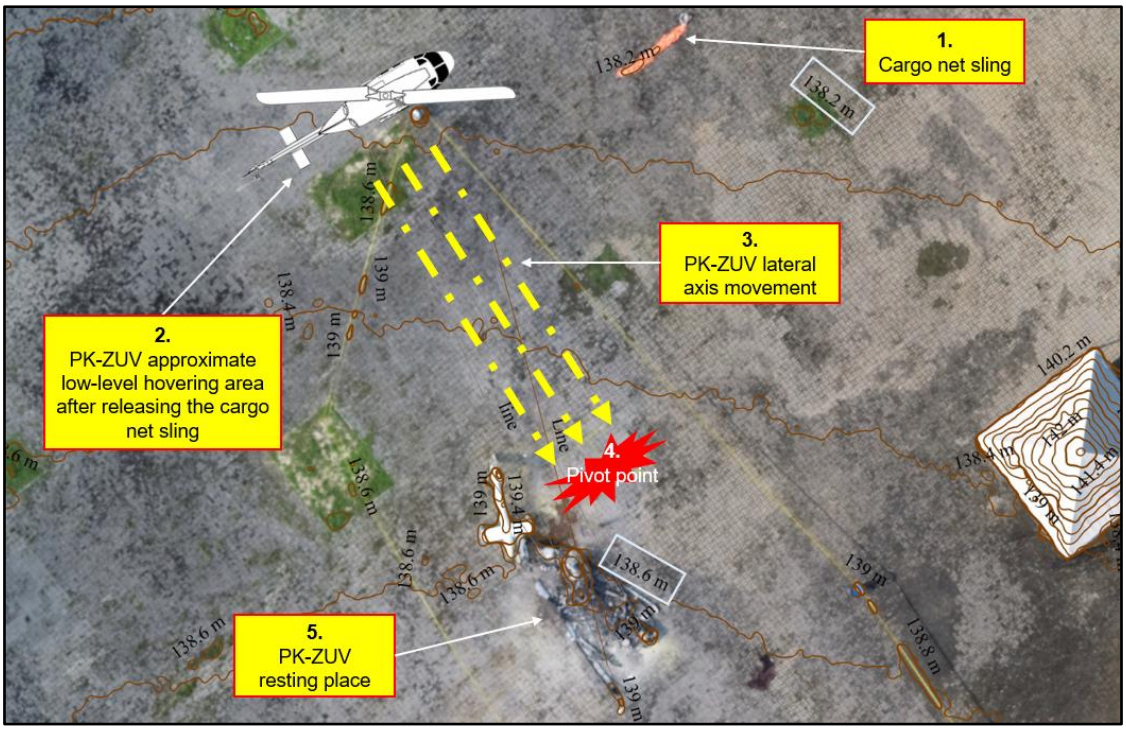


Figure 6: Chronology of events in relation to the ground features and surface conditions of the HLS 2 area

Prior to landing, PK-ZUV released the cargo net sling and entered a low-level hover over ground contour 138.2 meters. Upon realising the distance from the intended reference point (drum barrel located at ground contour 138.6 meters), the pilot initiated a low-level lateral manoeuvre to the right in an attempt to reposition the helicopter closer. During this manoeuvre, excessive control input caused the helicopter's right skid to strike the ground, resulting in a loss of control. The helicopter subsequently toppled and caught fire.

1.13 Medical and Pathological Information

The pilot underwent a urine drug panel screen, and the results were negative for substance abuse. Where else for the blood alcohol screening, the result was negative.

1.14 Fire

The helicopter was destroyed by a post-impact fire. The origin of the fire and the source of ignition remain undetermined.

1.15 Survival Aspects

On the day of the accident, while the helicopter was attempting to land for the purpose of refuelling, the pilot lost control of the aircraft. As a result, the helicopter overturned and immediately caught fire.

At the time, the engineer was waiting in proximity to the fuel drums. During the helicopter's overturn, the main rotor blade struck the engineer, causing a fatal injury.

At the site, two fuel drums had been positioned in preparation for refuelling operations. The fire caused one of the fuel drums to ignite, while the other was successfully moved away from the fire zone, preventing further escalation. The post-accident fire was extinguished using the fire extinguisher available at the facility.

The pilot survived the crash, sustaining only minor injuries. He was transported to the hospital for further medical treatment.

