KOMITE NASIONAL KESELAMATAN TRANSPORTASI
REPUBLIC OF INDONESIA

FINAL

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Aircraft Accident Investigation Report

Angkasa Aviation Academy

Cessna 172S; PK-WUG

Cimanuk River, Indramayu, West Java

Republic of Indonesia

22 July 2019

2020

This Final Report was published 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 initial investigation carried out by the KNKT in accordance with Annex 13 to the Convention on International Civil Aviation Organization, the Indonesian Aviation Act (UU No. 1/2009) and Government Regulation (PP No. 62/2013).

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Jakarta, 9 April 2020

KOMITE NASIONAL
KESELAMATAN TRANSPORTASI
CHAIRMAN

SOERJANTO TJAHJONO

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ABBREVIATIONS AND DEFINITIONS

AAA	:	PT. Angkasa Super Services (Angkasa Aviation Academy)
AGL	:	Above Ground Level
C of A	:	Certificate of Airworthiness
C of R	:	Certificate of Registration
CASR	:	Civil Aviation Safety Regulation
DAAO	:	Directorate of Airworthiness and Aircraft Operation
DPER	:	Designated Pilot Examiner Representative
GPS	:	Global Positioning System
KNKT	:	*Komite Nasional Keselamatan Transportasi*/National Transportation Safety Committee
LT	:	Local Time
MFD	:	Multi-Function Display
MSL	:	Mean Sea Level
NCP	:	Non-compliance
PIC	:	Pilot in Command
PPL	:	Private Pilot License
PSC	:	Pilot School Certificate
psi	:	pound per square inch
SD	:	Secure Digital
SOP	:	Standard Operating Procedures
TPM	:	Training Procedures Manual
UTC	:	Universal Time Coordinated

SYNOPSIS

On 22 July 2019, a Cessna 172S registered PK-WUG was being operated by Angkasa Aviation Academy (AAA) on a mutual flight training exercise from Cakrabhuwana Airport (WICD), Cirebon to Indramayu Training Area. The flight plan was filed with cruising altitude of 2,000 feet. The exercise for the student pilot was on C-14 Stage which contained exercises of mutual precision rate one turns, compass error and performance maneuvers.

Prior to the departure, there was no record or report of aircraft system malfunction. On board the aircraft were two student pilots and one of the students acted as Pilot in Command (PIC) while the other student pilot seated on the right seat.

At 1358 LT, the PK-WUG aircraft departed from Cirebon to the Indramayu Training Area. The Global Positioning System (GPS) installed in the aircraft recorded that when the aircraft was flying over the southern boundary of the Indramayu Training Area, the aircraft was descending. At 1425 LT, the aircraft flew westerly and was descending passed 750 feet.

The aircraft continued descend and while flew over the Cimanuk River passed 140 feet. About one minute flying over the river, the aircraft struck power line cables and crashed into the river.

After the aircraft stopped, both pilots self-evacuated from the aircraft and helped by local people to the river bank. During the evacuation, the Safety Pilot was drowned and fatally injured while the PIC had minor injury.

The investigation determined that the aircraft serviceability was not issue in this accident. The investigation concluded the contributing factor of the accident was:

- The available means to monitor flight training activities that had not been utilized resulted in the aircraft flying below the minimum safe altitude was undetected.
- Flying the aircraft below the minimum safe altitude and unaware of the power line cables ran across the river made the aircraft struck three power line cables.

The KNKT had been informed safety actions taken by the AAA and considered relevant to improve safety, however there still safety issues remain to be considered. Therefore, the KNKT issued safety recommendations to the AAA and Directorate General of Civil Aviation to address safety issues identified in this report.

1 FACTUAL INFORMATION

1.1 History of the Flight

On 22 July 2019, a Cessna 172S registered PK-WUG was being operated by Angkasa Aviation Academy (AAA) on a mutual flight training exercise from Cakrabhuwana Airport (WICD), Cirebon[1] to Indramayu Training Area[2]. The flight plan was filed with cruising altitude of 2,000 feet. The exercise for the student pilot was on C-14 Stage which contained exercise of mutual precision rate one turns, compass error and performance maneuvers.

Prior to the departure, there was no record or report of aircraft system malfunction. On board the aircraft were two student pilots and one of the students acted as Pilot in Command (PIC) while the other student pilot seated on the right seat.

At 0648 UTC (1348 LT[3]), the PIC requested engine start-up clearance to the Cakrabhuwana Tower controller (Cakrabhuwana controller) for a mutual training exercise. The Cakrabhuwana controller approved the request and asked the PIC to report when ready to taxi.

At 1351 LT, the PIC requested taxi clearance to the Cakrabhuwana controller and was instructed to taxi to holding point runway 04. At 1356 LT, the Cakrabhuwana controller instructed the PK-WUG to continue line up after one aircraft airborne from runway 04.

At 1358 LT, the Cakrabhuwana controller issued takeoff clearance to the PK-WUG. After the aircraft was airborne, the Cakrabhuwana controller instructed the PIC to maintain altitude 1,000 feet and to report when over CA[4].

At 1402 LT, the Cakrabhuwana controller instructed the PIC to contact Kertajati Tower controller (Kertajati controller) for further air traffic services.

At 1403 LT, the PIC reported to the Kertajati controller that the PK-WUG position was over CA at altitude 1,000 feet. The Kertajati controller then instructed the PIC to climb to an altitude of 2,000 feet and to report over visual check point Suranenggala[5].

At 1405 LT, the PIC reported to Kertajati controller that the PK-WUG position was over Suranenggala and was on climbing passed altitude of 1,600 feet. The Kertajati controller acknowledged and instructed the PIC to report visual check point Karang Ampel[6].

1 Cakrabhuwana Airport (WADY), Cirebon will be named as Cirebon for the purpose of this report.

2 Indramayu Training Area is located about 32 Nm from Cakrabhuwana Airport on bearing 339°.

3 The 24-hours clock in Local Time (LT) is used in this report to describe the time as specific events occured. Local time is Universal Time Coordinated (UTC) +7 hours.

4 CA is Non-Directional Beacon (a radio transmitter which used as navigation aids) located at approximately 4 Nm from Cakrabhuwana Airport on bearing 019°.

5 Suranenggala is visual checkpoint which located about 7.6 Nm from Cakrabhuwana Airport on bearing 360°.

6 Karang Ampel is visual checkpoint which located about 16.3 Nm from Cakrabhuwana Airport on bearing 360°.

At 1417 LT, the PIC reported to the Kertajati controller that the PK-WUG has arrived on the Indramayu training area at an altitude of 2,000 feet. The Kertajati controller instructed the PIC to report the estimated time leaving the training area. The PIC advised the Kertajati controller that the estimated time leaving the training area was 0830 UTC (1530 LT). The Kertajati controller then instructed the PIC to report when leaving the Indramayu training area.

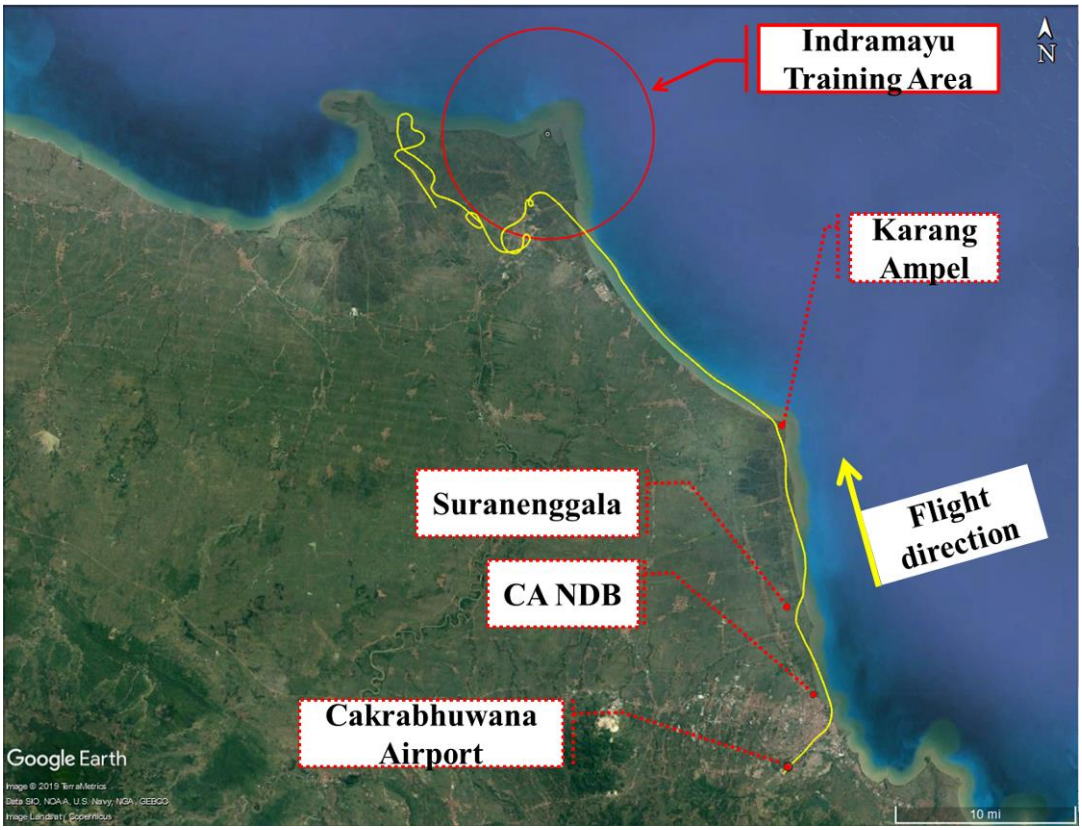

Figure 1: The flight profile (yellow line) based on GPS Garmin G1000 data

The PIC recalled that during exercise on Indramayu Training Area, the other student pilot who seated on the right seat (Other Student Pilot) suggested to fly over a river on west border of the training area for sightseeing. The Other Student Pilot was former aircraft engineer with 4-year-experience and was known among student pilots as skillful student pilot and mastered aircraft system. The PIC considered that the Other Student Pilot was familiar with the river area and then agreed to fly near the river.

The Global Positioning System (GPS) installed in the aircraft recorded that at 1421 LT, when the aircraft was flying over Indramayu city, the aircraft barometric altitude was decreasing from 2,000 feet indicated that the aircraft was descending.

The PIC was aware that the Kertajati controller did not utilize radar surveillance and there was no other aircraft with flight instructor flew in the Indramayu Training Area. In addition, the PIC knew that no systems to monitor the flight maneuver within the flying school and considered that no means to supervise the actual flight maneuver. Considering those conditions, the PIC decided to descend below the requirement of the minimum safe altitude and at 1425 LT, the aircraft flew westerly and passed altitude of 750 feet.

During flying parallel with the river at low altitude, as the weather was clear, the student pilots curious to fly over the river which had wide and straight contour. The aircraft altitude continued decreasing and at 14:35:12 LT, the aircraft flew over the Cimanuk River with the barometric altitude decreasing and passed 140 feet. The PIC was aware several power line cables ran parallel with the river but not have visual to power line cables that ran crossed the river. After about one minute flying over the river, the aircraft struck power line cables and crashed in the river.

After the aircraft stopped, both pilots self-evacuated from the aircraft and helped by local people to the river bank. During the evacuation, the Other Student Pilot drowned and fatally injured while the PIC had minor injury.

