KOMITE NASIONAL KESELAMATAN TRANSPORTASI
REPUBLIC OF INDONESIA

FINAL

KNKT.18.06.24.04

Aircraft Serious Incident Investigation Report

PT. Spirit Avia Sentosa (FlyingSAS)

Cessna 208B, PK-FSL

About 3.6 Nm from NBR VOR/DME on bearing of 105°, Nabire, Papua

Republic of Indonesia

18 June 2018

2021

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

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

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Jakarta, 19 April 2021
KOMITE NASIONAL
KESELAMATAN TRANSPORTASI
CHAIRMAN

SOERJANTO TJAHJONO

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ABBREVIATIONS AND DEFINITIONS

ACL	:	Authorization, Condition and Limitation
AIP	:	Aeronautical Information Publication
ALA	:	Aerodrome for light aircraft
AOC	:	Air operator certificate
ARP	:	Aerodrome reference point
ATC	:	Air traffic control
ATZ	:	Aerodrome traffic zone
BMKG	:	*Badan Meteorologi Klimatologi dan Geofisika* (Bureau of Meteorology, Climatology and Geophysics)
C of A	:	Certificate of Airworthiness
C of R	:	Certificate of Registration
CASR	:	Civil Aviation Safety Regulation
CB	:	Cumulonimbus
CPL	:	Commercial Pilot License
DGCA	:	Directorate General of Civil Aviation
DME	:	Distance Measuring Equipment
ETA	:	Estimate Time Arrival
FAA	:	Federal Aviation Administration
FOO	:	Flight Operation Officer
ft	:	feet
GA-EGPWS	:	General Aviation – Enhanced Ground Proximity Warning System
GPS	:	Global Positioning System
GPWS	:	Ground Proximity Warning System
ICAO	:	International Civil Aviation Organization
KNKT	:	*Komite Nasional Keselamatan Transportasi* (National Transportation Safety Committee/NTSC).
LPPNPI	:	*Lembaga Penyelenggara Pelayanan Navigasi Penerbangan Indonesia* (AirNav Indonesia)
LT	:	Local Time
MFD	:	Multi-Function Display
MHz	:	Megahertz
NBR	:	NBR is VHF Omnidirectional Range located at 0.9 Nm from Nabire on bearing 164°

NDB	:	Non-Directional Beacon
Nm	:	Nautical Mile
OM	:	Operation Manual
PF	:	Pilot Flying
PIC	:	Pilot in Command
PM	:	Pilot Monitoring
POH	:	Pilot's Operating Handbook
QFE	:	An aeronautical code Q code, referred to as atmospheric pressure at aerodrome elevation (or at runway threshold).
QNH	:	An aeronautical code Q code, indicating the atmospheric pressure adjusted to mean sea level
SIC	:	Second in Command
SOS	:	Save Our Soul, a code for distress signal
TAWS	:	Terrain Avoidance Warning System
TSO	:	Technical Standard Order
UTC	:	Universal Time Coordinated
VFR	:	Visual Flight Rules
VMC	:	Visual Meteorological Condition
VOR	:	Very High Frequency Omni-directional Range
ZR	:	ZR is Non-Directional Beacon located on 0.3 Nm from Nabire on bearing of 12°

SYNOPSIS

On 18 June 2018, two pilot of PT. Spirit Avia Sentosa (FlyingSAS) were conducting unscheduled passenger flights. The flights of the day planned for the pilots were from Douw Aturure Airport (WABI), Nabire to Sugapa Airstrip (WAYB), Bilorai and return for three times. The PIC acted as Pilot Flying (PF) and the SIC acted as Pilot Monitoring (PM) on all these flights.

The third flight from Nabire to Bilorai, the pilot used Cessna 208B aircraft registered PK-FSL and landed safely in Bilorai. Prior to the departure to Nabire, there was no report or record of aircraft system malfunction and the aircraft was operated within the approved weight and balance envelope. On board the aircraft were two pilots and 11 passengers.

At about 1415 LT on daylight condition, the aircraft departed Bilorai and cruised at altitude of 10,500 feet. At about 20 Nm before checkpoint BRAVO, which was about 40 Nm from NBR VOR/DME, the pilot started to descend and noticed development of clouds along the route. The pilot then decided to avoid the clouds by deviating to the right of the GPS route.

About 5 Nm from NBR VOR/DME, when the aircraft reached altitude 2,500 feet, the flight remained in Visual Meteorological Condition, the PF then continued the descend however shortly after the aircraft flew through clouds again. The PF continued the descent and looked outside attempting to get ground visual reference.

During the descend, the pilots noticed terrain in front of the aircraft. The PM subsequently shouted terrain and pull up, then the PF pulled the control column up to make the aircraft climb. During climb out, both pilots felt that the left side of the aircraft impacted to the top of tree. The aircraft climbed and then maintained at altitude of 3,000 feet. The flight continued and landed using runway 16 at Nabire.

No one injured in this occurrence and the aircraft was substantially damaged.

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

- VFR weather minimum requirement that was not implemented properly might have made the pilot did not have clear visual of the surrounding area.
- The consideration of less risk flying into clouds, and relying to the GPWS's aural alert or having visual contact to the terrain, resulted in the ignorance to the GPS alert and continuation of the descend while flying into clouds.

The KNKT acknowledged the safety actions taken by the related parties were relevant in improving safety, however, there still remain safety issues that need to be considered. Therefore, the KNKT issues safety recommendations addressed to the aircraft operator.

1 FACTUAL INFORMATION

1.1 History of the Flight

On 18 June 2018, two pilots of PT. Spirit Avia Sentosa (FlyingSAS) was conducting unscheduled passenger flights. The schedule flight of the day for the pilots were from Douw Aturure Airport (WABI), Nabire[1] to Sugapa Airstrip (WAYB), Bilorai[2] and return for three times. The Pilot in Command (PIC) acted as Pilot Flying (PF) and the Second in Command (SIC) acted as Pilot Monitoring (PM) on all these flights.

During the flight preparation of the first flight, the SIC would read the checklist as it was the task of SIC. The PIC advised the SIC that it was unnecessary and the SIC followed the PIC advice. There was no checklist reading throughout the day.

The first flight from Nabire to Bilorai departed about 0100 UTC (1000 LT[3]) and was delayed about 30 minutes from the scheduled time of departure. In this flight the pilots used a Cessna 208B aircraft registered PK-FSL. While returning to Nabire from Bilorai, the pilot selected the route on the top row of the flight route list that was displayed on the Global Positioning System (GPS). The route was from Bilorai – checkpoint ECHO[4] – checkpoint BRAVO[5] – NBR VOR/DME[6] – Nabire. The flight landed safely at Nabire, and continued for the subsequent flights.

The second flight from Nabire to Bilorai, the aircraft changed to another Cessna 208B registered PK-FSP. The aircraft departed and landed safely in Bilorai. At the returned flight to Nabire, the pilot selected the route on the top row of the flight route list that was on the GPS, which was from Bilorai – checkpoint ECHO – checkpoint BRAVO – checkpoint TOPO[7] – NBR VOR/DME – Nabire. The flight landed safely at Nabire, and continued for the subsequent flights.

The third flight from Nabire to Bilorai, the pilot used the PK-FSL aircraft again and landed safely in Bilorai. On the return flight to Nabire, the pilot planned to use the same route as the first flight. The route was consistent with the flight plan document signed by the PIC.

1 Douw Aturure Airport (WABI), Nabire will be named as Nabire for the purpose of this report.

2 Sugapa Airstrip (WAYB), Bilorai will be named as Bilorai for the purpose of this report.

3 The 24-hours clock in Local Time (LT) is used in this report to describe time as specific events occured. Local time is UTC+9 hours.

