KOMITE NASIONAL KESELAMATAN TRANSPORTASI
REPUBLIC OF INDONESIA

FINAL

KNKT.18.04.10.04

Aircraft Accident Investigation Report

PT Whitesky Aviation

Helicopter Bell 429, PK-WSX

Morowali, Sulawesi Tengah

Republic of Indonesia

20 April 2018

2022

This Final Report was produced by the Komite Nasional Keselamatan Transportasi (KNKT), Transportation Building, 3rd Floor, Jalan Medan Merdeka Timur No. 5 Jakarta 10110, Indonesia.

The report is based upon the investigation carried out by the KNKT in accordance with Annex 13 to the Convention on International Civil Aviation, the Indonesian Aviation Act (UU No. 1/2009) and Government Regulation (PP No. 62/2013).

Readers are advised that the KNKT investigates for the sole purpose of enhancing aviation safety. Consequently, the KNKT reports are confined to matters of safety significance and may be misleading if used for any other purpose.

As the KNKT believes that safety information is of greatest value if it is passed on for the use of others, readers are encouraged to copy or reprint for further distribution, acknowledging the KNKT as the source.

When the KNKT makes recommendations as a result of its investigations or research, safety is its primary consideration.

However, the KNKT fully recognizes that the implementation of recommendations arising from its investigations will in some cases incur a cost to the industry.

Readers should note that the information in KNKT reports and recommendations is provided to promote aviation safety. In no case is it intended to imply blame or liability.

Jakarta, 7 January 2022

KOMITE NASIONAL
KESELAMATAN TRANSPORTASI
CHAIRMAN

SOERJANTO TJAHJONO

TABLE OF CONTENTS

TABLE OF FIGURES

ABBREVIATIONS AND DEFINITIONS

ADIU	:	Aircraft Data Interface Unit
ADM	:	Aeronautical Decision Making
ADMM	:	Aircraft Data Memory Module
ATPL/H	:	Airline Transport Pilot License for Helicopter
CAS	:	Crew Alerting System
CAM	:	Cockpit Area Microphone
C of A	:	Certificate of Airworthiness
C of R	:	Certificate of Registration
CVR	:	Cockpit Voice Recorder
CCTV	:	Closed-Circuit Television
CDU	:	Center Display Unit
DCU	:	Data Collection Unit
DU	:	Display Unit
ECU	:	Engine Control Unit
EDR	:	Electronic Data Recorders
EEC	:	Electronic Engine Control
EGPWS	:	Enhance Ground Proximity Warning System
FAA	:	Federal Aviation Administration
FMM	:	Fuel Management Module
FDR	:	Flight Data Recorder
HUMS	:	Health and Usage Monitoring Systems
IMIP	:	PT Indonesia Morowali Industrial Park
KNKT	:	Komite Nasional Keselamatan Transportasi is the independent investigation authority of Indonesia, also known as National Transportation Safety Committee.
LT	:	Local Time
MPFR	:	Multi-Purpose Flight Recorder
OEI	:	One Engine Inoperative
PLA	:	Power Lever Angle
PSI	:	Power Situation Indicator

SYNOPSIS

A Bell 429 helicopter, registered PK-WSX was being operated by PT. Whitesky Aviation, on Friday, 20 April 2018 to conducted unscheduled passenger flight chartered by PT. Indonesia Morowali Industrial Park (IMIP) Company in Sulawesi Tengah.

The flight was planned from IMIP helipad at Morowali in Sulawesi Tengah to Haluoleo Airport at Kendari, Sulawesi Tenggara. The helipad located in the IMIP industrial complex.

At 0925 LT (0125 UTC) the helicopter took off. On board in this flight were one pilot, one engineer and six passengers with total load approximately of 556 kilograms.

About one minute after take-off, at altitude approximately 600 feet, the pilot noticed one of the Engine Control Unit (ECU) failed. After the discussion of the failed ECU between the pilot and engineer, afterward the pilot decided to return to the helipad.

The pilot selected one of the throttles to manual and afterward the altitude and the speed decreased. The pilot attempted to recover by manipulating the collective, throttle and cyclic, however the altitude and speed could not be recovered.

Before reaching the helipad, the helicopter impacted to the ground on the IMIP factory access road approximately 175 meters from the IMIP helipad.

All occupants were survived. One of the IMIP employees who walked at the road was fatally injured.

The investigation concluded that the contributing factor of the accident was the lack of experience related to the handling of EEC failure and QRH reading might led to the failure of the pilot to identify the failure of the EEC, resulted in the main rotor (NR) RPM to drop below 95% which could not withstand the helicopter in the air.

The KNKT had been informed safety action taken by the PT. Whitesky Aviation and considered relevant to the accident. KNKT issues safety recommendation to the aircraft operator to address identified safety issues.

1 FACTUAL INFORMATION

1.1 History of the Flight

A Bell 429 helicopter, registered PK-WSX was being operated by PT Whitesky Aviation, on Friday, 20 April 2018 to conduct unscheduled passenger flight that was chartered by PT Indonesia Morowali Industrial Park (IMIP) Company in Sulawesi Tengah.

The flight was planned from IMIP helipad[1] at Morowali, Sulawesi Tengah with intended destination of Haluoleo Airport at Kendari, Sulawesi Tenggara. The helipad located in the IMIP industrial complex at coordinate 2° 49’ 21.43” S; 122° 09’ 58.98” E with elevation of 120 feet above sea level.

At 0125 UTC[2] (0925 LT) the helicopter took off. On board in this flight were one pilot, one engineer and six passengers with total load approximately of 556 kilograms. The engineer sat at the left cockpit seat.

About one minute after take-off, when the altitude approximately 600 feet, the pilot noticed that one of the Engine Control Unit (ECU) failed. The pilot decided to return to the IMIP helipad. The pilot selected one of the throttles to manual and afterward the altitude and the speed decreased.

The pilot asked the engineer to determine which engine had the ECU failure. About 20 seconds later, the engineer stated that the ECU of the engine 2 (right engine) had failed and was agreed by the pilot. The Flight Data Recorder (FDR) data showed that most of the time after the ECU failed occurred the right engine power lever angle was lower than the left engine.

Before reaching the IMIP helipad, the helicopter impacted to the ground on the IMIP factory access road approximately 175 meters from the IMIP helipad at coordinate 2° 49’ 15.94” S; 122° 9’ 57.78” E with elevation approximately 75 feet above sea level. One of the IMIP employees who walked at the factory access road was fatally injured as result of the impact with the helicopter.

1.2 Injuries to Persons

Injuries	Flight crew	Engineer	Passengers	Total in aircraft	Others
Fatal	–	–	–	–	1
Serious	1	1	2	4	–
Minor	–	–	4	4	–
None	–	–	–	–	NA
TOTAL	1	1	6	8	1

1 IMIP helipad at Morowali Sulawesi Tengah will be named as IMIP helipad for the purpose of this report.

2 The 24-hour clock used in this report to describe the time of day as specific events occurred is in Coordinated Universal Time (UTC). Local time that be used in this report is Waktu Indonesia Tengah (WITA) or Central Indonesia Standard Time which is UTC +8 hours.

The pilot and the engineer were Indonesian and all passengers were Chinese. The IMIP employee who fatally injured was Indonesian.

1.3 Damage to Aircraft

The aircraft was destroyed.

1.4 Other Damage

There was no other damage to property or the environment.

1.5 Personnel Information

Pilot in Command

Gender	:	Male
Age	:	43 years old
Nationality	:	Indonesian
Marital status	:	Married
Date of joining company	:	2 October 2012
License	:	ATPL/H
Date of issue	:	5 November 2010
Aircraft type rating	:	Bell 429, Bell 407, BO 105
Medical certificate	:	First class
Last of medical	:	23 November 2017
Validity	:	23 May 2018
Medical limitation	:	None
Last line check	:	26 November 2017
Last proficiency check	:	23 December 2017

Flying experience

Total hours	:	4296.5 hours
Total on type	:	615.1 hours
Last 90 days	:	44.8 hours
Last 30 days	:	27.4 hours
Last 24 hours	:	1.2 hours
This flight	:	9 minutes

The last proficiency check that was conducted on 23 December 2017 was highlighted the emergency procedure including the single engine exercise.

The operator syllabus of pilot ground class training was consisted of four programs named as ‘Flight Period’. The EEC problem was included in the ‘Flight Period Three’ as stipulated in the operator training manual. The investigation revealed that the training of ECU failure has not been introduced to the pilot in the simulator training. The pilot had not experienced EEC problem previously during the flight.

1.6 Aircraft Information

1.6.1 General

Registration mark	:	PK-WSX
Manufacturer	:	Bell Helicopter Textron
Country of manufacturer	:	Canada
Type/Model	:	Bell 429
Serial Number	:	57186
Year of manufacture	:	2014
Certificate of Airworthiness		
Issued	:	2 February 2018
Validity	:	1 February 2019
Category	:	Normal
Limitations	:	None
Certificate of Registration		
Number	:	3612
Issued	:	2 February 2017
Validity	:	1 February 2020
Time Since New	:	307.3 hours
Cycles Since New	:	628 cycles
Last Major Check	:	4 Years Inspection (5 January 2018)
Last Minor Check	:	CCI 100 hours / 90 days (3 February 2018)

The aircraft flight and maintenance logbook did not record any report of helicopter system abnormality before the accident.

1.6.2 Engines

Manufacturer	:	Pratt & Whitney Canada
Type/Model	:	PW 207D1
Serial Number-1 engine	:	PCE-BL0377
▪ Time Since New	:	307.3 hours
▪ Cycles Since New	:	565 cycles
Serial Number-2 engine	:	PCE-BL0384
▪ Time Since New	:	307.3 hours
▪ Cycles Since New	:	565 cycles

1.6.3 Engine Mechanical Control

The collective control enabled the pilot to control the engine power. The collective also equipped with the twist grip to control the engine throttle.

