KOMITE NASIONAL KESELAMATAN TRANSPORTASI
REPUBLIC OF INDONESIA

FINAL

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Aircraft Accident Investigation Report

PT. Marta Buana Abadi (Dimonim Air)

PAC 750XL; PK-HVQ

Menuk Mountain, Oksibil, Papua

Republic of Indonesia

11 August 2018

2021

This Final Report is 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, the Indonesian Aviation Act (UU No. 1/2009) and Government Regulation (PP No. 62/2013).

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Jakarta, 19 April 2021

KOMITE NASIONAL
KESELAMATAN TRANSPORTASI
CHAIRMAN

SOERJANTO TJAHJONO

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ABBREVIATIONS AND DEFINITIONS

ACL	:	Authorization, Conditions and Limitations
ACO	:	Aeronautical Communication Officer
AFM	:	Aircraft Flight Manual
AGL	:	Above Ground Level
AIP	:	Aeronautical Information Publication
ALA	:	Aerodrome for Light Aircraft
ALT	:	Altitude
AOC	:	Air Operator Certificate
ATC	:	Air Traffic Control
ATS	:	Air Traffic Service
ATZ	:	Aerodrome Traffic Zone
AWOS	:	Automated Weather Observing System
BMKG	:	*Badan Meteorologi Klimatologi Geofisika*/Meteorological Climatological and Geophysics Agency
C of A	:	Certificate of Airworthiness
C of R	:	Certificate of Registration
CASR	:	Civil Aviation Safety Regulation
CDU	:	Cockpit Display Unit
CFIT	:	Controlled Flight into Terrain
CPL	:	Commercial Pilot License
DAAM	:	Data Acquisition Alarm Monitor
DAAO	:	Directorate of Airworthiness and Aircraft Operation
DAN	:	Directorate of Air Navigation
DGCA	:	Directorate General of Civil Aviation
EGPWS	:	Enhance Ground Proximity Warning System
ELT	:	Emergency Locator Transmitter
FAA	:	United States of America Federal Aviation Administration
FLTA	:	Forward Looking Terrain Avoidance
ft	:	Feet
GPS	:	Global Positioning System
GPWS	:	Ground Proximity Warning System
IAS	:	Indicated Air Speed

ICAO	:	International Civil Aviation Organization
kg	:	Kilogram
km	:	Kilometer
KNKT	:	*Komite Nasional Keselamatan Transportasi*
kts	:	Knots
lbs	:	Pound
LOCA	:	Letter of Operational Coordination Agreement
LT	:	Local Time
MFD	:	Multi-Function Display
MHz	:	Megahertz
NDB	:	Non-Directional Beacon
Nm	:	Nautical Mile
OM	:	Operation Manual
PDA	:	Premature Descent Alert
RPM	:	Rotation Per Minute
RWY	:	Runway
SI	:	Staff Instruction
SOP	:	Standard Operating Procedure
SOS	:	Save Our Soul, a code for distress signal
TAWS	:	Terrain Avoidance Warning System
TIBA	:	Traffic Information Broadcast by Aircraft
TSO	:	Technical Standard Order
UTC	:	Universal Time Coordinated
VFR	:	Visual Flight Rules

SYNOPSIS

On 11 August 2018, a PAC 750XL aircraft registered PK-HVQ was being operated by PT. Marta Buana Abadi (Dimonim Air) on unscheduled passenger flight from Tanah Merah to Oksibil. At the day of the occurrence the meteorological condition at Oksibil was below the requirement of Visual Flight Rule (VFR) weather minima and did not improve. Being aware that some flights had performed flight to Tanah Merah to Oksibil and returned, the pilot decided to fly to Oksibil.

At 1342 LT, on daylight condition the PK-HVQ aircraft departed from Tanah Merah to Oksibil, on board the aircraft were one pilot, one observer pilot and 7 passengers. According to the passenger and cargo manifest, the total weight of passenger and the baggage were 473 kg. Prior to the departure, there was no record or report of aircraft system malfunction.

At 1411 LT, the PK-HVQ pilot made initial contact to Oksibil Tower controller and reported that the aircraft was maintaining altitude of 7,000 feet over and the estimate time arrival at Oksibil would be 0520 UTC (1420 LT). The Oksibil Tower controller advised the pilot of the latest meteorological condition that the visibility was 1 up to 2 km and most of the area were covered by cloud.

At 1416 LT, the pilot reported that the aircraft position was over Oksibil Aiport and the Oksibil Tower controller instructed the pilot to continue the flight to the final runway 11 and to report when the runway had in sight.

The Oksibil Tower controller and pilots of other aircraft called the pilot but no reply. On the following day, the aircraft was found on a ridge of mountain about 3.8 Nm north west of Oksibil on bearing 331° with elevation about 6,800 feet. Eight occupants were fatally injured and one occupant was seriously injured.

Investigation involved Transport Accident Investigation Commission of New Zealand and Transportation Safety Board of Canada that assigned accredited representative according to the ICAO Annex 13.

The investigation determined the contributing factors of the occurrence as follows:

- VFR weather minimum requirement that was not implemented properly most likely had made the pilot did not have a clear visual to the surrounding area.
- Considering that the Pilot in Command (PIC) had lack knowledge of the terrain surrounding the Oksibil area, and the absence of voice alert from the TAWS when the aircraft flying close to terrain, resulted in the PIC did not have adequate awareness to the surrounding terrain while flying into clouds and continued to fly below the terrain height until the aircraft impacted the terrain.

The KNKT acknowledged the safety action taken by the related parties and considered the actions were relevant to improve safety, however, there still remain safety issues that need to be considered. Therefore, the KNKT issues safety recommendations addressed to the Dimonim Air, Directorate General of Civil Aviation (DGCA), and *Badan Meteorologi Klimatologi dan Geofisika*/Bureau of Meteorology, Climatology and Geophysics (BMKG).

1 FACTUAL INFORMATION

1.1 History of the Flight

On 11 August 2018, a PAC 750XL aircraft registered PK-HVQ was being operated by PT. Marta Buana Abadi (Dimonim Air) on unscheduled passenger and cargo flight in Papua area, Indonesia. The flights of the day scheduled for the aircraft were Boven Digoel Airport (WAKT), Tanah Merah[1] – Gunung Bintang Airport (WAJO), Okibil[2] – Tanah Merah – Manggelum Airstrip (WAKA) – Tanah Merah – Bomakia Airstrip (WAKL) – Tanah Merah.

About 0730 LT[3], Dimonim Air ground staff at Oksibil requested to the Oksibil Tower controller of the meteorological condition over Oksibil. The Oksibil Tower controller advised that the meteorological condition was below the requirement of Visual Flight Rule (VFR) weather minima. The Dimonim Air ground staff at Oksibil then relay the meteorological information to the Dimonim Air ground staff at Tanah Merah.

The flight plan of the PK-HVQ had been filed by the Pilot in Command (PIC) and was submitted to the Tanah Merah Aeronautical Communication Officer (ACO), the flight rules of the flight was filed with Visual Flight Rule (VFR). Thereafter, at 0926 LT, the flight plan of PK-HVQ aircraft with route Tanah Merah to Oksibil was submitted to the Oksibil ACO by the Tanah Merah ACO with estimate time of departure was 0945 LT.

The weather information of Oksibil indicated no improvement on weather condition, the pilot decided to change the flight schedule to Tanah Merah – Manggelum – Tanah Merah – Bomakia – Tanah Merah – Oksibil – Tanah Merah. At 1002 LT, the flight plan of PK-HVQ with route Tanah Merah to Oksibil was canceled.

At 1007 LT, the PK-HVQ aircraft departed from Tanah Merah to Manggelum.

The flights from Tanah Merah – Manggelum – Tanah Merah – Bomakia – Tanah Merah were uneventful, and at 1156 LT the aircraft landed safely at Tanah Merah. The flights were conducted as single pilot operation with one training pilot who seat on the right pilot seat acted as observer (Other Pilot 1)[4].

During those flights, the pilots monitored on the radio that there were two aircraft flew from Tanah Merah to Oksibil and returned.

1 Boven Digoel Airport (WAKT) Tanah Merah will be named as Tanah Merah for the purpose of this report.

2 Gunung Bintang Airport (WAJO), Oksibil will be named as Oksibil for the purpose of this report.

3 The Local Time (LT) in Papua is UTC+9 hours.

4 Another pilot who sat on the right seat on flights from Tanah Merah – Manggelum – Tanah Merah – Bomakia – Tanah Merah will be named as Other Pilot 1 for the purpose of this report.

After landed the pilot asked the Dimonim Air ground staff at Tanah Merah of the weather information from Oksibil and was advised that the weather still below the requirement of VFR. The PIC decided to continue the flight schedule to Oksibil and replaced the Other Pilot 1 with another pilot (Other Pilot 2)[5] who PIC believed had more experience to fly to Oksibil. The Other Pilot 2 was a captain pilot of Cessna 208 aircraft who had flown to Oksibil several times

At 1221 LT, the flight plan for PK-HVQ flight route Tanah Merah to Oksibil with estimate time departure of 1320 LT was submitted by Tanah Merah ACO to Oksibil ACO. The flight plan stated that the flight rule would be conducted under VFR.

At 1340 LT, on daylight condition a Cessna C208B aircraft registered PK-FSG departed from Tanah Merah to Oksibil. Two minutes later, the PK-HVQ aircraft departed from Tanah Merah to Oksibil with intended cruising altitude of 7,000 feet, on board the aircraft were two pilots, 7 passengers and 386 kg of fuel which was sufficient for about 2 hours of flight time. According to the passenger and cargo manifest, the total weight of passenger and the baggage were 473 kg. Prior to the departure, there was no record or report of aircraft system malfunction.

At 1408 LT, the PK-FSG aircraft landed using runway 11 at Oksibil.

At 1411 LT, the PK-HVQ pilot made initial contact to Oksibil Tower controller and reported that the aircraft was maintaining altitude of 7,000 feet over the visual check point IWUR, and the estimate time arrival at Oksibil would be 0520 UTC (1420 LT). The Oksibil Tower controller acknowledged the pilot report then instructed the pilot to report when the aircraft overhead Oksibil. The Oksibil Tower controller advised the pilot of the latest meteorological condition which was wind direction 110° with velocity of 9 knots, the visibility 1 up to 2 km. The Oksibil Tower controller also provided observation of the cloud condition of the IWUR area, right down wind, and right base of runway 11 that were covered by clouds and the cloud base over the airport area cloud base was about 4,700 feet above mean sea level (about 500 feet above the airport elevation) as reported by previous arrival pilot.

At 1414 LT, the PK-HVQ pilot used call sign PK-HVX, called the Oksibil Tower controller and reported that the aircraft position was over Global Positioning System (GPS) checkpoint OKSX. The Oksibil Tower controller acknowledged the position report.

At 1416 LT, the Oksibil Tower controller called the PK-HVQ pilot used call sign PK-HVX and confirmed whether the aircraft position was overhead Oksibil. The PK-HVQ pilot affirmed and advised the Oksibil Tower controller that the aircraft altitude was 7,000 feet. The Oksibil Tower controller acknowledged the pilot report and advised the pilot to continue the flight to final runway 11 and to report when the runway has in sight. The Oksibil Tower controller did not provide any instruction to use certain traffic circuit and let the pilot to decide the clearer traffic pattern for the landing approach as there was no other traffic in the vicinity. The Oksibil Tower controller assumed that pilot must knew better of the surrounding clouds condition.

5 Another pilot who PIC believed had more experience to fly to Oksibil, as the pilot was a captain pilot of Cessna 208 aircraft and had flown to Oksibil several times will be named as Other Pilot 2 for the purpose of this report.

At 1419 LT, the flight following system[6] of the Dimonim Air recorded the aircraft position was 3.1 Nm on bearing 321° from Oksibil with GPS altitude of 6,713 feet, ground speed 100 knots and the aircraft bearing 356°. This was the last record information on the flight following system. A few seconds later, the Oksibil Tower controller called the PK-HVQ pilot with call sign PK-HVX and asked the aircraft position several times with no answer.

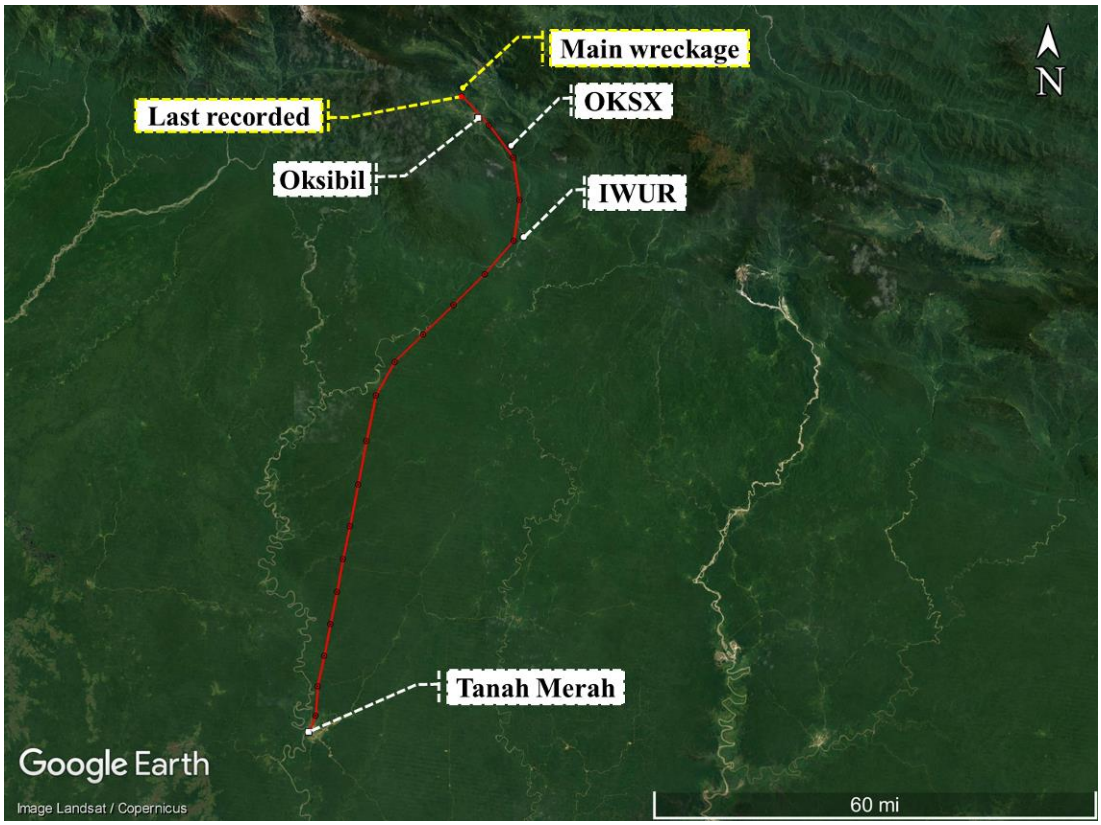


Figure 1: The PK-HVQ flight path based on Spidertracks

At 1421 LT, the PK-FSG pilot who monitored the Oksibil Tower frequency advised the tower controller that the right call sign for the arriving aircraft was PK-HVQ instead of PK-HVX. The tower controller then called the PK-HVQ pilot five times with no answer.

At 1423 LT, the Oksibil Tower controller requested the PK-FSG pilot to call the PK-HVQ pilot on Traffic Information Broadcast by Aircraft (TIBA) frequency (122.7 MHz) and there was no answer.

At 1433 LT, the Oksibil Tower controller requested pilot of another arrival aircraft, a Cessna 208B registered PK-RSC from Tanah Merah to Oksibil whether monitored PK-HVQ and was responded that there was no visual contact or communication from PK-HVQ pilot.

At 1439 LT, the PK-RSC aircraft landed on runway 11 at Oksibil.

6 The Dimonim Air utilizes flight following system provided by Spider Tracks Limited with type/model Spider 7 which manufactured in New Zealand.

At 1510 LT, the Oksibil Tower controller advised the occurrence to the ACO of Sentani International Airport (WAJJ), Papua[7] and National Search and Rescue Agency. The tower controller then asked the PK-HVQ flight to the nearby airstrips and there was no information of the PK-HVQ flight.

On 12 August 2018, at 0534 LT, a Cessna C208B aircraft registered PK-HVC operated by Dimonim Air departed from Tanah Merah to Oksibil for search mission. At 0615 LT, the PK-HVC pilot informed the Oksibil Tower controller that the pilot had visually seen the PK-HVQ wreckage at coordinate of 04° 51.07" S 140° 35.94" E.

At 0812 LT, the ground search and rescue team arrived on accident site, which was on Menuk Mountain, about 3.8 Nm north west of Oksibil on bearing about 315° with elevation about 6,800 feet. The aircraft was destroyed by impact forces. The eight occupants fatally injured, and one passenger was seriously injured. The occupants evacuated to the local hospital in Oksibil and transported to a hospital in Jayapura. The seriously injured passenger was given further treatment.

1.2 Injuries to Persons

Injuries	Flight crew	Passengers	Total in Aircraft	Others
Fatal	2	6	8	-
Serious	-	1	1	-
Minor	-	-	-	Not applicable
None	-	-	-	Not applicable
TOTAL	2	7	9	-

The fatally injured pilot was Papua New Guinean and the rest occupants were Indonesian.

The seriously injured passenger suffered broken arm and spleen injury.

1.3 Damage to Aircraft

The aircraft was destroyed by impact forces.

1.4 Other Damage

There was no other damage to property and/or the environment.

1.5 Personnel Information

1.5.1 Pilot in Command

The PIC was 53 years old Papua New Guinean who had valid Airline Transport Pilot License (ATPL) and qualified as pilot of PAC 750XL aircraft. The pilot also had valid First-Class medical certificate without any limitation.

The total flying hour of the PIC was 13,665.43 hours included 1,468.43 hours on PAC 750XL aircraft.

7 Sentani International Airport (WAJJ), Papua will be named as Sentani for the purpose of this report.

The PIC had joined the Dimonim Air since 17 October 2017, and the last proficiency check for the pilot was conducted on 10 May 2018, the result was satisfactory without any remarks. Before joining the Dimonim Air, the PIC flew in Papua New Guinea.

Based on the operation daily record provided by the Dimonin Air, since joined the company, the PIC had flown from Tanah Merah to Oksibil two times including the accident flight. The PIC also never flew to other destination that required flying over the Oksibil area which allowed the PIC to observe Oksibil area. This was because the flight operation at Tanah Merah area including Oksibil was conducted by Cessna 208B aircraft until it was replaced with PAC 750XL aircraft on 10 August 2018.