4 Checkpoint ECHO is located at about 41 Nm from Bilorai on bearing 278°.

5 Checkpoint BRAVO is located at about 26 Nm from Nabire on bearing 26°.

6 NBR is VHF Omnidirectional Range located at 0.9 Nm from Nabire on bearing 164°.

7 Checkpoint TOPO is located at about 10 Nm from Nabire on bearing 139°.

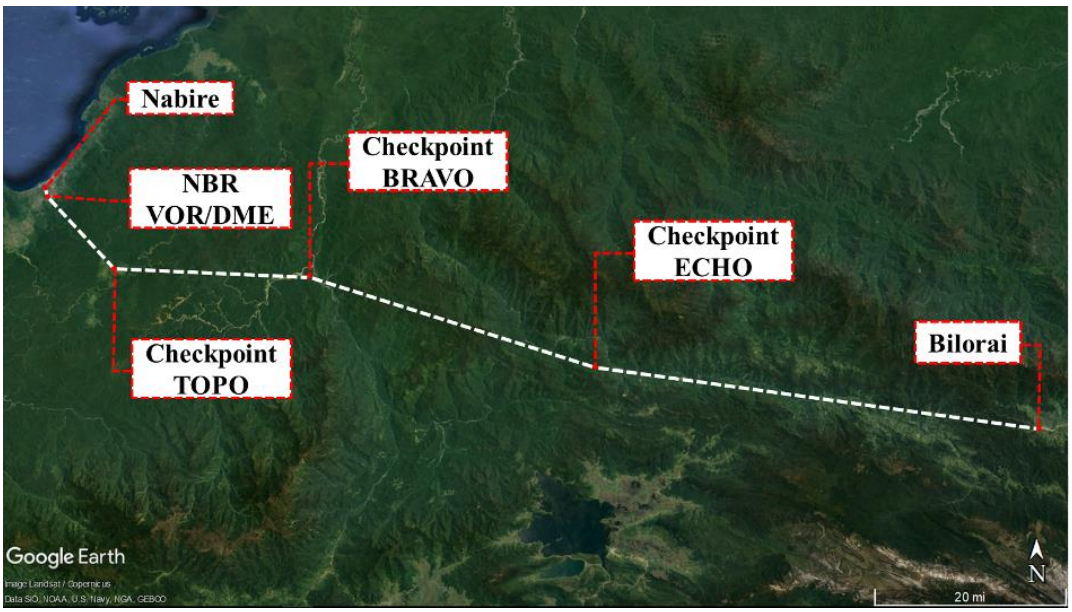

Figure 1: The flight plan route Bilorai to Nabire via checkpoint TOPO

Prior to the departure to Nabire, there was no report or record of aircraft system malfunction and the aircraft was operated within the approved weight and balance envelope. On board the aircraft was two pilots and 11 passengers.

At about 1415 LT on daylight condition, the aircraft departed Bilorai and cruised at altitude of 10,500 feet. At about 20 Nm before checkpoint BRAVO, which was about 40 Nm from NBR VOR/DME, the pilot started to descend with rate of descend about 500 fpm. The pilot noticed development of clouds along the route and decided to avoid the clouds by deviating to the right of the GPS route.

The aircraft flew on the class G airspace and when flew on Nabire aerodrome traffic zone (area with radius of 10 Nm centered at ZR NDB[8]) the airspace was class C airspace.

At 1442 LT, the pilot made initial contact with Nabire Tower controller (controller) and advised that the aircraft was in bound to Nabire from Bilorai with estimated time of arrival (ETA) of 0552 UTC (1452 LT) and the aircraft position was over checkpoint BRAVO, descending and passed altitude of 6,600 feet. The controller acknowledged the pilot message and issued clearance to fly to NBR VOR/DME and to expect landing on runway 34, with additional information of the latest wind condition and QNH. The controller then instructed the pilot to report when the aircraft position on 10 Nm from NBR VOR/DME.

When descending passed altitude of 4,000 feet, the aircraft was flying through clouds and when passing altitude of 3,500 feet the flight was returned to Visual Meteorological Condition (VMC).

At 1449 LT, the pilot advised to the controller that the aircraft position was 10 Nm from NBR VOR/DME and descending passed altitude of 3,300 feet. The controller instructed the pilot to continue approach and report when the aircraft position on final runway 34.

8 ZR is Non-Directional Beacon located on 0.3 Nm from Nabire on bearing of 12°.

The PF was aware of terrain area with elevation about 2,000 feet within radius 5 Nm of Nabire. The PF planned if due to the weather condition made the flight entered clouds again, the altitude would be maintained minimum at 2,500 feet and flew toward the coast area at the north of airport as the area was flat without any terrain.

About 5 Nm from NBR VOR/DME, when the aircraft reached altitude 2,500 feet, the flight remained in VMC, the PF then continued the descend however shortly after the aircraft flew through clouds again. The PF continued the descent and looked outside attempting to get ground visual reference. The PIC did not feel comfortable when not having visual to the terrain and decided to look outside to get ground visual reference, waited for any sign which indicated any terrain ahead.

At 1451 LT, about 4.5 Nm from NBR VOR/DME, the flight following system of the Flying SAS[9] recorded the aircraft altitude was 2,048 feet.

When the aircraft passed altitude about 2,000 feet, the PM noticed yellow area on the aircraft GPS indicating that the terrain on the area was between 1,000 feet and 100 feet below the aircraft altitude and informed to the PF. The PF disengaged the auto pilot, reduced the rate of descend and continued to look outside.

The PM then noticed a "X" symbol on the GPS, which indicated that the area of the symbol was a potential impact point and informed the PF. The PF continued the descent. Thereafter, the second "X" symbol appeared on the GPS and the PM informed to the PF. A few seconds later, the pilots noticed terrain in front of the aircraft. The PM subsequently shouted terrain and pull up, then PF pulled the control column up to make the aircraft climb. During climb out, both pilots felt that the left side of the aircraft impacted to the top of tree. The aircraft climbed and then maintained at altitude of 3,000 feet.

Both pilots did not recall any aural alerts from the aircraft Ground Proximity Warning System (GPWS).

At 1452 LT, the controller called the pilot and asked the aircraft position. The pilot responded that the aircraft was about 2 nm from NBR VOR/DME and the pilot requested to land on runway 16. The controller acknowledged the aircraft position and approved the pilot request.

At 1454 LT, the pilot reported to the controller that the aircraft was on right base runway 16. The controller then issued landing clearance to the pilot.

At 1455 LT, the aircraft landed using runway 16 at Nabire.

The pilot did not perform any briefings during all flights and the pilot did not advise the controller that the aircraft had impacted tree tops. After landed, the pilot advised the flight engineer that the aircraft impacted tree and damaged the left wing.

1.2 Injuries to Persons

No one injured in this occurrence.

9 The Flying SAS utilize flight monitoring system developed by Spider Tracks Limited with type/model of Spider 7. The detail information of the flight following system is in subchapter 1.17.1.

1.3 Damage to Aircraft

The aircraft was substantially damaged. The left-wing tip including the left aileron were damaged and several dents found on the left wing and on the left horizontal stabilizer.

Figure 2: The damage on the left-wing tip and left aileron

1.4 Other Damage

No other damage to property and/or the environment were found in this occurrence.

1.5 Personnel Information

1.5.1 Pilot in Command

The PIC is United States of America nationality who held valid Commercial Pilot License (CPL) and qualified as a single engine land aircraft pilot. The PIC also had valid first-class medical certificate with medical limitation to wear corrective lenses during flight.

The PIC was a qualified company flight instructor in the FlyingSAS who had total flying hour of 1,772 hours, included about 600 hours on Papua area. All of the flight in the Papua area was with Cessna 208B.

The last proficiency check for the PIC was conducted on 14 May 2018, the result was satisfactory without any remarks.

The day of the occurrence was the first duty assignment for the PIC after two weeks off schedule. Prior to the occurrence, the PIC had flown for about 4 hours 41 minutes.

The PIC was aware the meaning of color and symbols on the TERRAIN page of the aircraft GPS. The PIC also had experienced of following the GPS route at altitude 2,000 feet while the terrain feature on GPS indicating yellow and the aircraft was still higher than the terrain.

The PIC assumed that the alert on the GPS was not intended to be used as a primary reference for terrain avoidance, and did not relieve the pilot from the responsibility of being aware of surroundings during flight. The PIC considered aural alert from GPWS, or having visual contact to the terrain were the primary references that required avoidance maneuver.