About 1508 LT, the local people who helped the pilots called AAA office Head Quarter in Balaraja advising that the PK-WUG aircraft had crashed in Cimanuk River. The AAA officer then relayed the information to the Flight Operation personnel in Cirebon who then attempted to contact the PK-WUG via company frequency. After no response, the Flight Operation personnel informed the PK-WUJ pilots which were flying over the Losari area and asked to verify the occurrence of PK-WUG to the Kertajati controller.

At 1512 LT, the pilot from PK-WUJ aircraft asked the Kertajati controller of the PK-WUG aircraft position and was responded that aircraft was on the Indramayu training area. The PK-WUJ pilot then asked the Kertajati controller to call the PK-WUG.

The Kertajati controller then called the PK-WUG several times and no answer.

At 1513 LT, the Kertajati controller called the Angkasa Aviation Academy representative officer in Cirebon and informed that the controller unable to communicate with the PK-WUG. The officer then informed the Kertajati controller that the PK-WUG crashed in Cimanuk River.

At 1526 LT, the Kertajati controller advised the Search and Rescue Agency (Badan SAR Nasional) of the occurrence.

1.2 Injury to Person

The PIC suffered minor injured while the Other Student Pilot fatally injured. Both pilots were Indonesian.

1.3 Damage to Aircraft

The aircraft was substantially damaged.

1.4 Other Damage

Three power line cables were cut off.

1.5 Student Pilots Information

		PIC	Other Student Pilot
Gender	:	Male	Male
Age	:	23 years	25 years
Nationality	:	Indonesian	Indonesian
Marital status	:	Single	Single
Date of joining company	:	9 July 2018	9 July 2018
License	:	Private Pilot License (PPL)	PPL
Date of issue	:	7 February 2019	5 February 2019
Aircraft type rating	:	Single Engine Land	Single Engine Land
Instrument rating validity	:	-	-
Medical certificate	:	Second-class	Second-class
Last of medical	:	8 April 2019	2 April 2019
Validity	:	8 April 2020	2 April 2020
Medical limitation	:	-	-
Last line check	:	-	-
Last proficiency check	:	5 May 2019	15 May 2019
Flying experience			
Total hours	:	92 hours 4 minutes	85 hours 26 minutes
Total on type	:	92 hours 4 minutes	85 hours 26 minutes
Last 90 days	:	44 hours 28 minutes	39 hours 3 minutes
Last 30 days	:	22 hours 6 minutes	17 hours 21 minutes
Last 7 days	:	7 hours 38 minutes	1 hours 50 minutes
Last 24 hours	:	-	-
This flight	:	About 38 minutes	0

There was no report or indication that the student pilots were unfit during the occurrence. Both student pilots were able to swim.

1.6 Aircraft Information

The Cessna 172 S aircraft registered PK-WUG was manufactured in 2013 by Cessna Aircraft Company with serial number of 172S11326. The aircraft had valid Certificate of Airworthiness (C of A) and Certificate of Registration (C of R).

The aircraft total hour since new was 2,816 hours and 7 minutes and the total cycles since new was 4,338 cycles. The engine installed was IO-360-L2A manufactured by Textron Lycoming with serial number of L-35889.51E. The total time since new was 2,816 hours and 7 minutes.

The aircraft was equipped with Garmin G1000 Global Positioning System (GPS) which has capability of flight data logging. According to the Garmin G1000 Integrated Flight Deck Pilot's Guide, the data logging capability would automatically store critical flight and engine data on a Secure Digital (SD) data card inserted into the top card slot of the Multi-Function Display (MFD). The data logging is recorded on to the SD data card once every second while the MFD is powered ON.

The logging data capable to record 64 parameters including time, coordinate, GPS altitude, indicated airspeed, vertical speed, ground speed, pitch attitude angle and roll attitude angle. All of these recorded parameters could be downloaded.

After the occurrence, the data of the SD data card installed on the Garmin G1000 was successfully retrieved. The data consisted of 30 recorded files since 8 until 22 July 2019 included the accident flight which contained 45 minutes of aircraft movement.

1.7 Meteorological Information

The local people who helped the evacuation of the student pilots stated that the weather was clear and the sky over the accident area was clear without any cloud.

The *Badan Meteorologi Klimatologi dan Geofisika* (Bureau of Meteorology, Climatology and Geophysics) provided satellite images to the investigation which indicated the weather over the accident site was clear.

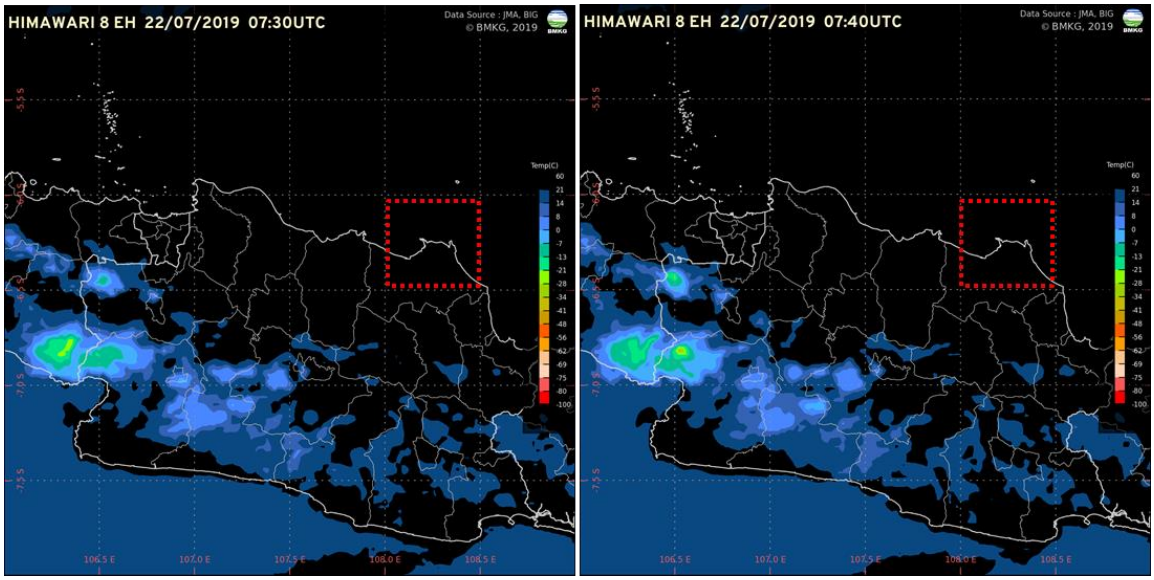

Figure 2: The satellite images over the accident site (red-dotted square)

1.8 Aids to Navigation

The AAA Training Procedures Manual (TPM) defines the Indramayu Training Area as:

> *1,500 to 5,000 ft and 5nm radius from area checkpoint, maintaining altitude 2,000 ft, fly visually to the north coastline and keep over coastline until reach TANJUNG INDRAMAYU.*

In the AAA TPM described departure guidance to the Indramayu Training Area from runway 04 of Cirebon as follows:

RWY IN USE 04 – NORMAL PROCEDURES

1. *After airborne maintain runway heading until 1000 ft.*
2. *Climb to maintain 2000 ft, clearing [look around].*
3. *Fly to the north coastline for west training area or fly to the east coastline for East training area.*
4. *Follow coast line to proceed to training area.*

.....

7. *For INDRAMAYU area fly over coastline until TANJUNG INDRAMAYU for INDRAMAYU area checkpoint.*

The AirNav Indonesia branch Cirebon determined visual border for Indramayu Training Area in the Standard Operating Procedure of Flying School as follows:

North	:	cape
East	:	beach
South	:	oil refinery Balongan
West	:	river (Cimanuk River)

1.9 Communications

The communication between student pilot and air traffic controller was recorded by ground based automatic voice recording equipment and the recorder was serviceable. The quality of the aircraft's recorded transmissions was good. The significant expert of the communication will be included in the final report

1.10 Aerodrome Information

The Cakrabhuwana Airport is located in Cirebon, East Java. According to the Minister of Transportation Decree number 55 of 2016, the airspace over Cirebon is included in the designated training area. Several flight schools use this airport as their flight training operation base including the AAA.

1.11 Flight Recorders

The aircraft was not equipped with flight recorder and it was not required by current Indonesia regulation for this type of aircraft.

1.12 Wreckage and Impact Information

The aircraft struck three power line cables that ran across the river from North-East to South-West direction on height of 10 meters (32 feet). All three power line cables broken and one of the cables got caught in the main landing gear struts.

The aircraft was found about 100 meters from the power line on South-East direction and tilted to the left with the left part of the aircraft was sunk into the river. A few moments later, the aircraft completely sunk into the river. The river depth was about 15 meters.

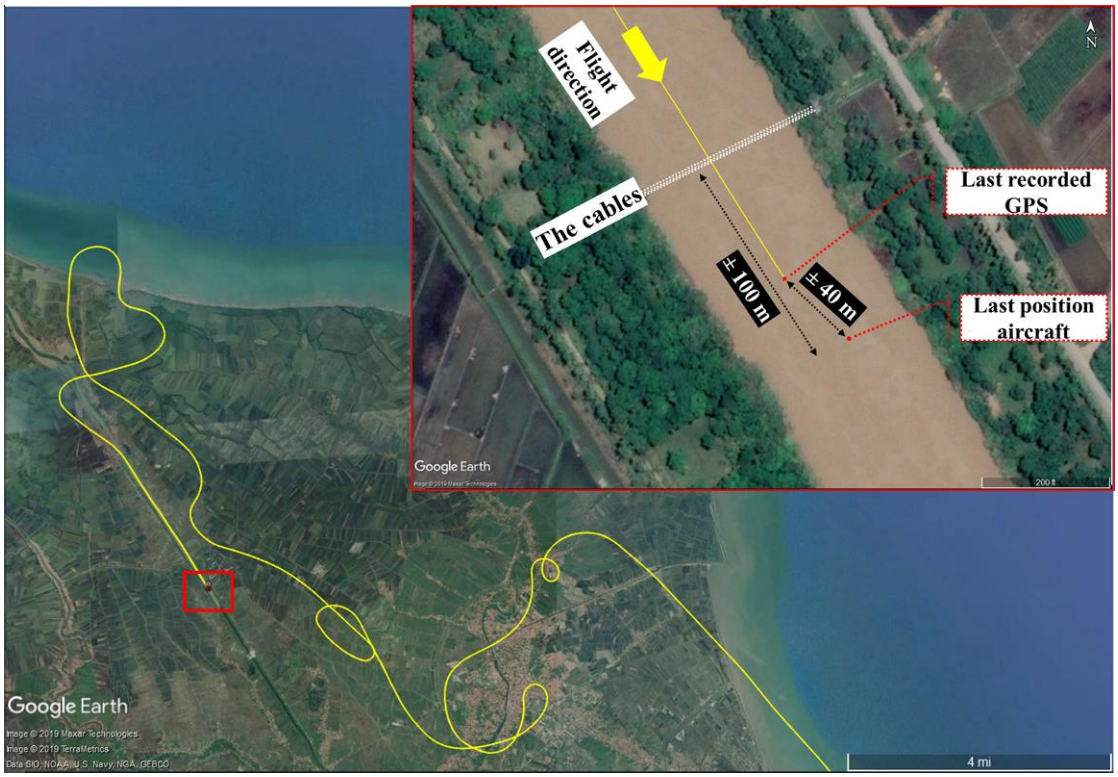

Figure 3: The aircraft flight profile and accident site information

One day after the accident, the aircraft heading changed to the South direction most likely due to river current. The diver who recovered the aircraft informed that the engine section folded down, the windshield cracked, and all the wheels detached. During the recovery process, the aircraft sustained additional damages.