The first flight for the PIC to fly to Oksibil was on the day of the PAC 750XL was operated in Tanah Merah. On this first flight to Oksibil, the PIC was accompanied by the Other Pilot 1.

At the day of the occurrence, in the morning prior to fly, the pilot told to the engineer and the Other Pilot 1 that the pilot had financial problem.

Several colleagues of the pilot in Dimonim Air described that the pilot had intention to help the others employees to get extra money as the company had not paid their allowance for several months.

1.5.2 Other Pilot 1

The Other Pilot 1 was Indonesian who had valid Commercial Pilot License (CPL). The Observer Pilot 1 had flown in Papua area since 2016.

On 10 August 2018, the Other Pilot 1 flew with the PIC for the first time from Tanah Merah to Oksibil. During that flight, the visibility was good and the landing approach used the left traffic circuit of runway 11.

The Other Pilot 1 advised that the Ground Proximity Warning System (GPWS)/Terrain Avoidance Warning System (TAWS) installed in the PK-HVQ aircraft only provided visual alert and did not provide aural alert.

1.5.3 Other Pilot 2

The Other Pilot 2 was the pilot who replaced the Other Pilot 1 during the accident flight. The Other Pilot 2 was 43 years old Indonesian who had valid CPL and qualified as Cessna 208 aircraft pilot. The Other Pilot 2 had First-Class medical certificate with limitation to wear lenses that correct for distant vision and possess glasses that correct for near vision.

The Other Pilot 2 had joined the Dimonim Air since 18 April 2018, and the last proficiency check was conducted on 4 June 2018, the result was satisfactory without any remarks.

The total flying hour of the Other Pilot 2 was 3,557.63 hours. The Other Pilot 2 did not have qualification as PAC 750XL aircraft pilot, however the Other Pilot 2 had 40 minutes of flying experience using PAC 750XL during familiarization program.

Based on the operation daily record provided by the Dimonin Air, in August 2018, the Other Pilot 2 had flown from Tanah Merah to Oksibil 8 times included the accident flight.

1.5.4 Oksibil Air Traffic Controller

		Controller	Supervisor
Age	:	26 years	32 years
Nationality	:	Indonesia	Indonesia
License	:	Air Traffic Controller	Air Traffic Controller
Date of issue	:	5 May 2017	1 November 2014
Type rating	:	Oksibil Control Tower	Oksibil Control Tower
Validity	:	15 November 2018	15 November 2018
Medical certificate	:	Third Class	Third Class
Last of medical	:	23 July 2018	23 July 2018
Validity	:	23 July 2020	23 July 2020
Medical limitation	:	None	None
ICAO Language Proficiency	:	Level 4	Level 4
Date of issue	:	6 January 2017	18 May 2018
Validity	:	6 January 2020	18 May 2021
Working time[8]			
Last 7 days	:	36 hours	27 hours
Last 24 hours	:	3 hours 19 minutes	5 hours
Duty time[9]			
Last 7 days	:	17 hours 30 minutes	15 hours 30 minutes
Last 24 hours	:	49 minutes	5 hours

The controller and the supervisor were aware that the left traffic circuit of runway 11 only can be used when the visibility was above 5 Km or as requested by the pilot.

1.6 Aircraft Information

1.6.1 General

The PAC 750XL with serial number of 144, registered PK-HVQ was manufactured by Pacific Aerospace Limited, New Zealand in 2008.

The aircraft had valid Certificate of Airworthiness (C of A) and Certificate of Registration (C of R) issued by the Directorate General of Civil Aviation (DGCA). The C of A for the PK-HVQ aircraft was standard airworthiness certificate, and was renewed on 15 June 2018 with category for normal aircraft without any limitations.

The aircraft had total hours since new was 4,574.70 hours and the total cycles since new was 5,227 cycles. The engine installed on the aircraft was PT6A-34 model, manufactured by Pratt & Whitney Canada with serial number of PCE-RB0397. The total times of the engine since new was 1,799.95 hours.

8 The working time is the time period when the person attends their particular working shift.

9 The duty time is the time period when the person performs their duty to provide air traffic control service.

1.6.2 Weight and Balance

Fuel on board	:	386 kg (850 lbs)
Total weight of passenger and baggage on board	:	473 kg (1,042 lbs)[10]
Total take-off weight	:	2,749 kg (6.060 lbs) maximum 3,401 kg (7,497 lbs)

At the accident site, several sacks of rice were found near the main wreckage, and this cargo was not listed in the passenger and cargo manifest. The investigation was advised that the aircraft loaded 24 sacks of rice with total weight of 240 kg.

1.6.3 Stall Warning System

The aircraft was equipped with stall warning system that could provide of audible warning to the pilot of impeding stall. The warning horn would sound when the aircraft speed was about 5 up to 10 above the stalling speed.

According to the Pilot's Operating Handbook and Civil Aviation Authority of New Zealand Approved Flight Manual for the PAC 750XL (AFM), the stall speeds were as follows:

WEIGHT lbs	FLAP SETTING	ANGLE OF BANK							
		0°		30°		45°		60°	
		KIAS	KCAS	KIAS	KCAS	KIAS	KCAS	KIAS	KCAS
7,500	UP	69	71	74	76	82	84	99	100
	20°	61	63	67	68	74	75	89	89
	40°	58	59	62	63	70	70	83	83
7,125	40°	57	58						
5,500	40°	51	53						
4,000	40°	45	47						

Figure 2: The stall speeds

1.6.4 Ground Proximity Warning System/Terrain Awareness and Warning System

Based on the Serialised Component Embodied document for the PK-HVQ aircraft provided by the Dimonim Air, the aircraft was equipped with two units of Global Positioning System (GPS) Garmin GNS 430 which can provide ground proximity visual alert to the pilot. The relevant descriptions of the GPS features are described in the subchapter 1.6.5.

The Dimonim Air advised to the KNKT that the Garmin GNS 430 installed in the aircraft was the Ground Proximity Warning System (GPWS)/Terrain Awareness and Warning System (TAWS) of the PK-HVQ aircraft.

10 The value listed on the passenger and cargo manifest.

The aircraft also equipped with Multi-Function Display (MFD) Bendix/King KMD 540. According to the Bendix/King installation manual, the KMD 540 could have a function as GPWS/TAWS if the MFD was installed with KAC 502 Enhanced Ground Proximity Warning System (EGPWS) Module and interfaced with EGPWS unit. If the KMD 540 did not have GPWS function, during powered the unit, the self-test page display would indicate the terrain interface did not pass the self-test.

Figure 3: Typical of self-test on KMD 540 without GPWS function

The Pacific Aerospace Limited described that during the first delivery of the PAC 750 XL serial number 144, the KMD 540 installed in the aircraft was not configured as GPWS/TAWS. The investigation did not find any documentation of aircraft modification related to the KMD 540 nor any document that indicated an EGPWS unit had been installed in the aircraft since the delivery until the day of the accident.

The recovered KMD 540 unit installed in the PK-HVQ aircraft indicated that the KAC 502 EGPWS Module was not installed.

1.6.5 Global Positioning System

The aircraft was fitted with two units of GPS Garmin GNS 430. The GPS had communication capability and provides navigation data including terrain information.

According to the Garmin GNS 430 Pilot's Guide and Reference manual, the GNS 430 had TERRAIN feature which could display terrain information based on database of Terrain Data card inserted in the GPS. The terrain information was visualized to pilot on the TERRAIN page of the GPS display. The TERRAIN feature on this GPS was not intended to be used as a primary reference for terrain avoidance and does not relieve the pilot from the responsibility of being aware of surroundings during flight.

The TERRAIN feature to be used only as an aid for situational awareness of terrain avoidance, and it was not certified as terrain awareness system referred to the United States of America Federal Aviation Administration (FAA) Technical Standard Order (TSO)-C151b.

The TERRAIN feature could only provide visual alert by displaying a visual annunciations alert when the flight conditions met parameters that were set within the software algorithms. The alerts depicted either an advisory or a caution alert severity level, or both. The advisory alert would be displayed as constant black text on a yellow background, while the caution alert would be displayed as flashing black text on a yellow background. The visual annunciations appeared in a dedicated field in the lower left corner of the display as showed in the following figure:

Figure 4: The terrain alert visual annunciation (red arrow)

The terrain information was visualized in color and symbols to represent obstacle and potential impact points, as follows:

- Red terrain color means the terrain/obstacle is above or within 100 feet below the aircraft altitude;
- Yellow terrain color means the terrain/obstacle is between 100 and 1,000 feet below the aircraft altitude; and
- Black terrain color means the terrain/obstacle is more than 1,000 feet below the aircraft altitude.

The terrain/obstacle colors and symbols used on the TERRAIN page are as follows:

	Unlighted Obstacle		Lighted Obstacle		Potential Impact Points	Obstacle Location	Alert Level
	< 1000′ AGL	> 1000′ AGL	< 1000′ AGL	> 1000′ AGL			
Obstacle Symbol						Obstacle above or within 100′ below current aircraft altitude	WARNING (Red)
						Obstacle between 100′ and 1000′ below current aircraft altitude	CAUTION (Yellow)

Figure 5: Terrain/obstacle colors and symbol

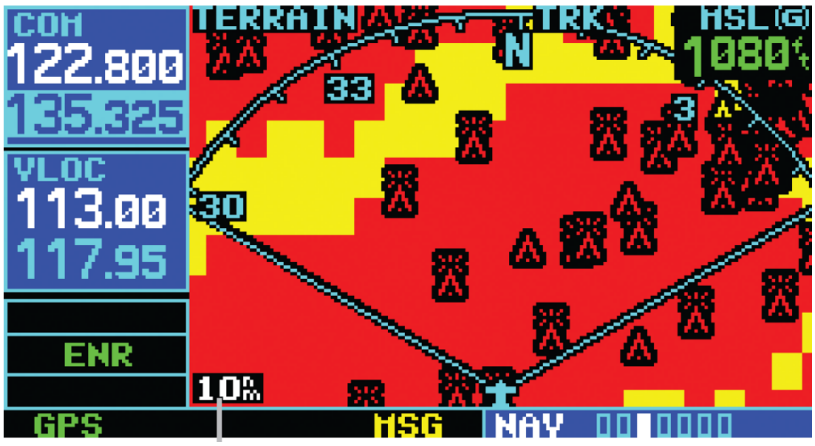


Figure 6: Sample of the TERRAIN page display

When the TERRAIN page was not displayed, the alert would be popped-up on the GPS display as showed in the following figure:

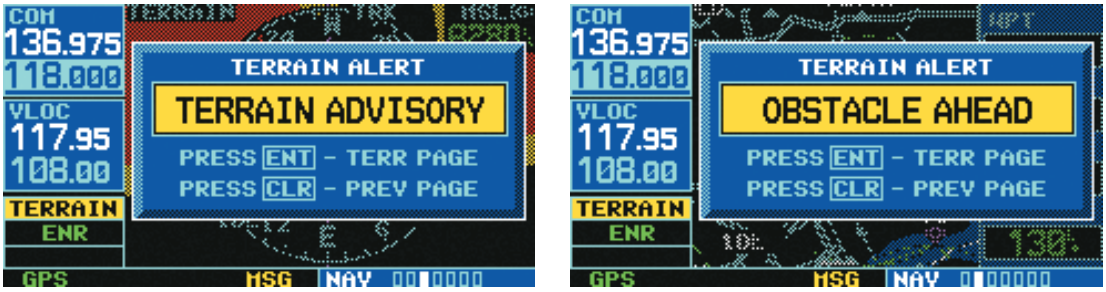


Figure 7: The advisory pop-up (left) and flashing caution pop-up (right)

1.6.6 Data Acquisition Alarm Monitor

The aircraft is equipped with Data Acquisition Alarm Monitor (DAAM) system manufactured by Perkins Technologies, Australia. The DAAM system is an onboard self-contained aircraft system monitor which is capable of monitoring, displaying, and recording critical aircraft and engine parameters, flight times, engine hours, engine trend monitoring data, and exceedance alarms.

The DAAM system can provide to the pilot a visual notification of any exceedance from the preset parameter limits of the aircraft, displayed in the single Cockpit Display Unit (CDU). The CDU is also equipped with a data port to download flight data from the system to a laptop computer for review and analysis.

The system can record up to 14 parameters data as follows:

- Starter button;
- Compressor Rotation Per Minute (RPM);
- Propeller RPM;
- Fuel Flow;
- 24-volt supply voltage;
- Air filter pressure;
- Outside air temperature;
- Torque;

- Fuselage g force;
- Turbine temperature;
- Indicated air speed;
- Pressure altitude;
- Horsepower; and
- Engine oil pressure.

The DAAM unit was found in the accident site and the data had been downloaded in the KNKT facility. The information of the downloaded data can be found in the subchapter 1.18.1.

1.6.7 Flight Following System

The aircraft installed with flight following system manufactured by Spider Tracks Limited with type/model Spider 7 which manufactured in New Zealand. The Dimonim Air subscribed the Spidertracks flight following system for 2 minutes interval data reporting. The reporting parameters in the flight following system contained several data including time, coordinate, GPS aircraft altitude, ground speed and bearing.

The Spider 7 installed in the aircraft utilized keypad with three different functions (figure 8).

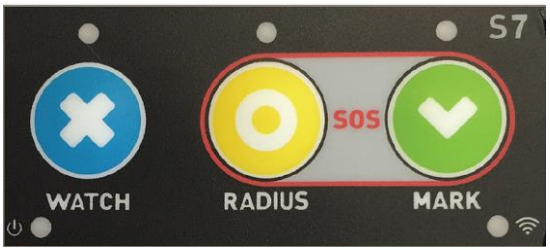


Figure 8: The Spider 7 keypad

The Spidertracks provided two tracking capabilities, which are passive (NORMAL mode) and active (WATCH mode). Both modes will send positional information and flight data to the monitoring system in real time depends on the interval time subscription.

Under the NORMAL mode, the Spidertracks would report positional information and flight event in real time, however, if the aircraft encounters an emergency situation in flight, ground personnel will be alerted when the SOS button was pressed by pilot.

The WATCH mode could be activated either manually by pressing WATCH button or automatically triggers by aircraft speed. The WATCH button must be pressed to disable the WATCH mode. There was no auto-off system for the WATCH mode.

In both modes, pilot could send SOS signal by pressing both RADIUS and MARK buttons simultaneously. While in WATCH mode, the SOS signal could be sent automatically to the system when the aircraft was unable to send flight data for a period of ten minutes.

The investigation retrieved the reporting Spidertracks data of the accident flight from the Dimonim Air. The information of the reporting data can be found in the subchapter 1.18.1.

1.7 Meteorological Information

The *Badan Meteorologi Klimatologi dan Geofisika* (BMKG – Bureau of Meteorology, Climatology and Geophysics) installed Automated Weather Observing System (AWOS) at Oksibil, however due to electrical problem the AWOS did not active on the day of the accident.

The weather information for air traffic at Oksibil was based on air traffic controller observation and pilot report, there was no aviation meteorological unit that provide meteorological information.

Considering that the several Papua areas was located in mountainous area, the weather condition was sometimes rapidly change.

1.7.1 Tower Controller Observation

At 1411 LT, the meteorological condition reported by the Oksibil Tower controller was wind direction from 110° with velocity of 9 knots, the visibility 1 up to 2 km, on IWUR area, right down wind, right base of runway 11 were covered with clouds. Over the airport the cloud base was about 4,700 feet AGL (or about 500 feet above airport elevation). This information was based on the report of another pilot of arrival aircraft.

The following pictures were taken at 1507 LT by the Oksibil Tower controller showed the clouds condition which were similar to the condition at the time of the accident.

Figure 9: The right downwind runway 11 condition at 1507 LT

Figure 10: The right base runway 11 condition at 1507 LT

Figure 11: The final runway 11 condition at 1507 LT

1.7.2 Satellite Image

The *Badan Meteorologi Klimatologi dan Geofisika* (BMKG – Bureau of Meteorology, Climatology and Geophysics) provided enhanced infrared and cloud type satellite images.

The enhanced infrared satellite images at 0500 UTC (1400 LT) up to 0525 UTC (1425 LT) with interval 5 minutes indicated that the temperature on the accident site (red circle) was from 0 up to 8°C.

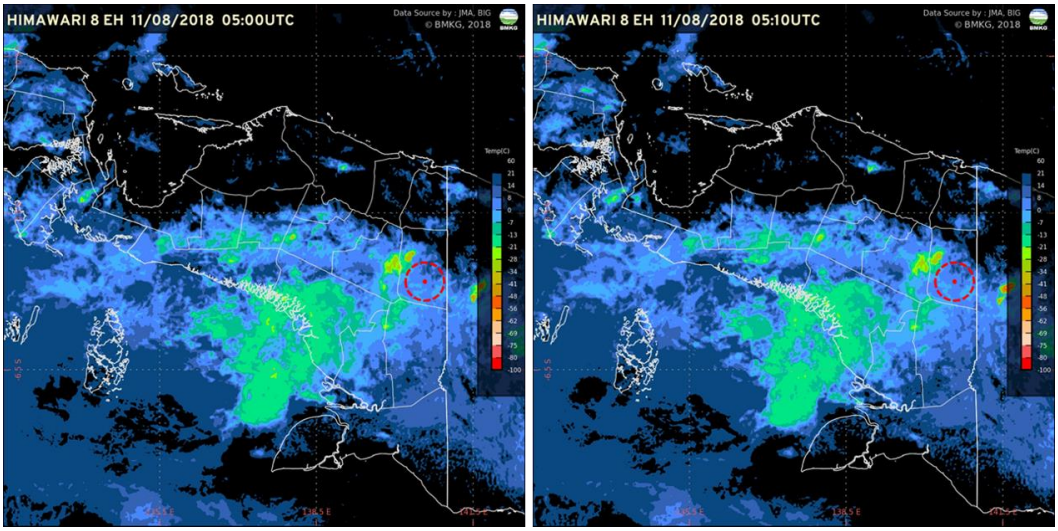


Figure 12: Enhanced infrared satellite image at 0500 UTC and 0510 UTC

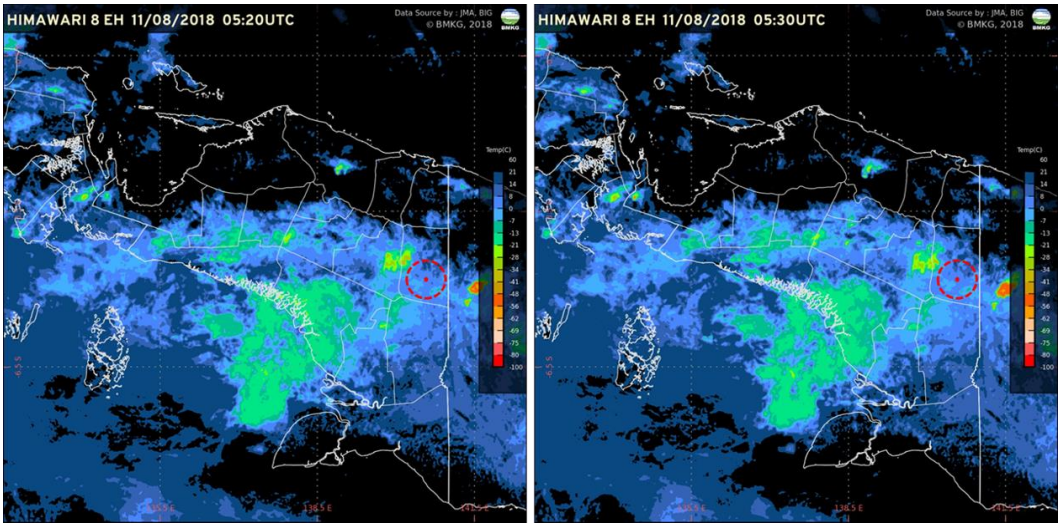


Figure 13: Enhanced infrared satellite image at 0520 UTC and 0530 UTC

The cloud type satellite images at 0500 UTC (1400 LT) and 0600 UTC (1500 LT) indicated middle cloud surrounded the accident site location.