1.5.2 Second in Command

The SIC is Indonesian who held valid Commercial Pilot License (CPL) and qualified as a single engine land aircraft pilot. The SIC also had valid first-class medical certificate without any medical limitation.

The SIC had total flying hour of 936 hours 16 minutes. The last proficiency check was conducted on 14 May 2018, the result was satisfactory without any remarks.

The day of the occurrence was the first time for the SIC paired with PIC.

1.5.3 Air Traffic Controller

The controller is Indonesian who held valid air traffic control license and qualified as an aerodrome tower controller in Nabire. The controller also had valid third-class medical certificate without any limitation.

1.6 Aircraft Information

1.6.1 General

The Cessna 208B with serial number of 208B-1254, registered PK-FSL was manufactured by Cessna Aircraft Company, United States of America in 2007. The aircraft had valid Certificate of Airworthiness (C of A) and Certificate of Registration (C of R).

The aircraft had total hour since new was 11,276 hours 51 minutes and the total cycles since new was 15,519 cycles. The engine installed on the aircraft was PT6A-114A model, manufactured by Pratt & Whitney Canada with serial number of PCE-PC0787. The total time of the engine since new was 15,313 hours 3 minutes.

1.6.2 Ground Proximity Warning System/Terrain Awareness and Warning System

According to Supplement S36 of the Pilot's Operating Handbook and FAA Approved Airplane Flight Manual (POH) applicable for the PK-FSL aircraft, the aircraft is equipped with Bendix/King KGP 560 General Aviation – Enhanced Ground Proximity Warning System (GA-EGPWS) manufactured by Honeywell in United States of America. The KGP 560 installed in the aircraft contained software version number 606 which satisfies the Terrain Avoidance and Warning Systems (TAWS) Class B installation as defined in Federal Aviation Administration (FAA) Technical Standard Order (TSO) C151b.

The KGP 560 uses GPS information from the aircraft-installed GPS receiver or an internal GPS receiver contained in the KGP 560 computer to determine the aircraft horizontal and lateral position. This position is then compared to the terrain, obstacle and runway database information contained in the KGP 560. Based on those process, the KGP 560 provides visual and aural alerts to the pilot, when the aircraft flies into danger where a conflict with terrain or a known obstacle is imminent.

The KGP 560 interfaced with terrain awareness display to show terrain ahead of the aircraft with additional information of altitude, track, range, and elevations of the highest and lowest points on the terrain display. The display used in the aircraft was Multi-Function Display (MFD) Bendix/King KMD 540.

The “Look-Ahead” alerts on the KGP 560 was described in the Supplement S36 of the POH applicable for the PK-FSL aircraft as follows:

When the system detects a terrain or obstacle threat at least 30 seconds ahead of the airplane, the voice alert "Caution Terrain, Caution Terrain" (or "Caution Obstacle, Caution Obstacle") sounds, and a bright yellow threat area is shown on the Terrain Display. The alert will be repeated approximately every 7 seconds.

If the airplane flight path approaches within 15 to 30 seconds of a threat area, the voice message "Terrain, Terrain, Pull Up, Pull Up" (or "Obstacle, Obstacle, Pull Up, Pull Up") sounds continuously and the threat area on the Terrain Display will be shown as solid red.

When the airplane flight path changes to avoid the threat, the alerts and warnings will cease and the threat areas shown on the Terrain Display will be removed.

CAUTION

The KGP 560 GA-EGPWS "Look-Ahead" function is gradually desensitized as an airplane nears a known runway. Airplanes operating in close proximity to known runways may experience very short or no advance warnings with respect to terrain or obstacles in the area

All visual and aural alerts may be inhibited by pressing the "Terrain Inhibit" switch (located on the right side of the pilot's instrument panel) once. Pressing the “Terrain Inhibit" switch again will reengage the visual and aural alerts. According to the KGP 560 Pilot’s Guide, the purpose of the “Terrain Inhibit” switch is to operate aircraft without nuisance or unwanted warnings at airports that are not in the system database. The "Terrain Inhibit" may be used when operating in good VFR conditions and should be NOT engaged for normal operations.

1.6.3 Global Positioning System

The aircraft was fitted with Global Positioning System (GPS) Garmin GNS 430 and Garmin GNS 530. Both GPS provides navigation data and communication capability including terrain information. The FlyingSAS utilized the GNS 430 for terrain information and the GNS 530 for navigation purposes.

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 cards 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 FAA TSO–C151b.

The TERRAIN feature used yellow (caution) and red (warning) to depict terrain information relative to aircraft altitude. 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 3: terrain/obstacle colors and symbol

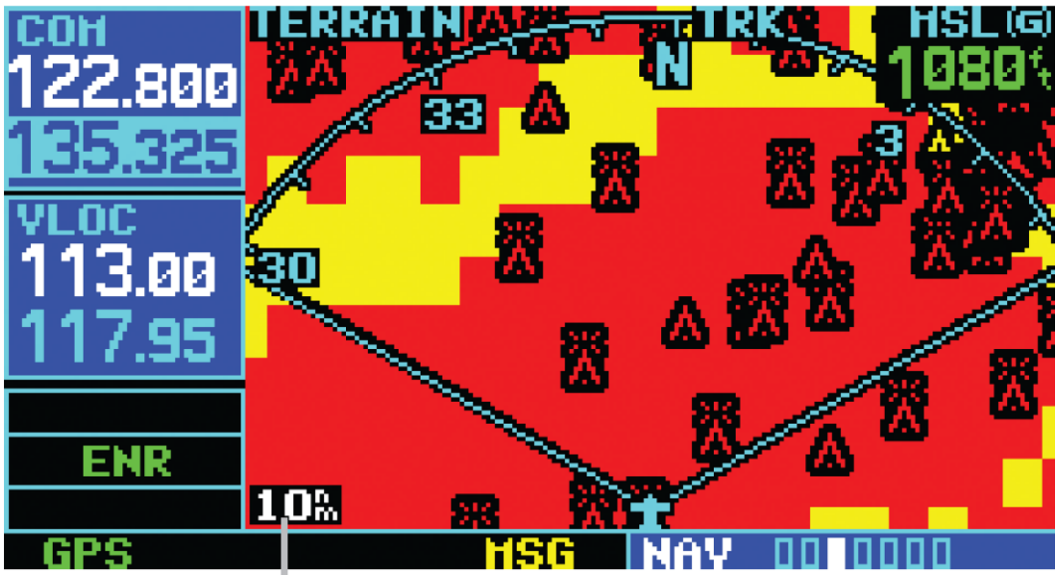

Figure 4: Sample of the TERRAIN page display

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 5: The terrain alert visual annunciation (red arrow)

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

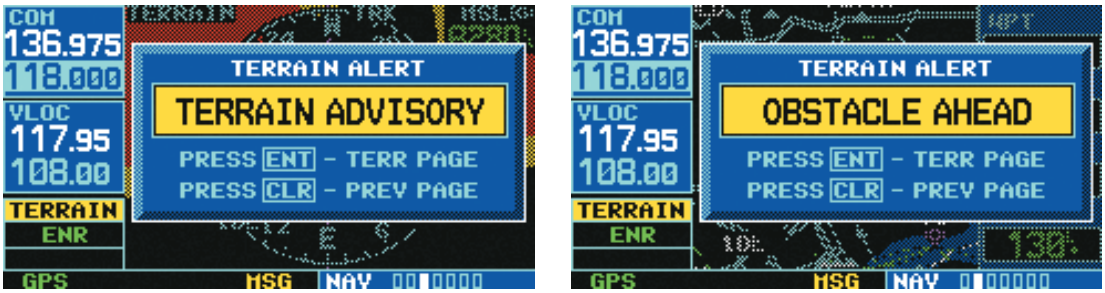

Figure 6: The advisory pop-up (left) and flashing caution pop-up (right)

The GNS 530 have similar capabilities with GNS 430 to provide pilot navigation data and communication capabilities however, no terrain alert features available.

The GNS 530 allows the pilot to create, edit and store up to 20 flight plans with up to 31 waypoints on each flight plan. The GNS 530 can use direct point-to-point navigation to provide guidance from a certain point or position to another point on the flight plan.

1.6.4 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 FlyingSAS 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 7).