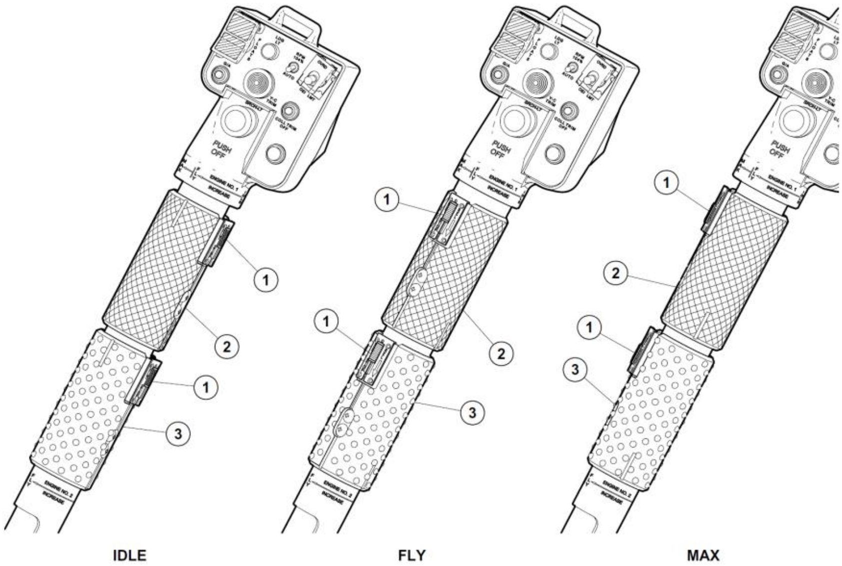


Figure 1: The collective control and the several throttle twist grip position

Note to the figure 1:

1. Grip lock button
2. Throttle twist grip engine 1
3. Throttle twist grip engine 2

The throttle twist grip equipped with a grip lock button which enable the pilot to lock the throttle in the FLY detent.

When the pilot slides the grips lock button downward, the throttle twist grip will be released from its detent enabling the pilot to rotate the throttle twist grip to control the engine manually.

The override switch enables the pilot to override the NG limit during emergency.

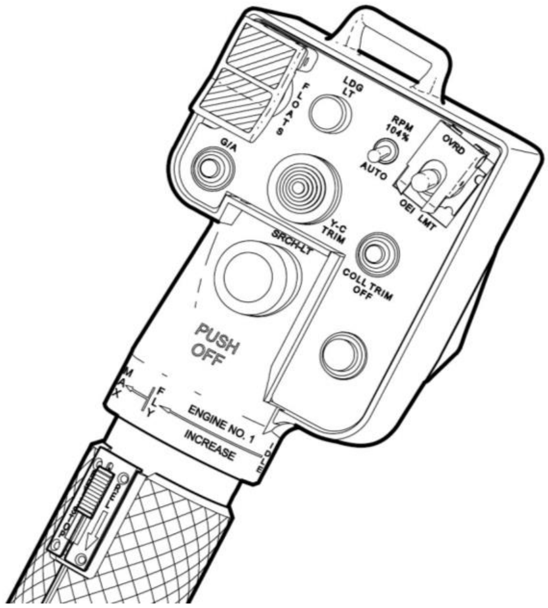


Figure 2: The view of the grip lock button

1.6.4 The Engine Fuel Control

Each engine PW 207D1 was equipped with Electronic Engine Control (EEC). Most of the technical manuals use the nomenclature of Electronic Engine Control (EEC). The Flight Manuals uses the nomenclature of Engine Control Unit (ECU) for the same component. Both ECU and EEC used in this report referring to the same component.

The EEC in conjunction with Fuel Management Module (FMM) uses inputs from both of the helicopter and the engines sensors to modulate the engine power by metering the fuel flow in response to the load demanded by the collective activity and the main rotor of the helicopter. The FMM is located within of the EEC unit. The FMM connected to the throttle twist grip on the collective via a control cable to the Power Lever Angle (PLA) gearbox.

The EEC and FMM metered the fuel into the engine in the automatic (AUTO) mode or in manual (MAN) mode based on the selection of the AUTO/MAN push button in the cockpit glareshield. When the EEC fails during the helicopter operation, the metering fuel into the engine automatically reverts to manual if AUTO/MAN push button is selected in AUTO. The FMM failure also results in the fuel management within the EEC unable to provide the fuel demand automatically.

The engine starting and run is initiated by selecting the ‘RUN’ and ‘START’ switch on the glareshield panel as shown in the figure below.

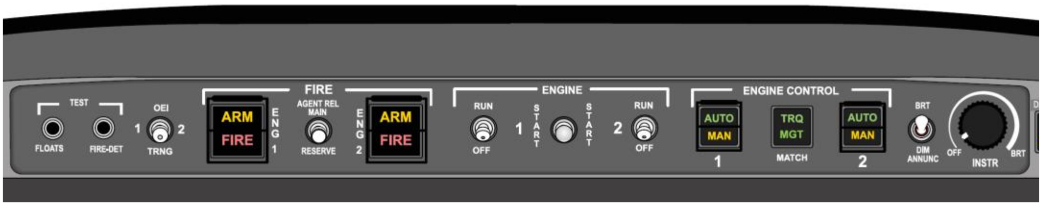


Figure 3: The glareshield panel

The NORMAL checklist (see figure 4 below), requires the ENGINE CONTROL 1 and 2 to be selected to AUTO before the engine start. The AUTO annunciator light will illuminate indicated that the EEC system was ready to engage the engine fuel control in the automatic mode. Normally, the throttle twist grip (on the collective) is placed in the IDLE position during the engine start sequence. The position of IDLE detent angle is between 10° and 12.5° of the throttle twist grip.

TC APPROVED BHT-429-FM-1

Electrical BUS INTCON — OVRD ON.

NOTE

Following warning/caution and advisory lights/messages should be illuminated.

ENG OUT 1

ENG OUT 2

Left:

FUEL 1 PRESS

ENG 1 OIL PRESS

AP 1

HYD 1 PRESS

FUEL 1 CLOSED

Center:

DUAL GEN

XMSN OIL PRESS

INTCON OVRD ON

Right:

FUEL 2 PRESS

ENG 2 OIL PRESS

AP 2

HYD 2 PRESS

FUEL 2 CLOSED

FUEL 1 and 2 COLD (if fuel heater kit installed) — Helicopter cold soaked in low ambient temperature.

FUEL 1 and 2 HOT (if fuel heater kit installed) — Helicopter heat soaked in high ambient temperature.

EXT PWR ON (when external power connected and powered).

17. Instrument panel — Set as follows:

a. RPM light (between ENG OUT 1 and 2) — Push and hold for 4 seconds to test audio tones and messages.

b. WARNING/CAUTION — Acknowledge (push to reset).

c. Standby attitude indicator — Cage.

d. Garmin 430W — As required.

e. Garmin 530W (if installed) — As required.

f. ELT pushbutton annunciator illuminated (if installed) — ELT ARM.

g. Audio control panel — ON, selection as required.

h. INSTR rheostat — As required.

i. BRT/DIM ANNUNC — As required.

j. ENGINE CONTROL 1 and 2 — AUTO.

k. ENGINE MATCH — As required.

l. FIRE AGENT REL — Centered.

m. FIRE ENG 1 and 2 — Cycle ARM and back.

n. OEI TRNG — Centered.

o. TEST FIRE DET — Press. Verify both engine FIRE and WARNING lights illuminated along with audio tone.

p. WARNING/CAUTION — Acknowledge (push to reset).

18. Throttles 1 and 2 check as follows:

a. Rotate individually to fly, check for smooth operation.

b. FLY STOP REL — Disengage.

c. Rotate individually to MAX, check for smooth operation.

d. Rotate both back to IDLE, verify FLY STOP REL has re-engaged.

Export Classification C, ECCN 9E991 15 DEC 2015 Rev. 10 2-9

Figure 4: The NORMAL checklist related to the ENGINE CONTROL selection.

The automatic fuel management by the EEC occurs when the AUTO mode had been selected and the throttle twist grip is engaged in the FLY detent (55° ± 2.5°).

The pilot should place the throttle twist grip in the FLY detent and remain in this position during the flight so that the EEC will command the FMM to control metered fuel flow over the entire operational range of the engine. The activation of AUTO mode will be indicated by the illumination of AUTO on the AUTO/MAN push button on the ENGINE CONTROL 1 and 2. When the AUTO mode has been engaged, the illumination of AUTO will not change even though the throttle twist grip is selected out of the FLY detent, and the fuel management by the EEC has no longer controlled automatically.

During the AUTO mode, the EEC automatically commanded the FMM to control the engine gas generator (NG) RPM, power turbine (NP) RPM and main rotor (NR)

RPM with taking the consideration of engine sensors, cockpit switch selections, ambient conditions and the collective position to set the required fuel into the engine.

In this auto mode, the pilot controls the helicopter power by managing the collective while the EEC will automatically manage the fuel required by the engine to maintain the NG RPM so that the NP RPM maintain within the limits and the NR RPM > 95%. In this case, the engine fuel control operates the engine in the NP RPM governing loop in which the fuel will be metered automatically by the EEC in response to the load demanding by the collective position and NR RPM. The throttle twist grip may be moved away from the FLY detent during the automatic mode, without changing the state of the engine fuel control mode.

When the EEC fails or the pilot depresses the AUTO/MAN push button switch in cockpit glareshield from AUTO to MAN, the engine fuel control reverts to manual mode in which the EEC no longer automatically commanded the FMM to meter the fuel into the engine. In the manual mode, the engine fuel control system reverts from the NP governing loop to the NG governing loop which means that the load demanding by the collective position and NR RPM will not be automatically compensated by the EEC. In this case the pilot should manage the fuel demand in response of collective position and NR RPM and by rotating throttle twist grip manually. In addition, the pilot should carefully monitor the Power Situation Indicator (PSI) and the affected engine parameter to avoid engine over limit.