Figure 4: The aircraft condition after recovered from the river

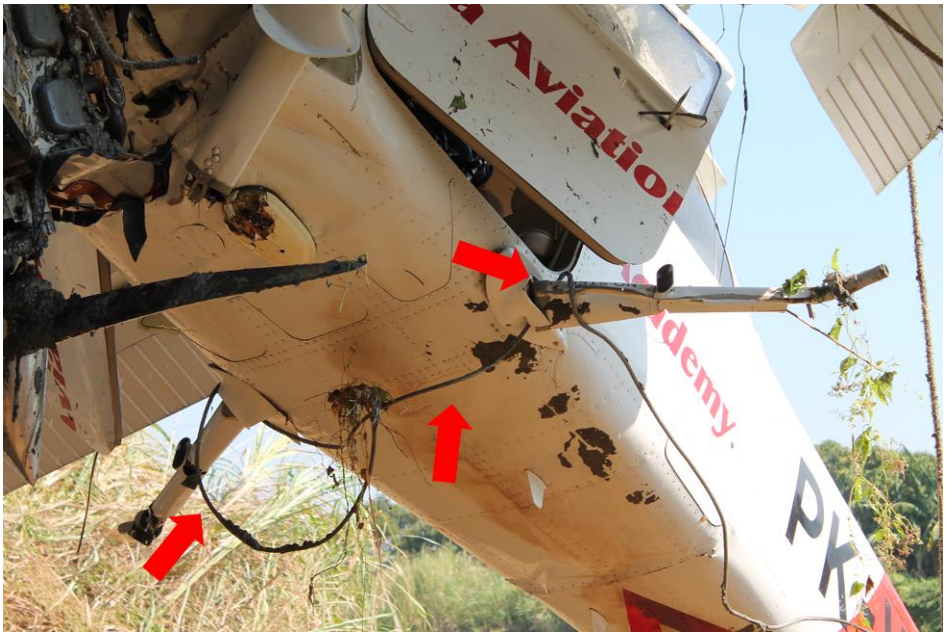

Figure 5: The power line cable caught in the main landing gear struts (red arrows)

The figure 6 showed the cables condition after repaired. The photo was taken using drone at GPS altitude of 22 feet about 42 meters from the cables.

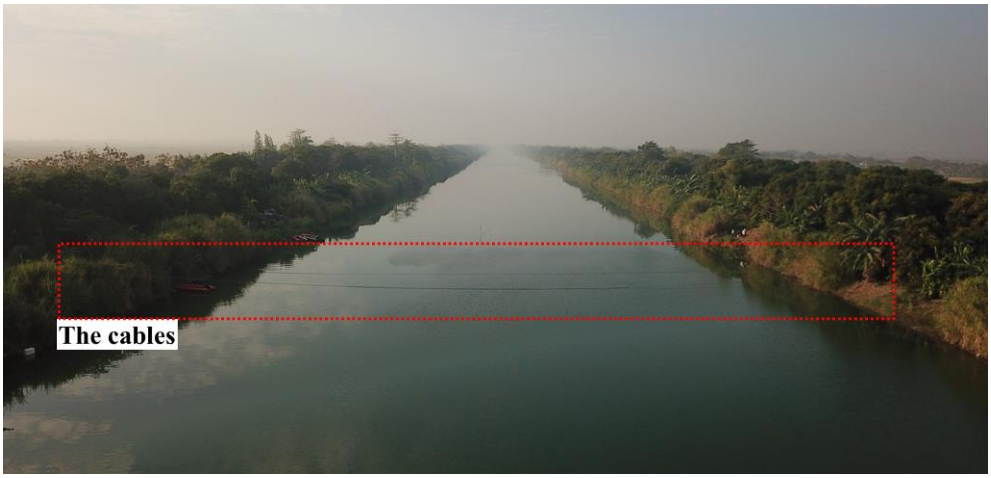

Figure 6: The cables across the river (in the red-doted square)

1.13 Medical and Pathological Information

Should any medical or pathological information will be included in the final report.

1.14 Fire

There was no evidence of fire.

1.15 Survival Aspects

After the aircraft stopped, the aircraft was partially immersed in the river and the water was flowing into the cockpit. Both student pilots were wearing the seatbelt. The PIC did not recall any mechanical issued when unfastened the seatbelt. The PIC self-evacuated through windshield as the door was unable to be opened. The PIC focused evacuating from the aircraft and did not search for the life vest as the PIC was able to swim. The PIC did not see the Other Student Pilot appeared on the water surface, the PIC then swam and dived to the right side of the aircraft try to find the Safety Pilot. The PIC did not have clear visibility in the water and floated back. The PIC then noticed the Other Student Pilot floated with his bag on the right side of the aircraft. The PIC did not recall seeing the Other Student Pilot had any injury. Both student pilots did not use the life vest available in the aircraft.

The PIC then helped the Other Student Pilot to swim to the river bank by pulling the Other Student Pilot hand. Two local people near the accident site helped to evacuate the student pilots to the river bank. The PIC recalled that the Other Student Pilot released the PIC hand. The PIC safely evacuated while the Other Student Pilot drowned into the river. The local people recalled that during the evacuation, they noticed strong smell of aircraft fuel which made them dizzy.

About 1508 LT, the local people who helped the pilots called AAA office advising that the PK-WUG aircraft crashed in Cimanuk River and reported the accident to the local police. The local police then coordinate with the *Badan SAR Nasional* (Search and Rescue Agency) to conduct the search and rescue activities. After the Kertajati controller was aware of the accident, the controller also notified the accident to the Search and Rescue Agency.

On 23 July 2019, at 0935 LT, the Other Student Pilot body was found about 100 meters from the main wreckage.

1.16 Tests and Research

On 7 August 2019, the investigation conducted engine teardown on the AAA facility in Cirebon. The detail of the engine teardown was as follows:

a. Visual inspection of engine mounting on the aircraft wreckage;
   The visual inspections of the engine mounts were to determine the engine mounting deformation. The engine mounts bend downward (relative to the aircraft longitudinal axis) suggested the result of the impact loading during the aircraft impacted into the water.

b. Visual inspection of fuel strainer;
   The fuel strainer which installed on the nose bulkhead was removed to observe the foreign object. The inspection was intended to determine whether any foreign object that prevent the fuel supply to the engine. The inspection found there was no foreign object in the strainer. The strainer was contaminated by water most likely due to immerse in the water.

c. Visual inspection of engine on jack;
   The engine was put on jack to observe the general condition after recovered from the water. The engine was relative clean, most likely had been rinsed before putting on jack. Some bare metal like exhaust and oil tank were partly corroded due to prolonged water contamination during preservation. The general visual inspection to the external engine was found no abnormality.

d. Visual inspection of fuel pump;
   The fuel pump was dismantled to expose the internal part including the membrane. There was no significant finding in the internal part of the fuel pump. The fuel membrane was intact and there was no sign of torn. The inspection concluded that the fuel pump was operative during the occurrence.

e. Visual inspection of fuel divider;
   The inspection suggested there was no sign of blockage in the fuel divider.

f. Visual inspection of fuel control unit;
   The fuel control unit was dismantled to expose the internal part. The inlet of the fuel control unit was covered by the mud. This mud most likely was sucked during the aircraft impacted into the water. The mud in the inlet indicated that there was inhaling action into the engine. The inhaling action indicated that the engine was operative during the impact into the water.
   The internal part of the fuel control unit was exposed. The inlet and outlet line were relative clear and there was no sign of blockage. The visual inspection indicated there was no abnormality during the visual inspection and suggested that the fuel control unit was operative during the occurrence.

g. Visual inspection of oil filter;
   The oil filter was opened using a special tool. The internal part of the oil filter was clean and there was no significant foreign deposit except water ingress. The visual inspection suggested that there was no abnormality in the oil filter.

h. Bench check of both magnetos;
   Both magnetos were placed onto the bench. Manually rotating the magnetos showed the electrical spark ignited from the output leads. The bench check suggested that both magnetos were operative during the occurrence.

i. Visual inspection of cylinders;
Before the cylinders were dismantled, the compression check was carried out to determine the current compression in each cylinder. The cylinder cover was removed to expose the inlet and exhaust valve. The valves were found corroded most likely due to water ingress. The result is as follow:

- Cylinder no 1: pressure in 80 psi, pressure in cylinder was read 0 psi
- Cylinder no 2: pressure in 80 psi, pressure in cylinder was read 0 psi
- Cylinder no 3: pressure in 80 psi, pressure in cylinder was read 48 psi
- Cylinder no 4: pressure in 80 psi, pressure in cylinder was read 5 psi

The compression test was found under the specified in the aircraft maintenance manual (under the pre-determined pressure 80 psi). This condition most likely due to the corrosion of the valve resulted in the lost pressure.
All pistons were removed and found some mud on the piston crowns. The mud leads to piston corrosion. The corrosion suggested the water ingress into the cylinders. After removal of the mud and corrosion, all the pistons exhibit normal condition without any sign of damage.
All cylinders were found corroded and it was suspected due to water ingress.

j. Bench check of all spark plugs;
All spark plugs were put on the bench to determine the serviceability. All the spark plugs were ignited normally.

Based on the visual inspection and bench check of the related engine components during the tear down, it concluded that the engine was operative during the occurrence.

1.17 Organizational and Management Information

1.17.1 Aircraft Operator

The aircraft is operated by PT. Angkasa Super Services (Angkasa Aviation Academy/AAA) which had valid Pilot School Certificate (PSC) number 141D-021. The AAA operates 22 aircraft consist of two Cessna 172P, four Cessna 172R and 16 Cessna 172S (including the occurrence aircraft).

The AAA had two flight operation bases – Palangkaraya and Cirebon flight operation base. During the accident, the PK-WUG aircraft was used for training purpose in Cirebon flight operation base.

The AAA developed Training Procedures Manual (TPM) which had been approved by the Directorate General of Civil Aviation (DGCA) on February 2014. The subchapter 1.6.1 of the TPM described that at the time student pilots enrolled, one of the requirements is the AAA must provide copy of procedures and practices that describe the use of the training facilities and the operation of its aircraft which include minimum altitude limitations and simulated emergency landing instructions.