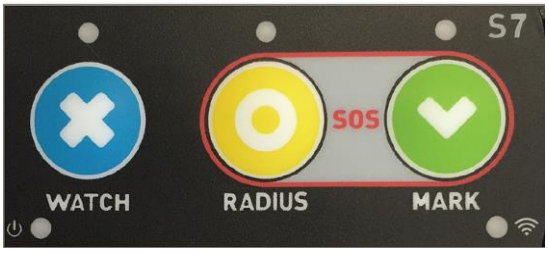

Figure 7: The Spider 7 keypad

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 events 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 the RADIUS and the MARK button together. 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 occurrence flight from the FlyingSAS. The information of the reporting data can be found in the subchapter 1.18.1.

1.7 Meteorological Information

Prior to the departure, pilot was provided with meteorological report at 1400 LT of Nabire by the Flight Operation Officer (FOO). The report contained information surface wind from 310° with velocity of 5 knots, horizontal visibility 7 km, cloud[10] FEW CB 1,600 feet, temperature 26°C and dew point 23°C, QNH[11] 1,009.9 mb/in Hg and QFE[12] 1,009.2 mb/in Hg.

The satellite images provided by *Badan Meteorologi Klimatologi dan Geofisika* (BMKG – Bureau of Meteorology, Climatology and Geophysics) indicated that between 0540 UTC (1440 LT) and 0550 UTC (1450 LT) significant development of clouds which potentially became Cumulonimbus.

10 Cloud amount is assessed in total which is the estimated total apparent area of the sky covered with cloud. The international unit for reporting cloud amount for Few (FEW) is when the clouds cover 1/8 up to 2/8 area of the sky.

11 QNH is an aeronautical code Q code, indicating the atmospheric pressure adjusted to mean sea level.

12 QFE is an aeronautical code Q code, referred to as atmospheric pressure at aerodrome elevation (or at runway threshold).

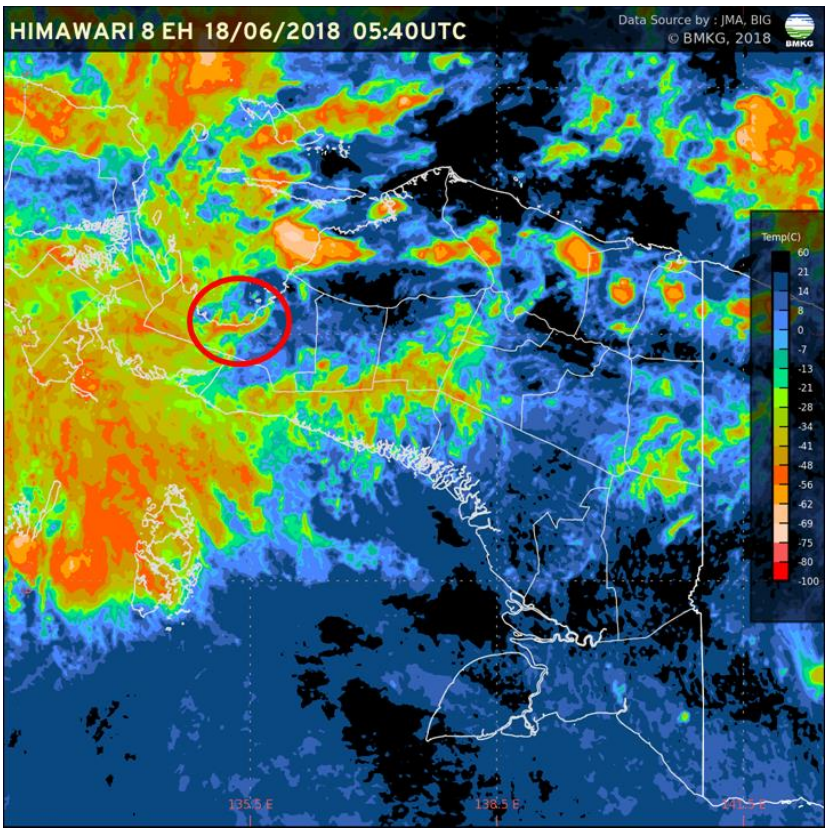

Figure 8: The satellite image of the occurrence site (red circle) at 0540 UTC

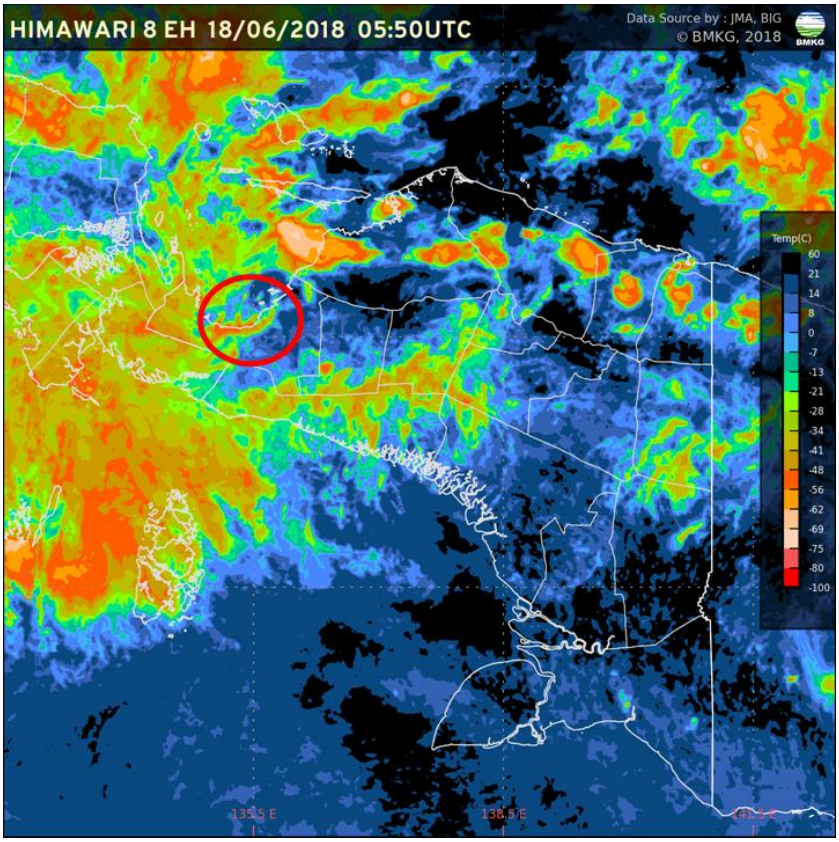

Figure 9: The satellite image of the occurrence site (red circle) at 0550 UTC

1.8 Aids to Navigation

According to the Aeronautical Information Publication (AIP) Volume IV (Aerodrome for Light Aircraft/ALA), Nabire equipped with a Non-Directional Beacon (NDB) identified as ZR and a Very High Frequency Omni-directional Range/Distance Measuring Equipment (VOR/DME) identified as NBR. The navigation equipment was serviceable during the occurrence.

The current AIP Volume IV subchapter WABI AD 2-6 at the day of the occurrence described the location of the NBR VOR/DME was on coordinate 03°23'38.1"S; 135°30'08"E, which was about 1.6 Nm from aerodrome reference point (ARP) of Nabire on bearing 169°. Meanwhile, the in the subchapter WABI AD 2.24-11 (the instrument approach chart) the coordinate of NBR VOR/DME was on 03°22'30.00"S; 135°29'47.00"E, which was about 0.43 Nm from Nabire ARP on bearing 185°.

The FlyingSAS GPS stored the position of the NBR VOR/DME on coordinate 03°22'55.05" S; 135°30'04.04" E. Referred to this coordinate, the NBR VOR/DME was about 0.9 Nm from Nabire ARP on bearing 164°.

After the occurrence, the AirNav Indonesia rechecked the NBR VOR/DME location and updated the actual location with the following coordinate 03°22'59.0"S; 135°30'05.1"E. The update location had been amended in the AIP Volume IV.