Figure 5: The Bell 429 helicopter instrument panel

In the manual mode, pulling the collective upward will increase the power but also decreasing the NP and NG RPM. The throttle twist grip shall be rotated to increase the NP RPM to compensate the load demand and to maintain the NR RPM above 95%. Further pulling the collective, requires the pilot to increase the NG RPM but it will also lead the NG RPM to increase, close to its limit. The pilot may override the NG RPM limit by activating the OVRD switch on the collective (see figure 2) but on further pulling of the collective after the engine reached the NG RPM limit, will cause the NR RPM to droop.

The EEC failure is indicated on the Crew Alerting System (CAS) by the message of ‘ECU # FAIL’ (the ‘#’ represents the number of the respective EEC failure) and the ‘MANUAL’ message displays below the digital readout of engine parameters of the respective engine. In the same time, the Power Situation Indicator (PSI) needle of affected engine turns color to cyan.

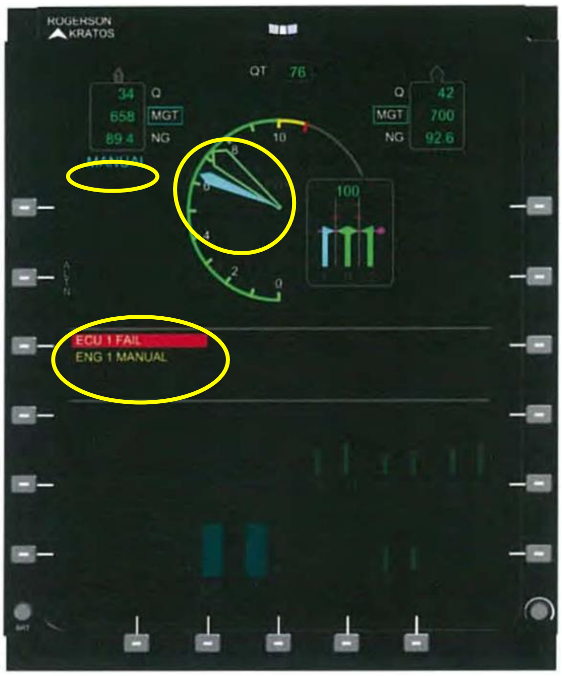


Figure 6: The indication of failure EEC or ECU of engine 1

The Quick Reference Handbook (QRH) provides the procedure to the pilot for flying in MANAUL mode when one of the EEC fails. The procedure stated that, the PSI needle of the affected engine shall be maintained slightly below PSI needle of the normal engine (two to three needles width split).

Either during auto or manual mode and the throttles are being manipulated manually, the CAS will display a message THROTTLE '#' below the digital readout of engine parameters of the respective engine as shown on the following figure.

Figure 7: The CAS display when the throttles are being manipulated manually

The EEC is connected to a Data Collection Unit (DCU) for engine data recording purposes. Each EEC and DCU on each engine are cross-communicate to the EEC and DCU of the other engine. The DCU had the capability to record the engine itself and the neighbor engine. If EEC or DCU of one engine fails, the DCU of both engines will record the event or fault and stored in the DCU memory.

1.6.5 Transmission Assembly

Manufacturer : Bell Helicopter Textron

Part number : 429-040-006-121

Serial Number : TN102

- Time Since New : 307.3 hours
- TBO : 5,000 hours

Manufacturer : Bell Helicopter Textron

Part number : 429-040-006-121

Serial Number : TN102

1.6.6 Main Rotor

Manufacturer : Bell Helicopter Textron

Part number : 429-015-100-135

Rotor Blade 1

- S/N : BH-48773
- Installed : 10 January 2014
- Time Since New : 307.3 hours

Rotor Blade 2

- S/N : BH-108467
- Installed : 10 January 2014
- Time Since New : 307.3 hours

Rotor Blade 3

- S/N : BH-114219
- Installed : 10 January 2014
- Time Since New : 307.3 hours

Rotor Blade 4

- S/N : BH-118275
- Installed : 10 January 2014
- Time Since New : 307.3 hours

The main rotor rotation (NR RPM) is monitored and presented to the pilot by mean of RPM annunciator light in the cockpit as shown in the figure below.

Figure 8: The RPM annunciator light

To maintain the helicopter on the air, the NR RPM should be maintained above 95%. The NR RPM annunciator light is controlled by an output from the Aircraft Data Interface Unit (ADIU) and comes on when the ADIU senses the NR RPM is between 20% and 95% or between 107% and 127%.

When the NR RPM is between 80% and 95% or between 107% and 127%, a continuous aural tone warning will appear (on frequency between 400 and 1,800 Hz) which is also supplied from the ADIU through the audio system to the pilot and copilot headsets. The aural tone warning is intended to draw the pilot attention that the helicopter is in critical situation to maintain on the air. If the NR RPM is between 80% and 95%, the aural tone warning can be cancelled by pressing the RPM annunciator light. Further decreasing NR RPM below 68%, the RPM annunciator light will remain on and the aural tone warning will be deactivated.

1.6.7 Tail Rotor Gearbox Assembly

Manufacturer : Bell Helicopter Textron

Part number : 429-042-001-101

- S/N : BH092359
- Installed : 10 January 2014
- Time Since New : 307.3 hours
- TBO : 5,000 hours

1.6.8 Tail Rotor

Manufacturer : Bell Helicopter Textron

Part number : 429-016-101-105

Tail Rotor Blade 1

- S/N : BH088595
- Installed 10 January 2014

- Time Since New 307.3 hours

Tail Rotor Blade 2

- S/N : BH088596
- Installed 10 January 2014
- Time Since New 307.3 hours

Tail Rotor Blade 3

- S/N : BH075794
- Installed 10 January 2014
- Time Since New 307.3 hours

Tail Rotor Blade 4

- S/N : BH075478
- Installed 10 January 2014
- Time Since New 307.3 hours

1.7 Meteorological Information

The IMIP helipad had automatic weather observation facility, located about 100 meters from the IMIP helipad. This weather observation facility is capable to measure wind, temperature and air pressure. The weather condition as reported on 20 April 2018 was clear with the wind was calm as shown in the table below.

Time (LT)	**0828**	**0928**
Wind (°/knots)	calm	calm
TT/TD[3] (°C)	26/23	27/22
QNH[4] (mb)	1,001.9	1,002.9
QFE[5] (mb)	1,014.3	1,015.3

1.8 Aids to Navigation

Not related to the accident.

1.9 Communications

The IMIP as the charterer company provided the communication facility consisted of high frequency (HF) radio on frequency 13.405 KHz and very high frequency (VHF) radio on frequency 130.85 MHz. The communication was not recorded. Along the flight, the pilot did not communicate with the IMIP radio operator.

3 TT/TD: TT – Temperature, TD –Dewpoint Temperature
4 QNH is the Q code indicating the atmospheric pressure adjusted to mean sea level.
5 QFE is the Q code indicating atmospheric pressure at the current ground level.

1.10 Helipad Information

Helipad Name	:	Indonesia Morowali Industrial Park (IMIP)
Helipad Identification	:	IMIP
Helipad Operator	:	PT Indonesia Morowali Industrial Park (IMIP) Company, Sulawesi Tengah
Helipad Certificate	:	083/ RSFC-DBU/ Ill/ 2016
Validity	:	11 March 2019
Type	:	Surface level heliport
Coordinate	:	2° 49’ 21.43” S; 122° 09’ 58.98” E
Elevation	:	120 feet

1.11 Flight Recorders

The helicopter was equipped with Penny & Giles solid state Multi-Purpose Flight Recorder (MPFR) capable to record flight data and cockpit voice. The MPFR was recovered from the accident site and transported to the KNKT recorder facility on 23 April 2018.

The details information of the MPFR was:

Manufacturer	:	Penny & Giles Aerospace Ltd.
Type/Model	:	Multi-Purpose Flight Recorder
Part Number	:	D51615-202-011 issue 1
Serial Number	:	A07951-001

The MPFR downloaded process was conducted at KNKT recorder facility. The download process successfully retrieved flight data consisted of 832 parameters of 25 hours of flight data comprising the accident flight.

The voice data contained 120 minutes of audio recording data on four channels consisted of Public Address (P/A), co-pilot, pilot and Cockpit Area Microphone (CAM) channels.

1.11.1 Flight Data Recorder (FDR)

Significant FDR information is shown on the following figures.