The AAA developed Standard Operating Procedures (SOP) for Cessna 172S which contains safety procedures to be followed by student pilot. The subchapter 5.1.8 of the SOP described minimum safe altitude procedures as follows:

> *Except for take-off and landings, all students will practice all air work, at or above 1,000 ft AGL. Force landings maneuvers will be done at a minimum altitude of 500 ft MSL with accompany authorized flight instructor, unless over an active airport runway. For SOLO or MUTUAL emergency practice or simulations will be done at a minimum altitude of 750 ft MSL, unless over an active airport runway.*

1.17.1.1 Aircraft Movement Monitoring Activities

From 19 to 25 February 2018, the Directorate of Airworthiness and Aircraft Operation (DAAO) of the DGCA conducted audit for renewal of the AAA PSC. One of the finding was the AAA had not developed system to monitor the movement of aircraft in real time as required in the Civil Aviation Safety Regulation (CASR) part 141. To close the finding, the AAA had upgraded the GPS installed in their aircraft with capability for broadcasting Automatic Dependent Surveillance – Broadcast (ADS–B)[7] data and used ADS-B-based flight tracker application to monitor the aircraft movement. The AAA TPM did not describe any procedure regarding the aircraft monitoring activities and only mentioned the following statement:

> *3.5.2. AIRCRAFT EQUIPMENT*
>
> *b. Meet the requirements of CASR 141.47 for monitor the movement of aircraft Angkasa Aviation Academy know installation and upgrade of Garmin 1000 with ADS-B out.*

Since the CASR part 141 had been amended to include flight following requirement until the accident of PK-WUG, there was no record that flight following had been conducted by the AAA. Monitoring of student pilot flight was performed by flight instructor while conducts training flight.

1.17.1.2 Global Positioning System Flight Data Log

The investigation retrieved Global Positioning System (GPS) Garmin G1000 flight data log from PK-WUG aircraft which contained 30 files including the accident flight. Each file contained data of flight since engine start until engine stop. The flight data for the accident flight recorded 64 parameters on 45 minutes of flight operation. The investigation utilized the flight data log and imposed to Google Earth (figure 7) to determine the sequence of events as follows:

- 13:59:28 LT, the fuel flow, ground speed and the propeller Rotation Per Minute (RPM) were increased and indicated that the aircraft was on open power for takeoff.
- 14:21:53 LT, the aircraft was over Indramayu city on heading 172°, the barometric altitude started to decrease which indicated the aircraft descend from 2,000 feet and the Indicated Airspeed (IAS) was 95 knots.
- 14:24:45 LT, the aircraft left Indramayu city on heading 280°, the barometric altitude continued decreasing and passed 990 feet and the IAS was 85 knots.

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7 Automatic Dependent Surveillance – Broadcast (ADS–B) is a surveillance technology in which an aircraft determines its position via satellite navigation and periodically broadcasts it, enabling it to be tracked.

- 14:25:28 LT, the aircraft continued heading 341° towards the Cimanuk River. The barometric altitude continued decreasing and passed 750 feet and the IAS was 83 knots.
- 14:35:12 LT, the aircraft flew over the Cimanuk River on heading 134°, the barometric altitude continued decreasing and passed 140 feet and the IAS was 85 knots.
- 14:35:39 LT, the aircraft flew over Cimanuk River on heading 140°, the barometric altitude reached 13 feet then started to increase to 70 feet in 6 seconds. Then at 14:35:46 LT, the barometric altitude started to decrease.
- 14:36:36 LT, the data recorded the aircraft on heading 145°, the barometric altitude was 13 feet and the IAS was 96 knots. According to the Google Earth, the aircraft position was before the cable location.
- 14:36:38 LT, the Garmin G1000 stopped recording.

The AAA downloaded the GPS Garmin G1000 flight data log every three days. The downloaded data then was stored in the engineering server, as there was no requirement from the CASR part 141 nor the AAA procedures the data has not been utilized to enhance safety or monitor flight operation.

The investigation retrieved 139 files that had been downloaded from the PK-WUG before the accident and 198 files from PK-WUJ aircraft since April 2019. The data indicated that 17 flight training exercises over training area descended below 500 feet MSL which consisted of 11 dual flights (student fly with flight instructor) and 6 mutual flights (student fly with another student)[8]. The detail of those 17 flights can be found in the appendix.

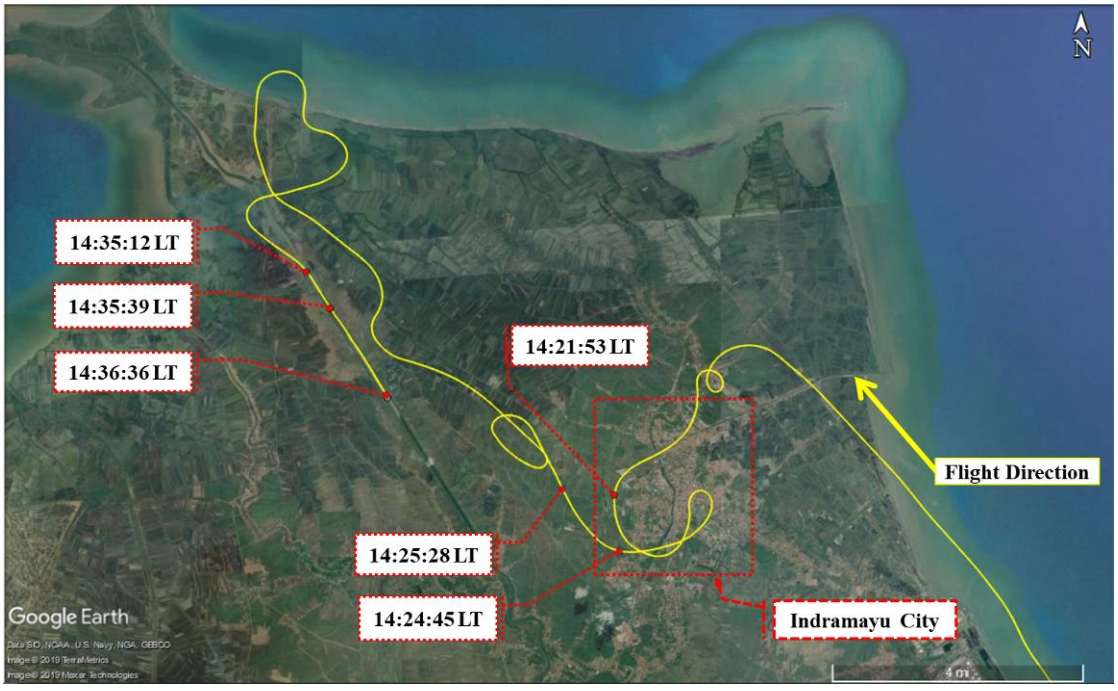

Figure 7: The GPS flight data log superimposed with Google Earth

8 The definition of Dual and Mutual flights is described by the AAA during the interview process.

1.17.1.3 Safety Management System

The Safety Management System within AAA was managed by Safety and Quality Assurance department, responsible to Head of Training.

The AAA developed Safety Management System Manual (SMSM) which had been approved by the Directorate General of Civil Aviation (DGCA) on February 2014. The SMSM chapter X described hazard as follows:

> *Condition, object or activity with any existing or potential condition that can lead to injury, illness, or death; damage to or loss of a system, equipment, or property; or damage to the environment. A hazard is a condition that might cause (is a prerequisite to) an accident or incident.*

The SMSM subchapter 1.5.2 described safety risk management as:

> *Process of hazard identification and management of risk to acceptable levels. This systematic process describes how to identify hazards, how to assess the risks, and then the procedures to control the risks.*

In term of hazard identification process, the AAA implemented air safety and/or hazard report. The SMSM subchapter 3.4.1.3 described that any individual involved directly or indirectly in the flight and maintenance activities of AAA (i.e., employees, part-time/contract personnel, and aviation students) must report any observed hazard to the Safety and Quality unit.

The engineer for the AAA aircraft several times found marks of insects on the landing gear after landing and the engineer had suspected that the aircraft had been flown on low altitude. No hazard or air safety report had been documented regarding those findings.

1.17.2 Directorate General of Civil Aviation

The Directorate General of Civil Aviation (DGCA) is government agency under the Ministry of Transportation which has authority to regulate the civil aviation in Indonesia. The DGCA has several directorates including the Directorate of Airworthiness and Aircraft Operation (DAAO) that responsible in formulating policy and standard including oversight of the pilot school activities.

1.17.2.1 Policy and Standard in the Civil Aviation Safety Regulation (CASR)

The CASR part 91 described general operating and flight rules of the aircraft operation. The relevant subpart of the CASR part 91 was as follows:

> *91.119 Minimum Safe Altitudes: General*
>
> *Except when necessary for takeoff or landing, no person may operate an aircraft below the following altitudes:*
>
> *(a) Anywhere. An altitude allows, if a power unit fails, an emergency landing without undue hazard to persons or property on the surface.*
>
> *(b) Over congested areas. Over any congested area of a city, town, or settlement, or over any open air assembly of persons, an altitude of 1,000 feet above the highest obstacle within a horizontal radius of 600 meters of the aircraft.*
>
> *(c) Over other than congested areas. An altitude of 500 feet above the surface, except over open water or sparsely populated areas. In those cases, the aircraft may not be operated closer than 200 meters to any person, vessel, vehicle, or structure.*

The CASR part 141 described certification and operating requirement for pilot school. On 2 April 2015, the Directorate General of Civil Aviation amended the CASR Part 141 to include the requirement of flight following to address safety issues of unmonitored training flight that deviate from the safety procedures. The requirement of flight following described in the subchapter 141.47 as follows:

141.47 Flight Following

An applicant to Pilot School Certificate or Provisional Pilot School Certificate shall provide a system to monitor the movement of aircraft that can shows the position, altitude, direction and speed in real time.

The CASR part 19 described minimum acceptable requirement regarding Safety Management System (SMS) for service provider[9] includes an approved training organization. The relevant subpart of the CASR part 19 was as follows:

19.1 Definitions

For the purpose of this regulation, the term:

10. Hazard means condition, object or activity with the potential of causing injuries to personnel, damage to equipment or structures, loss of material, or reduction of ability to perform a prescribed function.

19.29 Safety Data Collection and Processing systems

(a) A service provider shall develop and maintain Safety Data Collection and Processing systems (SDCPS) that provide for the identification of hazards and the analysis, assessment and mitigation of safety risks.

(b) A service provider's SDCPS shall include reactive, proactive and predictive methods of safety data collection.

19.31 Hazard Identification

(a) A service provider shall develop and maintain formal means for effectively collecting, recording, acting on and generating feedback about hazards in operations, which combine reactive, proactive and predictive methods of safety data collection. Formal means of safety data collection shall include mandatory, voluntary and confidential reporting systems as required by sections 19.57 and 19.59 of this part.

(b) The hazard identification process shall include the following steps:

(1) reporting of hazards, events or safety concerns;

(2) collection and storing the safety data;

(3) analysis of the safety data; and

(4) distribution of the safety information distilled from the safety data.

9 Service provider is an approved or certified organization providing aviation services.

19.33 Risk management

(a) A service provider shall develop and maintain a formal risk management process that ensures the analysis, assessment and mitigation of risks of consequences of hazards to an acceptable level.

(b) The risks of the consequences of each hazard identified through the hazard identification processes described in section 19.31 of this part shall be analyzed in terms of probability and severity of occurrence, and assessed for their tolerability.

(c) The organization shall define the levels of management with authority to make safety risk tolerability decisions.

(d) The organization shall define safety controls for each risk assessed as tolerable.

SUBPART C SAFETY DATA AND SAFETY INFORMATION COLLECTION, ANALYSIS, PROTECTION

19.59 Voluntary Reporting

(a) Each service provider shall establish a voluntary reporting system to facilitate the collection of:

(1) details of occurrences that may not be captured by the mandatory reporting system;

(2) other safety-related information which is perceived by the reporter as an actual or potential hazard to aviation safety.