1.16 Tests and Research

The Garmin GTN 6xx series unit was sent to the Science and Technology Research Institute for Defence (STRIDE) in Kajang for analysis, specifically to retrieve the memory card located on the side of the unit. However, due to the unit’s severely burned and distorted condition, it was necessary to dismantle the device to remove the circuit board from the casing and extract the memory card.

The unit was dismantled to access the internal components and retrieve the memory card. Once the casing was opened, the circuit board was fully removed, allowing for the extraction of the memory card. However, upon inspection, the memory card showed visible signs of burning and damage, rendering data extraction impossible (refer to Figure 7).

Figure 7: Retrieval of the Garmin GTN 6xx series unit memory card accessible

Picture 1: The unit is dismantled to access the circuit board and retrieve the memory card.

Picture 2: The circuit board is fully removed from the casing.

Picture 3: The memory card is extracted from the circuit board.

Picture 4: The memory card shows signs of burning and damage, making data extraction impossible.

1.17 Organisational and Management Information

1.17.1 The Lessee (MHS Aviation Berhad)

MHS Aviation Berhad (the Lessee) is a Malaysia-based aviation company specialising in air transportation services for major oil and gas companies. Its core operations include providing helicopter services for private charters, search and rescue missions, emergency medical services, as well as training, engineering, and technical support.

The Lessee has been appointed by Trenergy Infrastructure Sdn. Bhd. - a contractor engaged by Tenaga Nasional Berhad (TNB) - to conduct external helicopter operations for TNB's transmission tower construction project (OHL 275kV/500kV from Point Z to Point M). As part of its responsibilities, the Lessee oversees and monitors flight operations to ensure compliance with its commercial requirements.

For this project, the Lessee has engaged two additional companies, PT Zaveryna Utama and Nomad Aviation PTE. Limited, under wet-lease agreements. As the appointed contractor, the Lessee is required to comply with the protocols set by Trenergy Infrastructure Sdn. Bhd., particularly the Safety Working Procedure (SWP) for Underslung Multiple Helicopter Operations and Hot Refuelling, which outlined the procedure for multiple underslung helicopter operations, hot refuelling and to determine the safety measures.

1.17.2 The Lessor (PT. Zaveryna Utama – Aircraft Operator)

PT. Zaveryna Utama (the Lessor) is an Indonesia-based helicopter service company which had entered into an agreement with the Lessee for the provision of a Bell 206L4 (PK-ZUV) helicopter to provide external load lifting services for the construction of transmission towers for TNB. Being the Lessor, PT. Zaveryna Utama shall:

i) ensure the aircraft's flight monitoring system is operational during the term of the agreement and provide Lessee with login provisions to allow Lessee to track the movements of the aircraft;

ii) maintain sufficient insurance of the aircraft to cover aircraft hull and liability, hull war risk, passenger injury, and third-party liability;

iii) at all times during the operation period, provide Lessee with the latest aircraft journey log at the end of the day when the aircraft is utilised for this project;

iv) at all times have operational control over the aircraft.