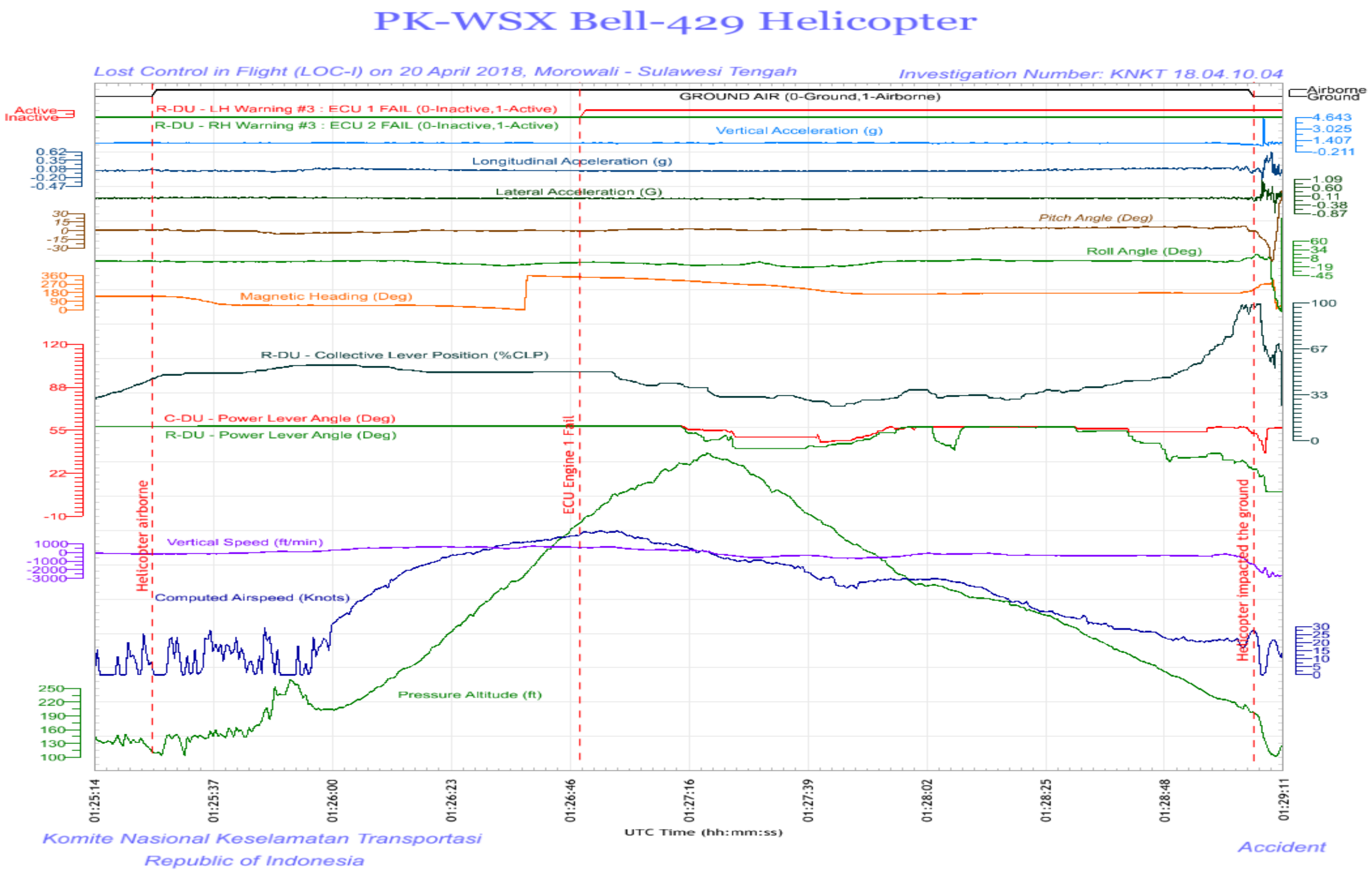


Figure 9: The FDR data of flight parameters

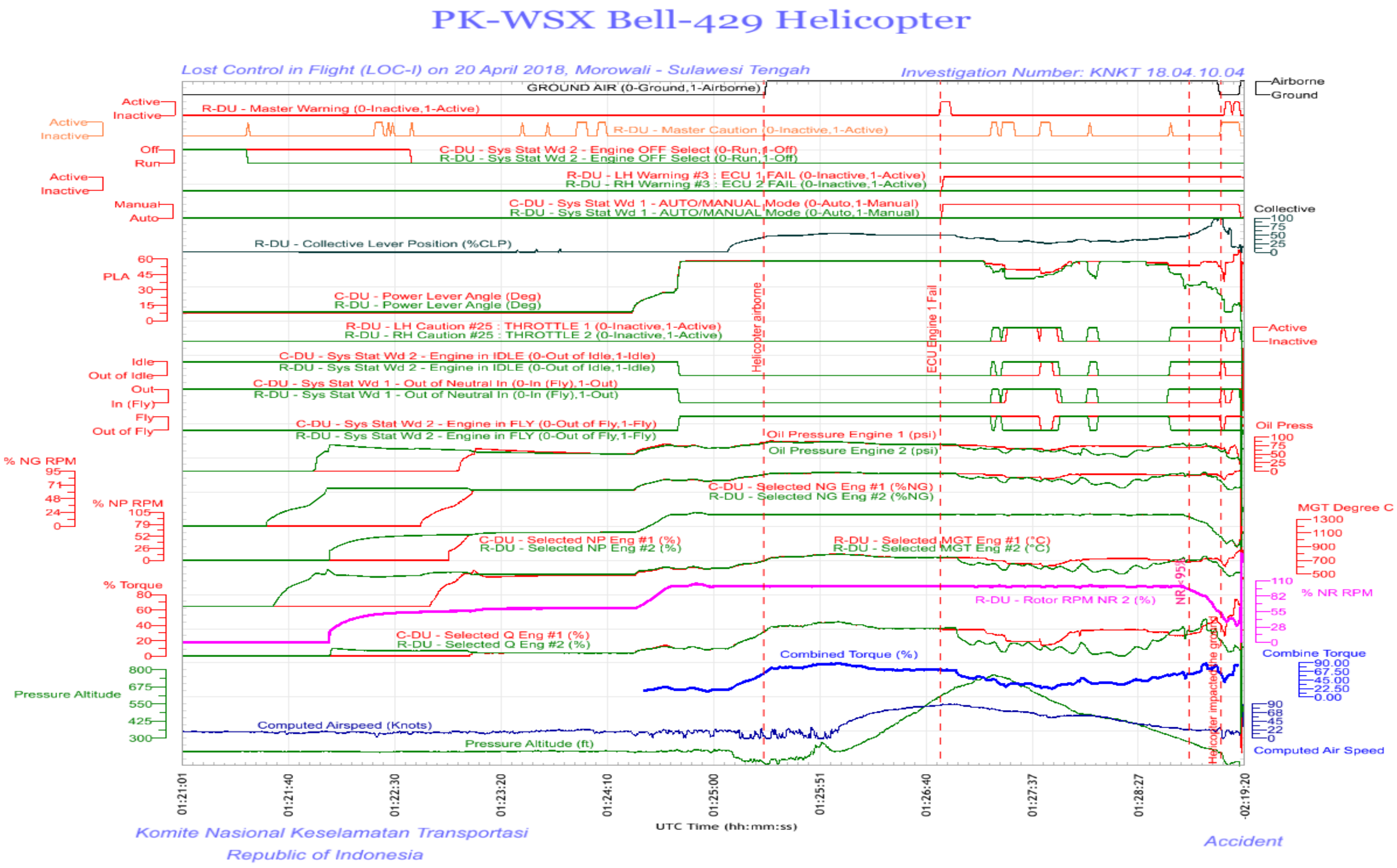


Figure 10: The FDR data of engine parameters

The FDR data represent on figure 9 showed the flight parameters and the figure 10 showed the engine parameters.

The significant FDR data are as follow:

1. At 09:21:32 LT, the NG of the engine 2 started to increase, indicated that the engine 2 starting process initiated and the engine stabilized at 09:22:00 LT.
2. At 09:22:45 LT, the NG of the engine 1 started to increase, indicated that the engine 1 starting process initiated and the engine stabilized at 09:23:10 LT.
3. At 09:24:42 LT, the main rotor as indicated by the Main Rotor RPM (NR) parameter reached 100% RPM.
4. At 09:24:46 LT, the throttle twist grip 1 and 2 was rotated and showed increasing to maximum angle of 58 degrees (as indicated by the 'Power Lever Angle' parameters) which mean that the throttle twist grips were placed in FLY detent.
5. At 09:25:09 LT, the collective increased followed by the increasing of engines torque or engine power (showed by the 'Selected Q Eng 1 and 2' parameters) indicated that the pilot intended to begin hover in preparation to take off.
6. At 09:25:27 LT, the helicopter lifted off the ground and the pressure altitude recorded about 120 feet.
7. At 09:26:49 LT, the pressure altitude was about 600 feet, the ECU 1 Fail warning active and followed by the Master Warning light illuminated one second after.
    - The parameter of 'C-DU - Sys Stat Wd 1 - AUTO/MANUAL Mode (0-Auto,1-Manual)' which represent the parameter for auto or manual mode of engine 1 changed the state from the 'AUTO' to 'MANUAL' until the end of recording,
    - The parameter of 'R-DU - Sys Stat Wd 1 - AUTO/MANUAL Mode (0-Auto, 1-Manual)' which represent the parameter for auto or manual mode of engine 2 remained in AUTO, until the end of recording.
8. At 09:27:03 LT, the engine 2 torque, NG, and the engine temperature (MGT) consistently drop when the collective was moved down but the engine 1 parameter was not change. This condition occurred because the EEC engine 1 had fail led to the engine 1 NG RPM remain unchanged. Therefore, to maintain the NR rotation and to avoid any over speed of NG RPM, the EEC engine 2 (which was still in AUTO) automatically adjusted the torque and NG of engine 2.
9. At 09:27:20 LT, the throttle engine 2 was moved out from FLY detent with a throttle angle of 49.8° for 2 seconds and then back to the FLY detent. This movement out of FLY detent of throttle engine 2 followed by the activation of Master Caution parameter.
10. At 09:27:25 LT, the throttle twist grip engine 2 was moved out from the FLY detent with a throttle angle of 49.8° and triggered the Master Caution parameter. The pilot rotated the throttle twist grip engine 2 for 27 seconds and back to the FLY detent at 09:27:52 LT. The throttle twist grip was in FLY detent with the throttle angle of 49.8°

11. At 09:27:43 LT, the throttle twist grip engine 1 was moved out from FLY detent for 6 seconds followed by the activation of Master Caution parameter and back to FLY detent at 09:27:49 LT. The throttle twist grip engine 1 position showed the throttle angle was 42.7°. The throttle twist grip engine 2 was also moved out from FLY detent with the throttle angle moved around 42.7° - 47.2°.
12. At 09:27:53 LT, both throttle twist grip was positioned in FLY detent.
13. At 09:28:06 LT, the throttle twist grip engine 2 was moved out from the FLY detent for 4 seconds and back to the FLY detent at 09:28:10 LT. The throttle twist grip engine 1 was in FLY detent.
14. At 09:28:10 LT, both throttle twist grip engine 1 and 2 were back to FLY detent.

    Along this varied movement of the throttles, the collective was lowered in varied values but the engine NP and NR were stabilized at 100%. It was also noticed that during the varied movement of the collective, the value of NG RPM engine 2 varied below 90% while NG RPM engine 1 relatively maintain between 99% and 100%.
15. At 09:28:44 LT, the throttle twist grip engine 1 was in FLY detent with the throttle angle of 53.9°. The throttle twist grip engine 2 was move out from FLY detent with the throttle angle of 47 and decreasing and followed by the activation of the Master Caution light. Starting at this time, the collective had been increased gradually and the throttle twist grip engine 2 was decreased gradually. At the same time the NP RPM and NR RPM were decreasing.
16. At 09:28:53 LT, the NR RPM decreased below 95%, at the same time the collective was continued to increase followed by continued decreasing of the NR RPM and NP RPM. Increasing the collective was also resulted in increasing of the torque while the throttle angle of engine 2 was 34.4° and continued decreasing.
17. At 09:29:07 LT, the FDR recorded the ground parameter was activated.
18. At 09:29:15 LT, the end of recording.