1.17.2.2 Oversight Activities

The DAAO conducts oversight through audit and surveillance program to Pilot School Certificate (PSC) or Provisional Pilot School Certificate holders to promote conformance with the aviation regulations and standards described in the CASRs, including the CASR part 141. The DAAO will conduct audit prior the issuance of PSC and prior the reissuance/renewal of the PSC. In regards with the surveillance program as a continuing oversight for the PSC holder, the DAAO divided the program into three groups as follows:

- Group A surveillance which covered:
  - management personnel;
  - training procedure manual;
  - curriculum and syllabus;
  - rating and authorization;
  - examinations authority;
  - training course outline;
  - staff qualification.

- Group B surveillance which covered:
  - record;
  - training facilities;
  - airport;
  - ground trainers and training aids;
  - quality of instruction;
  - manual/publication library;
- Group C surveillance which covered:
  - Minimum Equipment List (MEL);
  - flight instructor;
  - DPER (Designated Pilot Examiner Representative).

The conformity to the flight following requirement is included in the Group B surveillance under the area of training facilities.

The DAAO inspector uses Staff Instruction (SI) 8900-6.3 as procedure to conduct the audit and surveillance. The SI 8900-6.3 described Non-Compliance (NCP) as:

> *Deficiency in characteristic, documentation, or procedure with respect to provisions of the Aviation Act No. 01 of 2009 or a CASR. This is action must be taken immediately but not exceed than 15 days upon identification of the audit and surveillance finding. Audit findings that have direct impact on aviation safety may be taken to stop the operation of aircraft, maintenance, suspend of personnel licensing or termination of AOC activities.*

The DAAO inspector used DGCA form 141-04 as checklist when conducted audit and surveillance on PSC holder. The form provides question checklist to be followed by inspector to determine the conformity of PSC with the requirement standards. The DAAO inspector explained that the question checklist to check the conformity of flight following was included in the Operation Area under the subject of Training Facilities and Quality of Instruction. The questions were:

9. Training Facilities

- *Does the pilot school have continuous use of the facilities?*
- *Does the pilot school have adequate space of area office, classroom?*
- *Are Available Each training aid, including any audio-visual aid, projector, tape recorder, mock-up, chart, or aircraft component listed in the approved training course outline, must be accurate and appropriate to the course for which it is used?*
- *Does the pilot school have briefing area?*
- *Does other pilot school use the briefing area during the same period as the principal school?*
- *Is the room or other space used for instructional purposes, heated, lighted, and ventilated to conform to local building, sanitation and health codes?*
- *Is each aircraft necessary for that training meets the regulation standards?*
- *Are available flight simulators or flight training device used for training?*
- *Are flight simulator certified and approved by the DGCA?*

12. Quality of Instruction

- *Has each graduate or pilot recommended for a pilot certificate or rating completed the training and required final test?*
- *Does the pilot* school:
  a) *Conduct training and instruction in accordance with its approved course of training?*
  b) *Enroll the student in its approved course before receiving the instruction and training?*
- *Has each student solo practice flight been approved by an authorized flight instructor who is present at that airport*
- *Has the chief instructor conducted each stage or test given to a student enrolled in appropriated of instructions*
- *Has the chief instructor maintained training techniques, procedure and standard for the school that are acceptable to the DGCA?*
- *Has the pilot school immediately notified to the DGCA in writing of any change in its designation of a chief instructor for an approved training course?*
- *Has the pilot school conducted training in instruction for more than 60 days without a chief instructor?*

1.17.2.3 Oversight on Flight Following Activity

From 19 to 25 February 2018, the DAAO conducted audit for renewal of the Pilot School Certificate of the AAA using the DGCA form 141-04 as an audit checklist. While following the checklist on the Operation Area under Training Facilities subject to check the flight following conformity, the inspector used list question of "*is each aircraft necessary for that training meets the regulation standards"* with subchapter 141.47 of CASR part 141 as reference.

The AAA provided evidence that one of their aircraft was able to be monitored in real time using flight tracking application named RadarBox[10], as the aircraft GPS had been upgraded with capability to broadcast ADS-B data. The inspector determined that the evidence was not sufficient and determined that the AAA has not established a flight following to monitor the movement of aircraft. This finding was classified as Non-Compliance (NCP) finding.

In order to close the NCP finding of the flight following, the AAA required to improve the capability of their all aircraft GPS. The AAA proposed waiver to the DGCA which described the plan to finish the upgrade. On 9 March 2018, the DAAO closed the flight following finding after considered that the evidence of one aircraft was able to be monitored using flight tracking application and the plan to finish the upgrading process were sufficient to ensure that flight following activity was conducted within the AAA.

On 15 March 2018, the AAA requested additional time of 60 days to enable all aircraft to be equipped with ADS-B data broadcast capability. The additional time request was approved by DAAO and would conduct evidence data verification after the AAA finished the upgrading process.

10 RadarBox is a flight tracking company that displays aircraft and flight information in real-time on a map. The detail information of RadarBox can be found in the following link: https://www.radarbox.com/about

On 16 March 2018, after considered that all findings were closed, the DGCA reissued the Pilot School Certificate of the AAA.

On 17 May 2018, the AAA completed the GPS system upgrade which enables all aircraft to have capability of ADS-B data broadcast which had been verified by the DAAO.

From 9 to 10 October 2018, the DAAO conducted routine surveillance to the AAA which included surveillance area of the training facilities. The DAAO inspector used the DGCA form 141-04 while referring to the question of "*is each aircraft necessary for that training meets the regulation standards?"* the DAAO inspector referred to the aircraft Certificate of Airworthiness (C of A) and Certificate of Registration (C of R). There was no finding regarding the flight following requirement.

During the investigation, the DAAO explained to the KNKT if any Pilot School Certificate or Provisional Pilot School Certificate holder able to show that their aircraft can be monitored in real time during audit or surveillance, the flight following requirement in the subchapter 141.27 will be consider as comply. There was no requirement to provide evidence that the training flight is systematically monitored.

1.17.2.4 Special Audit after the Accident

As result of the accident of PK-WUG, the DAAO conducted special audit from 31 July to 2 August 2019. The inspector determined that the flight following which utilized the ADS-B data had been conducted within AAA in Palangkaraya Base. However, in the Cirebon Base, the flight following activity had not been established due to the AAA did not have ADS-B receiver in Cirebon. The AAA then conducted corrective action by installing ADS-B receiver on 5 September 2019 and the DAAO considered that the flight following had been established within the AAA.

1.18 Additional Information

1.18.1 Similar Occurrence

On the day of the accident, another Cessna 172 of another flying school departed from Cirebon experienced cable strike on the Losari Area which located about 18 Nm from Cakrabhuawa Airport on bearing 108°. On board the aircraft were two student pilots that were conducting mutual training exercise. The student pilot continued the flight and landed safely in Cirebon.

KNKT inspect to the aircraft involved and found damages on the aircraft vertical stabilizer that most likely was caused by impact to power line cable (figure 8). The electrical power company also reported broken cables on the Losari Area.

The flying school had not extented the subscription of the flight following application therefore, the system to monitor the movement of aircraft in real time was inactive during the occurrence.

KNKT decided not to investigate this occurrence, considering that the occurrence was due to reckless operation, and the safety issues will be similar to the accident of PK-WUG. The KNKT has reported this decision to the DGCA.

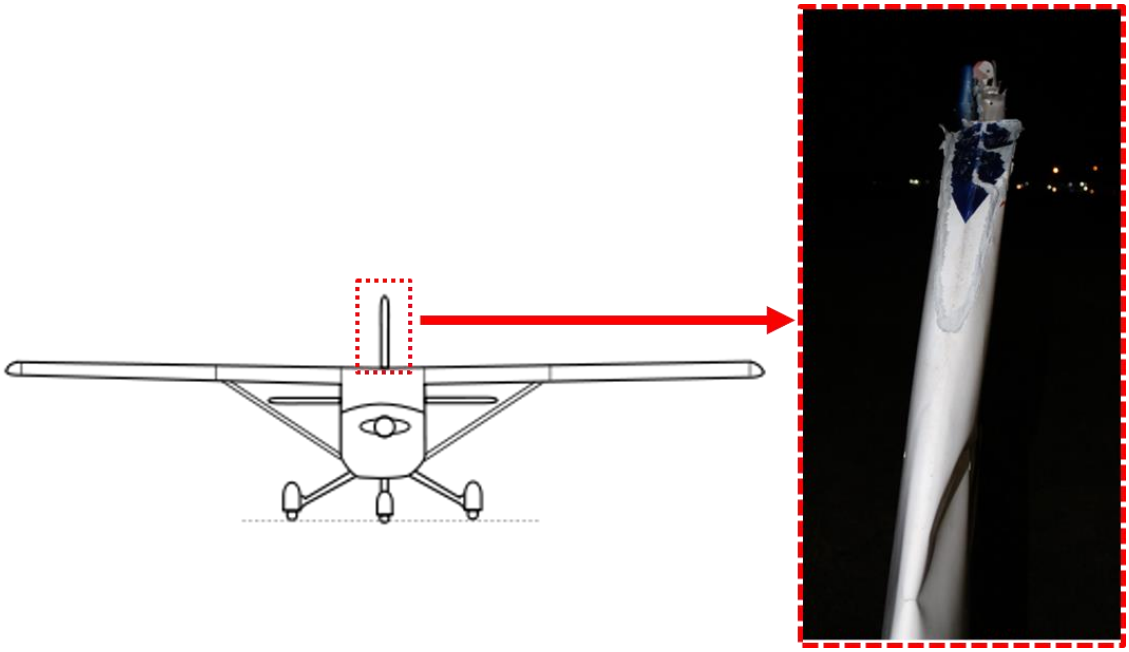

Figure 8: The damaged aircraft vertical stabilizer (in the red-dotted square)

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

Prior the departure, there was no record of report of aircraft system malfunction and the PIC described that during the accident there was no indication of aircraft handling problem. The engine teardown conducted after the accident concluded that the engine was operating during the occurrence. The investigation determined that the aircraft serviceability was not issue in this accident. Therefore, the analysis will discuss the relevant issues as follows:

- Aircraft movement;
- Flight following compliances;
- Flight monitoring activities; and
- Survival aspect.

2.1 Aircraft Movement

The PIC recalled that during exercise on Indramayu Training Area, the Other Student Pilot suggested to fly over a river on west side of the training area for sightseeing. The Other Student Pilot formerly was an aircraft engineer with 4-year-experience and was known among the student pilots as skillful student pilot and mastered aircraft system. The PIC considered that the Other Student Pilot was familiar with the river area and agreed to fly over the river.

The PIC was aware that the Kertajati controller did not equipped with radar surveillance and there was no other aircraft with flight instructor flew around Indramayu Training Area. In addition, the PIC knew that there was no system established by the AAA flying school to monitor the flight maneuver. Based on those conditions, the PIC concluded that there was no means available to supervise the actual flight maneuver. The absence of flight monitoring and accompanied by a skillful student pilot who was familiar with the river area made the PIC decided to descend below the requirement of the minimum safe altitude described in the AAA SOP.

During flying parallel with the river on low altitude, the student pilots observed the wide and straight contour of the river, and the clear weather condition made the student pilots decided to fly on low altitude over the river. The student pilots were aware power line cables ran parallel with the river and did not have visual of the power line cables ran across the river.

The absence of monitoring system and the river contour had made the student pilots decided to do low flying over the river. Without visual cue of the power line cables ran across the river made the aircraft stroke power line cable during low flying.