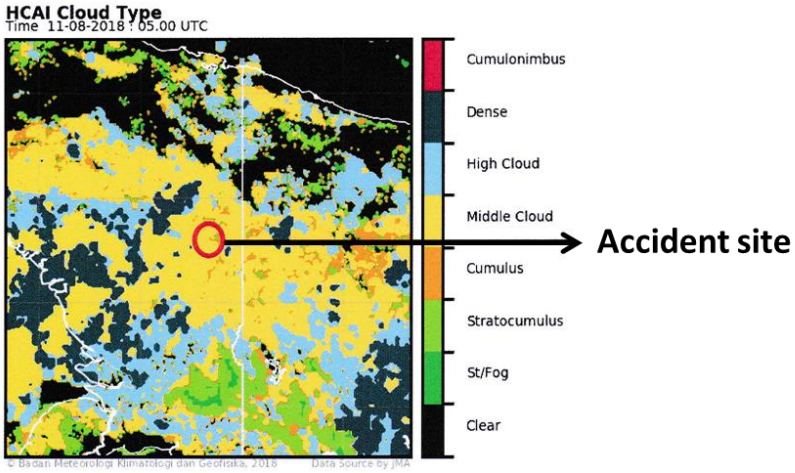


Figure 14: Cloud type satellite image at 0500 UTC (1400 LT)

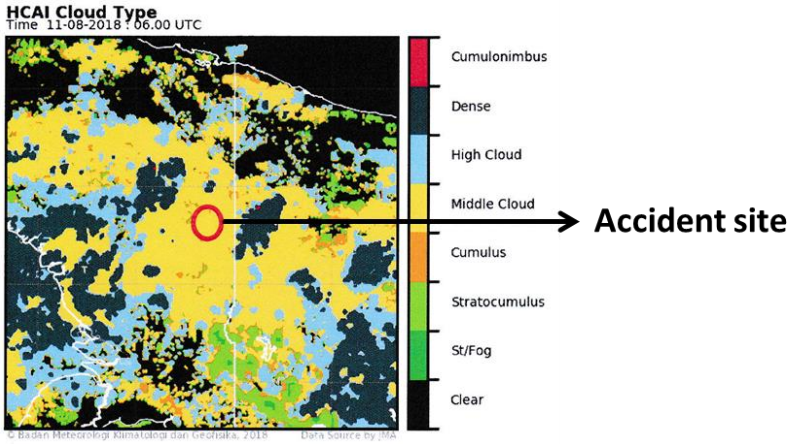


Figure 15: Cloud type satellite image at 0600 UTC (1500 LT)

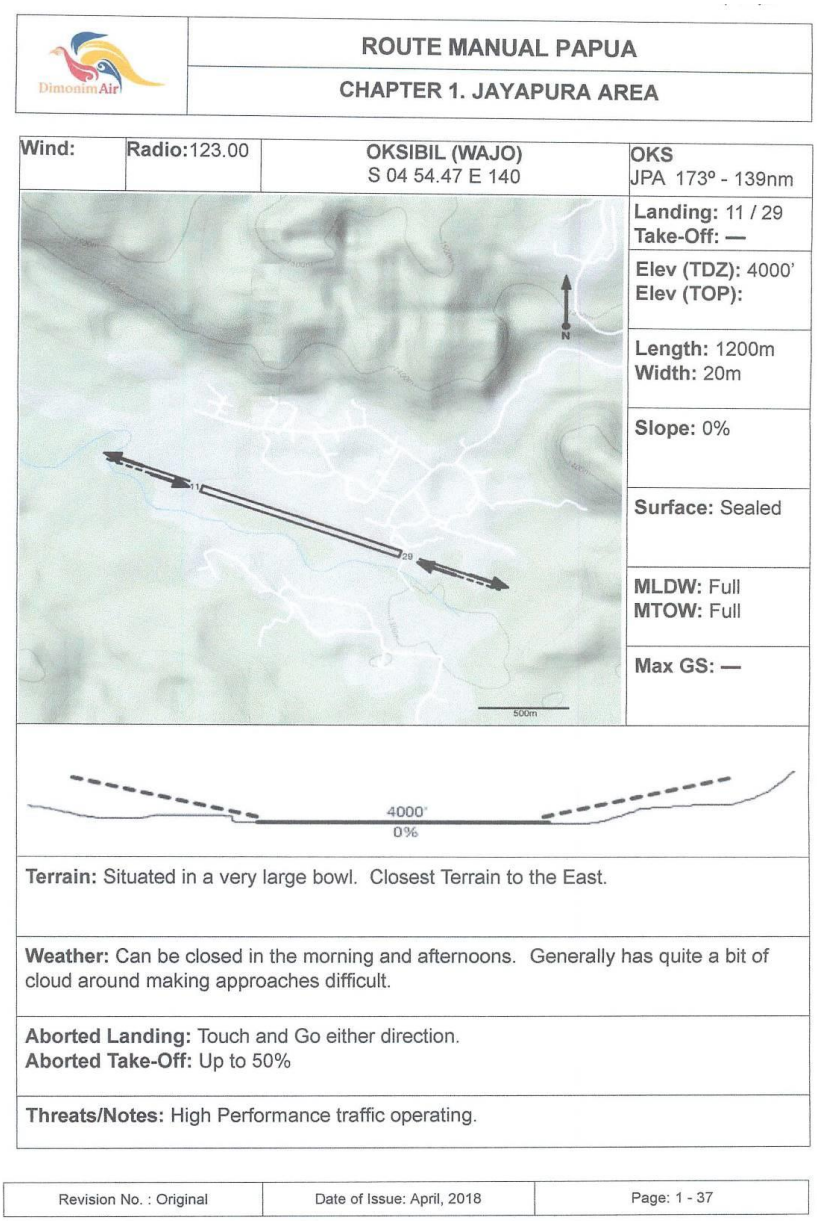
1.8 Aids to Navigation

According to the Aeronautical Information Publication (AIP) Volume IV – Aerodrome for Light Aircraft/ALA, the Oksibil was equipped with Non-Directional Beacon (NDB) identified as ZX. The NDB was unserviceable during the occurrence. The AIP Volume IV did not include approach guidance for Oksibil.

The Dimonim Air Operation Manual – Part C (OM – Part C) subchapter 2.1.6 described aerodrome information of Oksibil, and included terrain information as follows:

This aerodrome is surrounded by High Terrain aerodrome elevation 4264 ft

The Dimonim Air issued Route Manual Papua that was used for internal use which contained information of Oksibil as follows:



ROUTE MANUAL PAPUA

CHAPTER 1. JAYAPURA AREA

Wind:	Radio: 123.00	OKSIBIL (WAJO) S 04 54.47 E 140	OKS JPA 173° - 139nm

Landing: 11 / 29 **Take-Off:** —
Elev (TDZ): 4000' **Elev (TOP):**
Length: 1200m **Width:** 20m
Slope: 0%
Surface: Sealed
MLDW: Full **MTOW:** Full
Max GS: —

Terrain: Situated in a very large bowl. Closest Terrain to the East.
Weather: Can be closed in the morning and afternoons. Generally has quite a bit of cloud around making approaches difficult.
Aborted Landing: Touch and Go either direction. **Aborted Take-Off:** Up to 50%
Threats/Notes: High Performance traffic operating.

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Figure 16: The route manual of Oksibil

The investigation was unable to find GPS checkpoint OKSX used by the pilot during the accident in the Dimonim Air OM – Part C or Route Manual.

The investigation found several aircraft operators issued route guidance for internal use that contained different check point location which used for internal use. The visual guidance route to Oksibil issued by another aircraft operator described GPS checkpoint OKSX located on coordinate 04° 57.65’ S; 140° 41.64’ E or about 4.9 Nm on bearing 125° from Oksibil.

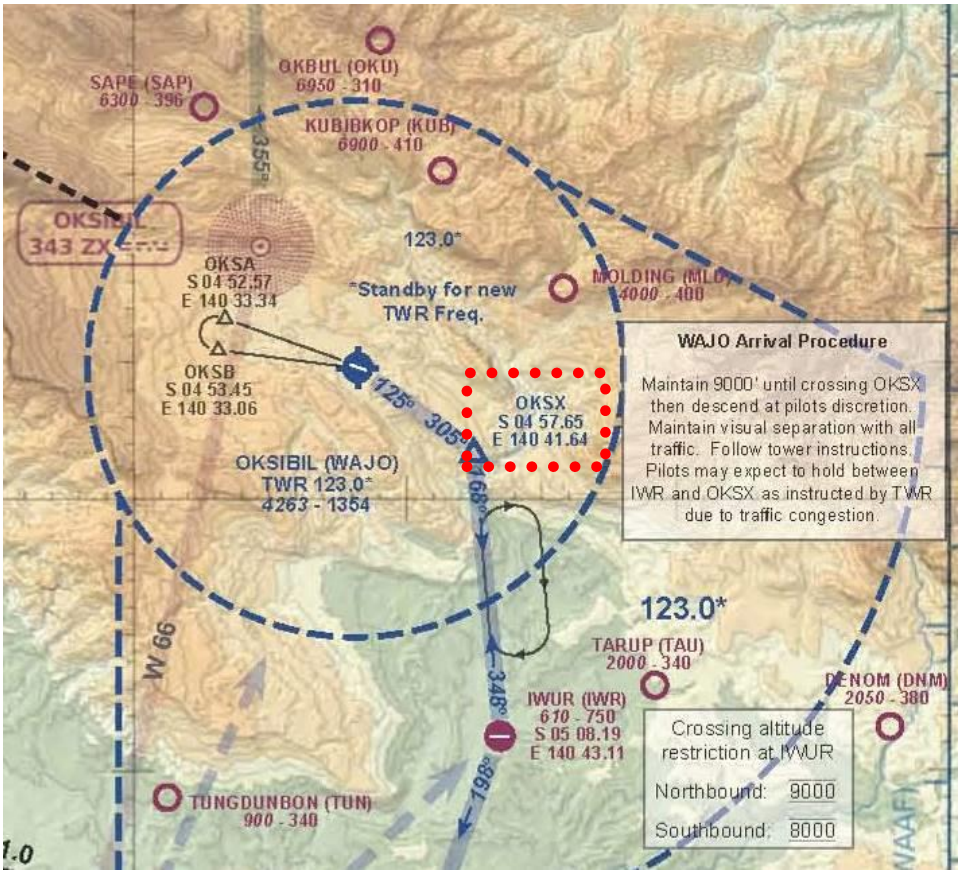


Figure 17: The OKSX location (red dot square) on visual guidance route published by other aircraft operator

1.9 Communications

The communication on Oksibil radio frequency (123.0 MHz) was recorded by ground-based automatic voice recording equipment. The quality of the recorded communication was good.

The excerpt of the communication was as follows:

Time (LT)	Communication
14:11:19	The pilot made initial contact with Oksibil Tower controller and advised that the aircraft position was overhead visual check point IWUR maintaining altitude of 7,000 feet, and advised the estimate time of arrival at Oksibil would be 0520 UTC (1420 LT).
14:11:46	The Oksibil Tower controller acknowledged the pilot report then instructed the pilot to report when the aircraft overhead Oksibil. The Oksibil Tower controller also advised the pilot of the latest meteorological condition which was wind direction from 110° with velocity of 9 knots, the visibility 1 up to 2 km, and provide clouds condition of the IWUR area, right down wind, right base of runway 11 were closed by clouds and the overhead cloud base was about 4,700 feet.

Time (LT)	Communication
14:12:09	The pilot acknowledged the meteorological information provided by the Oksibil Tower controller.
14:14:24	The pilot used call sign PK-HVX, called the Oksibil Tower controller and reported that the aircraft position was over GPS checkpoint OKSX. The Oksibil Tower controller acknowledged the position report.
14:16:55	The Oksibil Tower controller called the PK-HVQ pilot used call sign PK-HVX and confirmed whether the aircraft position was overhead Oksibil.
14:16:57	The pilot affirmed the Oksibil Tower controller that the aircraft position was overhead Oksibil and advised the aircraft altitude was 7,000 feet.
14:17:01	The Oksibil Tower controller acknowledged the pilot report and advised the pilot to continue the flight to final runway 11 and to report when the runway has in sight. The pilot acknowledged the Oksibil Tower controller instruction.
14:19:35	The Oksibil Tower controller called the PK-HVQ pilot with call sign PK-HVX and asked the aircraft position several times with no answer.

1.10 Aerodrome Information

Airport Name	:	Gunung Bintang
Airport Identification	:	WAJO
Airport Operator	:	Directorate General of Civil Aviation (DGCA)
Coordinate	:	04°54’26” S; 140°37’49” E
Elevation	:	4,263 feet
Runway Direction	:	11 – 29 (114° – 294°)
Runway Length	:	1,354 meters
Runway Width	:	30 meters
Surface	:	Asphalt

The airport situated on a valley surrounded by mountainous area. Within 5 Nm from the airport, the highest terrain was up to 7,600 feet at northwest direction from the airport.

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 wreckage was found about 3.8 Nm north west of Oksibil on bearing 331° with elevation about 6,800 feet and the main wreckage was on bearing about 315°. The location was on a ridge of mountain with the height of about 7,600 feet.

The last recorded of flight data reporting on the flight following system indicated the aircraft was at altitude of 6,713 feet. The last reporting data to the accident site was about 1 Nm on bearing 008°.

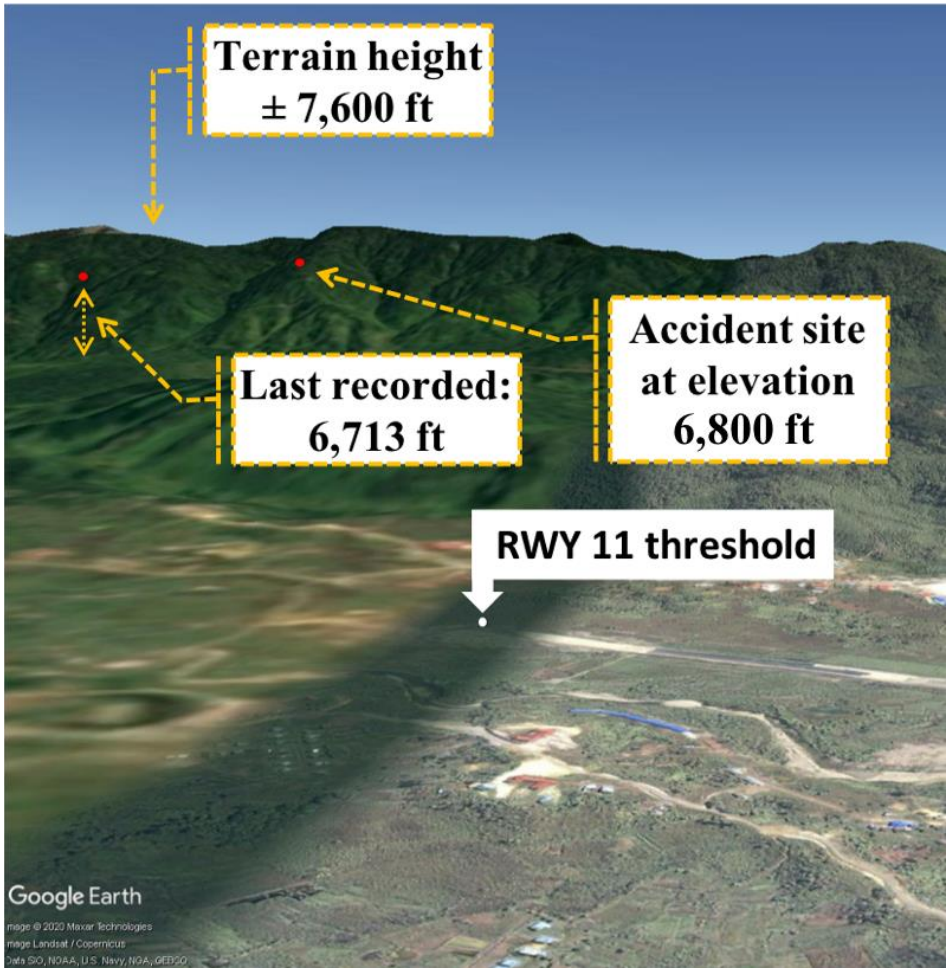


Figure 18: The view of accident site relative to the airport

The cockpit including the engine was separated at about 2 meters from the fuselage. The outer left wing detached and found about 17 meters from the main wreckage. Tree cuts were found at about 12 meters on bearing about 150° from to the main wreckage. There were two trees that cut down in direction about 130°.