1.11.2 Cockpit Voice Recorder (CVR)

The Cockpit Voice Recorder was successfully downloaded. The quality of the voice and aural message were clearly recorded. The relevant excerpt of CVR was as follows:

Time (LT)	Event
09:23:54	Sound similar to the door being closed
09:26:05	The EGPWS alert ‘CAUTION TERRAIN’ activated two times.
09:26:49	A chime active.
09:26:57	The pilot called “ECU Fail” and was confirmed by the engineer.
09:27:03	The pilot noticed a red light and decided to return to the IMIP helipad.
09:27:06	The chime active and followed by the pilot called “fuel pump”.

Time (LT)	Event
09:27:13	The pilot restated ‘ECU fail’ and was confirmed by the engineer.
09:27:15	The pilot said that would revert to manual and confirmed by the engineer.
09:27:17	The chime active.
09:27:21	The engineer questioning what was happening.
09:27:24	The pilot said once again that he would like to revert to manual and also decided to return. The engineer agreed.
09:27:39	The pilot asked to the engineer to identify which engine had experienced ECU failed.
09:27:43	The pilot said “reset… reset”.
09:27:45	The pilot once again requested the engineer to reset something.
09:27:51	The EGPWS alert ‘CAUTION TERRAIN’ activated twice.
09:27:58	The engineer stated that the ECU of the engine 2 had failed. The pilot reconfirmed and was reassured by the engineer.
09:28:06	The chime activated.
From 09:28:02 until 09:28:34	The EGPWS alert ‘CAUTION TERRAIN’ active 10 times.
09:28:36	The pilot asking the engineer to monitor and agreed by the engineer.
09:28:38	The EGPWS alert ‘CAUTION TERRAIN’ active.
09:28:40	The pilot ensuring that the manual setting has been executed.
09:28:41	A chime active and continued by the activation of the EGPWS alerts ‘CAUTION TERRAIN’.
09:28:50	The pilot stated that the throttle was being manipulated. At the same time the synthetic voice ‘CHECK HEIGHT’ active, followed by the EGPWS altitude callout of ‘TWO HUNDRED’.
09:28:52	The sound similar to ‘low main rotor’ aural tone warning was recorded.
09:28:59	The EGPWS altitude callout ‘ONE HUNDRED’ active.
09:29:01	The ‘low main rotor’ aural tone warning stopped.
09:29:06	Sound similar to impact.
09:29:15	The end of recording

1.12 Wreckage and Impact Information

The last helicopter position was rolled over to the left on heading approximately 080°. The wreckage occupied the dimension approximately 10 meters × 10 meters situated on the intersection IMIP factory access road as shown in the figure below.

Figure 11: Aerial view of the helicopter

All main rotor blades were broken and detached from the main rotor hub. The tail boom broken and found on the right of the helicopter and all the tail rotor blades were still intact.

The left landing gear skid detached and found on the right of the helicopter while floatation device was slightly open but not expanded. The right landing gear skid intact and the floatation device unfurled but not expanded.

Figure 12: The wreckage of the helicopter

1.13 Medical and Pathological Information

All occupants were evacuated to IMIP medical facility for initial treatment. The pilot and the engineer identified suffer coccydynia or the tailbone injury as the result of the impact.

1.14 Fire

KNKT received video record of the Closed-Circuit Television (CCTV) installed on the security post near the crash site that recorded the occurrence.

Based on the recorded video, there was no inflight fire. Approximately ten seconds after impact, small explosion followed by fire burst off identified on the engine exhaust. Approximately 50 seconds later, the fire grown bigger and one of the security personnel sprayed the portable fire extinguisher into the exhaust until the fire extinguished.

1.15 Survival Aspects

Based on the recorded video on the CCTV, approximately 40 seconds after impact, the first passenger evacuated through the passenger door while the main rotor hub was still rotating. The main rotor hub stops rotating approximately one minute after the impact.

Approximately two minutes after impact, the pilot evacuated through the right cockpit window and the passengers evacuated one by one assisted by the security personnel. All occupants were transported to the IMIP medical facility.

The engineer was evacuated by security personnel, approximately five minutes after the impact and was the last occupant evacuated from the helicopter. The engineer transported to the medical facility.

1.16 Tests and Research

1.16.1 The Wreckage Detail Examination by Bell and Pratt & Whitney

On 1 May 2018 KNKT, the representative of Bell and Pratt & Whitney visited the wreckage in Morowali for detail examination of the wreckage. The summary of the examination is as follow.

Airframe Examination

No pre-impact anomalies were observed in the fuselage/airframe and all observed fractures were consistent with overload fractures during impact.

The airframe fuselage exhibited significant damage from impact forces on a concrete road. Airframe damage is consistent with a relatively level, but slightly nose low hard impact. Numerous fractures were observed in the airframe structure. The nose and aircraft belly surfaces exhibited crushed skin and structure from ground impact forces as shown in the figure below.

Figure 13: The nose and belly condition

Above the pilot and copilot seats was observed fractured airframe roof structure as shown in the figure below.

Figure 14: The fracture of the airframe roof structure

The tail boom was fractured from a forward location due to overload forces during the impact sequence and separated from the main fuselage as shown in the figure below. A puncture in a fuel cell resulted in fuel leaking out after the accident.

Figure 15: The tail boom condition

Cockpit and Controls

The copilot and pilot restraints both exhibited intact seat belts and shoulder harnesses. Both shoulder harness inertial reels operated properly as demonstrated by hand movement (the inertial reels moved freely, locked with hard hand pressure, and then released when hand pressure was relaxed).

All circuit breakers were “in”. The battery switch was found in the “Off” position. Both engine switches were found to be “Off”. It was reported that the pilot turned off the engines (as shown in the figure below) before egressing the helicopter. Video of the accident helicopter revealed that the main rotor remnants were rotating after impact until it appeared that the engines were shutdown.

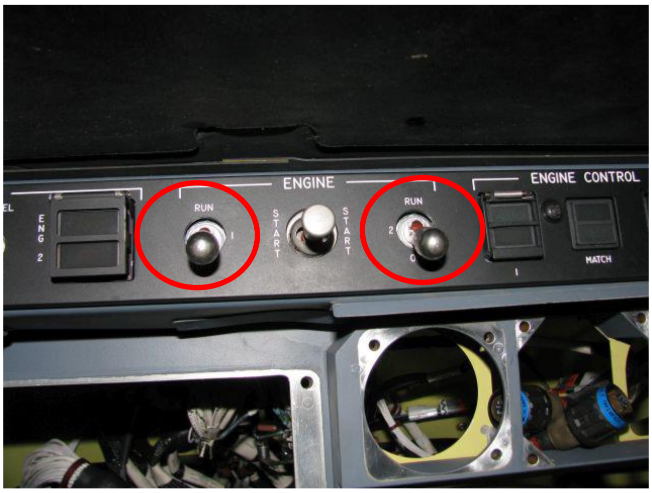


Figure 16: The engine switch in the cockpit

The collective was at up position however the angle was not measured. The throttle of engine 1 was found above the maximum position and the throttle of engine 2 was found at the idle position as shown in the figure below.

	
Throttle position of engine 1	Throttle position of engine 2

Figure 17: The throttle position after accident

Rotors and Drive System

No pre-impact anomalies were observed in the main and tail rotor systems or in the main and tail drive systems. All observed fractures were overload fractures consistent with occurring during the impact sequence.

During impact, the helicopter rolled over to the right with the engines still powering the main rotor and tail rotor driveshaft on the aft fuselage as observed from the video of the accident taken from the security post CCTV camera. As a result, all four main rotor blades fractured away from the main rotor hub and into numerous pieces because of rotating contact with the concrete road. Additionally, the main rotor hub assembly exhibited fractured yoke flexures from rotating contact with the road after initial impact (see figure below).

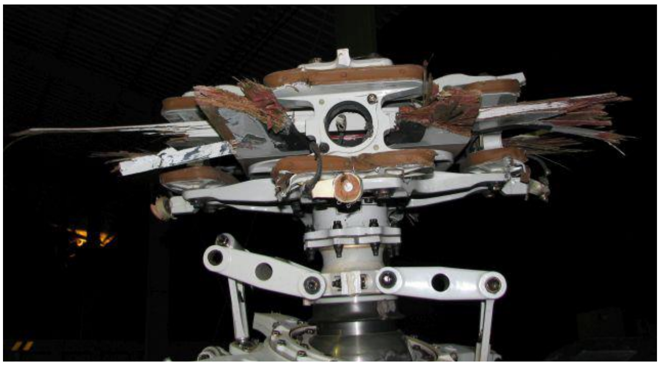


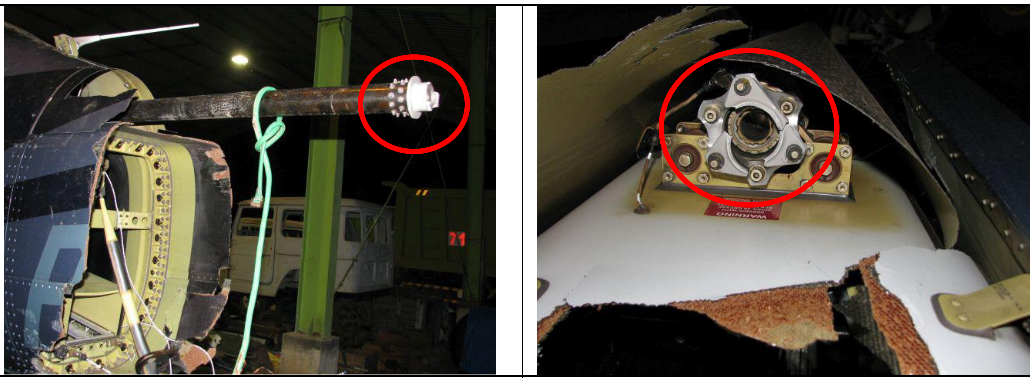
Figure 18: The main rotor condition

The tail rotor hub and blades exhibited ground impact damage from the impact sequence. The Blue tail rotor blade exhibited a mid-span chord wise overload fracture as shown in the figure below.