2.2 Flight Following Compliances

On 2 April 2015, the Directorate General of Civil Aviation amended the Civil Aviation Safety Regulation (CASR) part 141 to include the flight following requirement to address safety issues of unmonitored training flight flying against procedures. The applicant to Pilot School Certificate (PSC) or Provisional Pilot School Certificate must establish a system to monitor the movement of aircraft that able to monitor the position, altitude, direction and speed in real time.

The AAA had not established flight following system in accordance with the CASR Part 141 until the day of the accident.

During the audit for renewal of AAA Pilot School Certificate (PSC) on February 2018, the DAAO inspector referred to the CASR Part 141.47 and used the DGCA form 141-04 for the renewal audit. On the checklist question of "*is each aircraft necessary for that training meets the regulation standards"* the inspector determined that the AAA did not have flight following system to monitor aircraft movement.

To be able to have flight following system, the AAA conducted corrective action by upgrading the aircraft GPS with capability to broadcast Automatic Dependent Surveillance – Broadcast (ADS–B) data and monitored in a real time using ADS-B-based flight tracking application. This method was presented to the DAAO inspector to show that the aircraft was able to be monitored. The DAAO considered that the method complied with flight following requirement.

The method that was established by the AAA was not included with the procedure of conducting this flight following activity. Therefore, no one within the AAA was responsible to monitor the aircraft movement using the established method.

From 9 to 10 October 2018, during the Group B surveillance to the AAA, the DAAO inspector used the same DGCA form 141-04, and while using the checklist question of "*is each aircraft necessary for that training meets the regulation standards?"* the DAAO inspector referred to the aircraft Certificate of Airworthiness (C of A) and Certificate of Registration (C of R). The flight following system was not oversighted. The use of the checklist resulted in multiple interpretation depends on the reference that was used by the inspector. This indicated that the checklist was not sufficient and, in this case, the flight following requirement was not oversighted thoroughly.

During the investigation, the DAAO explained to the KNKT if a PSC or Provisional Pilot School Certificate holder show their capability to monitor the aircraft in real time during audit or surveillance, the flight following requirement in the subchapter 141.27 will be consider as comply. There was no requirement to provide evidence that the aircraft was systematically monitored. By showing the flight tracking method which able to monitor aircraft only without any procedure to conduct the flight following activities was not sufficient to ensure that the flight following had been conducted systematically. This also supported the fact that the KNKT found two aircraft had been flown over training area below the AAA minimum safe altitude requirement for 17 times within four months.

The lack of checklist guidance combined with differ understanding of the flight following purpose made the absence of system to monitor flight training activity in the AAA was not detected.

2.3 Flight Monitoring Activities

The AAA determined the minimum safe altitude in the Cessna 172S Standard Operating Procedures (SOP). To ensure the requirement was implemented, the AAA included this requirement as mandatory material to be followed by a student during enrolled in the AAA. In addition, the flight instructors are assigned to supervise the flying conducts by student pilots. Air safety/hazard report was also used as a tool to report any training flight that did not follow the standard requirement.

The CASR part 19 required approved training organization to have Safety Data Collection and Processing Systems (SDCPS) for the identification of hazards and the analysis, assessment and mitigation of safety risks. The SDCPS included voluntary reporting that collects details of occurrences that may not be captured by the mandatory reporting system, and other safety-related information which is perceived by the reporter as an actual or potential hazard to aviation safety.

The AAA aircraft engineer ever found small insects stuck in the leading edge of aircraft after landing and the engineer had suspected that the aircraft had been flown on low altitude. However, the investigation did not find any air safety/hazard report regarding this finding.

All of AAA aircraft were equipped with Garmin G1000 Global Positioning System (GPS) which capability of flight data logging and to broadcast ADS-B data. The Garmin G1000 flight data logging feature can be used to detect whether any flight that flying below the minimum safe altitude requirement.

The AAA downloaded the Garmin G1000 flight data log every three days. As there was no procedure to utilize the recorded data, the downloaded data was stored in the engineering server have not been utilized for any purpose. The KNKT utilized the Garmin G1000 recorded data of two aircraft within four months prior the PK-WUG accident and found 17 training flights were flying below the minimum safe altitude.

The available means to monitor the aircraft that had not been utilized and the absence of air safety/hazard report regarding the suspect of low altitude flight made the training flight which flying below the minimum safe altitude had not been detected within the AAA. This indicated that safety risk management within the safety management system had not been properly implemented.

2.4 Survival Aspect

After the aircraft stopped, the aircraft was sinking in the river and the water was flowing into the cockpit. Both student pilots were wearing the seatbelt. The PIC did not recall any mechanical issued when unfastened the seatbelt. The PIC self-evacuated through the aircraft windshield as the door was unable to be opened. The engine section of the aircraft folded down as result of impact forces which might make the left door was unable to be opened.

The PIC focused evacuating from the aircraft and did not search the life vest as the PIC was able to swim. The investigation was unable to determine the reason why the Other Student Pilot did not use life vest available in the aircraft.

The Other Student Pilot had prolonged time in the water than the PIC and the reason was undetermined. The PIC recalled that when the Other Student Pilot floated on the right side of the aircraft, he was holding his bag. The Other Student Pilot might require time to search his bag which might contribute to prolong time in the water. The PIC also did not recall seeing the Other Student Pilot had any injury. The PIC helped the Other Student Pilot to swim to the river bank by pulling the Other Student Pilot hand which then was released by the Other Student Pilot. The local people described that during the evacuation, they noticed strong smell of aircraft fuel which made them dizzy. The reason of the Other Student Pilot released the PIC hand was undetermined, however the prolong time in the water with fuel that possibly made people dizzy might contribute to reduce the swimming capability and by not wearing the life vest resulted in the Other Student Pilot drowned into the river.

3 CONCLUSIONS

3.1 Findings

The 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.

The KNKT identified findings as follows:

1. The student pilots had valid private pilot licenses which qualified as single engine land pilot and valid second-class medical certificates. There was no report or indication that the student pilots were unfit during the occurrence.
2. The aircraft had valid Certificate of Airworthiness (C of A) and Certificate of Registration (C of R).
3. The aircraft was equipped with Garmin G1000 Global Positioning System (GPS) which has capability of flight data logging. The aircraft was not equipped with flight recorder and it was not required by current Indonesia regulation for this type of aircraft.
4. Prior to the departure, there was no record or report of aircraft system malfunction.
5. The accident flight was mutual flight training exercise and was assigned to Indramayu Training area, and the exercise for the student pilot was on C-14 Stage which contained exercise of mutual precision rate one turns, compass error and performance maneuvers.
6. The PIC recalled that during exercise on training area, the Other Student Pilot suggested to fly over a river on west border of the training are for sightseeing and was agreed by the PIC considering that the Other Student Pilot was familiar with the river area.
7. The flight data log of the Global Positioning System (GPS) recorded that when the aircraft was flying over Indramayu city, the aircraft was descending from 2,000 feet.
8. The AAA SOP subchapter 5.1.8 described that except for take-off and landings, all air work must be performed at minimum altitude of 1,000 feet Above Ground Level (AGL). Force landings maneuvers must be performed at a minimum altitude of 500 feet MSL with accompany authorized flight instructor, for Solo or Mutual emergency simulations must be performed at a minimum altitude of 750 feet MSL unless over an active airport runway.
9. The absence of flight monitoring and accompanied by a skillful student pilot who was familiar with the river area made the PIC decided to descend below the requirement of the minimum safe altitude described in the AAA SOP.
10. At 14:35:12 LT, the aircraft flew over the Cimanuk River and was descending passed 140 feet. About one minute flying over the river, the aircraft struck power line cables and crashed in the river. The cables broken and one of the cables caught in the main landing gear struts.

11. The student pilots were aware power line cables ran parallel with the river and did not have visual of the power line cables ran across the river. Descended the aircraft below a minimum safe altitude without visual cue of power line cables ran across the river made the aircraft stroke power line cable during low flying.
12. The aircraft wreckage found about 100 meters from the power line on South-East direction.
13. After the aircraft stopped, the aircraft was sinking in the river and the water was flowing into the cockpit. The PIC self-evacuated through the aircraft windshield as the door was unable to be opened. The engine section of the aircraft folded down as result of impact forces which might make the left door was unable to be opened.
14. Both student pilots were wearing the seatbelt. The PIC did not recall any mechanical issued when unfastened the seatbelt.
15. The PIC focused evacuating from the aircraft and did not search the life vest as the PIC was able to swim. The investigation was unable to determine the reason why the Other Student Pilot did not use life vest available in the aircraft.
16. The Other Student Pilot had prolonged time in the water than the PIC and the reason was undetermined. The PIC recalled that when the Other Student Pilot floated on the right side of the aircraft, he was holding his bag.
17. The local people described that during the evacuation, they noticed strong smell of aircraft fuel which made them dizzy. The PIC helped the Other Student Pilot to swim to the river bank by pulling the Other Student Pilot hand which then was released by the Other Student Pilot. The reason of the Other Student Pilot released the PIC hand was undetermined, however the prolong time in the water with fuel that possibly made people dizzy might contribute to reduce the swimming capability and by not wearing the life vest resulted in the Safety Pilot drowned into the river.
18. The diver who recovered the aircraft informed that the engine section folded down, the windshield cracked, and all the wheels were detached. During the recovery process, the aircraft sustained additional damages.
19. The satellite images record during the accident indicated the weather over the accident site was clear. The local people who helped the evacuation of the student pilots stated that the weather was clear.
20. The engine teardown was based on the visual inspection and bench check of the related engine components, it concluded that the engine was operative during the occurrence.
21. On the day of the accident, there was another Cessna 172 from different flying school departed from Cirebon experienced cable strike on the Losari Training Area which indicated by the damages found on the aircraft vertical stabilizer. The electrical power company also reported broke cables on the Losari area. The flying school had not established a system to monitor the movement of aircraft in real time.
22. The CASR part 141 subchapter 141.47 requires applicant to Pilot School Certificate (PSC) or Provisional Pilot School Certificate shall provide a system to monitor the movement of aircraft that can shows the position, altitude, direction and speed in real time.

23. From 19 to 25 February 2018, the DAAO conducted audit for renewal of the AAA PSC and determined that the AAA has not established a flight following to monitor the movement of aircraft as required in the CASR part 141.
24. On 9 March 2018, the DAAO closed the flight following finding after considered that the evidence of one aircraft was able to be monitored using flight tracking application and the plan to finish the upgrading process were considered sufficient to ensure that flight following activity.
25. The AAA did not have procedure to conduct flight following activity therefore no one was responsible to monitor the aircraft movement using the established method.
26. The DAAO inspector used checklist on DGCA form 141-04 to check the conformity of flight following requirement which resulted in multiple interpretation depends on the reference that was used by the inspector. This indicated that the checklist was not sufficient and, in this case, the flight following requirement was not oversighted thoroughly.
27. The DAAO inspector explained that if a PSC or Provisional Pilot School Certificate holder shows their capability to monitor the aircraft in real time during audit or surveillance, the flight following requirement in the subchapter 141.27 will be consider as comply. There was no requirement to provide evidence that the aircraft was systematically monitored.
28. The lack of checklist guidance combined with differ understanding of the flight following purpose made the absence of system to monitor flight training activity in the AAA was not detected.
29. By showing the flight tracking method which able to monitor aircraft only without any procedure to conduct the flight following activities was not sufficient to ensure that the flight following had been conducted systematically. This also supported the fact that the GPS Garmin G1000 flight data log recorded two aircraft had been flown over training area below the AAA minimum safe altitude requirement for 17 times within four months.
30. The CASR part 19 required approved training organization to have Safety Data Collection and Processing Systems (SDCPS) for the identification of hazards and the analysis, assessment and mitigation of safety risks. The SDCPS included voluntary reporting that collects details of occurrences that may not be captured by the mandatory reporting system, and other safety-related information which is perceived by the reporter as an actual or potential hazard to aviation safety.
31. In term of hazard identification process, the AAA implemented air safety and/or hazard report. The SMSM subchapter 3.4.1.3 described that any individual involved directly or indirectly in the flight and maintenance activities of AAA (i.e., employees, part-time/contract personnel, and aviation students) must report any observed hazard to the Safety and Quality unit.
32. The aircraft engineer ever found small insects stuck in the leading edge of aircraft after landing and the engineer suspected that the aircraft had flown on low altitude. However, the investigation did not find any air safety/hazard report regarding this finding.