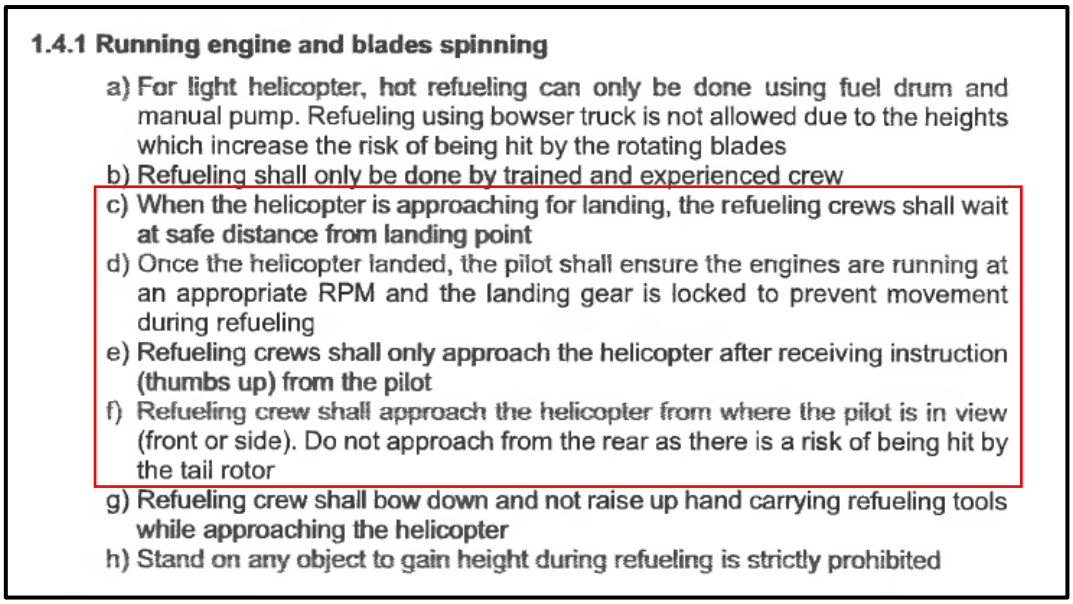
1.18 Additional Information

1.18.1 Helicopter Hot Refuelling

Throughout this project, the helicopter operators are allowed to perform hot refuelling during the operation. Hot refuelling is the process of refuelling a helicopter while the engine is running and the rotor is rotating. The Bell 206L4 light helicopter requires hot refuelling due to operational demands and time-sensitive constraints.

This procedure inherently carries risks due to the presence of running engines, spinning rotors, and flammable fuel, making strict safety protocols essential. In light of these risks, Trenergy Infrastructure Sdn. Bhd. has issued a SWP (refer to Figure 8) to the Lessee to ensure the safety of the refueler, the helicopter, and the surrounding environment while performing their tasks during hot refuelling.

As previously mentioned, part of the agreement requires the Lessee to oversee and monitor flight operations to ensure compliance with its commercial requirements. Therefore, it is their responsibility to ensure that the companies engaged under their contract adhere to these obligations.



1.4.1 Running engine and blades spinning

a) For light helicopter, hot refueling can only be done using fuel drum and manual pump. Refueling using bowser truck is not allowed due to the heights which increase the risk of being hit by the rotating blades
b) Refueling shall only be done by trained and experienced crew
c) When the helicopter is approaching for landing, the refueling crews shall wait at safe distance from landing point
d) Once the helicopter landed, the pilot shall ensure the engines are running at an appropriate RPM and the landing gear is locked to prevent movement during refueling
e) Refueling crews shall only approach the helicopter after receiving instruction (thumbs up) from the pilot
f) Refueling crew shall approach the helicopter from where the pilot is in view (front or side). Do not approach from the rear as there is a risk of being hit by the tail rotor
g) Refueling crew shall bow down and not raise up hand carrying refueling tools while approaching the helicopter
h) Stand on any object to gain height during refueling is strictly prohibited

Figure 8: Safety Working Procedure: Hot Refuelling

Based on video footage of PK-ZUV conducting hot refuelling a day before the accident (refer to Figure 9), it was observed that the crew from the Lessor did not adhere to the

prescribed SWP for hot refuelling. Such non-compliance poses a potential risk and could lead to unsafe conditions.

Figure 9: PK-ZUV hot refuelling a day before

Figure 8, Paragraph 1.4.1 (c), (e), and (f) clearly define the SWP for conducting hot refuelling. However, as observed in Figure 9, the aircraft operator or the Lessor failed to adhere to these procedures.

The unsafe actions of both the pilot and the ground engineer introduced potential hazards. The helicopter was hovering with its rotor blades still running while moving closer to the ground engineer, who was positioned directly beneath the main rotor disc. This is a direct violation of paragraph 1.4.1 (c), which mandates that crew members must wait at a safe distance from the landing point.

Additionally, Paragraph 1.4.1 (e) states that the refuelling crew should only approach the helicopter after receiving a clear instruction (thumbs-up) from the pilot. However, as shown in Figure 9, the crew is already positioned beneath the helicopter while it is still hovering and approaching for landing, indicating a clear violation of this procedure.

When the Lessor fails to comply with safety regulations, it is the Lessee's responsibility to oversee and monitor operations to ensure adherence to established requirements. In this case, the absence of a Safety Officer from the Lessee at HLS 2 to supervise

the hot refuelling process contributed to crew complacency, further increasing operational risks.

1.19 Useful or Effective Investigation Techniques

The investigation team deployed a drone to capture aerial imagery, offering a bird's-eye view and improved perspective of the crash site. The images collected were later processed using Pix4Dmapper software to generate a detailed surface contour map of the area. This allowed investigators to identify and analyse the ground gradient present at the crash site.

2.0 ANALYSIS

This report presents a human factors analysis of the PK-ZUV helicopter accident using the Dirty Dozen framework, a tool developed to identify 12 common human errors or conditions that contribute to aviation incidents and accidents. The purpose of this analysis is to highlight contributing factors, identify root causes, and propose preventative measures to improve operational safety and reduce human error in future operations.