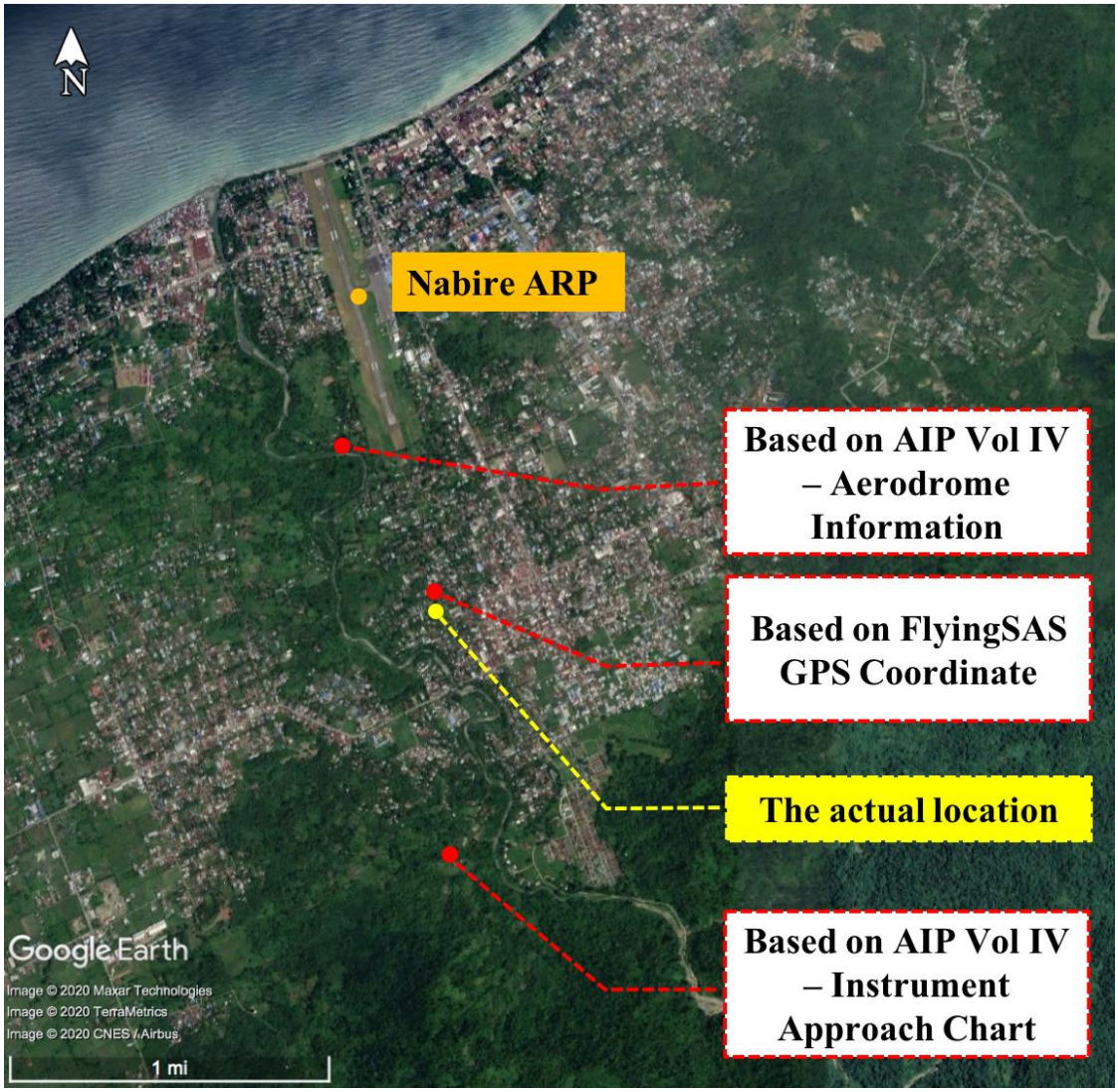

Figure 10: The NBR VOR/DME locations

The AIP Volume I (General and Enroutes) subchapter ENR 6-1-L described Visual Flight Rules (VFR) route chart within Papua areas as reference route that can be used by pilot. The chart described two available arrival routes to Nabire after checkpoint BRAVO, which were NABIRE ARRIVAL and VICTOR 20/27/30/32/33 route.

The NABIRE ARRIVAL route required pilot to fly toward check point TOPO with lowest altitude limit of 6,500 feet and then toward ZR NDB with lowest altitude limit of 4,000 feet. The VICTOR 20/27/30/32/33 route required to fly direct to ZR NDB with lowest altitude limit of 6,500 feet. The upper altitude limit for both routes were 24,500 feet.

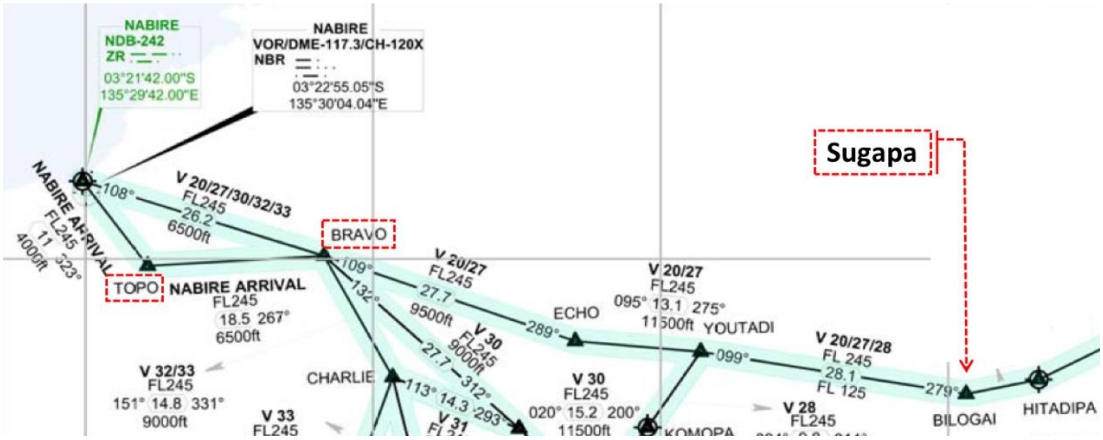

Figure 11: The VFR Route chart from Sugapa to Nabire or return

The FlyingSAS issued Route and Airport Instruction of Nabire, and Visual Flight Rules (VFR) Chart for route Nabire – Sugapa (Bilorai) and return (figure 12). These guidance were contained in the FlyingSAS Operation Manual (OM) – Part C.

The Route and Airport Instruction for arrival to Nabire described:

> *Aircraft inbound from West or North area is expected to contact Nabire Tower 60 Nm from Nabire. When clear of descend aircraft will be given clearance to 2500 feet and call at 10 Nm. If runway 16 in use then will be directed to intercept final runway 16. If runway 34 in use then will be directed to join left downwind runway 34. Aircraft inbound from East area must contact Nabire Tower when approaching Point B check point. After living Point B, aircraft shall tracking to Topo area then follow Nabire Tower instruction to call at 10 Nm. If runway 34 in use aircraft will be directed to join final runway 34. If runway 16 in use the aircraft will be directed to join right downwind runway 16. When using runway 34 aircraft will be making a high approach.*

Figure 12: The VFR chart of Nabire – Sugapa and return

1.9 Communications

The communication between the pilot and the controller on Nabire radio frequency (122.3 MHz) was recorded by ground based automatic voice recording equipment and the recorder was serviceable. There was no radio communication transmission issue during the occurrence.

1.10 Aerodrome Information

The Douw Aturure airport (WABI), Nabire was operated by Directorate General of Civil Aviation. The airport had a runway with direction of 16 – 34 (156° – 336°). The runway dimension was 1,399 meters length and 29 meters width.

The airport situated on coastline with airport elevation was 40 feet and the aerodrome reference point was on coordinate 03°22'04.53"S; 135°29'49.55"E. The north direction of the airport was coastal area without any terrain, while the east direction was mountainous area and within range of 5 Nm from the ARP, the highest terrain was up to 1,800 feet.

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

Evidence of impact marks were found on the left side of the aircraft which were on the main landing gear strut, wing strut fairing, wing and horizontal stabilizer.