The wreckage distribution of the accident was as follows:

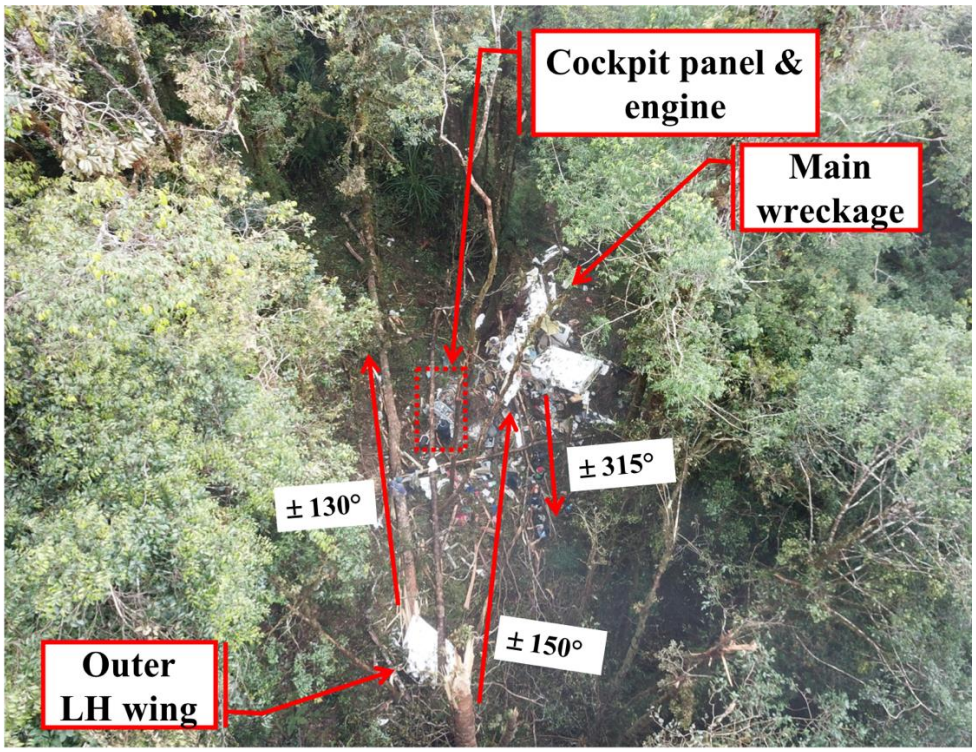


Figure 19: The wreckage distribution

Figure 20: The fuselage and left-wing condition

Figure 21: The cockpit, engine and propeller condition

1.13 Medical and Pathological Information

The medical assessment for the survived passenger indicated that the injury prevented the passenger to walk.

1.14 Fire

There was no evidence of fire in-flight or after the aircraft impacted terrain.

1.15 Survival Aspects

At 1416 LT, the PK-HVQ pilot advised the Oksibil Tower controller that the aircraft was overhead Oksibil at altitude of 7,000 feet and was instructed to report when the runway was insight. About three minutes later, the Oksibil Tower controller called the PK-HVQ pilot with call sign PK-HVX twice, asking the aircraft position and no reply from the pilot. Afterwards, the PK-FSG pilot advised the Oksibil Tower controller that the call sign was PK-HVQ instead of PK-HVX.

The Oksibil Tower controller called the PK-HVQ pilot several times and no reply from the pilot. Thereafter, the Oksibil Tower controller asked the PK-FSG pilot to call the PK-HVQ pilot on TIBA frequency (122.7 MHz) and still no reply from the pilot. The PK-FSG pilot then advised the Dimonim Air officer at Tanah Merah regarding the lost contact of the PK-HVQ aircraft. The officer then called the Dimonim Air operation center in Jakarta to check the aircraft position from the Spidertracks. The last aircraft position was on coordinate 4°51'57.71"S; 140°35'51.99"E, which was about 3.5 Nm from Oksibil on bearing 321°.

At 1433 LT, the Oksibil Tower controller requested pilot of another arrival aircraft, a Cessna 208B registered PK-RSC from Tanah Merah to Oksibil whether monitored PK-HVQ and was responded that there was no visual contact or communication from PK-HVQ pilot.

At 1510 LT, The Oksibil Tower controller advised the occurrence to the Aeronautical Reporting Office of Sentani International Airport and National Search and Rescue Agency. The Oksibil Tower controller then asked the PK-HVQ flight to the nearby airport and airstrip.

The search and rescue operation was initiated consisted of the National Search and Rescue Agency, police, army and local citizen. The ground search of the PK-HVQ aircraft was conducted to the mountainous area on north direction from Oksibil.

At 1511 LT, the AirNav Indonesia branch office Sentani declared alert phase (ALERFA)[11] and at 1543 LT, the distress phase (DETRESFA)[12] was declared.

At 1611 LT, a Cessna C208B aircraft registered PK-HVC operated by Dimonim Air departed from Sentani to conduct search mission in Oksibil. At 1730 LT, the PK-HVC pilot advised the Oksibil Tower controller that the pilot did not get Emergency Locator Transmitter (ELT) signal from PK-HVQ aircraft and unable to search visually due to cloud condition. The pilot then decided to stop the search activity and flew to Tanah Merah.

On 12 August 2018, at 0534 LT, the PK-HVC aircraft departed from Tanah Merah to Oksibil continuing the search mission. At 0615 LT, the PK-HVC pilot informed the Oksibil Tower controller that the pilot had visual contact with the PK-HVQ wreckage on coordinate of 04° 51.07" S 140° 35.94" E.

At 0812 LT, the ground search teams arrived on accident site and found eight occupants were fatally injured and one occupant was seriously injured. The six fatally injured occupants were found outside the aircraft wreckage while the rest were found insight the aircraft wreckage including the survived passenger.

The occupants evacuated to the local hospital in Oksibil and transported to hospital in Jayapura.

11 Alert phase (ALERFA) is a situation wherein apprehension exists as to the safety of an aircraft and its occupants.

12 Distress phase (DETRESFA) is a situation wherein there is a reasonable certainty that an aircraft and its occupants are threatened by grave and imminent danger and require immediate assistance.

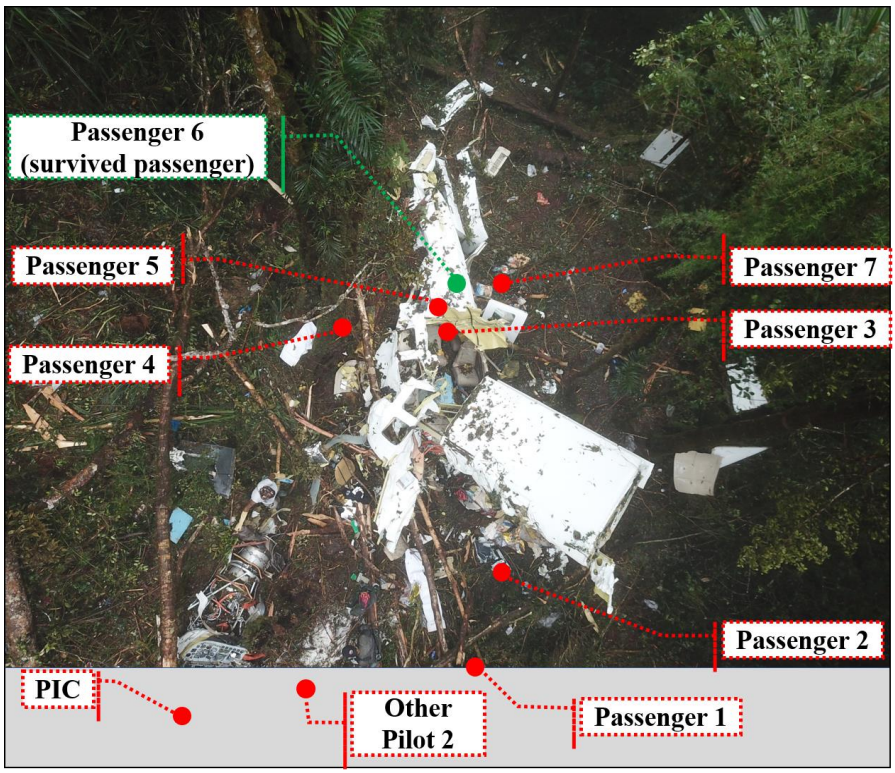


Figure 22: The occupant location

1.16 Tests and Research

Test and research were not conducted in this investigation.

1.17 Organizational and Management Information

1.17.1 Aircraft Operator

Aircraft Owner and Operator	:	PT. Marta Buana Abadi (Dimonim Air)
Address	:	Jalan Cimandiri, No. 6, Cikini, Jakarta Pusat, Republic of Indonesia

The Dimonim Air had valid Air Operator Certificate (AOC) number 135-049 which authorized to conduct air transportation carrying passengers and cargo in non-scheduled operation within and outside Indonesia for aircraft operations under Civil Aviation Safety Regulation (CASR) Part 135. The Dimonim Air conducted unscheduled passenger and cargo flight on Papua and Bali area.

The Dimonim Air operated two Eurocopter AS 350B2 helicopter, one Eurocopter AS 350BA helicopter, one Kamov Ka-32A helicopter, eight Cessna 208B aircraft, one DHC 6-300 aircraft and one PAC 750XL (the accident aircraft).

The Dimonim Air used Cessna 208B aircraft to conduct the flight operation at Oksibil area, however due to the Cessna 208B was in maintenance schedule, the flight operation was replaced with PAC 750 XL. Prior to the change of the operation, the Dimonim Air did not conduct any hazard identification and risk assessment.

Several employees stated that their salaries had not been paid for several months and they also stated that the Dimonim Air was having financial problem.

According to the Authorization, Conditions and Limitations (ACL) issued by the DGCA, the operation of PAC 750XL aircraft registered PK-HVQ was limited on Visual Flight Rules (VFR) on day light condition, and the aircraft was approved for 9 passenger seats configuration.

The Dimonim Air developed several Operation Manuals (OM)s which contains policy and procedure approved by the DGCA.

1.17.1.1 Visual Flight Rules Weather Minimum Requirement

The Dimonim Air Operation Manual – Part A (OM – Part A) subchapter 8.5.1 described a basic Visual Flight Rules (VFR) weather minimum which was referred to the Civil Aviation Safety Regulation (CASR) Part 91 – General Operating and Flight Rules. The requirement was not allowed for any pilot to operate an aircraft under VFR on airspace class C when the flight visibility is less, or at a distance from clouds that is less, than that prescribed for the corresponding altitude and class of airspace in the following table:

Airspace	Flight Visibility	Distance from Clouds
Class C	8 km above 10,000 feet 5 km below 10,000 feet	1,000 feet above 1,000 feet above 1,500 meters horizontal

The subchapter 8.5.1 also described that:

a. *No Aircraft may operate beneath the ceiling under VFR within the lateral boundaries of controlled airspace designated to the surface for an airport when the ceiling is less than 1,000 feet.*
b. *Day VFR operations. No aircraft under VFR during the day at an altitude less than 1,000 feet above the surface or less than 1,000 feet from any mountain, hill, or other obstruction to flight.*
c. *No Aircraft may take off or land an aircraft, or enter the traffic pattern of an airport, under VFR, within the lateral boundaries of the surface areas of Class B, Class C, Class D, or Class E airspace designated for an airport:*
    - *Unless ground visibility at that airport is at least 3 statute miles (4.8 km).*
    - *If ground visibility is not reported at that airport, unless flight visibility during landing or takeoff, or while operating in the traffic pattern is at least3 statute miles (4.8 km).*

The OM – Part A subchapter 8.5.3 described a requirement of VFR takeoff and landing minima that referred to the CASR Part 135 as follows:

a. *No Pilot may takeoff or land an aircraft under VFR when the reported ceiling or visibility are less than 1.000 – foot ceiling and the visibility is not less than 3 statue miles (4.8 km) and the weather conditions along the route to be flown and at destination airport indicated the flight could be conducted under VFR.*

1.17.1.2 Aerodrome Risk Classification

According to the Dimonim Air Operation Manual – Part C (OM – Part C) subchapter 1.5.3, the Dimonim Air have to make risk classification of the aerodrome that would be flown during the aircraft operation. The risk classification was developed in three level – Mountain Level 1 (the lowest risk), Level 2 (the high risk) and Level 3 (the highest risk). The detail description was as follows:

a. *Mountain Level 1:*

   Class 1 is the lowest of the category C airstrips but still represents a medium to high level of risk. Mountain Level 1 airstrips may have some or all of the following hazards: Slope, softness, slipperiness, undulations, wind issues (crosswind, tailwind and/or turbulence), crown, and/or shorter lengths. Most class 1 airstrips are one-way strips with a key point and abort point beyond which a go-around is not possible. Mountain Level 1 airstrips usually have weight restrictions for takeoff and may have higher field elevations.

b. *Mountain Level 2:*

   Class 2 airstrips have all of the hazards and associated risks of Mountain Level 1 airstrips plus may have: higher touchdown slope, changes in slope along the runway length, side slope, visual illusions, short or modified approaches, even shorter runway lengths, and are more susceptible to wind issues including updrafts and downdrafts on final. The weather may change rapidly causing the airstrip to close down quickly. Mountain Level 2 airstrips are considered high risk.

c. *Mountain Level 3:*

   Class 3 airstrips are the highest risk airstrip. They may have all of the hazards and associated risks of Mountain Level 1 and Mountain Level 2 and additionally may have some or all of the following risks: sun / shadow, unseen hazards such as strong updrafts or downdrafts on short final, problems with wind requiring a wind restriction, strong visual illusions, reduced margin, very steep touchdown slope, many or large changes in runway slope, be very rough or soft, have changes in runway heading (doglegs), limited visual reference to the runway on approach or during takeoff, short, steep or angled approaches, quickly changing wind or weather conditions, be in very tight valleys where the abort point is quite far out and the go-around options are very limited and require precise aircraft control.

   Mountain Level 3 airstrips are considered very technical airstrips that represent the highest level of risk acceptable to PT. Marta Buana Abadi's operations. As with all aviation operations each pilot must be constantly assessing the current risk level during the entire operation and maintain the very highest level of vigilance and safety, being prepared at anytime to reject the operation for any reason.

In order to ensure a pilot qualified to fly in airport/airstrip that classified as Mountain Level 2, the Dimonim Air Operation Manual – Part D (OM – Part D) subchapter 3.12 described that:

> *To qualify as a Mountain 2 Captain, pilots will require a minimum of 500 hours in Papua. This 500 hours may include line training towards the Mountain 2 qualification at the discretion of the Chief Pilot.*

Prior to the occurrence, the risk assessment of Oksibil flight operation had not been conducted by the Dimonim Air.

1.17.1.3 Route and Airport Familiarization

The OM – Part A subchapter 5.3 described a requirement for Dimonim Air pilot in regards to the route and airport qualification as follows:

a. *All flight crew shall be experienced with, and have an adequate knowledge of the routes to be flown and airports to be used.*
b. *All flight crew will be thoroughly briefed regarding route and airports before leaving base, by making full use of all available information.*
c. *It is the responsibility of the individual pilot to ensure that he is qualified to fly a particular route, or use a particular airstrip/airport. He must be thoroughly knowledgeable of all aspects of the operation, and be able to comply with all applicable regulations and local procedures for the route to be flown.*

The PIC must have current and pertinent knowledge of route to the satisfaction of the Chief Pilot. This includes:

a. *Seasonal meteorological conditions;*
b. *Communication and navigational facilities including airport visual aids;*
c. *Kinds of terrain and obstruction;*
d. *Minimum safe flight levels;*
e. *En-route and terminal area arrival and departure procedures, holding procedures and authorized instrument approach procedures for the airport involved;*
f. *Congested area and physical layout of each airport in terminal area involved.*

In order to ensure pilot having adequate knowledge of the routes and airport, including the terrain information, the OM – Part A subchapter 10.7 described:

> *Before being assigned as Commander or as pilot to whom the conduct of the flight is delegated, the pilot shall obtain adequate knowledge of the route to be flown. This shall include knowledge of:*
>
> a. *the terrain and minimum safe altitudes*
> b. *the seasonal meteorological conditions*
> c. *the meteorological, communication, air traffic facilities and service procedures*
> d. *the search and rescue procedures*
> e. *the navigational facilities associated with the route along which the flight will be conducted*

This knowledge is achieved by self-study of the applicable parts of the AFM.

Before a flight to any aerodrome, all pilots shall obtain adequate knowledge of the aerodromes which are used, including the procedures applicable to flight paths over heavily populated areas and areas of high traffic intensity, obstructions, physical layout, lighting, approach aids and arrival, departure, holding and instrument approach procedures and applicable aerodrome operating minima.

For complete explanation on area, route, and airport familiarization refer to:

a. AIP;

b. Jeppesen Airways Manual;

c. VFR Route Guidance;

d. Operations Manual Part C.

These four documents stated in the OM – Part A which contained explanation of area, route, and airport familiarization did not contain information of terrain height over the Oksibil.

1.17.1.4 Operational Control and Supervision

According to the OM – Part A subchapter 3.3, the Dimonim Air developed operational control system to ensure the operation of the flight is conducted in safe and efficient manner. The operation control system provided planning, controlling, monitoring, reporting and evaluation of the flights. The flight operation in Tanah Merah area used pilot-self dispatch system which means the authority and responsibility for flight release, operation, and flight following were delegated to pilot in command.

In term of tracking the daily flight operation, the Dimonim Air utilized flight following system provided by Spider Tracks Limited with type/model Spider 7 which manufactured in New Zealand. The tracking and flight data from the aircraft transmitted to the Spidertracks website and monitored by Dimonim Air staff in Jakarta.

The flight following system did not able to monitor the implementation of VFR weather minimum requirement and the monitoring relied on the company reporting system. Prior to the accident, the Dimonim Air did not have record or report of VFR flight that operated below the VFR weather minimum requirement.

One day prior and the accident flights, the investigation had been notified cargo that were carried and not listed in the passenger and cargo manifest. The Dimonim Air management was not aware of this additional cargo. During the accident, the management also did not aware that the pilot replaced the Observer Pilot 1 with a pilot that did not rated for PAC 750 XL.

1.17.1.5 Ground Proximity Warning System Requirement

The GPWS requirement was described in the OM – Part A subchapter 10.12 as follow:

> *It is Company policy that comprehensive training be provided to all Pilots to attain a proficient operational standard associated to the EGPWS/GPWS. Recurrent training shall make provision for regular practice and test of crew competency inappropriate crew response to alerts and warnings generated by the system.*

The Dimonim Air operation manuals did not include any procedure for pilot to use GPWS or TAWS nor proper pilot reaction in response to the alerts and warnings for the operation of PAC 750XL aircraft.

1.17.1.6 Pilot Training

According to the OM – Part D subchapter 5.3.3 described that the procedure of Enhanced Ground Proximity Warning System (EGPWS) alert was included in the training syllabus for PAC 750 XL aircraft.

The EGPWS or TAWS alert was not included in any training check forms for PAC 750XL aircraft and only included in the training check form for Cessna C208 aircraft.

1.17.2 Air Traffic Service Provider

The Air Traffic Control (ATC) service in Oksibil was provided by Perum LPPNPI (AirNav Indonesia) branch office Oksibil, the ATC service was provided in Oksibil aerodrome traffic zone (ATZ) which was within radius of 10 Nm centered at ZX NDB with vertical limit from surface up to 4,000 feet above the airport elevation. The airspace classification on the Oksibil ATZ was class C airspace.