2.1 Dirty Dozen Human Factors Analysis

2.1.1 Lack of Communication

The absence of verbal or visual confirmation between the pilot and ground engineer prior to the lateral repositioning manoeuvre led to a lack of shared situational awareness. This communication failure resulted in the helicopter manoeuvring in close proximity to the engineer, who was positioned within the reach of the main rotor blades without receiving a clear clearance signal.

2.1.2 Complacency

Repeated successful operations in the same area likely led to a relaxed attitude toward safety protocols. This is evidenced by video footage from the previous day showing identical non-compliance with hot refuelling procedures, suggesting the crew underestimated the risks of the landing environment.

2.1.3 Lack of Knowledge

The pilot’s execution of a low-level lateral hover over a ground contour varying from 138.2m to 138.6m indicates an insufficient technical awareness of dynamic rollover risks on sloped terrain. This lack of specific terrain-induced risk knowledge contributed to the excessive control inputs used during the attempted recovery.

2.1.4 Distraction

The complexity of the landing site, including the proximity of fuel drums, the presence of the engineer, and the ground gradient likely divided the pilot's attention during the critical repositioning phase. This distraction reduced the pilot's ability to focus on precise flight control management.

2.1.5 Lack of Teamwork

The unsafe proximity of the engineer to the hovering helicopter demonstrates a breakdown in site coordination. Ineffective Crew Resource Management (CRM) meant that neither the pilot nor the ground crew acted as a "second set of eyes" to prevent the hazardous positioning.

2.1.6 Fatigue

While the pilot was medically fit and had more than 8 hours of rest, fatigue is not considered a contributing factor in this occurrence.

2.1.7 Lack of Resources

The absence of a designated Safety Officer at HLS 2 meant there was no authoritative figure to monitor ground operations or enforce the Safe Working Procedure (SWP). This lack of supervisory resources allowed unsafe behaviours to persist unchecked.

2.1.8 Pressure

The operational requirement for hot refuelling to meet project deadlines likely imposed a subtle pressure on the crew to expedite the landing and refuelling process. This perceived need for efficiency may have led to the decision to manoeuvre the aircraft while the engineer was already in a hazardous position.

2.1.9 Lack of Assertiveness

Despite being in an unsafe position directly beneath the rotor disc, the ground engineer did not signal the pilot to delay or abort the approach. This lack of assertiveness

prevented the correction of a dangerous situation before it escalated into a fatal accident

2.1.10 Stress

Attempting a low-level lateral repositioning manoeuvre on uneven ground likely increased the pilot's cognitive load and stress. This elevated stress level contributed to the abrupt and excessive control inputs made when the right skid made contact with the ground.

2.1.11 Lack of Awareness

The pilot failed to recognise the dynamic rollover potential of the unmapped ground gradient at HLS 2. This failure to maintain situational awareness regarding both the terrain and the engineer’s fatal proximity led to the loss of control.

2.1.12 Norms

The repeated violation of hot refuelling procedures observed in previous flights indicates a "normalisation of deviance". Bypassing the mandated "thumbs-up" signal and safe distance requirements had become the standard operational norm, directly leading to the fatal outcome when a flight control error occurred.

2.2 Analysis of Helicopter Hot Refuelling Operations

The investigation into the operational environment at HLS 2 reveals a significant misalignment between established safety protocols and the actual practices conducted by the flight and ground crew. Hot refuelling, defined as the intake of fuel while the engine is running and the rotors are turning, was a routine requirement for the Bell 206L4 due to high-cycle aerial work demands and strict time-sensitive constraints. While this procedure is inherently high-risk, the governing SWP issued by Trenergy Infrastructure Sdn. Bhd. provided clear mitigation strategies to ensure the safety of personnel and the aircraft. Specifically, paragraph 1.4.1 of the SWP mandated that refuelling crews must maintain a safe distance from the landing point during the approach and are strictly prohibited from approaching the helicopter until the pilot provides a clear "thumbs-up" signal.

However, a comparison between these mandates and factual evidence obtained from video footage recorded one day prior to the accident identifies a critical safety gap.

The footage shows the ground engineer and fuel drums positioned directly beneath the active main rotor disc while the helicopter was still in a hover and attempting to land. This behaviour constitutes a direct violation of the SWP's requirement for crews to remain at a safe distance and approach only after receiving explicit pilot instruction. These unsafe actions introduced potential hazards into the operational environment, effectively bypassing the defensive layers intended to prevent rotor strikes.