Figure 19: The tail rotor condition

All four tail-rotor pitch change links were not fractured. All tail rotor pitch change link rod end bearings exhibited minimal axial or radial play. Two pitch change links were found bent, consistent with impact forces. The Orange blade's short link and the Blue blade's long link were found bent consistent with impact forces.

A tail rotor driveshaft on the main fuselage was rotated freely by hand and rotation of the main rotor was observed, demonstrating drive continuity of the main transmission. The tail rotor system was rotated by hand freely and corresponding rotation through the tail rotor gearbox was observed at fractured tail rotor driveshaft coupling adaptor located near the forward fractured tail boom location (see figure below).



Forward end of tail rotor driveshaft coupling adaptor facture near tail boom fracture	Aft end of tail driveshaft coupling adaptor fracture

Figure 20: The tail rotor drive shaft

1.16.2 Display Unit (DU), Health and Usage Monitoring Systems (HUMS) and Aircraft Data Memory Module (ADMM) Examination by Bell

In addition to the wreckage examination, the Bell representative removed the component related to the accident. Those components were:

1. Three (3) Compact Flash Cards from the Display Units (DUs) as follows:
   a. The compact flash card memory module taken from the Right Display Units (R/DU) serial number 14090554.
   b. The compact flash card memory module taken from the Center Display Units (C/DU) serial number 14090550.
   c. The compact flash card memory module taken from the Left Display Units (L/DU) serial number 14090556.
2. The Aircraft Data Memory Module (ADMM) part number 429-005-010-101 serial number PUI-00226.
3. The Health and Usage Monitoring Systems (HUMS) processor box part number 429-267-401 serial number 00101.

Those components were brought to the Bell facility for data downloading process.

The Display Unit (DU) Download Result

The DUs contain a Display Unit Electronic Data Recorders (EDRs) which was stored in the compact flash card memory module. The compact flash which was installed in the DU is shown in the following figures.

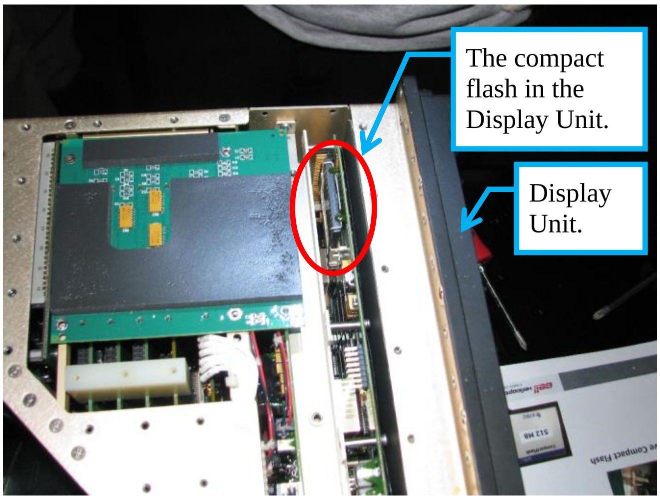


Figure 21: The compact flash in the Display Unit

Downloading of the EDRs data was attempted on the R/DU, C/DU and L/DU by Bell in the 429 System Integration Lab in Fort Worth, Texas.

Several key points of the data were selected and input into Bell's test DU. The aural chime recorded in the CVR was used to synchronize the CVR and the DU EDR time stamp. The time stamps between the CVR and DU EDR may not be at exactly matched however it is considered acceptable for comparison.

The figure 22 below showed the engine PWR Situation Indicator (PSI). The engine 1 PWR Situation Indicator (PSI) needle is represented by a solid green color and the engine 2 is shown in the hollow green color.

When the first aural chime was recorded in CVR, the red warning of ECU 1 FAIL was displayed on the DU in conjunction with the 'MANUAL' message below the engine data as shown in the figure 22 below. At the time, both needles on the PSI indicated the same value which correlated to equal engine power. The needle color of the failure ECU would turn to cyan.

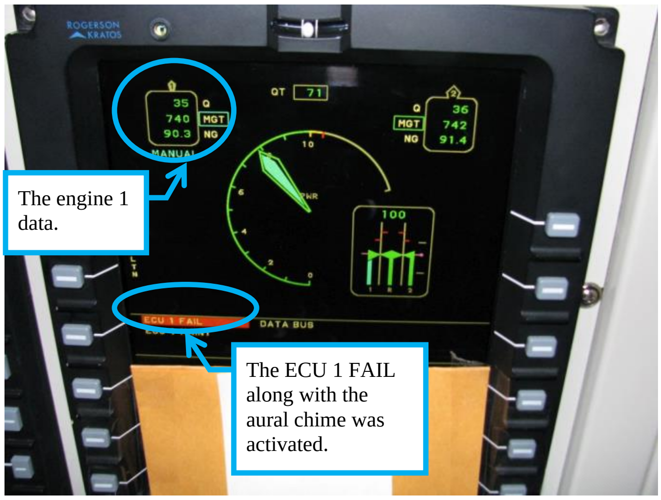


Figure 22: The first indication of the DU based on the aural chime point

When ‘MANUAL” message was displayed under the engine 1 data, the engine power turbine (NP) RPM of engine 1 was no longer governed by the Electronic Control Unit (ECU) or Electronic Engine Control (EEC). The ‘MANUAL’ message was the indication that the pilot should control manually the engine 1 NP RPM by manipulating the engine 1 throttle twist grip.

In the figure 23 below, the DU showed a message ‘THROTTLE 2’ which mean that the pilot had manipulated the throttle twist grip engine 2 manually.

As shown in the figure 23 below, the power (PWR) needles on the Power Situation Indicator (PSI) had split. The hollow green color (the engine 2) showed slightly below the solid green color (the engine 1) as the pilot manually controls the throttle twist grip of engine 2.

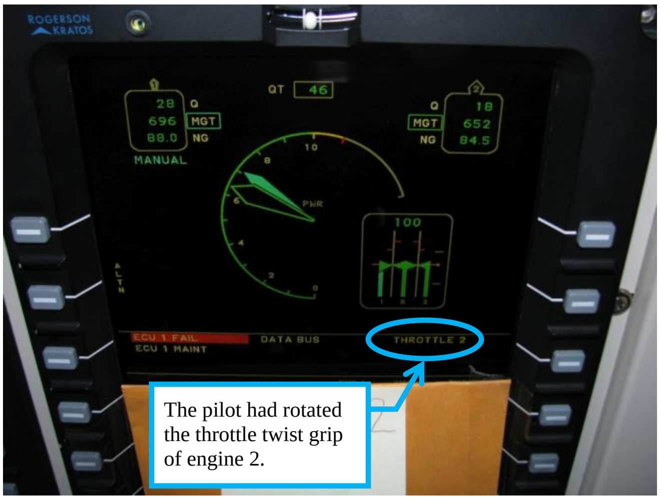


Figure 23: The pilot rotated the throttle engine 2

In the figure 24 below, the ‘THROTTLE 1’ and ‘THROTTLE 2’ messages were shown on the DU while both needles showed decreasing.

Figure 24: The PWR needle in the PSI showed the lower value

Since 09:27:03 LT the ‘THROTTLE 1’ and ‘THROTTLE 2’ messages alternately showed, indicated that the pilot had rotated the throttle twist grip engine 1 and engine 2 manually. In addition, during this situation, the NR RPM was still showed the green color (above 95% NR RPM).

Health and Usage Monitoring Systems (HUMS)

The attempt to download of the Health and Usage Monitoring Systems (HUMS) box was unsuccessful. An error message (ERR) was displayed and no data was downloaded as shown in the figure below.

Figure 25: The error message of the HUMS

Aircraft Data Memory Module (ADMM)

The two channels of the Aircraft Data Memory Module (ADMM), Channel A and Channel B were downloaded. There was no difference in the Channel A and B data. The downloaded data were as follow:

1. The flight log recorded the correct accident flight time which was 0.1 hour.
2. The timer or counter of the aircraft operation time was recorded as follow:
   a. The operation time 409.4 hours
   b. The airtime 307.4 hours
   c. The cycles (take off landing) 629 cycles
   d. The engine start times 566 starts
   e. The most recent power assurance check was performed on 14 April 2018.

1.16.3 Data Collection Unit (DCU) Examination by Pratt & Whitney

Each engine PW 207D1 is equipped with a Data Collection Unit (DCU) which installed on the forward left side of the engine.

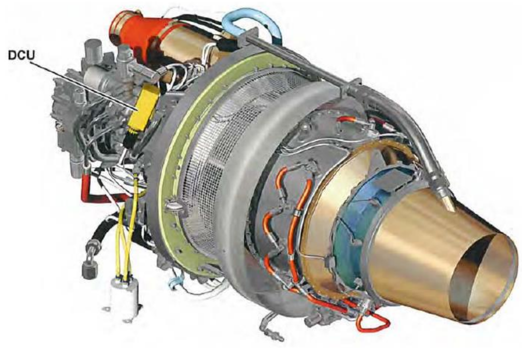


Figure 26: The Data Collection Unit (DCU)

The purpose of the DCU is to serve as a repository for various engine trim parameters, accumulated operation times, accumulated part cycles and specific operational exceedance excursion data. The DCU records and stores the last 200 faults and 200 events in a rotating buffer. In addition to storing the data for the engine itself, each DCU also records the data of the neighbor engine.

The EEC automatically stores the engine data in the DCU in snapshot format. A snapshot is taken when an event or fault is triggered. This could be a One Engine Inoperative (OEI) rating range/ultimate limit that is exceeded, a fault or an event such as a commanded auto to manual mode changeover or unexpected flame out. A snapshot consists of 24 standard parameters.