Figure 13: The impact marks on the aircraft found in the area inside red dot lines

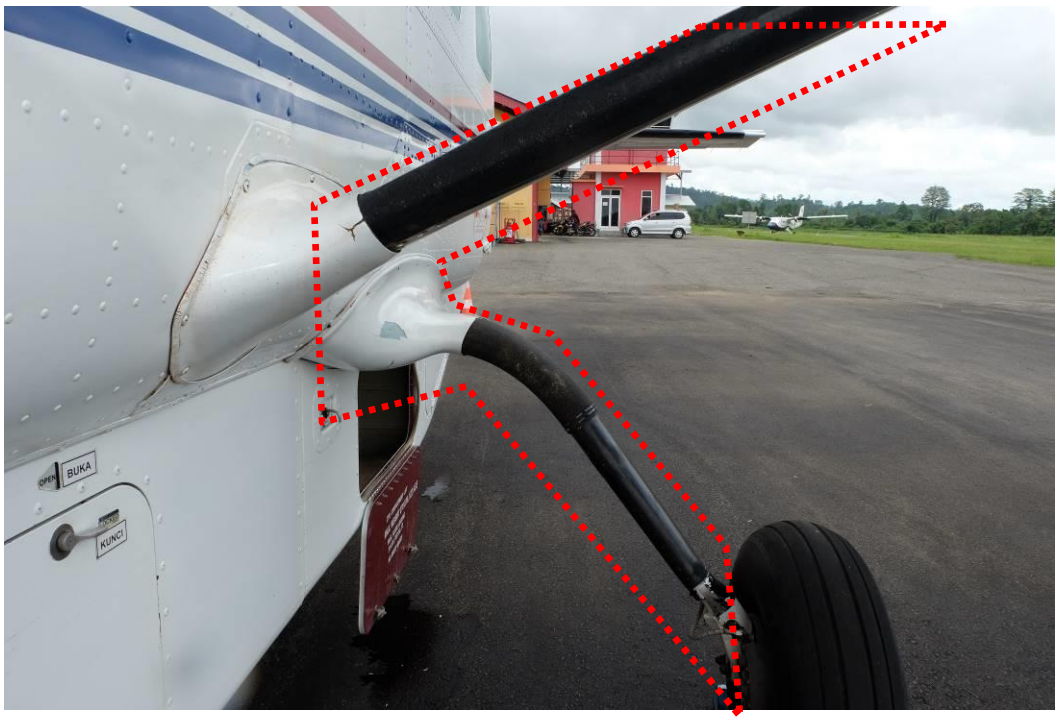

Figure 14: The impact marks on left hand main landing gear strut and wing strut fairing (inside the red dot line)

Figure 15: The wood impact marks on left wing leading edge

Figure 16: The dent and impact marks on left horizontal stabilizer

1.13 Medical and Pathological Information

No medical or pathological investigations had been conducted in this investigation.

1.14 Fire

There was no evidence of fire after the aircraft hit the tree.

1.15 Survival Aspects

No injury to person in this occurrence and not relevant to this investigation.

1.16 Tests and Research

1.16.1 Estimation of the Terrain Location and Height

The investigation was unable to find the exact location when the aircraft impacted the top of the tree. In order to estimate the terrain location and its height, the investigation utilized the pilot recollection information, the 2-minute interval data of the flight following record, and the terrain information on the Google Earth.

The PM recalled that when the aircraft passed altitude about 2,000 feet, he noticed yellow area on the aircraft GPS which means the terrain on the area was between 1,000 feet and 100 feet below the aircraft altitude. Afterwards, the PM noticed a “X” symbol on the GPS, which indicated that the area of the symbol was a potential impact point. The aircraft was continued descending and the second “X” symbol appeared on the GPS. A few seconds later, the PF noticed terrain in front of the aircraft and pulled the control column to climb aircraft. The left side of the aircraft impacted to the top of tree.

During the descend, at 14:51:12 LT the flight following system of the Flying SAS recorded the aircraft altitude was 2,048 feet, the ground speed was 128 knots, and the heading was 285°. The next recorded data was at 14:53:12 LT, the aircraft altitude was 2,366 feet, the ground speed was 117 knots, and the heading was 296°. At this time indicated that the aircraft had already climbed for terrain avoidance. Therefore, the terrain location was between those two recorded locations.

There was high terrain area with height between 1,500 feet up to 1,700 feet about 1.3 Nm ahead the recorded location at 14:51:12 UTC. If the aircraft heading was maintained using the recorded value at 285°, the highest terrain ahead was 1,620 feet and if the aircraft heading was changed to 290° directing to the recorded location at 14:53:12 UTC, the highest terrain ahead was 1,678 feet.

The KGP 560 will trigger aural alert "Caution Terrain, Caution Terrain" (or "Caution Obstacle, Caution Obstacle") sounds when the system detects terrain 30 seconds ahead of the aircraft. Furthermore, if the terrain is detected within 15 to 30 seconds ahead of the aircraft, the aural alert "Terrain, Terrain, Pull Up, Pull Up" (or "Obstacle, Obstacle, Pull Up, Pull Up") will be sounded.

The pilots did not recall any KGP 560 sound activation during the occurrence flight, therefore, the investigation considered necessary to determine the point of the activation of the alerts.

Using the formula S (distance) = V (speed) x t (time), if the aircraft speed was 128 knots, the 30 seconds of GPWS alert area would be at distance about 1,05 Nm, while the 15 seconds of GPWS alert area would be 0.52 Nm towards the estimated terrain locations. Both alert ranges should trigger the aural alert if the aircraft was descended at the same of the terrain height.

The estimated terrain location and GPWS alerts area can be seen on the following figure.