Furthermore, the persistence of these deviations suggests a failure in organisational oversight. As the entity responsible for monitoring flight operations and ensuring commercial compliance, the Lessee failed to provide independent safety supervision at HLS 2. The absence of a designated Safety Officer allowed the "normalisation of deviance" to take root, as the crew repeatedly performed non-compliant manoeuvres without intervention or correction. Consequently, the lack of authoritative supervision at the site significantly increased operational risks, directly contributing to the crew's complacency during the fatal flight.

3.0 CONCLUSION

3.1 Findings

3.1.1 Pilot

i) The pilot was qualified and approved to perform the flight in accordance with existing regulations.

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

iii) Results for the urine drug panel screen test were negative for substance abuse, and the blood alcohol screening test was negative.

iv) The pilot underestimated the dynamic risks associated with performing a lateral hover manoeuvre over an unrecognised ground gradient terrain.

v) The pilot had a prior accident in 2019 involving the same type of helicopter.

3.1.2 Aircraft

i) The helicopter was equipped and maintained in accordance with existing regulations and approved procedures.

ii) The helicopter had a valid C of A and had been maintained in compliance with the regulations.

iii) The maintenance records indicated that the helicopter is equipped and maintained in accordance with existing regulations and approved procedures.

iv) The helicopter was not equipped with an FDR or a CVR.

v) The helicopter was destroyed by post-impact fire; however, the tail boom section of the helicopter remained intact.

3.1.3 The Engineer

i) The ground engineer was qualified and authorised to conduct the ground duties in accordance with existing regulations.

ii) The engineer was standing right behind the drum barrels within the main rotor blades' reach (unsafe distance) when the helicopter approached.

iii) The engineer instantly succumbed to the injury on the head due to the hit from the main rotor blades.

3.1.4 HLS 2 landing area

i) The landing area featured an unrecognised slope profile with vertical gradients, which had not been accounted for during the operation.

3.1.5 The Lessee

i) The Lessee was appointed by Trenergy Infrastructure Sdn. Bhd. to conduct external helicopter operations for TNB’s transmission tower construction project.

ii) Responsible for overseeing and monitoring flight operations to ensure compliance with its commercial requirements.

iii) Having 2 HLSs to facilitate the operation of additional helicopters.

iv) There was an absence of a Safety Officer from the Lessee at HLS 2 to supervise the hot refuelling activities.

3.1.6 The Lessor

i) Entered an agreement with the Lessee for the provision of a Bell 206L4 (PK-ZUV) helicopter for the construction of transmission towers for TNB.

ii) The crew did not adhere to the prescribed SWP for hot refuelling.

3.2 Cause/Contributing Factors

3.2.1 Primary Cause - The cause of the accident is due to the pilot's excessive and abrupt input on the flight controls to fix the situation after the right skid struck the ground during the lateral repositioning, which subsequently led to a dynamic rollover and the post-impact fire. The accident is categorised as **Abnormal Runway Contact (ARC)[2].**

3.2.2 Contributing Factors - One of the key contributing factors to the accident was the lack of adequate supervision at HLS 2. At the time of the operation, no Safety Officer was present to oversee flight and ground activities. The absence of direct supervision meant that there was no authoritative figure to enforce compliance with standard operating procedures, monitor crew behaviour, or intervene when unsafe practices were observed.

Additionally, there were repeated breaches of the SWP for hot refuelling. Despite the inherent risks associated with conducting refuelling operations with rotors running, video evidence from the day before the accident showed clear deviations from the prescribed safety protocols. These included the presence of ground personnel beneath the main rotor disc during landing and the premature approach of crew members before receiving clearance from the pilot.

[2] ***ARC: Abnormal Runway Contact*** – Any landing or take off involving abnormal runway or landing surface contact.

The accident also revealed shortcomings in crew coordination and communication. The actions of both the pilot and the ground engineer indicated a lack of shared situational awareness and ineffective use of standard communication cues, particularly during critical phases of the operation, such as landing and repositioning for refuelling.

Finally, the continued non-compliance with safety procedures over multiple operations suggests a normalisation of deviance. Over time, repeated exposure to risk without incident may have led the crew to perceive such behaviour as acceptable, thereby eroding the safety culture and increasing the likelihood of an accident.