The DCU data download found that the EEC of engine 1 detected a fault in the Fuel Management Module (FMM). The FMM is part of the EEC unit. The FMM fault mean that the fuel management in the EEC was unable to provide the fuel demand automatically and resulted in the red warning of 'ECU 1 FAIL' was displayed in the DU in conjunction with the 'MANUAL' message located below the engine data as shown in the figure 22. At the time of EEC failure, the DCU engine 1 also recorded that the engine 2 showed the same torque value.

The message of 'ECU 1 FAIL' will result in a reversion of the engine 1 from automatic to manual mode. The manual mode of engine 1 was recorded in the DCU engine 1 until the end of recording of the DCU.

In the DCU engine 2, the fault of the EEC engine 1 and the reversion into the manual mode of the engine 1 was also detected and recorded in the memory of DCU engine 2.

1.17 Organizational and Management Information

1.17.1 General

Aircraft owner and operator	:	PT. Whitesky Aviation Secure Building – Tower A1.1 Floor Jalan Raya Protokol Halim Perdanakusuma Jakarta 13610
Air operator certificate	:	135-016

The operator had operation base in Jakarta. The operator operated total of 2 helicopters Bell 429 including the accident flight, 2 helicopters Bell 505, 1 helicopter EC130 T2, 2 Cessna 208B and 2 Cessna 402B.

The investigation did not find the information regarding the duties and responsibilities of the engineer on board in the aircraft operator manuals.

1.17.2 Operator Training Manual

The Electronic Engine Control (EEC) failure training for the pilot was scheduled at the 'Flight Period Three' as follow.

3. Flight Period Three – 1.0 - 1.5 hours dual flight instruction. 30 minutes ground briefing

Objective: Reviews and practice maneuvers and procedures from previous flight periods introduce procedures for ECU system malfunction.

CONTENT:

Review:

1) Normal flight maneuvers-all previously introduced maneuvers

2) Emergency procedures-all previously introduced maneuvers

Introduce:

3) ECU system malfunctions.

4) DU malfunction

5) Use of coupled auto pilot functions

Completion Standard: Customer should demonstration increased understanding of aircraft system and improvement in ability to execute normal maneuvers and emergency procedures.

1.17.3 The Operator Standard Operating Procedure of Bell 429

2.2 FLIGHT CREW

Minimum flight crew for VFR consists of one pilot. Pilot may operate helicopter from either crew seat if dual controls and left DU are installed; otherwise pilot shall operate helicopter from right crew seat. Single pilot IFR shall be operated from right crew seat. Dual controls and left DU shall be installed for dual pilot IFR. Left crew seat may be used for an additional pilot when approved dual controls are installed.

1.17.4 Quick Reference Handbook

The operator utilized the operator quick reference handbook (QRH) that was derived from the manufacture manual. The relevant part of the QRH is shown in the figure below.

WHITESKY AVIATION

QRH EMERGENCY CHECKLIST

8

ECU FAILURE

NOTE

30 second OEI power may not be available in MANUAL mode. OEI maximum continuous power is available for all ambient conditions.

NOTE

If ECU failure occurs at high power, collective should be reduced before reducing affected engine throttle, al lowing engine in AUTO mode to remain within limits.

1. FLY STOP REL (affected engine) --------------------------- Disengage.
2. Throttle (affected engine) and collective — Coordinate and adjust as necessary to maintain PSI needle of affected engine slightly below PSI needle of normal engine (two to three needle width split).
3. Land as soon as practical.

Figure 27: The operator QRH of ECU failure

The relevant QRH from the manufacture manual is shown in the figure below.

3-3-G. ECU FAILURE

NOTE

30 second OEI power may not be available in MANUAL mode. OEI maximum continuous power is available for all ambient conditions.

- **INDICATIONS:**

ECU FAIL message illuminated.

Affected engine automatically switches to manual mode.

ENGINE CONTROL switch (affected engine) indicates MAN.

PSI display indicates MANUAL under Q, MGT, N_G display of affected engine and PSI needle changes color to cyan.

Possibly other ECU messages displayed.

NOTE

If ECU failure occurs at high power, collective should be reduced before reducing affected engine throttle, allowing engine in AUTO mode to remain within limits.

- **PROCEDURE:**

1. **FLY STOP REL (affected engine) — Disengage.**
2. **Throttle (affected engine) and collective — Coordinate and adjust as necessary to maintain PSI needle of affected engine slightly below PSI needle of normal engine (two to three needle width split).**
3. **Land as soon as practical.**

Figure 28: The manufacture QRH of ECU Failure

1.18 Additional Information

There was no other information that was relevant to the circumstances leading up to the occurrence.

1.19 Useful or Effective Investigation Techniques

The investigation was conducted in accordance with the KNKT approved policies and procedures, and in accordance with the standards and recommended practices of Annex 13 to the Chicago Convention.

2 ANALYSIS

The aircraft was maintained in accordance with the manufacturer manual and no aircraft system abnormality reported prior to the flight.

The analysis focused on the discussion of the engine behavior during the EEC engine 1 failure and the pilot identification of failure system to overcome the EEC failure.

2.1 The Electronic Engine Control (EEC) Engine 1 Failure

The Data Collection Unit (DCU) data download found that the engine 1 Fuel Management Module (FMM) had failed. The FMM is part of the Electronic Engine Control (EEC) and the FMM failure resulted in the EEC was unable to provide the fuel demand automatically. The FMM failure in the EEC unit would trigger a warning message of ‘ECU 1 FAIL’ displayed to the pilot in Crew Alerting System (CAS) and ‘MANUAL’ message was displayed below the affected engine data in the Display Unit (DU). In addition, the needle in the Power Situation Indicator (PSI) of the affected engine would change the color to cyan.

The FDR recorded that the EEC fail occurred at 09:26:49 LT and the CVR data revealed that the pilot identified the failure of one of the EEC 8 seconds later.

The procedures of EEC Failure described in the QRH, stated that the pilot should control the throttle of the affected engine manually, where in this case was the engine 1.

The FDR recorded 24 seconds after the EEC failure, the pilot started to manage the throttle twist grip engine 2 manually and the ‘THROTTLE 2’ message was displayed on the CAS DU.

Along the action to manage the throttle twist grip engine 2 manually, the pilot also managed the throttle twist grip engine 1 and at the same time the CAS DU showed the message of ‘THROTTLE 1’. For about 24 seconds, the collective was not moved significantly and the FDR data showed both engines power were relatively constant value and the main rotor RPM maintained above 95%.

About 23 seconds before impact, after the pilot had the information from the engineer, the pilot manipulated the throttle twist grip engine 2 and placed the throttle twist grip engine 1 in the FLY detent until the end of the flight. Since the EEC engine 1 had failed, the engine 1 power should be controlled manually by manipulating the throttle twist grip. Without manually controlling the throttle twist grip, the engine gas generator would remain at the last RPM even though the throttle twist grip lock button engine 1 was in the FLY detent. Therefore, the engine 1 would fix at the last engine gas generator RPM and the EEC would not adjust the fuel to overcome the collective demand as in the auto mode.

The FDR also recorded that at this time, the collective increased gradually. Increasing the collective will decrease the main rotor RPM and requires increasing engine gas generator RPM. Because the gas generator RPM of engine 1 was fix, therefore the engine 1 could not provide sufficient power demand as required by the increasing of the collective. Meanwhile, the throttle twist grip of engine 2 (which was still in the auto mode) had been move away from the FLY detent which made the engine 2 could not provide the sufficient engine gas generator automatically to provide the power demand required by the increasing of the collective. In addition, the pilot decreased the engine gas generator of engine 2 by rotating the throttle twist grip even more. The minimum main rotor RPM of 95% is required to withstand the helicopter in the air. The condition of engine 1 and 2 could not provide the sufficient power to maintain the minimum main rotor RPM and continued decreasing. The FDR recorded that this occurred about 9 seconds after the collective being increased.

When the main rotor RPM drop below 95%, the main rotor could not withstand the helicopter in the air. The FDR recorded the helicopter impacted to the ground about 14 seconds after the main rotor RPM drop below 95%.

The action of increasing the collective without adequately recovering the throttles resulted in the decreasing of the main rotor RPM to below the requirement that unable to maintain the helicopter on the air.

2.2 Identification of the failure system

The failure of the EEC engine 1 indicated by several clues, consisted of displayed on the Crew Alerting System (CAS) of the DU with the message of ‘ECU 1 FAIL’, ‘MANUAL’ message below the affected engine indicators and the change on the Power Situation Indicator (PSI) needle color from green to cyan.

The data showed that the pilot manually initially manipulating the throttle twist grip engine 2, thereafter asked to the engineer to identify which EEC that had been failed. The CVR recorded that the engineer replied to the PIC command to identify the fault EEC as the throttle twist grip engine 2 has been manually manipulated, while the throttle twist grip engine 1 was not changed.

The CVR showed evidence that the engineer was also confused in identifying the failure EEC. Even though the EEC failure was displayed in the CAS DU with the message of ‘ECU 1 FAIL’, the engineer still required more time to conclude the correct EEC failure. The confusing most likely became severe when the CAS DU showed the message of ‘THROTTLE 1’ and ‘THROTTLE 2’ alternately as the result of the pilot manipulating the throttle twist grip engine 1 and 2. The confusing might had been distracted the judgment of the engineer to decide which engine had experienced the EEC problem. The engineer then informed the pilot that the engine 2 EEC that was fail.

The pilot action to manually manipulated the throttle of the engine 2 and the command to the engineer to identify the failure EEC indicated that the pilot unable to identify of the failure EEC despite the available clues.

As discussed on the earlier analysis that during manipulating both throttle grips, resulted in the main rotor RPM dropped below 95%, which below the minimum requirement and the main rotor could not withstand the helicopter in the air.