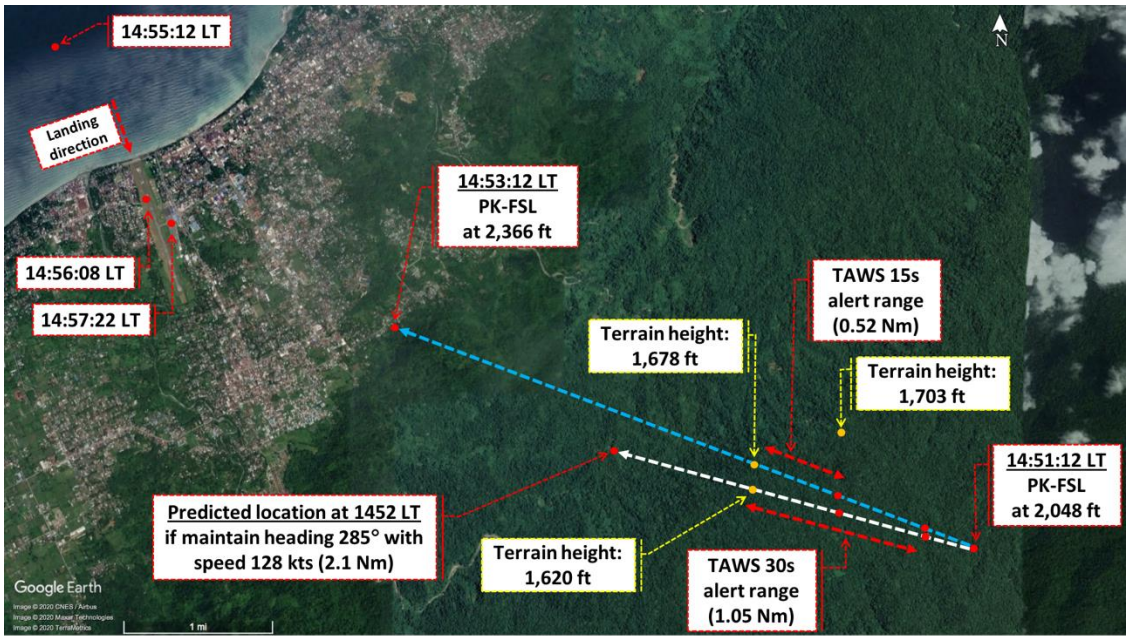

Figure 17: The estimated terrain location and GPWS alerts range

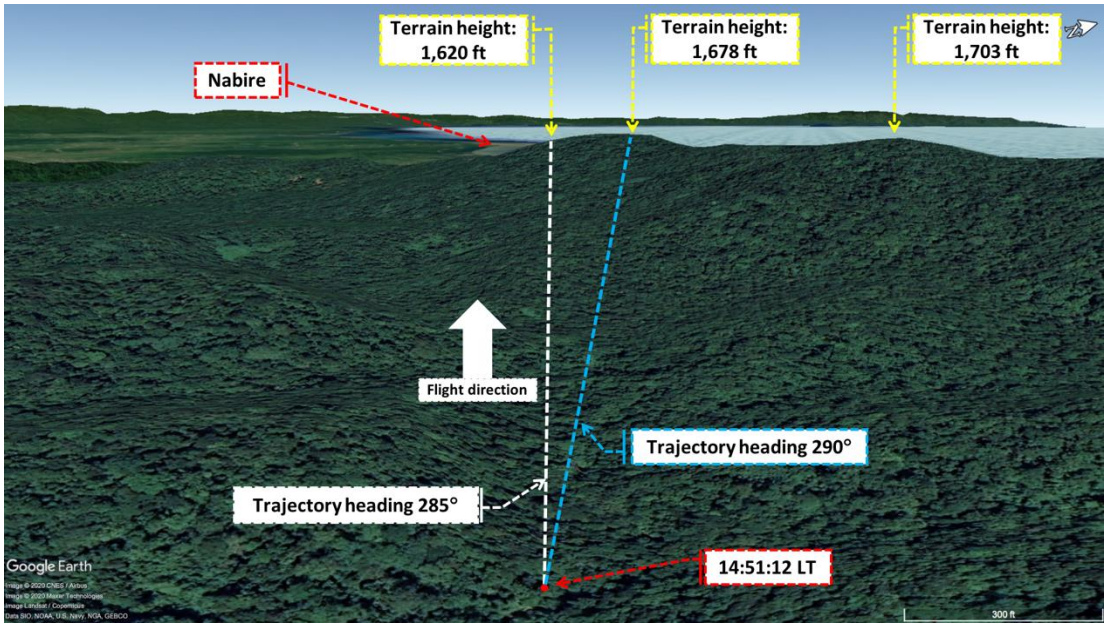

Figure 18: The estimated terrain location from vertical view

1.17 Organizational and Management Information

1.17.1 Aircraft Operator

Aircraft Owner	:	Pacific Air Holdings, dba Delta Wing Equipment, LLC
Address	:	2202 Airport Drive Shawnee, Oklahoma, 74804, United States of America
Aircraft Operator	:	PT. Spirit Avia Sentosa (FlyingSAS)
Address	:	Jalan Protokol Halim Perdanakusuma No. 8, Jakarta Timur, 13620, Republic of Indonesia

The PT. Spirit Avia Sentosa (FlyingSAS) had valid Aircraft Operator Certificate (AOC) number 135-058 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.

According to the Operations Specifications issued by the DGCA, the flight operation of the FlyingSAS was limited on Visual Flight Rules (VFR) during day light condition only.

The Flying SAS operated four Cessna 208B aircraft including the PK-FSL aircraft to serve on Papua area, and based on the Authorization, Condition and Limitation (ACL) of the Directorate General of Civil Aviation (DGCA), those Cessna 208B was configured for 9 passenger seats.

1.17.1.1 Visual Flight Rules Weather Minimum Requirement

The FlyingSAS 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 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 and G 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
Class G	• 8 km above 10.000 feet • 5 km below 10.000 feet. • The higher of: 3000 feet AMSL 5 km, or 1000 feet AGL in sight	• 1,000 feet above • 1,000 feet above • 1,500 meters horizontal • Clear of clouds

1.17.1.2 Pilot Briefing and Use of Checklist Requirement

The OM – Part A subchapter 10.7 described departure and approach briefing requirement. All pilots must perform a departure and approach briefing at specified phase of flight. The departure including takeoff briefing should be given before starting engine or before starting checklist reading, while the approach briefing should include in the descent briefing and be given at a convenient time before the descent is start. The PIC is responsible for performing the briefing or delegates to the SIC when acting as Pilot Flying.

The FlyingSAS Operation Manual – Part B (OM – Part B) subchapter 1.4.10 described use of checklist requirement as follow:

> *It is pilot's responsibility to use the checklist during operating the aircraft. This aircraft which has a more complicated switches and instruments should be operated in orderly manner. Therefore, the use of the checklist is mandatory.*

1.17.1.3 Pilot Familiarization Procedure

The OM – Part A subchapter 10.8 described that all pilots must be familiar with the area, route and airports that FlyingSAS aircraft planning to fly and to land. The familiarization training will be included on ground and in-flight routes and airports indoctrinations.

Before being assigned as PIC, the pilot must obtain adequate knowledge of the route to be flown, includes the terrain and minimum safe altitudes.

The subchapter 10.8 also described that:

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

- *FlyingSAS OM Part C - VFR Route Guidance and Airport Analysis Manual.*
- *FlyingSAS OM Part D Training Manual.*

However, neither the FlyingSAS Operation Manual – Part C (OM – Part C) and Operation Manual – Part D (OM – Part D) provided the information of terrain and minimum safe altitude information.

1.17.1.4 Ground Proximity Warning System Procedures

The OM – Part A subchapter 10.16.1 described that all FlyingSAS aircraft was equipped with Enhanced Ground Proximity Warning System (EGPWS). The pilot required to take corrective action immediately when proximity to the ground is detected by the pilot or a GPWS installed in the aircraft. In addition, the pilot also required to use the GPWS or EGPWS unit on board the aircraft during all flight when terrain is known to be encounter.

The OM – Part A also described that the specific technical detail of the GPWS procedures will be described in the OM – Part B which then required pilot to refer to the Pilot's Operating Handbook and FAA Approved Airplane Flight Manual (POH).

The Supplement S36 of the POH applicable for PK-FSL described procedure when the KGP 560 provided ground proximity alert as follows:

"PULL UP"

In IMC or Night VMC:

1. *Level wings and simultaneously pitch up to achieve best angle of climb airspeed.*
2. *Apply maximum climb power.*
3. *Continue climb until all visual and aural warnings cease.*

In Day VMC:

1. *Take corrective action as necessary to avoid terrain and/or obstacles.*

"TERRAIN, TERRAIN" or "OBSTACLE, OBSTACLE"

1. *Take immediate action to adjust flight path away from threat until warning ceases.*

"CAUTION TERRAIN" or "CAUTION OBSTACLE"

1. *Adjust flight path as required away from threat until alert ceases.*

"TOO LOW TERRAIN"

1. *Adjust flight path to recover safe terrain clearance until alert ceases.*

The Supplement S36 also provided checklist which required pilot to conduct GA-EGPWS self-test before takeoff as follow:

1. *Self-Test Switch – PRESS.*
2. *NOT AVAILABLE and WARNING Annunciators – CHECK illuminated.*
3. *EGPWS SYSTEM, OK – Audible.*
4. *WARNING Annunciator – CHECK extinguished.*
5. *CAUTION Annunciator – CHECK illuminated.*
6. *GA-EGPWS Display – CHECK test pattern for 6 to 8 seconds.*
7. *CAUTION and NOT AVAILABLE Annunciators – CHECK extinguished.*

NOTE

If internal GPS is used, the GA-EGPWS could take up to 12 minutes to acquire position.

On 1 May 2017, the FlyingSAS developed daily normal checklist for PK-FSL aircraft which included Terrain Avoidance Warning System (TAWS)/GPWS self-test in the Before Start checklist. The checklist then amended on March 2018 (see appendices 6.2 for the detail checklist).

1.17.1.5 Operational Control and Supervision

The OM – Part A subchapter 3.3 described that the FlyingSAS developed operational control system to ensure the operation of the flight is conducted in safe, legal and efficient manner. The operation control system provided planning, controlling, monitoring, reporting and evaluation of the flights.

In term of tracking the daily flight operation, the FlyingSAS utilizes 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 Flying SAS officer in Jakarta.