33. The GPS Garmin G1000 flight data log was downloaded periodically and stored in the engineering server and have not been utilized for any purpose. The data can be utilized to detect whether any flight that flying below the minimum safe altitude requirement.
34. The available means to monitor the aircraft that had not been utilized made training flight which flying below the minimum safe altitude was not detected within the AAA. This indicated that safety risk management within the safety management system had not been properly implemented.

3.2 Contributing Factors

The 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 identification of contributing factors does not imply the assignment of fault or the determination of administrative, civil or criminal liability. The presentation of the contributing factors is based on chronological order and not to show the degree of contribution.

The investigation concluded the contributing factor of the accident was:

- The available means to monitor flight training activities that had not been utilized resulted in the aircraft flying below the minimum safe altitude was undetected.
- Flying the aircraft below the minimum safe altitude and unaware of the power line cables ran across the river made the aircraft struck three power line cables.

4 SAFETY ACTION

At the time of issuing this report, the KNKT had been informed safety actions taken by the Directorate General of Civil Aviation (DGCA) and the Angkasa Aviation Academy (AAA).

4.1 Directorate General of Civil Aviation

On 31 July until 2 August 2019, the DGCA conducted special audit to the AAA and one of the finding was the AAA did not have receiver of ADS-B in the Cirebon flight operation base.

On 15 August 2018, the DGCA conducted Safety Awareness meeting which invited all aircraft operator in Indonesia. One of the meeting agenda highlighted the requirement of flight following activity for Pilot School Certificate holder.

On 15 November 2019, the DGCA issued safety circular which instructed Pilot School Certificate holders to:

- Conduct training to ensure minimum safe altitude requirement and reckless operation prohibition described in the CASR are implemented by all student pilots.
- Develop procedure, designate personnel and provide facility to conduct flight following activities;
- Conduct flight following activities in accordance with CASR part 191 subchapter 141.47. If the flight following system cannot be used, the flight training exercise must be conducted in the aerodrome circuit.
- Improve the oversight to ensure avoid reckless operation.
- Report to the DAOO Principal Training Inspector of the progress of the action taken following this safety circular.

4.2 Angkasa Aviation Academy

On 29 July 2019, issued Training Quality Notice to Flight Operation officer and all pilots (including student pilot) as follows:

- The simulated engine failure exercise must not be conducted during solo and mutual flight training. The exercise must only be conducted under supervision of a flight instructor and followed the height restriction in accordance with the AAA SOP subchapter 5.1.8 and 5.28.4. In addition, the instructor must be made aware that the field selection for exercise must avoid towns or other densely populated area. Otherwise, this exercise may be done during FTD session.
- All student pilots must undergo a mutual check by flight instructor, and the instructor must debrief the student regarding the function and responsibility of the Safety Pilot.
- For mutual and solo flight training, the student must report to the company channel after performing steep turn and stall exercise on area.

- PIC is reminded to fill the Maintenance Log Book after the completion of every flight. Flight Operations will be responsible in ensuring the logbooks are properly filled by the pilot every flight. Pilots should not commence the flight if they found that the maintenance logbook has not been filled accordingly.

On 5 September 2019, the AAA installed ADS-B receiver in the Cirebon flight operation base to enhance the capability to retrieve ADS-B data in order to monitor the movement of aircraft in real time.

On 16 December 2019, the AAA developed Standard Operational Procedure (SOP) of flight following activities which requires dedicated personnel to monitor flight activities every minute using ADS-B-based flight tracker application. The following procedure was the original SOP in Bahasa and was translated by the investigator for the purpose of this report:

The original text	**The translated text**
Flight Following bertujuan agar pihak sekolah mengetahui dan monitoring status pesawat untuk keselamatan penerbangan.	The Flight Following is intended for the flying school to be able to identify and monitor the aircraft status for safety purposes.
Adapun metode yang digunakan sebagai berikut:	The methods of flight following activities:
1. Petugas flight following menggunakan aplikasi RadarBox	1. Flight following personnel uses the RadarBox
2. Petugas di Flight Operation (Flops) menggunakan radio untuk berkomunikasi dengan PIC dan SIC tiap pesawat	2. Flight operation (Flops) personnel uses radio to communicate with PIC and SIC of each aircraft;
3. Petugas flight following selalu memonitor kegiatan penerbangan tiap menitnya	3. Flight following personnel always monitor the flight activities every minute.

5 SAFETY RECOMMENDATIONS

The KNKT acknowledges the safety actions taken by the Angkasa Aviation Academy (AAA) 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 the AAA and Directorate General of Civil Aviation to address safety issues identified in this report.

5.1 Angkasa Aviation Academy

- **04.O-2019-14.1**

  Flying below the minimum safe altitude is contrary to the Indonesia regulation and AAA procedure and hazardous especially if any obstacles surround the flight path. The Garmin G1000 data log of two AAA aircraft within period of four months prior the PK-WUG accident recorded 17 training flights flying below the minimum safe altitude. These low flying were not detected as the AAA had not established systems to monitor the movement of aircraft or to review and analyze the available data, such as Garmin G1000 data log.

  After the accident, the AAA installed ADS-B receiver in the Cirebon flight operation office to enhance the capability to retrieve ADS-B data in order to monitor the movement of aircraft in real time. The AAA had developed Standard Operation Procedure (SOP) of flight following activities which requires dedicated personnel to monitor flight activities using ADS-B-based flight tracker application. However, the procedure did not describe requirement to conduct immediate corrective action when deviation from requirement standard has been detected during flight training activity.

  Therefore, KNKT recommends the AAA develop system to monitor the training activity using the available means to detect flight training activity that deviate from the requirement standard and to enable immediate corrective action.

- **04.O-2019-14.2**

  The AAA aircraft engineer that had suspected the aircraft had flown on low altitude. However, the investigation did not find any air safety/hazard report regarding this finding. The hazard that is not reported makes the absence of risk assessment and the mitigation that may resulted in accident or incident.

  KNKT recommends the AAA to improve the safety management system implementation including hazard report by all company employees.

5.2 Directorate General of Civil Aviation (DGCA)

- **04.R-2019-14.3**

  The DAAO inspector used DGCA form 141-04 which comprised of several checklist questions to check the conformity of requirement standard in the CASR part 141. Different interpretation of the checklist guidance by DAAO inspectors had made the requirement of the flight following did not oversight thoroughly.

  The DAAO inspectors explained that if PSC or Provisional Pilot School Certificate holder able show the ability to monitor the aircraft in real time during audit or surveillance, it considered complied with the flight following requirement in the subchapter 141.27. There was no requirement to provide evidence that the training flight was systematically monitored. Showing the flight tracking application that able to monitor aircraft without any procedure to conduct the flight following activities was insufficient to ensure that the flight following had been conducted systematically. This also supported the fact that the AAA that had established a method without procedure had made the method did not implement and resulted in 17 flights that were flying below the AAA minimum safe altitude requirement undetected.

  The lack of checklist guidance resulted in different interpretation of the checklist and the quality of the oversight.

  Therefore, the KNKT recommend to review the DGCA form 141-04 to ensure all inspectors have same interpretation and able to conduct oversight all requirement standard of the CASR Part 141 thoroughly including the flight following requirement.

6 APPENDIX

6.1 Summary of Identified Flight Exercise below 500 feet MSL

No	Date	Flight Type	Exercise Information (area name & exercise type)	Remarks
1.	3 May 2019	Dual Flight	Karang Ampel (C11) • Dual Training Area • Evaluation BCM • Simulated emergency landings at least from 3,000 feet	Descended below 500 feet over coastline for 1 minute 29 seconds. • The lowest altitude was 28.3 feet MSL (07:14:50 UTC)
2.	9 May 2019	Dual Flight	Arjawinangun (C15) • Dual Training Area • All Exercises • All circuit exercises • CPL Phase	Descended below 500 feet over open field for 1 minute 14 seconds. • The lowest altitude was 47.6 feet MSL (06:23:18 UTC)
3.	13 May 2019	Dual Flight	Karang Ampel (C23) • Dual Training Area • Assessment on Basic Commercial Manuevers • Precision Flying	Descended below 500 feet over open field for 1 minute 11 seconds. • The lowest altitude was 73.7 feet MSL (06:54:13 UTC)
4.	16 May 2019	Dual Flight	Karang Ampel (CX CPL)	Descended below 500 feet over open field for 1 minute 7 seconds. • The lowest altitude was 42.5 feet MSL (07:03:10 UTC)
5.	16 May 2019	Dual Flight	Losari (C27) • Dual Training Area • All Exercises • All circuit exercises	Descended below 500 feet over open field for 1 minute 13 seconds. • The lowest altitude was 89.9 feet MSL (05:55:12 UTC)
6.	16 May 2019	Mutual Flight	Arjawinangun (C24) • Mutual precision rate one turn • Compass Error • Performance Maneuvers	Descended below 500 feet over open field for 41 seconds. • The lowest altitude was 440 feet MSL (07:36:49 UTC)
7.	23 May 2019	Mutual Flight	Indramayu (C14) • Mutual Precision rate one turn • Compass error • Performance maneuvers • Mutual Precision rate one turn • Performance Maneuvers	Descended below 500 feet over open field for 1 minute 3 seconds. • The lowest altitude was 145.4 feet MSL (02:13:05 UTC)