The AirNav Indonesia branch office Oksibil had Air Traffic Service (ATS) provider certificate which had been issued by the DGCA on 17 November 2016 and valid until surrendered, suspended or canceled.

The ATS provider certificate issued by the DGCA had conditions of approval, which required the AirNav Indonesia branch office Oksibil to have Letter of Operational Coordination Agreement (LOCA) with the *Badan Meteorologi Klimatologi dan Geofisika* (BMKG – Bureau of Meteorology, Climatology and Geophysics). Until the day of the accident, the LOCA between AirNav Indonesia branch office Oksibil and BMKG had not been established.

1.17.2.1 Traffic Circuit Policy

The ATS Standard Operating Procedure (SOP) of Oksibil subchapter 7.1.3 described the aerodrome traffic circuit as follows:

Runway	*Aerodrome Traffic Circuit*
11	*Right Hand Traffic Circuit*
29	*Left Hand Traffic Circuit*

Based on the interview with several air traffic controllers at Oksibil, the left traffic circuit of runway 11 could be used when the visibility was above 5 Km or requested by pilot. The investigation was unable to find those procedure in the existing company document. In addition, the controllers assumed that pilot would have their own consideration to choose the traffic circuit based on the aircraft performance and visibility from the cockpit.

1.17.3 Civil Aviation Authority

The civil aviation in Indonesia was regulated by Directorate General of Civil Aviation (DGCA) under the Ministry of Transportation. The DGCA had several directorates including the Directorate of Airworthiness and Aircraft Operation (DAAO) that responsible in formulating policy and standard including oversight to the civil aircraft operator, and the Directorate of Air Navigation (DAN) that responsible in formulating policy and standard including oversight to the ATS provider and aviation meteorological provider.

1.17.3.1 Ground Proximity Warning System Standard Requirement

The DGCA used the term Terrain Awareness and Warning System (TAWS) which referred to the International Civil Aviation Organization (ICAO) Annex 6 Ground Proximity Warning System (GPWS). The DGCA described standard requirement of TAWS for aircraft operated under CASR Part 135 in the CASR Part 135 amendment 12 subpart 135.319, as follow:

(a) No person may operate a turbine-powered airplane configured with 10 or more passenger seats, excluding any pilot seat, unless that airplane is equipped with an approved Terrain Awareness and Warning System (TAWS) that meets the requirements for Class A equipment in the FAA Technical Standard Order (TSO)–C151 or its equivalent. The airplane must also include an approved terrain situational awareness display.

(b) No person may operate a turbine-powered airplane configured with 6 to 9 passenger seats, excluding any pilot seat, unless that airplane is equipped with an approved Terrain Awareness and Warning System (TAWS) that meets as a minimum the requirements for Class B equipment in the FAA Technical Standard Order (TSO)–C151 or its equivalent.

(c) Airplane Flight Manual. The airplane Flight Manual shall contain appropriate procedures for—

(1) The use of the Terrain Awareness and Warning System (TAWS); and

(2) Proper flight crew reaction in response to the Terrain Awareness and Warning System (TAWS) audio and visual warnings.

This requirement was the same standard described in the previous amendment of the CASR Part 135 (amendment 11). The DGCA did not include the detail requirement of the FAA Technical Standard Order (TSO) – C151 in any requirement standard document published by the DGCA.

The FAA TSO-C151c appendix 1, which was effective until 28 February 2019, described the Minimum Performance Standards (MPS) for TAWS Class B, as follow:

***1.3 SYSTEM FUNCTION AND OVERVIEW**. The system must provide the flight crew with sufficient information and appropriate alerts to detect a potentially hazardous terrain situation that, in turn, prevents a CFIT event. The basic TAWS functions for all TAWS systems approved under this TSO include the following:*

a. A forward looking terrain avoidance (FLTA) function. The FLTA function looks ahead of the airplane along and below the airplane's lateral and vertical flight path and provides suitable alerts if a potential CFIT threat exists.

b. A premature descent alert (PDA) function. The PDA function of the TAWS uses the airplane's current position and flight path information, as determined from a suitable navigation source and airport database, to determine if the airplane is hazardously below the normal (typically three-degree) approach path for the nearest runway as defined by the alerting algorithm.

c. An appropriate visual and aural discrete signal for both caution and warning alerts.

…

f. Class B equipment basic TAWS functions include functions listed in paragraphs 1.3.a through 1.3.c and it must provide indications of imminent contact with the ground during the following airplane operations as defined in paragraph 3.4 of this appendix:

- *Mode 1: Excessive rates of descent*
- *Mode 3: Negative climb rate or altitude loss after takeoff*
- *Altitude Callout: A voice callout ("Five Hundred") when the airplane descends to 500 feet above the nearest runway elevation. All TAWS equipment must provide the 500 foot voice call out.*

3.4 Class B Requirements for GPWS Alerting.

a. Class B equipment must provide alerts for excessive descent rates…

b. Class B equipment must provide alerts for "negative climb rate after takeoff or missed approach" or "altitude loss after takeoff,"…

c. This feature also has an important CFIT protection function. In the event the airplane is operated unintentionally close to terrain when not in the airport area or the area for which PDA protection is provided, this voice callout will alert the flight crew to hazardous conditions. The equipment must meet the requirements specified in appendix 2, section 9.0. Class B TAWS equipment must provide a 500 foot voice call out when descending through 500 feet above the runway threshold elevation for landing. This feature is primarily intended to provide situational awareness to the flight crew when the airplane is being operated properly, per normal procedures. During a normal approach, it is

useful to provide the flight crew with a voice callout at 500 feet, relative to the runway threshold elevation for the runway of intended landing. The Class B TAWS equipment must also provide a 500 foot voice call out above terrain when not landing. This 500 foot voice call out above terrain when not landing is an important CFIT protection function. In the event the airplane is operated unintentionally close to terrain when not in the airport area or the area for which PDA protection is provided, this voice callout will indicate to the flight crew to hazardous conditions.

4.0 AURAL AND VISUAL ALERTS.

4.1 The TAWS is required to provide aural and visual alerts for each of the functions described in section 3.0 of this appendix.

…

4.9 At a minimum, the TAWS must be capable of providing aural alert messages described in Table 4-1. In addition to this minimum set, other voice alerts may be provided.

STANDARD SET OF VISUAL AND AURAL ALERTS		
Alert Function	***Caution***	***Warning***
FLTA Functions *Reduced Required Terrain Clearance and Imminent Impact with Terrain* *Class A & Class B*	***Visual Alert*** *Amber text message that is obvious, concise, and must be consistent with the aural message.* ***Aural Alerts*** *Minimum selectable voice alerts:* *"Caution, Terrain; Caution, Terrain" and "Terrain Ahead; Terrain Ahead"*	***Visual Alert*** *Red text message that is obvious, concise and must be consistent with the aural message.* ***Aural Alerts*** *Minimum selectable voice alerts:* *"Terrain, Terrain; Pull-Up, Pull-Up"* ***and*** *"Terrain Ahead, Pull-Up; Terrain Ahead, Pull-Up"*

8.0 CLASS A AND CLASS B REQUIREMENTS FOR SELF-TEST. *Class A and Class B equipment must have a self-test function to verify system operation and integrity. It must monitor the equipment itself, input power, input signals, and aural and visual outputs. Failure of the system to successfully pass the self-test must be annunciated.*

Note*: Flight crew verification of the aural and visual outputs during a self-test is an acceptable method for monitoring aural and visual outputs.*

1.17.3.2 DGCA Oversight on the GPWS/TAWS Requirement Standard

The DGCA had Staff Instruction (SI) and form that must be used by inspector when conducting oversight to the aircraft operator. The oversight of the TAWS requirement standard was conducted by the inspector prior to the issuance of initial or renewal aircraft C of A, and prior to issue approval of the aircraft operator operation manual.

According to the DGCA Staff Instruction (SI) 21-02 subchapter 802 described:

> *802. REVIEW AND COMPLETION OF DAAO FORM NO. 21-40, INSPECTION RECORD ISSUANCE OF (ORIGINAL) AIRWORTHINESS CERTIFICATE. This form is used by DGCA Inspector as an inspection checklist prior to issue Certificate of Airworthiness. Part I, all blocks must be completed using the information obtained during inspection. Part II, III, IV, V tick column "Yes" for satisfactory condition or tick column "No" for unsatisfactory condition, and enter N/A if corresponding inspection item is not applicable.*

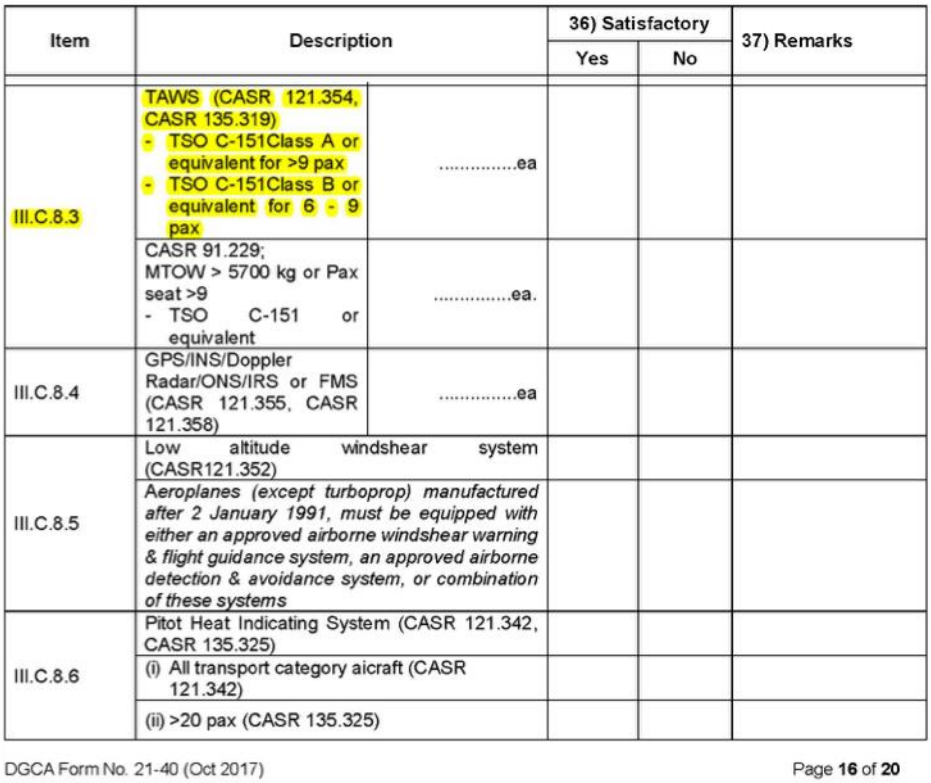
The DGCA/DAAO form number 21-40 revision August 2015 inspection item III.C.4.h, required inspector to conduct inspection to the TAWS installed in the aircraft with reference standard of CASR part 135 Amendment 10 subchapter 135.320.

	Description		Satisfactory Yes	Satisfactory No	Remarks
	4. Navigation				
a.	Direction Indicator (Magnetic Compass, ADF, RMI, or Gyroscopic Stabilized) (CASR 91.205)	.....ea			
b.	VOR (CASR 91.205)	.....ea			
c.	DME (CASR 91.205)	.....ea			
d.	ILS (CASR 91.129)	.....ea			
e.	Weather Radar (CASR 121.357, 135.315)	.....ea			
f.	GPWS (CASR 135.319) (Delete ref 135 Amdt 11)	.....ea			
g.	TCAS (CASR 121.356, CASR 135.322) N/A DUE SEAT<10				
	(i) Turbine, MTOW>33.000 lbs TCAS II	.....ea			
	(ii) Turbine, Pax10 - 30 seat TCAS I	.....ea			
	(iii) Piston, MTOW>33.000 lbs TCAS I	.....ea			
h.	TAWS (CASR 121.354, CASR 135.320)	.....ea			

DAAO Form 21-40 (Aug 2015) Page 9 of 11

Figure 23: The excerpt of DAAO Form 21-40 revision August 2015

On October 2017, the DGCA/DAAO Form 21-40 had been amended, and the inspection item for the TAWS was changed to III.C.8.3 with reference standard of the CASR part 135 Amendment 10 subchapter 135.319.



Item	Description		36) Satisfactory		37) Remarks
			Yes	No	
III.C.8.3	TAWS (CASR 121.354, CASR 135.319) - TSO C-151Class A or equivalent for >9 pax - TSO C-151Class B or equivalent for 6 - 9 pax	.....ea			
	CASR 91.229; MTOW > 5700 kg or Pax seat >9 - TSO C-151 or equivalent	.....ea.			
III.C.8.4	GPS/INS/Doppler Radar/ONS/IRS or FMS (CASR 121.355, CASR 121.358)	.....ea			
III.C.8.5	Low altitude windshear system (CASR121.352)				
	Aeroplanes (except turboprop) manufactured after 2 January 1991, must be equipped with either an approved airborne windshear warning & flight guidance system, an approved airborne detection & avoidance system, or combination of these systems				
III.C.8.6	Pitot Heat Indicating System (CASR 121.342, CASR 135.325)				
	(i) All transport category aicraft (CASR 121.342)				
	(ii) >20 pax (CASR 135.325)				

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Figure 24: The excerpt of DGCA/DAAO Form 21-40 revision October 2017

According to the DGCA Staff Instruction SI 8900 – 3.324 subchapter 2.2.2, prior to approve the aircraft operator operation manuals, inspector must ensure that the operation manual of aircraft operator met with CASR requirement standards including a procedure to use TAWS and response to ground proximity warning. The inspector must use DGCA Form 120-31 as a checklist when reviewed the operation manuals, and the review subject related to the TAWS procedure was on Part B subject number 5 (k).

NO	SUBJECT	SAT	UNSAT	N/A	REFFERENCE
5.	**Abnormal and emergency procedures and duties.** The manual shall contain a listing of abnormal and emergency procedures assigned to crew members with appropriate check-lists that include a system for use of the check-lists and a statement covering the necessary co-ordination procedures between flight and cabin crew. The following abnormal and emergency procedures and duties shall be included: a) general considerations and policy; b) fire and smoke drills; c) unpressurised and partially pressurized flight, as applicable; d) exceeding structural limits such as overweight landing; e) exceeding cosmic radiation limits, as applicable; f) lightning strikes; g) distress communications and alerting ATC to emergencies; h) engine failure; i) system failures; j) guidance for diversion in case of serious technical failure; k) ground proximity warning; l) TCAS advisories; m) windshear; n) emergency landing/ditching; o) aircraft evacuation; p) fuel jettisoning (as applicable); q) crew incapacitation ; r) emergency descent; s) low fuel; t) emergency signal for cabin crew members; u) communication procedures;				
6.	**Performance data.** Performance data shall be provided in a form in which it can be used without difficulty. Performance material which provides the necessary data to allow the flight crew to				

DGCA Form No. 120-31 (Jun 2019) Page 10 of 14

Figure 25: The excerpt of DGCA Form 120-31

1.17.3.3 DGCA Oversight Activities on TAWS Requirement

On 17 February 2017, the inspector conducted inspection to the PK-HVQ aircraft prior to the issuance of the initial C of A. The inspector used the DGCA/DAAO form number 21-40 revision August 2015 and ticked the "Yes/Satisfactory" in the inspection item III.C.4.h column for the TAWS.

On 8 May 2018, another inspector conducted inspection to the PK-HVQ aircraft prior to the issuance of the renewal C of A, and this inspection was the last TAWS inspection by the DAAO before the accident. The inspector used the DGCA/DAAO form number 21-40 revision October 2017 and ticked the "Yes/Satisfactory" in the inspection item III.C.8.3 column for the TAWS.

Both inspectors had not received training or familiarization regarding the TAWS requirement in accordance with FAA TSO C-151 or its equivalent as required in the CASR Part 135. In order to certify the minimum requirements for the TAWS Class B equipment according to the FAA TSO–C151, both inspectors relied on the functional test of the unit. During the inspection, both inspectors considered that the terrain function of the MFD KMD 540 had the function of the TAWS in the aircraft. The inspectors recalled that during the aircraft inspection, the Dimonim Air representative performed functional test of the terrain function of KMD 540, and the result was satisfactory. There was no finding or remarks of the TAWS function during the inspection for initial and renewal of the C of A.

On March 2017, prior to issue approval of the Dimonim Air operation manuals, the DGCA inspector conducted inspection of operation manuals without any findings on procedure to use TAWS and response to ground proximity warning.

1.17.3.4 Provision of Aviation Meteorology Standard Requirement

The CASR Part 174 subpart 174.15 described the user of aviation meteorology information must use the meteorology information provided by the *Badan Meteorologi Klimatologi dan Geofisika*/Bureau of Meteorology, Climatology and Geophysics (BMKG). The BMKG was the meteorological information provider in Indonesia.

The CASR Part 174 subpart 174.50 required the BMKG to have one or more aerodrome meteorological units in aerodrome that able to provide meteorological information services require for air navigation. The aerodrome meteorological unit required to have several functions as necessary to meet the requirement of flight operations at the aerodrome, included:

- prepare and/or obtain forecast and other relevant information for flight with which it is concerned. The extent of its responsibilities to prepare forecasts shall be related to the local availability and use of en-route and aerodrome forecast material received from other offices;
- maintained continuous survey of the meteorological conditions over the aerodrome for which it is designated to prepare local report and forecasts of meteorological conditions.

The CASR Part 170 subpart 2.2 described that the ATS provider requires to have coordination with aviation meteorological information provider to ensure the provision of current meteorological information. The CASR Part 172 subpart 172.135, also described that ATS provider must have LOCA with the aviation meteorological information provider.

1.17.3.5 DGCA Oversight of the Provision of Aviation Meteorology Standard Requirement

The DGCA had oversight checklist that must be used by inspector when conducting oversight to the ATS provider and aviation meteorological provider. The oversight of the provision of aviation meteorology was conducted by inspector prior to the issuance of ATS provider certificate.

The oversight checklist did not include requirement to check whether the ATS provider has meteorological information provided by aviation meteorological provider. However, the oversight checklist revision of 25 September 2015 required the inspector to check the availability of LOCA between ATS provider and aviation meteorological information provider to ensure the provision of meteorological information.

In 2016, the DGCA conducted oversight prior to the issuance of the ATS provider certificate of the AirNav Indonesia branch office Oksibil, the inspector identified that there was no LOCA with the aviation meteorological provider. Thereafter, on 17 November 2016, the DGCA issued ATS provider certificate for the AirNav Indonesia branch office Oksibil to conduct aerodrome control service with several conditions of approval, included to have LOCA with the BKMG. This condition would be reviewed by the DGCA at a period not greater than five years form the date of the issuance.