4.0 SAFETY RECOMMENDATIONS

4.1 Immediate Safety Actions of the Preliminary Report

4.1.1 The Preliminary Report for this accident issued on 06 March 2025 contained the following recommendation for immediate safety actions to the Lessee:

"The Lessee shall ensure that a Safety Officer is present to oversee and monitor flight operations to ensure compliance with commercial requirements whenever activities are conducted at the site."

In line with the proposed immediate safety actions, no feedback has been received from the Lessee regarding this matter. Therefore, the proposed safety action remains in effect.

4.1.2 The Preliminary Report for this accident issued on 06 March 2025 contained the following recommendation for immediate safety actions to the Lessor (aircraft operator):

"The Lessor shall facilitate for the pilot to undergo a comprehensive mental and physical health evaluation with an aviation medical professional to ensure fitness for resuming flying duties."

In response to the proposed immediate safety actions, the Lessor arranged for the pilot to undergo a comprehensive mental and physical health evaluation by an aviation medical professional. The evaluation has been completed, and the results, along with the corresponding recommendations, have been received.

"The Lessor shall update the Company's Maintenance Manual (CMM) and Operations Manual – A to explicitly define the safe distance required for the ground crew during helicopter approaches for landing during hot refuelling."

In line with the proposed immediate safety actions, no feedback has been received from the Lessor regarding this matter. Therefore, the proposed safety action remains in effect.

4.2 Safety Recommendations of this Report

The Safety Recommendations to the respective organisations to address the safety concerns identified in this investigation are as follows:

4.2.1 The Lessee

4.2.1.1 To enhance its site oversight mechanisms at remote Helicopter Landing Sites (HLS) to ensure that independent safety supervision is consistently present during high-risk ground and flight activities.

4.2.1.2 To establish a robust monitoring and audit process to ensure that all contracted operators strictly comply with the project-specific Safe Working Procedures (SWP), particularly during underslung and hot refuelling operations.

4.2.2 The Lessor (Aircraft Operator)

4.2.2.1 To review and update its operational documentation to ensure that safety distances and ground crew positioning requirements during landing and refuelling are clearly defined and consistent with specific site hazards.

4.2.2.2 To incorporate training modules that address the specific risks of dynamic rollover, with particular focus on control management during manoeuvres over varied terrain.

4.2.2.3 To strengthen its Crew Resource Management (CRM) training to improve communication and assertiveness between pilots and ground crew, specifically for high-intensity aerial work environments.

4.2.2.4 To enhance its safety management systems to proactively identify and mitigate the "normalisation of deviance" regarding established safety protocols.

4.2.2.5 To consider terrain and slope evaluations during site planning for helicopter operations to mitigate rollover risks.

4.2.2.6 To implement and enhance a comprehensive Safety Awareness Program focusing on Human Factors and Fitness-for-Duty in ensuring that all personnel involved in high-risk aerial work and hot refuelling operations maintain peak physiological and psychological readiness to mitigate the risks of complacency and lack of situational awareness during critical mission phases.

4.2.2.7 To incorporate structured Threat and Error Management (TEM) training into its recurrent training program for pilots and ground crew, focusing on the identification of operational threats, management of human errors, and implementation of defensive strategies to prevent unsafe conditions during aerial work and hot refuelling operations.

5.0 COMMENTS TO THE REPORT AS REQUIRED BY ICAO ANNEX 13 PARAGRAPH 6.3

As required by ICAO Annex 13, paragraph 6.3, the draft Final Report was sent to the State of Occurrence (CAAM), State of Registry/Operator (NTSC) and State of Manufacture (TSB), inviting their significant and substantiated comments on the report. The following is the status of the comments received: -

States/Organisations	Status of Significant and Substantiated Comments
Civil Aviation Authority of Malaysia (CAAM)	Report received and no comments.
The National Transportation Safety Committee (NTSC)	Comments that are accepted have been amended accordingly in this report. Comments not agreed upon have been justified to the relevant States.
The Transportation Safety Board of Canada (TSB)	Report received and no comments.

CONCLUDING STATEMENT

This investigation has identified many instances of non-compliance and operational deficiencies. However, in accordance with ICAO Annex 13 principles, it must be emphasised that these findings are not intended to apportion blame or liability, but rather to facilitate the prevention of future accidents and enhance overall aviation safety. The adoption of the recommended safety measures will help address the identified shortcomings, strengthen the aviation safety framework, and mitigate risks associated with operational lapses and regulatory gaps. All stakeholders are urged to prioritise safety and collaborate in implementing the necessary measures to prevent recurrence.

Investigator-in-charge
AAIB
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