No	Date	Flight Type	Exercise Information (area name & exercise type)	Remarks
8.	24 May 2019	Mutual Flight	Karang Ampel (C13) • Mutual Flying • Compass Error • Limited Panel • Slow Flights level turn & Descent	Descended below 500 feet over open field for 55 seconds. • The lowest altitude was 311.7 feet MSL (07:41:13 UTC) Descended below 500 feet over coastline for 1 minute 29 seconds. • The lowest altitude was 61.7 feet MSL (07:45:46 UTC)
9.	28 May 2019	Dual Flight	Karang Ampel (C4) • Dual Training Area • Mutual Check Ride	Descended below 500 feet over open field for 1 minute 9 seconds. • The lowest altitude was 72.5 feet MSL (05:37:08 UTC)
10.	29 May 2019	Mutual Flight	Arjawinangun (C25) • Mutual precision rate one turn • Performance Maneuvers	Descended below 500 feet parallel with toll road twice for 1 minute 7 seconds and 1 minute 10 seconds. • The lowest altitude on the first maneuver was 403.4 feet MSL (07:26:16 UTC) • The lowest altitude on the second maneuver was 367.1 feet MSL (07:32:31 UTC)
11.	18 June 2019	Dual Flight	Arjawinangun (C7) • Dual Training Area • Flight instrument Flying • Limited Panel • Compass Error • Takeoffs & Landings • Normal & Crosswind • Go-arounds • Circuit Pattern	Descended below 500 feet over open field twice for 1 minute 16 seconds and for 1 minute 36 seconds. • The lowest altitude on the first maneuver was 62.4 feet MSL (05:34:00 UTC) • The lowest altitude on the second maneuver was 52.3 feet MSL (05:37:12 UTC)
12.	25 June 2019	Dual Flight	Karang Ampel (IR4) • Dual Training Area • NDB Holding • VOR Holding • VOR DME Holding	Descended below 500 feet over open field for 40 seconds. • The lowest altitude was 260.2 feet MSL (07:14:05 UTC)

No	Date	Flight Type	Exercise Information (area name & exercise type)	Remarks
13.	1 July 2019	Dual Flight	Karang Ampel (C15) • Dual Training Area • All Exercises • All circuit exercises CPL Phase	Descended below 500 feet over open field for 1 minute 26 seconds. • The lowest altitude was 27.2 feet MSL (04:32:12 UTC)
14.	2 July 2019	Dual Flight	Karang Ampel (C15) • Dual Training Area • All Exercises • All circuit exercises CPL Phase	Descended below 500 feet over open field for 1 minute 28 seconds. • The lowest altitude was 48.7 feet MSL (02:21:38 UTC)
15.	4 July 2019	Mutual Flight	Losari (C9) • Mutual Flying • Compass error • Limited Panel • Slow Flights level Turn & Descent Mutual Precision Rate One Turn Performance Maneuvers	Descended below 500 feet over open field twice for 1 minute 6 seconds and 1 minute 15 seconds. • The lowest altitude on the first maneuver was 51.3 feet MSL (07:22:42 UTC) • The lowest altitude on the second maneuver was 21 feet MSL (07:24:50 UTC)
16.	8 July 2019	Dual Flight	Karang Ampel (C15) • Dual Training Area • All Exercises • All circuit exercises • CPL Phase	Descended below 500 feet over open field for 1 minute 11 seconds. • The lowest altitude was 81.1 feet MSL (04:33:18 UTC)
17.	8 July 2019	Mutual Flight	Karang Ampel (C10) • Mutual Precision rate on turns • Compass error • Mutual Precision rate on turns	Descended below 500 feet over coastline twice • The lowest altitude on the first maneuver was 197.2 feet MSL (08:20:25 UTC) • The lowest altitude on the second maneuver was 63.3 feet MSL (08:23:59 UTC)

6.2 The Directorate General of Civil Aviation Comments

Reference Chapter, Page, Paragraph	Original Text	Proposed Amendment	Reason for Proposed Change	KNKT Response
1.17.1.3 Safety Management System Paragraph 6 3.1 Findings Number 30	The engineer for the AAA aircraft several times found marks of insects on the landing gear after landing and the engineer suspected that the aircraft had flown on low altitude. No hazard or air safety report had been documented regarding those findings.	The marks of insects on the landing gear after landing was not classified as hazard, as the condition did not have the potential of causing injuries to personnel, damage to equipment or structures, loss of material, or reduction of ability to perform a prescribed function. That condition was unable to be assumed that the aircraft had been flown on low altitude.	Based on the CASR part 91 subpart 19.1, hazard is defined as follows: *Hazard means condition, object or activity with the potential of causing injuries to personnel, damage to equipment or structures, loss of material, or reduction of ability to perform a prescribed function.*	The issue discussed in the paragraph 6 and finding number 30 was the absence of hazard or air safety report from the engineer that suspected aircraft flew at low altitude, that should have been reported. The report must be followed up by the organization to prove whether the aircraft had been flying low. This issue also was supported by the finding of several aircraft had flown below the minimum safe altitude prior the accident. The CASR part 19 required approved training organization to have Safety Data Collection and Processing Systems (SDCPS) for the identification of hazards and the analysis, assessment and mitigation of safety risks. The SDCPS included voluntary reporting that collects details of occurrences that may not be captured by the mandatory reporting system, and other safety-related information which is perceived by the reporter as an actual or potential hazard to aviation safety. The KNKT added the requirement of CASR part 19 in the factual information subchapter 1.17.2.1 and added the summarized requirement in the analysis subchapter 2.3 and findings.
2.3 Flight Monitoring Activities Paragraph 5	The available means to monitor the aircraft that had not been utilized and the absence of air safety/hazard report regarding the suspect of low altitude flight made the training flight which flying below the minimum safe altitude had not been detected within the AAA.	Referred to CASR part 91 subpart 91.119 (c) described that flight below 500 feet was prohibited with or without available means to monitor the aircraft.	*CASR part 91 subpart 91.119* *(c) Over other than congested areas. An altitude of 500 feet above the surface, except over open water or sparsely populated areas. In those cases, the aircraft may not be operated closer than 200 meters to any person, vessel, vehicle, or structure.*	Despite the existing regulation, the investigation found several flights were conducted below 500 feet. The AAA had means to monitor aircraft using the Garmin G1000 flight data log and air safety or hazard report. Should the Garmin G1000 flight data log was utilized, the flight that were not performed in accordance with the requirement would be able to be identified and prevented in timely manner. Another way of identifying the violation to the regulation was by the air safety or hazard report which might able to identify hazard in timely manner.

Reference Chapter, Page, Paragraph	Original Text	Proposed Amendment	Reason for Proposed Change	KNKT Response
3.1 Findings Number 9	The absence of flight monitoring and accompanied by a skillful student pilot who was familiar with the river area made the PIC decided to descend below the requirement of the minimum safe altitude described in the AAA SOP.	Referred to CASR part 91 subpart 91.119 (c) described that flight below 500 feet was prohibited with or without available means to monitor the aircraft.	*CASR part 91 subpart 91.119* *(c) Over other than congested areas. An altitude of 500 feet above the surface, except over open water or sparsely populated areas. In those cases, the aircraft may not be operated closer than 200 meters to any person, vessel, vehicle, or structure.*	The finding number 9 described safety issue that contributed to the PIC decision to descend the aircraft below the requirement of the minimum safe altitude. In this case, if the flight monitoring activities had been conducted properly might prevent the PIC to descend the aircraft below the requirement as the flight was monitored by the AAA.
3.1 Findings No. 21	On the day of the accident, there was another Cessna 172 from different flying school departed from Cirebon experienced cable strike on the Losari Training Area which indicated by the damages found on the aircraft vertical stabilizer. The electrical power company also reported broke cables on the Losari area. The flying school had not established a system to monitor the movement of aircraft in real time.	The KNKT did not have evidence from investigation report that concluded the flying school did not have system to monitor the aircraft movement in real time.	-	Subchapter 1.18.1 paragraph 4 had described: *The flying school had not extended the subscription of the flight following therefore, the system to monitor the movement of aircraft in real time was inactive during the occurrence.*
3.1 Findings No. 26	The DAAO inspector used checklist on DGCA form 141-04 to check the conformity of flight following requirement which resulted in multiple interpretation depends on the reference that was used by the inspector. This indicated that the checklist was not sufficient and, in this case, the flight following requirement was not oversighted thoroughly.	The analysis that described multiple interpretation of the DGCA form 141-04 need to be deleted.	KNKT did not have enough evidence as there was no survey had been conducted by KNKT to supervise the use of DGCA form 141-04.	The subchapter 1.17.2.3 described that the use DGCA form 141-04 on list question of "is each aircraft necessary for that training meets the regulation standards" was interpreted differently between the inspectors during the renewal audit and routine surveillance. The first inspector referred the CASR part 141 subchapter 141.47 of CASR part 141 to check the conformity of flight following requirement, while the other inspector used the C of A and C of R as compliance evidence, which made the conformity check of flight following was not oversighted thoroughly.

Reference Chapter, Page, Paragraph	Original Text	Proposed Amendment	Reason for Proposed Change	KNKT Response
3.1 Findings Number 31	The GPS Garmin G1000 flight data log was downloaded periodically and stored in the engineering server and have not been utilized for any purpose	The GPS Garmin G1000 flight data log was downloaded periodically and stored in the engineering server ~~and have not been utilized for any purpose~~.	The CASR part 91 and CASR part 141 did not require approved training organization to utilize GPS recorded data for any purpose.	The CASR part 19 described the following requirements: *19.31 Hazard Identification* *(b) The hazard identification process shall include the following steps:* *(1) reporting of hazards, events or safety concerns;* *(2) collection and storing the safety data;* *(3) analysis of the safety data; and* *(4) distribution of the safety information distilled from the safety data.* *19.33 Risk management* *(a) A service provider shall develop and maintain a formal risk management process that ensures the analysis, assessment and mitigation of risks of consequences of hazards to an acceptable level.* *(b) The risks of the consequences of each hazard identified through the hazard identification processes described in section 19.31 of this part shall be analyzed in terms of probability and severity of occurrence, and assessed for their tolerability.* *(c) The organization shall define the levels of management with authority to make safety risk tolerability decisions.* *(d) The organization shall define safety controls for each risk assessed as tolerable.* The KNKT utilized flight data log and identified several flights that flew below 500 feet. The AAA should implement the CASR 19.31 (b) by collecting and storing safety data, and analysis the safety data. The analysis of safety data is also required by CASR Part 19.33. The utilization of the GPS flight data log by the AAA should have been able to identify the flights that were performed below 500 feet and enable immediate corrective action to prevent the accident of PK-WUG.

Reference Chapter, Page, Paragraph	Original Text	Proposed Amendment	Reason for Proposed Change	KNKT Response
3.2 Contributing Factor	The investigation concluded the contributing factor of the accident was: • The available means to monitor flight training activities that had not been utilized resulted in the aircraft flying below the minimum safe altitude was undetected. • Flying the aircraft below the minimum safe altitude and unaware of the power line cables ran across the river made the aircraft struck three power line cables.	The investigation concluded the contributing factor of the accident was reckless operation. ~~• The available means to monitor flight training activities that had not been utilized resulted in the aircraft flying below the minimum safe altitude was undetected.~~ ~~• Flying the aircraft below the minimum safe altitude and unaware of the power line cables ran across the river made the aircraft struck three power line cables.~~	The CASR part 91 subpart 91.119 described: *(c) Over other than congested areas. An altitude of 500 feet above the surface, except over open water or sparsely populated areas. In those cases, the aircraft may not be operated closer than 200 meters to any person, vessel, vehicle, or structure.* Based on the requirement above, the flight below 500 feet was prohibited with or without available means to monitor the aircraft. The power line height was below 500 feet which did not require awareness of pilot during flight.	The KNKT described contributing factors 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 KNKT investigation is solely conducted for preventing accident by determining the safety issue, it is not the purpose of this activity to apportion blame or liability. The KNKT believes that the individual actions are not act alone, they are but one element of a complex system. Therefore, the KNKT did not focus on the reckless operation by individual action, but focused on how the system can be improved to prevent the reckless operation. The first dot of the contributing factors was described from point of view the reason of why the reckless operation happened. The second dot was described why the other flight that had been flown below 500 feet did not result an accident.

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