In 2017 and 2018 prior to the occurrence, the DGCA had conducted oversight to the AirNav Indonesia branch office Oksibil, included to oversight the compliance of LOCA. The DGCA inspectors were aware that there was no aviation meteorology provider at Oksibil and the risk assessment for this condition was extremely improbable and neglectable. The inspectors did not consider that the absence of the LOCA between AirNav Indonesia branch office Oksibil and the BMKG as a finding.

1.18 Additional Information

1.18.1 Recorded Electronic Data from Aircraft

The KNKT utilized the recorded flight following report data of the accident flight. The recorded data contained of 25 reporting data with two minutes interval, starting from 0432 UTC until 0519 UTC. The reporting data from the flight following system did not indicate any activation of SOS button by the pilot.

The KNKT also downloaded the DAAM unit installed in the aircraft that recorded 11 parameters of about 11 hours of aircraft operation included the accident flight.

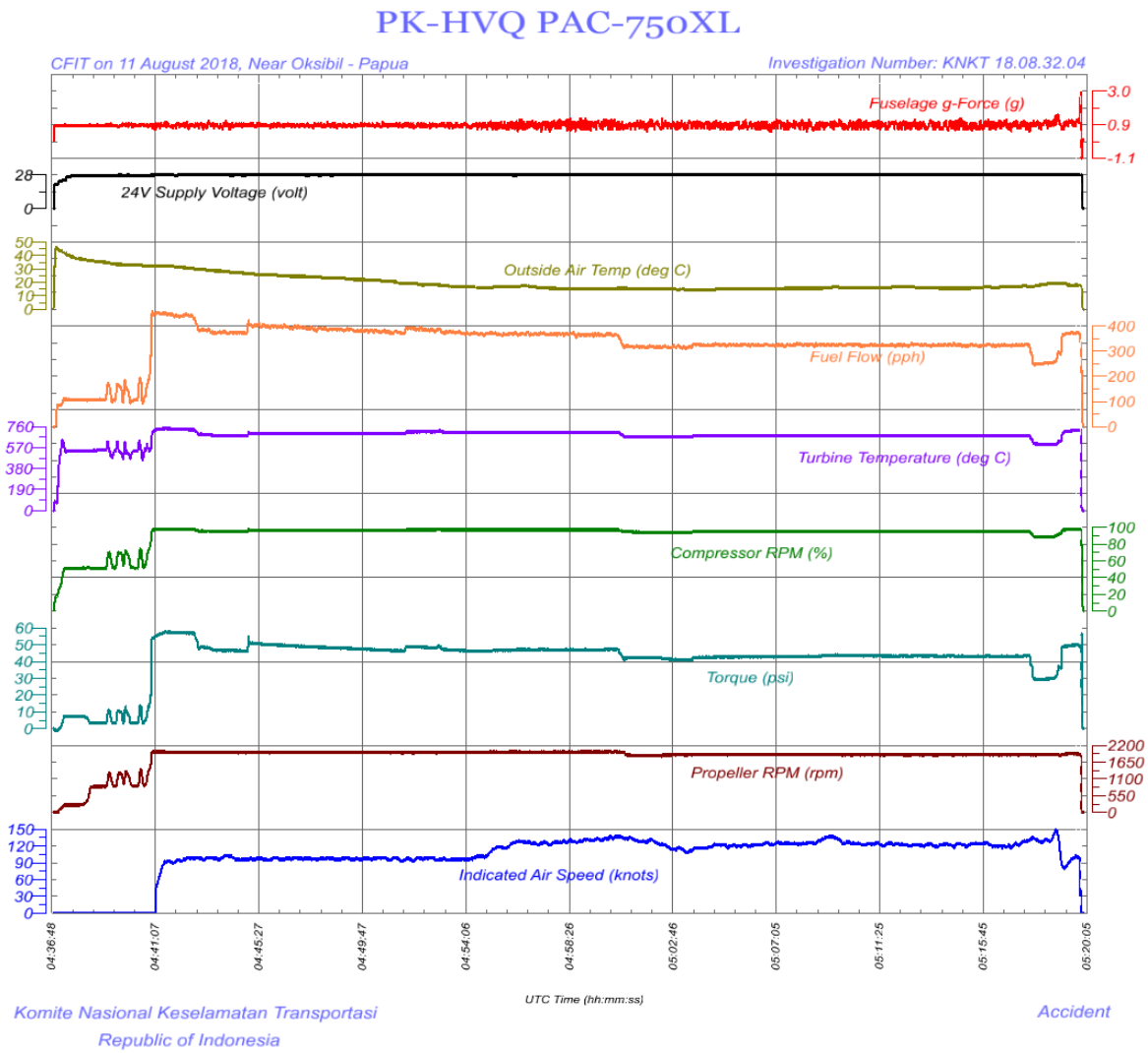

Figure 26: Graphic of the DAAM recorded data

The DAAM recorded data indicated that the aircraft engine operated normally. The pressure altitude value was at constant value of -990 feet, and the investigation considered the altitude data was unreliable. The investigation used the recorded GPS altitude from the aircraft flight following system, and synchronized the time parameter of the DAAM unit with the flight following system.

The significant information on from the recorded parameters of the DAAM and flight following system were as follows:

- 0515 UTC, the GPS altitude was 7,455 feet, the aircraft bearing was 350° and the ground speed was 145 knots;
- 0517 UTC, the GPS altitude was 7,320 feet, the aircraft bearing was 303° and the ground speed was 143 knots;
- 05:18:48 UTC, the Indicated Air Speed (IAS) decreased from 149 knots and continued decreasing until reach 80 knots at 05:19:10 UTC. While the torque maintained at 31 psi.
- 05:18:51 UTC, the compressor Rotation Per Minute (RPM) increased from 90% and continued increasing until reach 98% at 05:19:15 UTC. The torque increased from 31 psi and continued increasing until reach 49 psi at 05:19:12 UTC.
- 0519 UTC, the GPS altitude was 6,713 feet, the aircraft bearing was 356° and the ground speed was 100 knots. This was the last data reporting on the flight following system.
- 05:19:11 UTC, the compressor RPM maintained 97% until 05:19:14 UTC. The torque increased from 48 psi to 49 psi. The IAS increased from 80 knots and continued increasing until reached 103 knots at 05:19:38 UTC.
- 05:19:12 UTC, the torque reached and maintained to 49 psi until 05:19:50 UTC.
- 05:19:15 UTC, the compressor RPM increased from 97% to 98% and maintained until 05:19:50 UTC.
- 05:19:39 UTC, the IAS reduced from 103 knots to 102 knots and continued reducing.
- 05:19:49 UTC, the fuselage g-force reduced from 1.4 g to -2.8 g. The IAS was 98 knots, the compressor RPM maintained 98% and the torque maintained 49 psi.
- 05:19:50 UTC, the fuselage g-force increased from -2.8 g to 3 g. The IAS reduced from 98 knots to 0 until the end of recording, the compressor RPM maintained 98% and the torque maintained 49 psi.
- 05:19:51 UTC, the fuselage g-force increased from 3 g to 5 g then reduced to -4.4 g. The compressor RPM reduced from 98% to 96% and continued reducing. The torque reduced from 49 psi to 19 psi.
- 05:19:52 UTC, the fuselage g force increased from -4.4 g and maintained to -1.1 g. The compressor RPM reduced from 96% and maintained to 91% until the end of recording, while the torque increased from 19 and maintained to 56 psi until the end of recording.
- 05:19:54 UTC, the end of the DAAM data recording.

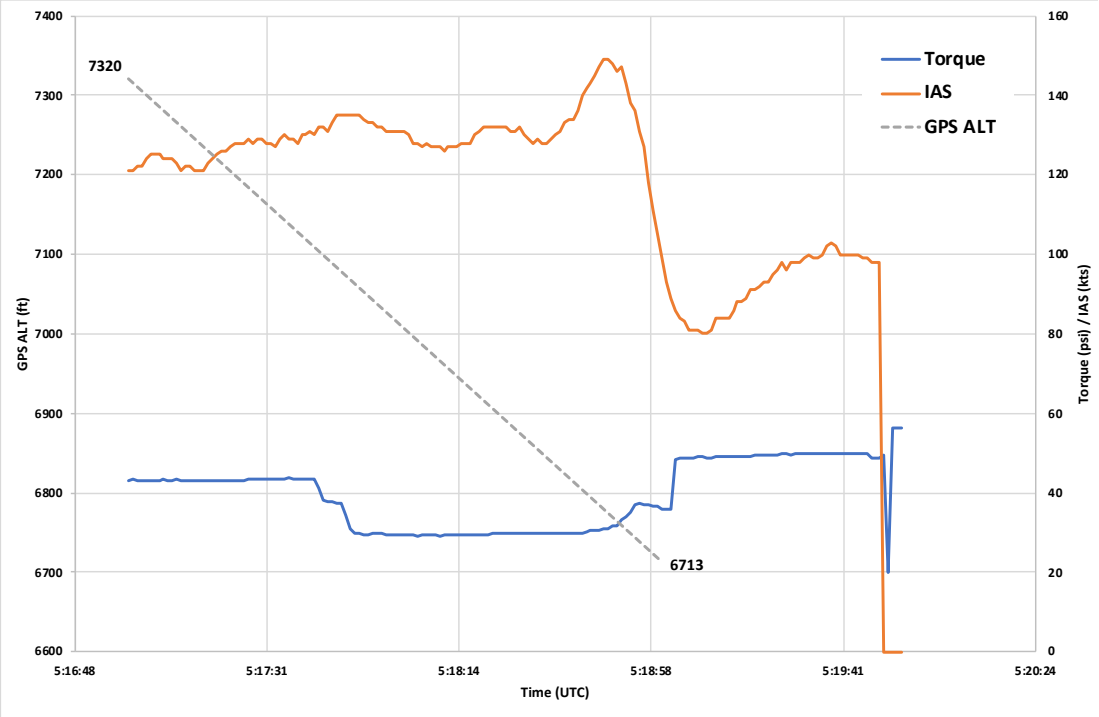

Figure 27: The GPS altitude of the flight following data and the last 3 minutes of the DAAM data

1.18.2 Survived Passenger Recollection

The survived passenger was 12 years old. The interview conducted about one month after the accident, due to physical and mental condition consideration.

The survived passenger described that he seated in the rearmost seat near the passenger/cargo door with his father. During the flight, the aircraft encountered light turbulence and the pilot advised the passengers to use seatbelt. The survived passenger noticed that the aircraft flew in and out clouds. When the aircraft was over Oksibil, the survived passenger was able to see the airport. Thereafter, the pilot turned the aircraft, which was assumed as the pilot attempted to avoid clouds, and the aircraft encountered several turbulences again. The survived passenger then heard sound from the aircraft system.

During the interview, the investigator played some sound of the aircraft warnings, then the survived passenger identified that the stall warning was the sound he heard during the occurrence.

The survived passenger was unable to recall the aircraft condition when impacted terrain.

1.18.3 Investigation Process

The Transport Accident Investigation Commission of New Zealand and Transportation Safety Board of Canada participate in this investigation and assigned accredited representative according to the ICAO Annex 13.

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 to the departure there was no record or report of the aircraft system malfunction. The flight following system also did not indicate any SOS signal activation by the pilot and the downloaded DAAM data did not indicate any engine parameter anomaly. In addition, there was no distress message from the pilot recorded in the ground-based automatic voice recording equipment. Therefore, the investigation determined that there was no aircraft system malfunction and the analysis will discuss the following issues:

- Aircraft flight profile;
- Situational awareness towards terrain;
- Aircraft operator Operational Control and Supervision;
- Terrain Avoidance Warning System Compliances; and
- Provision of meteorological information.

2.1 Aircraft Flight Profile

While approaching Oksibil, the pilot advised the Oksibil Tower controller that the aircraft position was over GPS checkpoint OKSX. This GPS checkpoint was not mentioned in the Route Manual Papua for Oksibil published by the Dimonim Air nor in the Aeronautical Information Publication (AIP) Volume IV. Several aircraft operators issued route guidance for internal use that contained different check point location. This may confuse air traffic controller and pilot of other aircraft operator.

During the initial contact to the Oksibil Tower controller, the pilot was informed that the right downwind and right base of runway 11 were blocked by clouds and a few minute later the controller advised the pilot to continue the flight to final runway 11.

According to the Oksibil Air Traffic Services Standard Operating Procedure (ATS SOP) subchapter 7.1.3, the traffic circuit of runway 11 was only right traffic circuit. However, this procedure was not described in any aeronautic publication. Several controllers at Oksibil assumed that the pilot would choose the traffic circuit based on the aircraft performance and visibility from the cockpit. Therefore, the controller did not prohibit the pilot to use the left traffic circuit.

The information that the right pattern was blocked by clouds and the absence of prohibition to use left traffic circuit might have made the pilot flew to the left traffic circuit during the occurrence flight.

The last communication from the pilot to the Oksibil controller indicated that the aircraft flew over Oksibil at altitude of 7,000 feet, and the pilot was instructed to continue the flight to final runway 11.

The last three data reporting on the flight following system indicated that the aircraft GPS altitude decreased indicated that the aircraft was descending. The last data reporting, indicated that the aircraft was about 3 Nm north west of Oksibil on bearing 321° at altitude of 6,713 feet and the aircraft heading was 356°. These data indicated that the aircraft had descended and flew toward terrain area with the highest height of 7,600 feet and away from the left circuit pattern of runway 11. As the flight following system recorded 2 minutes interval of data reporting, this indicated that the accident occurred not more than 2 minutes after the last reporting data.

At the accident site, tree cuts were found at about 12 meters to the main wreckage on bearing about 150° and the trees cut down on direction about 130°. The aircraft wreckage was found approximately on elevation 6,800 feet with the main wreckage was approximately on bearing 315°. The damage on the left-wing indicated that the most likely the left wing impacted to trees which then made the main wreckage turned to heading 315°.

The 130° direction of the trees cut down showed that the aircraft heading during the impact was about 130°, this indicated that the aircraft had been turned toward Oksibil.

The last data reporting on the flight following system at 0519 UTC indicated that the aircraft heading was 356°, and about 54 seconds later the DAAM stopped recording. The last reporting data to the accident site was about 1 Nm on bearing 008°. To be able to reach the accident site, most likely the aircraft flew on northwest direction then made a turn. The turning maneuver from 356° to heading 130° within minute required pilot to conduct steep turn maneuver.

In the last one minute, the DAAM indicated that the IAS decreased from 149 knots to the lowest of 80 knots while the torque maintained about 31 psi. The rapid deceleration of aircraft speed without additional power indicated that the aircraft climbed. The survived passenger also heard sound from the aircraft system which similar with stall warning sound after the aircraft passed over the Oksibil. The activation of the stall warning at speed about 80 knots, might be an indication that the aircraft was on bank angle 45° or more which reduced the aircraft stalling speed. According to the stall speed table, the stalling speed might decrease to about 80 knots and the stall warning would active about 5 up to 10 above the stalling speed. The steep turn and climb maneuver might indicate that the pilot attempted to avoid the mountainous area in the northwest of the Oksibil.

After the IAS decreased, the DAAM data recorded maintaining value of the torque, and when the IAS almost reached the lowest value of 80 knots, the torque then increased and maintained about 49 psi. Thereafter the IAS gradually increased up to 103 knots. The increased value of the torque above the cruising value most likely indicated that the pilot attempted to prevent the stall by gaining more speed.

At 05:19:39 UTC or 16 seconds before the DAAM recording stopped, the IAS decreased from 103 knots while the torque maintained. At 05:19:49 UTC, the fuselage g-force reduced from 1.4 g to -2.8 g, the IAS was reducing to 98 knots and the torque still maintained at 49 psi. The decreased value by -4.2 g of fuselage g-force within second indicated that rapid deceleration occurred most likely due to the aircraft impacted terrain.

2.2 Situational Awareness Towards Terrain

The Dimonim Air Operation Manual Part A (OM – Part A) subchapter 5.3 and 10.7 described requirement for pilot to have adequate experience and knowledge of the route and airport to be flown, including the understanding of the terrain and minimum safe altitudes. The OM – Part A also stated that the information of route and airport to be flown were described in the AIP, Jeppesen Airway Manual, VFR Route Guidance and OM- Part C. However, the mentioned documents did not provide information of terrain height over the Oksibil.

Before joining the Dimonim Air on October 2017, the Pilot in Command (PIC) flew in Papua New Guinea. Based on the operation daily record provided by the Dimonin Air, since joined the company, the PIC flew to Oksibil once and never flew to other destination that required flying over the Oksibil area which allowed the PIC to observe Oksibil area. Based on the conditions of no information of terrain height and limited experience of flying to or over Oksibil, the PIC was considered had lack knowledge of the terrain surrounding Oksibil area.

After landed in Tanah Merah from the previous sector, the PIC was advised by the Dimonim Air ground staff at Tanah Merah that the weather at Oksibil remained below the requirement of VFR. The PIC decided to continue the flight schedule to Oksibil and replaced the Other Pilot 1 to the Other Pilot 2 who PIC believed had experienced to fly to Oksibil. The flight plan to Oksibil stated that the flight was conducted under VFR.

The PIC decision to depart was most likely affected by several aircraft that had successfully flew to Oksibil and return. The decision also might be affected by his intention to help his colleagues to get extra money from the unlisted cargo, as their salaries had not been paid for several months.

Based on the survived passenger recollection, the aircraft flew in and out clouds. When the aircraft was over Oksibil, the survived passenger was able to see airport. Thereafter, the pilot turned the aircraft, which was assumed as the pilot attempt to avoid clouds, and the aircraft encountered several turbulences again.

The last data report of the flight following system indicated that the aircraft had been descended from altitude of 7,000 feet and flew away from the left traffic circuit toward terrain area. Those aircraft maneuver might be an indication that the left traffic circuit was also in cloudy condition and the pilot attempted to get visual reference with the ground.

The Operations Specification issued by the DGCA for the Dimonim Air was limited on Visual Flight Rules (VFR) flight during day light condition only. The Dimomin Air Operation Manual – Part A (OM – Part A) and Civil Aviation Safety Regulation (CASR) Part 91 prohibited pilot to fly into a cloud when operates an aircraft under VFR.

The VFR flight which flown into clouds indicated that the VFR weather minimum requirement was not implemented properly, and might have made the pilot did not have a clear visual of the surrounding area.