The pilot stated that the EEC problem is the first time encountered to the pilot however, in the ‘Flight Period Three’ of the training program the EEC problem had been introduced to the pilot during ground training. The pilot had not been trained for EEC failure in the simulator. The proficiency training which was conducted at 2017 the pilot only had the highlight of emergency situation including the single engine exercise which in this case did not represent the EEC failure.

The QRH of the aircraft operator did not include the section of ‘indications’, which mainly contain of clues to identify a failure system. The CVR did not record the pilot read the QRH, however if the QRH was read, the pilot would not get the indication of EEC failure as described in the section ‘indication’.

The investigation did not find the engineer role during the flight in the operator manual however the engineer might think that the role was not a part of flight crew member. The engineer probably did not train properly to monitor the helicopter parameters in flight, therefore when the engineer seeking on which engine had experienced EEC fail, the engineer could not properly identify.

The lack of experience related to the handling of EEC failure and QRH reading might led to the failure of the pilot to identify the failure EEC. The engineer was not part of flight crew and probably has not experience to identify failure of EEC system in flight. The flight was a single pilot operation therefore the pilot should be able to manage the flight in normal and emergency. The pilot might have been preoccupied with the new experience of technical problem combined with the improper information from the engineer led to inappropriate decision to select the throttle twist grip engine 2 instead of engine 1.

The pilot decided to return to IMIP helipad and turned the aircraft about 7 seconds after the EEC problem occurs or about 2 minutes after takeoff. The pilot decision might have been a good decision to prevent flying with a failure system that might increase the complexity of the flight.

3 CONCLUSIONS

Findings are statements of all significant conditions, events or circumstances in the accident sequence. The findings are significant steps in the accident sequence, but they are not always causal, or indicate deficiencies. Some findings point out the conditions that pre-existed the accident sequence, but they are usually essential to the understanding of the occurrence, usually in chronological order.

3.1 Findings

According to factual information during the investigation, the KNKT identified initial findings as follows:

1. The pilot held valid licenses and medical certificates.
2. The aircraft had a valid Certificate of Airworthiness (C of A) and Certificate of Registration (C of R).
3. There was no system abnormality reported prior to the flight.
4. The flight was planned from IMIP helipad at Morowali in Sulawesi Tengah to Haluoleo Airport at Kendari Sulawesi Tenggara. On board in this flight were one pilot, one engineer and six passengers with total load approximately of 556 kilograms.
5. At about one minute after take-off, at altitude approximately 600 feet, the pilot noticed one of the Engine Control Unit (ECU) failed. The pilot and the engineer discussed to determine which ECU had failed. The pilot decided to return to the IMIP helipad. The pilot selected one of the throttles to manual and afterward the altitude and the speed decreased. The pilot attempted to recover by manipulating the collective, throttle and cyclic, however the altitude and speed could not be recovered.
6. Before reaching the IMIP helipad, the helicopter impacted to the ground on the IMIP factory access road approximately 175 meters from the IMIP helipad at coordinate 2°49’15.94” S, 122° 9’ 57.78” E with elevation approximately 75 feet above sea level.
7. All occupants were survived and one of the IMIP employees who walked at the road was fatally injured.
8. The aircraft was destroyed. The wreckage occupied the dimension approximately 10 meters × 10 meters.
9. The IMIP helipad had automatic weather observation facility, located about 100 meters from the IMIP helipad which measure wind, temperature and air pressure. At the time of the accident, the weather was reported clear.
10. The IMIP as the charterer company provided the communication facility consisted of HF radio on frequency 13.405 KHz and VHF radio on frequency 130.85 MHz. The communication was not recorded and the pilot had not communicated with the IMIP radio operator during the flight until the accident.
11. The MPFR downloaded process was conducted at KNKT recorder facility. The download process successfully retrieved flight data consisted of 832 parameters

of 25 hours of flight data comprising including the voice data contained 120 minutes of audio recording data on four channels consisted of Public Address (P/A), co-pilot, pilot and Cockpit Area Microphone (CAM) channels.

12. There was no inflight fire however, approximately ten seconds after impact, small explosion followed by fire burst off from the exhaust. Approximately 50 seconds later the fire grown bigger and one of the security personnel sprayed the portable fire extinguisher into the exhaust until the fire was extinguished.
13. All of the occupants were evacuated from the helicopter assisted by the security personnel and IMIP employees. The pilot and the engineer were transported to the medical facility nearby.
14. The investigation did not find the information regarding the duties and responsibilities regarding the engineer on board.
15. The operator utilized the operator QRH that was derived from the manufacture manual where the cockpit indication did not include in the aircraft operator QRH.
16. As soon as the EEC engine 1 had failed, the pilot started to manage the throttle twist grip engine 2 instead of engine 1.
17. Along the action to manage the throttle twist grip engine 2 manually, the pilot also managed the throttle twist grip engine 1 several time but not so intense like throttle twist grip engine 2.
18. Even though the EEC failure was displayed in the CAS with the message of ‘ECU 1 FAIL’, the engineer was confused to conclude the correct EEC failure. The confusing most likely became severe when the CAS showed the message of ‘THROTTLE 1’ and ‘THROTTLE 2’ as the result of the pilot manipulating the throttle twist grip engine 1 and 2.
19. After the engineer stated the EEC problem was engine 2, the pilot placed the throttle twist grip engine 1 in the FLY detent and decreased the throttle twist grip engine 2 until the helicopter impacted to the ground.
20. The engine 1 could not anticipate the power demand by the increasing of the collective as the fuel control system had reverted into manual mode and required manual throttle control. The engine 2 could not provide the sufficient power demand by the increasing the collective as the throttle twist grip of the engine 2 had moved away from FLY detent and continuedly reduced.
21. The inability of both engines to provide sufficient power demand, resulted in the power turbine (NP) RPM to drop and consequently the main rotor (NR) RPM also dropped. When the main rotor (NR) RPM drop below 95%, the main rotor could not withstand the helicopter in the air.
22. The engineer probably did not train to monitor the helicopter parameters in flight, therefore the engineer could not properly identify the failure EEC.
23. The flight was a single pilot operation therefore the pilot should able to manage the flight in normal and emergency. The pilot might have been preoccupied with the new experience of technical problem combined with the improper information from the engineer led to inappropriate decision to select the throttle twist grip engine 2 instead of engine 1.

24. The action of increasing the collective without recovering the throttle properly resulted in the decreasing of NP RPM and NR RPM until the decreasing of NR RPM reached the critical situation to withstand the helicopter on the air.

3.2 Contributing Factors

Contributing factors defines as actions, omissions, events, conditions, or a combination thereof, which, if eliminated, avoided or absent, would have reduced the probability of the accident or incident occurring, or mitigated the severity of the consequences of the accident or incident. The investigation concluded that the contributing factors to this accident was:

The lack of experience related to the handling of EEC failure and QRH reading might led to the failure of the pilot to identify the failure of the EEC, resulted in the main rotor (NR) RPM to drop below 95% which could not withstand the helicopter in the air.

4 SAFETY ACTION

At the time of issuing this Preliminary Report, the KNKT had been informed of safety actions by the operator as result from this occurrence.

4.1 PT. Whitesky Aviation

1. Assembled the internal investigation team lead by safety accountable executive.
2. Issued Safety Recommendation #003/QSS/SR/IV/2018 dated 24 April 2018 regarding immediate post-accident actions to be taken by all employee and company including to assemble the Working Safety Group which periodically review the Emergency Procedure for all aircraft operated by the company.
3. Issued Safety Notice number 04/QSS/SN/V/2018 dated 2 May 2018 regarding Single Pilot which include:
   a. To obey the Safety Circular published by the DGCA number SE-013 issued on 2018 regarding the Single Pilot Crew Resource Management.
   b. To uphold the airmanship principle for all Pilot in Command as Single Pilot Operations and comprehend the duties and responsibility regarding the flight safety.
   c. Encourage for all Pilot in Command as Single Pilot Operations to improve the proficiency and system knowledge in compliance to the procedure.
4. Reminding for non-crew personnel due to their onboard duties (Engineer or HLO or FOO Onboard) to aware and respect the roles, duties and responsibilities of Pilot in Command.

The KNKT did not receive any further safety action until the issuance of the final report.

5 SAFETY RECOMMENDATIONS

The KNKT acknowledges the safety actions taken by PT. Whitesky Aviation and considered that the safety actions were relevant to improve safety, however there still safety issues remain to be considered. Therefore, the KNKT issued safety recommendations to address safety issues identified in this report.

5.1 PT. Whitesky Aviation

- **04.O.2022.10.2**

Even though the EEC failure was displayed in the CAS with the message of 'ECU 1 FAIL', the engineer was confused to conclude the correct EEC failure. The confusing most likely became severe when the CAS showed the message of 'THROTTLE 1' and 'THROTTLE 2' as the result of the pilot manipulating the throttle twist grip engine 1 and 2. The confusion might be affected by the lag of technical knowledge. The lag of technical knowledge of the cockpit failure message might affect the proper problem identification.

KNKT recommend to operator to review the engineer training of the aircraft system including the system failure indication.

- **04.O.2022.10.3**

The operator syllabus of pilot ground class training was consisted of four programs named as 'Flight Period'. The EEC problem was included in the 'Flight Period Three' as stipulated in the operator training manual. The investigation revealed that the training of ECU failure has not been introduced to the pilot in the simulator training. The pilot had not experienced EEC problem previously during the flight. Insufficient training might make the pilot inexperience in handling of aircraft system failure. The lack of experience related to the handling of EEC failure resulted in the inappropriate decision to select the throttle twist grip engine 2 instead of engine 1.

KNKT recommend the operator to review the pilot training to provide all pilots with handling of system abnormality.

6 APPENDICES

Not applicable.

KOMITE NASIONAL KESELAMATAN TRANSPORTASI REPUBLIK INDONESIA
Jl. Medan Merdeka Timur No.5 Jakarta 10110 INDONESIA
Phone : (021) 351 7606 / 384 7601 Fax : (021) 351 7606 Call Center : 0812 12 655 155
website 1 : http://knkt.dephub.go.id/webknkt/ website 2 : http://knkt.dephub.go.id/knkt/
email : knkt@dephub.go.id