The aircraft was fitted with GPS with TERRAIN feature that provided visual alert to increase the pilot awareness toward the terrain. As there was no record or report of aircraft system prior to the departure, the GPS might provide visual alert to the pilot of the terrain. The TERRAIN feature was not intended to be used as a primary reference for terrain avoidance and did not relieve the pilot for being aware of surroundings during flight. This condition might have made the pilot did not consider the alert of the TERRAIN feature and attempted to get visual reference.

The aircraft did not have a Terrain Awareness and Warning System (TAWS) as required by the CASR Part 135 that able to provide visual and voice alerts when the aircraft flying close to terrain. The absence of the voice alert from the TAWS might have made the pilot relied on the visual reference to the terrain for the avoidance maneuver.

Considering that the PIC had lack knowledge of the terrain surrounding the Oksibil area and the absence of voice alert from the TAWS when the aircraft flying close to terrain, resulted in the PIC did not have adequate awareness to the surrounding terrain while flying into clouds and continued to fly below the terrain height until the aircraft impacted the terrain.

2.3 Aircraft Operator Operational Control and Supervision

According to the OM – Part A subchapter 3.3, the Dimonim Air developed operational control system to ensure the operation of the flight is conducted in safe and efficient manner. The flight operation in the Tanah Merah area used pilot-self dispatch system, therefore the authority and responsibility for flight release, operation, and flight following were delegated to pilot in command.

In order to detect flight operation that was not conducted within the VFR weather minimum, the Dimonim Air relied upon their reporting. Prior to the accident, the Dimonim Air management did not have any report or record of flight operation that did not implement the VFR weather minimum requirement.

Considering that the several Papua areas was located in mountainous area, the weather condition was sometimes rapidly change and pilot might inadvertently enter cloud during the flight. The absence of report or record might be an indication that the operation control and supervision system within the Dimonim Air was unable to capture the VFR flight that did not implement the VFR weather minimum requirement.

Prior to the occurrence flight, the pilot decided to continue the flight schedule to Oksibil and replaced the observer pilot to the other pilot who had experienced to fly to Oksibil who did not have qualification as PAC 750XL aircraft pilot. The Dimonim Air management was not aware of this crew change.

At the accident site, the investigation found 24 sacks of rice with total weight of 240 kg. The cargo was not listed in the cargo manifest, and the Dimonim Air management was not aware of this additional cargo.

The unidentified VFR flight that unable to implement the VFR weather minimum requirement, unaware of the crew change, and the unaware of cargo that was not listed in the cargo manifest indicated the operational control and supervision within the aircraft operator was not conducted properly. These conditions resulted in the flight was unable to be conducted in safe and efficient manner as intended by the OM – Part A subchapter 3.3.

2.4 Terrain Avoidance Warning System Compliances

According to the Authorization, Conditions and Limitations (ACL) issued by the DGCA, the operation of PAC 750XL aircraft registered PK-HVQ was approved for 9 passenger seats configuration. Therefore, in accordance with the CASR Part 135 subpart 135.319, the aircraft required to be equipped with a Terrain Awareness and Warning System (TAWS) that met the minimum requirement of the FAA TSO-C151 for Class B TAWS. The FAA TSO-C151 required TAWS Class B to have Ground Proximity Warning System (GPWS) alerting that must include voice callout when the aircraft flying close to terrain.

During the aircraft inspection prior to the issuance of initial and renewal Certificate of Airworthiness (C of A) for the PK-HVQ aircraft, the DGCA inspectors used the DGCA Form 21-40 to check the compliance of TAWS requirement standard. The inspectors considered that the terrain function of the KMD 540 as the TAWS installed in the aircraft.

The inspectors had not been trained or familiarized regarding the TAWS requirement standard in accordance with FAA TSO C-151 or its equivalent as required in the CASR Part 135. Therefore, the inspection of the TAWS compliance to the requirement relied on the functional test of the unit. The inspectors recalled that during the inspection, the Dimonim Air representative performed functional test of the terrain function in the Multi-Function Display (MFD) Bendix/King KMD 540, and the result was satisfactory. There was no finding or remarks of the TAWS function during the inspection for initial and renewal of the C of A.

According to the Bendix/King installation manual, the KMD 540 could have function as Ground Proximity Warning System (GPWS)/TAWS if the MFD was installed with KAC 502 Enhanced Ground Proximity Warning System (EGPWS) Module and interfaced with EGPWS unit. If the KMD 540 did not have GPWS function, during powered the unit, the self-test page display would indicate the terrain interface did not pass the self-test.

The Pacific Aerospace Limited (PAL) described that during the first delivery of the PAC 750 XL serial number 144 (PK-HVQ aircraft), the KMD 540 installed in the aircraft was not configured as GPWS/TAWS. The investigation did not find any documentation of aircraft modification related to the KMD 540 nor any document that indicated an EGPWS unit had been installed in the aircraft since the delivery until the day of the accident. In addition, the recovered KMD 540 unit installed in the PK-HVQ aircraft indicated that the KAC 502 EGPWS Module was not installed. The investigation concluded that the KMD 540 installed in the PK-HVQ aircraft was not configured as GPWS/TAWS.

The absence of training or familiarization of the TAWS requirement standard in accordance with FAA TSO C-151 or its equivalent as required in the CASR Part 135 might have made the inspection of the TAWS had not been performed appropriately and unable to detect the aircraft that was not equipped with TAWS as required in the CASR Part 135.

The Dimonim Air assumed that the Garmin GNS 430 installed in the aircraft met the requirement of TAWS as the unit had TERRAIN feature. However, the Garmin GNS 430 would only provide visual alert and was unable to provide voice callout when the aircraft close to terrain as required by the CASR Part 135 subpart 135.319. The Garmin GNS 430 Pilot's Guide and Reference manual described that the TERRAIN feature was not certified as terrain awareness system referred to the FAA TSO-C151.

The DGCA did not include the detail requirement of the FAA TSO-C151 or its equivalent in the CASR Part 135 nor another requirement standard published by the DGCA. This might have made the Dimonim Air considered the Garmin GNS430 as TAWS that met the requirement standard of the CASR Part 135.

The CASR Part 135 subpart 135.319, also required the aircraft flight manual must contain appropriate procedures for the use of the TAWS including flight crew reaction in response to the TAWS audio and/or visual warnings. The investigation was unable to find the aforesaid procedures in the Dimonim Air operation manuals for the operation of PAC 750XL aircraft.

Prior to issue approval of the Dimonim Air operation manuals, the DGCA inspector conducted manual inspection. The absence of procedure to use of TAWS and the response to audio and/or visual warnings were unable to be identified by the inspector. This indicated that the inspection of the operation manuals was not conducted thoroughly.

The absence of TAWS without any voice callout was not in accordance with the TAWS alerting requirement for aircraft operations under CASR Part 135 for 9 passenger seats configuration. This condition might increase the likelihood of Controlled Flight into Terrain accident as the pilot was not provided with the standard TAWS alerting feature.

2.5 Provision of Meteorological Information

The CASR Part 174 subpart 174.15 described that every user of aviation meteorology must only use the information provided by the *Badan Meteorologi Klimatologi dan Geofisika*/Bureau of Meteorology, Climatology and Geophysics (BMKG). The BMKG was the aviation meteorology provider that was oversighted by the DGCA to meet the standard requirement in the CASR Part 174 and in accordance with the standard and recommended practice described in the International Civil Aviation Organization (ICAO) Annex 3.

The CASR Part 174 subpart 174.50 described that the BMKG must have one or more aerodrome meteorological units in aerodrome that adequate to provide the meteorological services required to fulfil the needs of air navigation.

The CASR Part 170 subpart 2.2 described that the ATS provider requires to have coordination with aviation meteorological information provider to ensure the provision of current meteorological information. The CASR Part 172 subpart 172.135, also described that ATS provider must have LOCA with the aviation meteorological information provider.

In 2016, the DGCA conducted oversight prior to the issuance of the AirNav Indonesia branch office Oksibil, the inspector identified that there was no LOCA with the aviation meteorological provider. On 17 November 2016, the DGCA issued ATS provider certificate for the AirNav Indonesia branch office Oksibil to conduct aerodrome control service with several conditions of approval, included to have LOCA with the BMKG. This condition of approval would be revisited by the DGCA at a period not greater than five years form the date of the issuance.

In 2017 and 2018 prior to the occurrence, the DGCA conducted oversight to the AirNav Indonesia branch office Oksibil, including oversighted the compliance of LOCA. The DGCA inspectors were aware that there was no aviation meteorology provider at Oksibil and did not consider this condition had safety risk for aircraft operation. Therefore, the absence of the LOCA between AirNav Indonesia branch office Oksibil and the BMKG was not considered as a finding.

The BMKG had installed Automated Weather Observing System (AWOS) at Oksibil, however due to electrical problem the AWOS was not activated during the accident flight. During the accident flight, the weather information for air traffic at Oksibil was based on air traffic controller observation and pilot report, there was no meteorological information provided by aviation meteorological unit.

The absence of aviation meteorological unit that provide meteorological information at Oksibil was not in accordance with CASR Part 174. Considering that the Oksibil was in mountainous area which made the weather condition sometimes rapidly change, the absence of proper meteorological information considered as hazard in aircraft operation.

3 CONCLUSION

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.

In this occurrence, the KNKT identified several findings as follows:

1. The pilots and air traffic controller held valid license and medical certificate.
2. The flights of the day scheduled for the aircraft and the pilot were Tanah Merah – Oksibil – Tanah Merah – Manggelum – Tanah Merah – Bomakia – Tanah Merah.
3. Due to weather condition at Oksibil was below the requirement of Visual Flight Rule (VFR) weather minima, the pilot decided to change the flight schedule.
4. The flights from Tanah Merah – Manggelum – Tanah Merah – Bomakia – Tanah Merah were uneventful and the aircraft landed safely in Tanah Merah. The flights were conducted as single pilot operation with one training pilot who seat on the right pilot seat acted as observer (Other Pilot 1).
5. During the previous flight sectors, the pilots monitored on the radio that there were two aircraft flew from Tanah Merah to Oksibil and returned.
6. After landed in Tanah Merah from the previous sector, the PIC asked the Dimonim Air ground staff at Tanah Merah of the weather information from Oksibil and was advised that the weather still below the requirement of VFR.
7. The PIC decided to continue the flight schedule to Oksibil and replaced the Other Pilot 1 with Other Pilot 2 who PIC believed had more experience to fly to Oksibil. The Other Pilot 2 was a captain pilot of Cessna 208 aircraft who had flew to Oksibil several times.
8. The Other Pilot 2 did not have qualification as PAC 750XL aircraft pilot, and the Dimonim Air management was not aware of this crew change.
9. The flight plan to Oksibil stated that the flight was conducted under VFR.
10. At 1342 LT, on daylight condition the PK-HVQ aircraft departed from Tanah Merah to Oksibil carried cargo that was not listed in the cargo manifest, and the Dimonim Air management was not aware of this cargo.
11. The PIC decision to depart was most likely affected by several aircraft that had successfully flew to Oksibil and return. The decision also might be affected by his intention to help his colleagues to get extra money from the unlisted cargo, as their allowance had not been paid for several months.
12. During the initial contact to the Oksibil Tower controller, the pilot was informed that the right downwind and right base of runway 11 were blocked by clouds and the controller advised the pilot to continue the flight to final runway 11.

13. While approaching Oksibil, the pilot advised the Oksibil Tower controller that the aircraft position was over Global Positioning System (GPS) checkpoint OKSX. The GPS checkpoint OKSX was not mentioned in the Route Manual Papua for Oksibil published by the Dimonim Air nor in the Aeronautical Information Publication (AIP) Volume IV.
14. The investigation found several aircraft operators issued route guidance for internal use that contained different check point location. This may confuse air traffic controller and pilot of other aircraft operator.
15. According to the Oksibil Air Traffic Services Standard Operating Procedure (ATS SOP) subchapter 7.1.3, the traffic circuit of runway 11 was only right traffic circuit. However, this procedure was not described in any aeronautic publication.
16. Several controllers at Oksibil assumed that the pilot would choose the traffic circuit based on the aircraft performance and visibility from the cockpit. Therefore, the controller did not prohibit the pilot to use the left traffic circuit.
17. The information that the right pattern was blocked by clouds and the absence of prohibition to use left traffic circuit might have made the pilot flew to the left traffic circuit during the occurrence flight.
18. Based on the survived passenger recollection, the aircraft flew in and out clouds. When the aircraft was over Oksibil, the survived passenger was able to see airport. Thereafter, the pilot turned the aircraft, which was assumed as the pilot attempt to avoid clouds, and the aircraft encountered several turbulences again.
19. The Operations Specification issued by the Directorate General of Civil Aviation (DGCA) for the Dimonim Air was limited on VFR flight during day light condition only. The Dimonim Air Operation Manual – Part A (OM – Part A) and Civil Aviation Safety Regulation (CASR) Part 91 prohibited pilot to fly into a cloud when operates an aircraft under VFR.
20. The VFR flight which flown into clouds indicated that the VFR weather minimum requirement was not implemented properly, and might have made the pilot did not have a clear visual of the surrounding area.
21. The last three data reporting on the flight following system indicated that the aircraft had been descended from altitude of 7,000 feet and flew toward terrain area with the highest height of 7,600 feet and away from the left circuit pattern of runway 11. Those aircraft maneuver might be an indication that the left traffic circuit was also in cloudy condition and the pilot attempted to get visual reference with the ground.
22. The last data reporting on the flight following system at 0519 UTC, the last Data Acquisition Alarm Monitor (DAAM) stopped recording data and the wreckage distribution indicated that prior to impact, the aircraft turned from 356° to heading 130° within minute, which considered the pilot conducted steep turn maneuver.
23. The steep turn and climb maneuver might indicate that the pilot attempted to avoid the mountainous area in the northwest of the Oksibil.

24. In the last one minute, the DAAM indicated that the Indicated Air Speed (IAS) decreased from 149 knots to the lowest of 80 knots while the torque maintained about 31 psi. The rapid deceleration of aircraft speed without additional power indicated that the aircraft climbed.

25. The survived passenger heard sound from the aircraft system which similar with stall warning sound after the aircraft passed over the Oksibil. The activation of the stall warning at speed about 80 knots, might be an indication that the aircraft was on bank angle 45° or more which reduced the aircraft stalling speed.

26. According to the stall speed table, the stalling speed might decrease to about 80 knots and the stall warning would active about 5 up to 10 above the stalling speed.

27. At 05:19:39 UTC or 16 seconds before the DAAM recording stopped, the IAS decreased from 103 knots while the torque maintained. At 05:19:49 UTC, the fuselage g-force reduced from 1.4 g to -2.8 g, the IAS was reducing to 98 knots and the torque still maintained at 49 psi.

28. The decreased value by -4.2 g of fuselage g-force within second indicated that rapid deceleration occurred most likely due to the aircraft impacted terrain.

29. On 12 August 2018, which was one day after the accident, a Cessna C208B aircraft registered PK-HVC operated by Dimonim Air departed from Sentani to conduct search mission in Oksibil and found the PK-HVQ wreckage on coordinate of 04° 51.07” S 140° 35.94” E.

30. At 0812 LT, the ground search teams arrived on accident site and found eight occupants were fatally injured and one occupant was seriously injured. The six fatally injured occupants were found outside the aircraft wreckage while the rest were found insight the aircraft wreckage including the survived passenger.

31. The flight following system did not indicate any SOS signal activation by the pilot and the downloaded DAAM data did not indicate any engine parameter anomaly. In addition, there was no distress message from the pilot recorded in the ground-based automatic voice recording equipment. Therefore, the investigation determined that there was no aircraft system malfunction during the occurrence.

32. The OM – Part A subchapter 5.3 and 10.7 described requirement for pilot to have adequate experience and knowledge of the route and airport to be flown, including the understanding of the terrain and minimum safe altitudes.

33. The OM – Part A also stated that the information of route and airport to be flown were described in the AIP, Jeppesen Airway Manual, VFR Route Guidance and Dimonim Air Operation Manual Part C (OM- Part C). However, the mentioned documents did not provide information of terrain height over the Oksibil.

34. Before joining the Dimonim Air on October 2017, the PIC flew in Papua New Guinea. Based on the operation daily record provided by the Dimonin Air, since joined the company, the PIC flew to Oksibil once and never flew to other destination that required flying over the Oksibil area which allowed the pilot to observe Oksibil area.

35. Based on the conditions of no information of terrain height provided to the PIC and limited experience of flying to or over Oksibil, the PIC was considered had lack knowledge of the terrain surrounding Oksibil area.

36. The aircraft had valid Certificate of Airworthiness (C of A) and Certificate of Registration (C of R) issued by the Directorate General of Civil Aviation (DGCA). Prior to departure, there was no report or record of aircraft system malfunction.

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

38. Based on the Serialised Component Embodied document for the PK-HVQ aircraft provided by the Dimonim Air, the aircraft was equipped with two units of GPS Garmin GNS 430 which can provide visual ground proximity visual alert to the pilot.

39. The aircraft equipped with Multi-Function Display (MFD) Bendix/King KMD 540 which able to have a function as Ground Proximity Warning System (GPWS) if the MFD was installed with KAC 502 Enhanced Ground Proximity Warning System (EGPWS) Module and interfaced with EGPWS unit.

40. If the KMD 540 did not have GPWS function, the self-test page display would indicate the terrain interface did not pass the self-test.

41. The Pacific Aerospace Limited described that during the first delivery of the PAC 750XL serial number 144, the KMD 540 installed in the aircraft was not configured as GPWS/TAWS. The investigation did not find any documentation of aircraft modification related to the KMD 540 nor any document that indicated an EGPWS unit had been installed in the aircraft since the delivery until the day of the accident. In addition, the recovered KMD 540 unit installed in the PK-HVQ aircraft indicated that the KAC 502 EPWS Module was not installed.

42. The investigation concluded that the KMD 540 installed in the PK-HVQ aircraft was not configured as GPWS/TAWS.

43. The TERRAIN feature of the GPS installed in the aircraft might provide visual alert to the pilot of the terrain. However, the TERRAIN feature was not intended to be used as a primary reference for terrain avoidance and did not relieve the pilot for being aware of surroundings during flight. This condition might have made the pilot did not consider the alert of the TERRAIN feature and attempted to get visual reference.

44. According to the Authorization, Conditions and Limitations (ACL) issued by the DGCA, the operation of PAC 750XL aircraft registered PK-HVQ was approved for 9 passenger seats configuration. Therefore, in accordance with the CASR Part 135 subpart 135.319, the aircraft required to be equipped with a Terrain Awareness and Warning System (TAWS) that met the minimum requirement of the FAA TSO-C151 for Class B TAWS or its equivalent.

45. The FAA TSO-C151 required TAWS Class B to have GPWS alerting that must include voice callout when the aircraft close to terrain.

46. The CASR Part 135 subpart 135.319, also required the aircraft flight manual must contain appropriate procedures for the use of the TAWS including flight crew reaction in response to the TAWS audio and/or visual warnings. The investigation was unable to find the aforesaid procedures in the Dimonim Air operation manuals for the operation of PAC 750XL aircraft.

47. Prior to issue approval of the Dimonim Air operation manuals, the DGCA inspector conducted manual inspection. The absence of procedure to use of TAWS and the response to audio and/or visual warnings were unable to be identified by the inspector. This indicated that the inspection of the operation manuals was not conducted thoroughly.

48. During the aircraft inspection prior to the issuance of initial and renewal C of A for the PK-HVQ aircraft, the DGCA inspectors considered that the terrain function of the KMD 540 as the TAWS installed in the aircraft.

49. The DGCA inspectors who conducted the inspection had not been trained or familiarized regarding the TAWS requirement standard in accordance with FAA TSO C-151 or its equivalent as required in the CASR Part 135., and the inspection of the TAWS compliance to the requirements relied on the functional test of the unit.

50. The DGCA inspectors recalled that during the aircraft inspection, the Dimonim Air representative performed functional test of the terrain function in the KMD 540, and the result was satisfactory. There was no finding or remarks of the TAWS function during the inspection for initial and renewal of the C of A.

51. The absence of training or familiarization of the TAWS requirement standard in accordance with FAA TSO C-151 or its equivalent as required in the CASR Part 135 might have made the inspection of the TAWS had not been performed appropriately and unable to detect the aircraft that was not equipped with TAWS as required in the CASR Part 135.

52. The Dimonim Air assumed that the Garmin GNS 430 installed in the aircraft met the requirement of TAWS as the unit had TERRAIN feature. However, the Garmin GNS 430 would only provide visual alert and was unable to provide voice callout when the aircraft close to terrain as required by the CASR Part 135 subpart 135.319.

53. The Garmin GNS 430 Pilot's Guide and Reference manual described that the TERRAIN feature was not certified as terrain awareness system referred to the FAA TSO-C151.

54. The DGCA did not include the detail requirement of the FAA TSO-C151 or its equivalent in the CASR Part 135 nor another requirement standard published by the DGCA. This might have made the Dimonim Air considered the Garmin GNS430 as TAWS that met the requirement standard of the CASR Part 135.

55. The absence of TAWS without any voice callout was not in accordance with the TAWS alerting requirement for aircraft operations under CASR Part 135 for 9 passenger seats configuration. This condition might increase the likelihood of Controlled Flight into Terrain accident as the pilot was not provided with the standard TAWS alerting feature.

56. The aircraft did not have a TAWS as required by the CASR Part 135 that able to provide alerts when the aircraft flying close to terrain. The absence of the voice alert might have made the pilot relied on the visual reference to the terrain for the avoidance maneuver.

57. Considering that the PIC had lack knowledge of the terrain surrounding the Oksibil area and the absence of voice alert from the TAWS when the aircraft flying close to terrain, resulted in the PIC did not have adequate awareness to the surrounding terrain while flying into clouds and continued to fly below the terrain height until the aircraft impacted the terrain.

58. According to the OM – Part A subchapter 3.3, the Dimonim Air developed operational control system to ensure the operation of the flight is conducted in safe and efficient manner.

59. The flight operation in the Tanah Merah area used pilot-self dispatch system, therefore the authority and responsibility for flight release, operation, and flight following were delegated to pilot in command.

60. In order to detect flight operation that was not conducted within the VFR weather minimum, the Dimonim Air relied upon their reporting system.

61. Prior to the accident, the Dimonim Air management did not have any report or record of flight operation that did not implement the VFR weather minimum requirement.

62. Considering that the several Papua areas was located in mountainous area, the weather condition was sometimes rapidly change and pilot might inadvertently enter cloud during the flight.

63. The absence of report or record might be an indication that the operation control and supervision system within the Dimonim Air was unable to capture the VFR flight that did not implement the VFR weather minimum requirement.

64. The unidentified VFR flight that unable to implement the VFR weather minimum requirement, unaware of the crew change, and the unaware of cargo that was not listed in the cargo manifest indicated the operational control and supervision within the aircraft operator was not conducted properly. These conditions resulted in the flight was unable to be conducted in safe and efficient manner as intended by the OM – Part A subchapter 3.3.

65. The CASR Part 174 subpart 174.15 described that every user of aviation meteorology must only use the information provided by the *Badan Meteorologi Klimatologi dan Geofisika*/Bureau of Meteorology, Climatology and Geophysics (BMKG).

66. The BMKG was the aviation meteorology provider that was oversighted by the DGCA to meet the standard requirement in the CASR Part 174 and in accordance with the standard and recommended practice described in the International Civil Aviation Organization (ICAO) Annex 3.

67. The CASR Part 174 subpart 174.50 described that the BMKG must have one or more aerodrome meteorological units that adequate to provide the meteorological services required to fulfil the needs of air navigation.

68. The CASR Part 170 subpart 2.2 described that the ATS provider requires to have coordination with aviation meteorological information provider to ensure the provision of current meteorological information. The CASR Part 172 subpart 172.135, also described that ATS provider must have Letter of Operational Coordination Agreement (LOCA) with the aviation meteorological information provider.

69. In 2016, the DGCA conducted oversight prior to the issuance of the AirNav Indonesia branch office Oksibil, the inspector identified that there was no LOCA with the aviation meteorological provider.

70. On 17 November 2016, the DGCA issued ATS provider certificate for the AirNav Indonesia branch office Oksibil to conduct aerodrome control service with several conditions of approval, included to have LOCA with the BMKG. This condition of approval would be revisited by the DGCA at a period not greater than five years form the date of the issuance.

71. In 2017 and 2018 prior to the occurrence, the DGCA conducted oversight to the AirNav Indonesia branch office Oksibil, including oversighted the compliance of LOCA. The DGCA inspectors were aware that there was no aviation meteorology provider at Oksibil and did not consider this condition had safety risk for aircraft operation. Therefore, the absence of the LOCA between AirNav Indonesia branch office Oksibil and the BMKG was not considered as a finding.

72. The BMKG had installed Automated Weather Observing System (AWOS) at Oksibil, however due to electrical problem the AWOS was not activated during the accident flight. During the accident flight, the weather information for air traffic at Oksibil was based on air traffic controller observation and pilot report, there was no meteorological information provided by aviation meteorological unit.

73. The absence of aviation meteorological unit that provide meteorological information at Oksibil was not in accordance with CASR Part 174. Considering that the Oksibil was in mountainous area which made the weather condition sometimes rapidly change, the absence of proper meteorological information considered as hazard in aircraft operation.

3.2 Contributing Factors

Contributing factors is defined 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 KNKT concluded the contributing factors as follows:

- The VFR weather minimum requirement that was not implemented properly most likely had made the pilot did not have a clear visual to the surrounding area.
- Considering that the Pilot in Command (PIC) had lack knowledge of the terrain surrounding the Oksibil area, and the absence of voice alert from the TAWS when the aircraft flying close to terrain, resulted in the PIC did not have adequate awareness to the surrounding terrain while flying into clouds and continued to fly below the terrain height until the aircraft impacted the terrain.

4 SAFETY ACTION

At the time of issuing this report, the KNKT had been informed of safety actions taken by involved parties resulting from this occurrence.

4.1 Directorate General of Civil Aviation

The DGCA had conducted corrective action to address the KNKT safety recommendation in the Preliminary Report as follow:

04.R-2018-32.02

In 2017, KNKT issued safety recommendation number 04.R-2015-17.6 that recommended the Directorate General of Civil Aviation (DGCA) to publish the visual route guidance for airport without instrument approach procedure. The recommendation was responded that the DGCA offered aircraft operator to submit draft visual guidance to DGCA and AirNav Indonesia for further discussion. The same recommendation has been issued to the DGCA in 10 July 2018.

During this occurrence, the AIP Volume IV did not include approach guidance for Oksibil. The Dimonim Air issued Route Manual Papua which contained information of Oksibil and this route manual was used for internal use.

While approaching Oksibil, the PK-HVQ pilot advised the Oksibil Tower controller that the aircraft position was over GPS checkpoint OKSX. This GPS checkpoint was not mentioned in the Route Manual Papua for Oksibil published by the Dimonim Air.

Several aircraft operator issued route guidance for internal use that contained different check point location. This may confuse air traffic controller and pilot from other aircraft operator.

KNKT recommends the DGCA to ensure that the safety recommendation number 04.R-2015-17.6 which published in 2017 and 04.R-2018-24.3 in 2018 to publish the visual route guidance for airport without instrument approach procedure.

Responding to the safety recommendation number 04.R-2018-32.02 above, the DGCA with the AirNav Indonesia and aircraft operator had drafted departure and arrival route guidance for several airport at Papua included Oksibil.

The draft of arrival route guidance for runway 11 described that the pilot instructed to use right traffic circuit of runway 11 or as instructed by the air traffic controller.

4.2 Dimonim Air

On September 2018, the Dimonim Air conducted risk assessment for the flight operation at Oksibil and determined that the Oksibil was classified as Mountain Level 1 of aerodrome risk classification.

5 SAFETY RECOMMENDATIONS

The KNKT acknowledged the safety action taken by the related parties and considered the actions were relevant to improve safety, however, there still remain safety issues that need to be considered. Therefore, the KNKT issues the following safety recommendations addressed to the Dimonim Air, Directorate General of Civil Aviation (DGCA), and *Badan Meteorologi Klimatologi dan Geofisika*/Bureau of Meteorology, Climatology and Geophysics (BMKG).

5.1 Dimonim Air

- On 5 October 2018, KNKT published Preliminary Report which contained safety recommendation addressed to the Dimonim Air as follow:

  04.O-2018-32.01

  The weather information from Oksibil indicated no improvement on weather condition and the flight from Tanah Merah to Oksibil was canceled. The pilot conducted flight to other scheduled routes. During those flights, the pilot monitored from the radio frequency that there were two aircraft flew from Tanah Merah to Oksibil and returned.

  After landed in Tanah Merah, the pilot asked the ground staff of the weather information from Oksibil and was advised that the weather still below the requirement of VFR. The PK-HVQ departed to Oksibil under Visual Flight Rules.

  On initial contact with Oksibil Tower controller, the PK-HVQ pilot was advised of the latest meteorological condition including the visibility 1 up to 2 km, and the clouds base of over the airport and surrounding area was about 4,700 feet above mean sea level or about 700 feet above ground level.

  According to the CASR Part 135, subchapter 135.615 for VFR takeoff minima describes no person shall commence a VFR flight unless the latest available ceiling and visibility reports or forecasts indicate that the weather conditions along the route to be flown and at the destination airport indicated the flight could be conducted under VFR. According to the CASR Part 91, no person may enter traffic pattern of an airport under VFR, within the lateral boundaries of the surface areas of Class C airspace designated for an airport unless ground visibility at that airport is at least 3 statute miles (4.8 km).

  Flying under Visual Flight Rules in weather condition below VMC could make the pilot unable to see terrain or obstacle on the surrounding area.

  KNKT recommends the Dimonim Air to ensure all flights are conducted at or above the required weather minima.

  Until the issuance of this report, the KNKT had not received any respond from the Dimonim Air responding to the aforesaid safety recommendation. Therefore, the KNKT encourage the Dimonim Air to conduct the safety recommendation number 04.O-2018-32.01 that had been issued in the Preliminary Report.

- **04.O-2018-32.03**

  According to the OM – Part A subchapter 3.3, the Dimonim Air developed operational control system to ensure the operation of the flight is conducted in safe and efficient manner. The flight operation in the Tanah Merah area used pilot-self dispatch system, therefore the authority and responsibility for flight release, operation, and flight following were delegated to pilot in command.

  The unidentified VFR flight that unable to implement the VFR weather minimum requirement, unaware of the crew change, and the unaware of cargo that was not listed in the cargo manifest indicated the operational control and supervision within the aircraft operator was not conducted properly. These conditions resulted in the flight was unable to be conducted in safe and efficient manner as intended by the OM – Part A subchapter 3.3.

  Therefore, the KNKT recommends the Dimonim Air to review the operational control system to improve the operational control and supervision within the company for ensuring the flight operation is conducted in safe and efficient manner.

5.2 Directorate General of Civil Aviation

- **04.R-2018-32.04**

  The PAC 750XL aircraft registered PK-HVQ was approved for 9 passenger seats configuration. Therefore, in accordance with the CASR Part 135 subpart 135.319, the aircraft the aircraft required to be equipped with a Terrain Awareness and Warning System (TAWS) that met the minimum requirement of the FAA TSO-C151 for Class B TAWS.

  The FAA TSO-C151 required TAWS Class B to have Ground Proximity Warning System (GPWS) alerting that must include voice callout when the aircraft unintentionally close to terrain.

  Based on the Serialised Component Embodied document for the PK-HVQ aircraft provided by the Dimonim Air, the aircraft was equipped with two units of Global Positioning System (GPS) Garmin GNS 430 which can provide visual ground proximity warning to the pilot. The Garmin GNS 430 Pilot's Guide and Reference manual described that the TERRAIN feature was not certified as terrain awareness system referred to the FAA TSO–C151.

  The aircraft also equipped with Multi-Function Display (MFD) Bendix/King KMD 540 which had function as GPWS if the MFD was interfaced with Enhanced Ground Proximity Warning System (EGPWS) unit. The PK-HVQ was not equipped with any EGPWS unit as the MFD 540 was used as weather radar display.

  During the aircraft inspection prior to the issuance of initial and renewal Certificate of Airworthiness (C of A) for the PK-HVQ aircraft, the DGCA inspectors considered that the terrain function of the KMD 540 as the TAWS installed in the aircraft, and had met the CASR Part 135 requirement standard of TAWS.

The inspectors had not been trained or familiarized to the TAWS requirement standard in accordance with FAA TSO C-151 or its equivalent as required in the CASR Part 135, and the inspection of the TAWS compliance to the requirement relied on the functional test of the unit.

The absence of training or familiarization of the TAWS requirement standard might have made the inspection of the TAWS had not been performed appropriately and unable to detect the aircraft that was not equipped with TAWS as required in the CASR Part 135.

Therefore, the KNKT recommends the DGCA to provide inspector with sufficient knowledge of TAWS requirement standard as required in the CASR Part 135 for ensuring the inspection of the TAWS can be performed appropriately.

- **04.R-2018-32.05**

  The CASR Part 135 subpart 135.319, required the aircraft flight manual must contain appropriate procedures for the use of the TAWS including flight crew reaction in response to the TAWS audio and/or visual warnings. The investigation was unable to find the aforesaid procedures in the Dimonim Air operation manuals for the operation of PAC 750XL aircraft.

  Prior to issue approval of the Dimonim Air operation manuals, the DGCA inspector conducted manual inspection. The absence of procedure to use of TAWS and the response to audio and/or visual warnings were unable to be identified by the inspector. This indicated that the inspection of the operation manuals was not conducted thoroughly.

  Therefore, the KNKT recommends the DGCA to review the manual inspection process for ensuring that the inspection of the operation manuals is able to identify the absence of procedure to use of TAWS and the response to audio and/or visual warnings.

- **04.R-2018-32.06**

  The Dimonim Air assumed that the Garmin GNS 430 installed in the aircraft met the requirement of TAWS as the unit had TERRAIN feature. However, the Garmin GNS 430 would only provide visual alert and was unable to provide voice callout when the aircraft close to terrain as required by the CASR Part 135 subpart 135.319.

  The DGCA did not include the detail requirement of the FAA TSO – C151 or its equivalent in the CASR Part 135 nor another requirement standard published by the DGCA. This might have made the Dimonim Air considered the Garmin GNS430 as TAWS that met the requirement standard of the CASR part 135.

  Therefore, KNKT recommends the DGCA to review the standard requirement of TAWS in the CASR Part 135 or another requirement standard published by the DGCA to include the detail requirement of the TAWS.

- **04.R-2018-32.07**

  The CASR Part 174 subpart 174.50 described that the *Badan Meteorologi Klimatologi dan Geofisika*/Bureau of Meteorology, Climatology and Geophysics (BMKG) must have one or more aerodrome meteorological units that adequate to provide the meteorological services required to fulfil the needs of air navigation.

  The CASR Part 170 subpart 2.2 described that the ATS provider requires to have coordination with aviation meteorological information provider to ensure the provision of current meteorological information. The CASR Part 172 subpart 172.135, also described that ATS provider must have LOCA with the aviation meteorological information provider.

  On 17 November 2016, the DGCA issued ATS provider certificate for the AirNav Indonesia branch office Oksibil to conduct aerodrome control service with several conditions of approval, included to have LOCA with the BMKG. This condition of approval would be revisited by the DGCA at a period not greater than five years form the date of the issuance.

  In 2017 and 2018 prior to the occurrence, the DGCA conducted oversight to the AirNav Indonesia branch office Oksibil, including oversighted the compliance of LOCA. The DGCA inspectors were aware that there was no aviation meteorology provider at Oksibil and did not consider this condition had safety risk for aircraft operation. Therefore, the absence of the LOCA between AirNav Indonesia branch office Oksibil and the BMKG was not considered as a finding.

  The BMKG had installed Automated Weather Observing System (AWOS) at Oksibil, however due to electrical problem the AWOS was not activated during the accident flight. During the accident flight, the weather information for air traffic at Oksibil was based on air traffic controller observation and pilot report, there was no meteorological information provided by aviation meteorological unit.

  The absence of aviation meteorological unit that provide meteorological information at Oksibil was not in accordance with CASR Part 174. Considering that the Oksibil was in mountainous area which made the weather condition sometimes rapidly change, the absence of proper meteorological information considered as hazard in aircraft operation.

  Therefore, the KNKT recommends the DGCA the finding of non-compliance standard requirement to provide meteorology information to be followed up as soon as possible to improve the safety of aircraft operation.

5.3 *Badan Meteorologi Klimatologi dan Geofisika*/Bureau of Meteorology, Climatology and Geophysics

- **04.L-2018-32.08**

  The CASR Part 174 subpart 174.50 described that the *Badan Meteorologi Klimatologi dan Geofisika*/Bureau of Meteorology, Climatology and Geophysics (BMKG) must have one or more aerodrome meteorological units in aerodrome that adequate to provide the meteorological services required to fulfil the needs of air navigation.

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  Therefore, the KNKT recommends the BMKG to provide implement the requirement standard of CASR Part 174 to have one or more aerodrome meteorological units in aerodrome that adequate to provide the meteorological services required to fulfil the needs of air navigation.

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