The aircraft operator subscribed the Spidertracks flight following system for 2 minutes interval data reporting for each fleet, including the PK-FSL and PK-FSP aircraft. The reporting parameters in the tracking system contained several data including time, coordinate, aircraft altitude, speed and bearing. The tracking system begins to send position report when the device is powered in open area.

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

1.17.2 Air Traffic Service Provider

The Air traffic control (ATC) services in Nabire were provided by Perum LPPNPI (AirNav Indonesia) branch office Nabire on the aerodrome traffic zone (ATZ) which was within radius of 10 Nm centered at ZR NDB. The ATC services provided in Nabire was aerodrome control service. The airspace classification on the Nabire ATZ was class C airspace.

1.17.3 Aeronautical Information Publication in Indonesia

The Aeronautical Information Publication (AIP) Indonesia is validated and published by the DGCA. The data source for the publication are provided by several relevant organizations. In regards with the navigation aids information described in the AIP Volume IV, the data source was provided by the AirNav Indonesia.

1.18 Additional Information

1.18.1 Recorded Flight Following Data

The investigation downloaded the reporting Spidertracks data of the three flights from Bilorai to Nabire during the day of the occurrence. The latitude and the longitude parameters were superimposed with Google Earth application as follow:

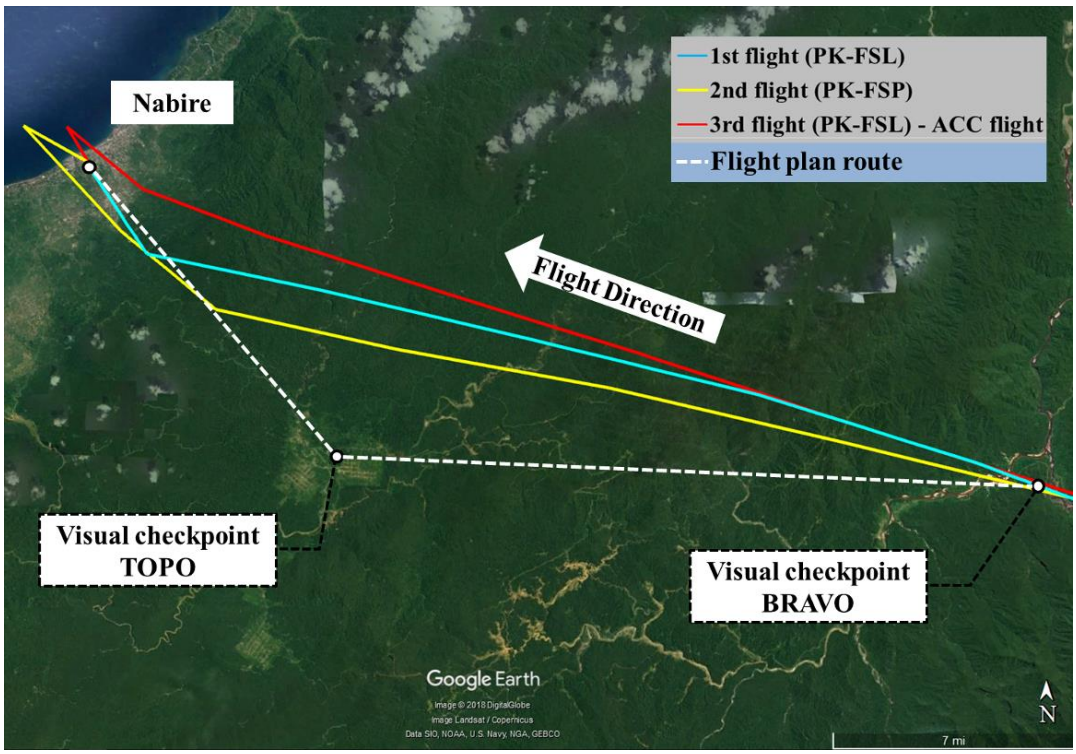

Figure 19: The flight profile of the Bilorai – Nabire flights on 18 June 2018

1.18.2 Human Performance

The take-off and landing are the phases of flight with the highest workload, therefore, multiple take-offs and landings in a day might be expected to have cumulative effects on fatigue and human performance (Gander et al, 1998)[13]. Powel et al (2007) also described that the number of sectors was the most important influences on fatigue as the greater number of sectors increased the fatigue in a linear fashion.

1.18.3 Press-on-itis

The SKYbrary[14] described press-on-itis as:

> *the result of a decision-making error that involves continuing toward the destination (objective) despite a lack of readiness of the airplane or crew and the availability of reasonable lower-risk alternatives. Press-on-itis often occurs when there is an unsuitable environment such as bad weather at the destination. The pilot may continue on despite warnings from ATC or other crew members.*

13 Gander et al (1998). Flight Crew Fatigue II: Short-Haul Fixed-Wing Air Transport Operations.

14 The full article on press-on-itis can be found in the following link https://www.skybrary.aero/index.php/Press-on-itis_(OGHFA_BN) .The article accessed on 18 May 2020.

The article also described that pilot may succumb to press-on-itis for several reasons, included:

- *They want to "just get the job done" (excessive commitment to task accomplishment) and are influenced by organizational goals such as on-time arrival, fuel savings and passenger convenience;*
- *"We are almost there, let's just do it and get it over with";*
- *"We do not want to divert, with all the associated additional work";*
- *They are fatigued.*

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

Based on the factual gathered during the investigation, the analysis will discuss the following issues:

- Aircraft flight profile;
- Terrain awareness;
- Aircraft operator operational control and supervision.

2.1 Aircraft Flight Profile

The Aeronautical Information Publication (AIP) Volume I subchapter ENR 6-1-L described two Visual Flight Rules (VFR) routes from checkpoint BRAVO to Nabire, which were NABIRE ARRIVAL and VICTOR 20/27/30/32/33 route. The NABIRE ARRIVAL route requires pilot to fly toward check point TOPO with minimum altitude limit of 6,500 feet and then toward ZR NDB with minimum altitude limit of 4,000 feet. The VICTOR 20/27/30/32/33 route was a direct route to ZR NDB with minimum altitude limit of 6,500 feet.

The FlyingSAS provided Route and Airport Instruction, and Visual Flight Rules (VFR) chart which included flight guidance to Nabire. The Route and Airport Instruction required pilot to fly from checkpoint BRAVO to checkpoint TOPO then follows the tower controller instruction, and the VFR chart provided direct route from checkpoint BRAVO to Nabire. The two different guidance provided by the company resulted in two different flight plan routes to Nabire stored in the aircraft Global Positioning System (GPS).

At the day of the occurrence, the pilots scheduled to conduct three times flight from Bilorai to Nabire. The first and the second flight had been conducted using different aircraft with different flight plan routes. The Pilot in Command (PIC) always followed the top of the list of the stored flight plan in the GPS. During the occurrence flight, the pilot flew the direct route from checkpoint BRAVO to the NBR VOR/DME.

On the occurrence flight, when the aircraft position about 20 Nm from the checkpoint BRAVO which was about 40 Nm from NBR VOR/DME, the pilot noticed development of clouds along the route and decided to avoid the clouds by deviating the aircraft track to the right of the GPS route. Deviating to the right from a direct route to NBR VOR/DME resulted in the aircraft flew toward higher terrain area which located within radius of 5 Nm from the airport. This high terrain area required pilot awareness.

2.2 Terrain Awareness

According to the Operations Specification issued by the DGCA, the FlyingSAS flight operation was limited on Visual Flight Rules (VFR) during day light condition only. The FlyingSAS Operation Manual – Part A (OM – Part A) and Civil Aviation Safety Regulation (CASR) Part 91 prohibited pilot to operate the aircraft under VFR flew into cloud.

The FlyingSAS Operation Manual Part A (OM – Part A) subchapter 10.8 described that pilot who will be assigned as PIC must obtain adequate knowledge of the route to be flown, included the terrain height and minimum safe altitudes.

The subchapter 10.8 also described that the pilot can use the FlyingSAS Operation Manual – Part C and Part D to get the complete explanation on area, route, and airport familiarization. However, nor the OM – Part C and Part D provided information of terrain height and minimum safe altitude information for Nabire area.

The FlyingSAS had provided flight guidance to Nabire for pilot, however the guidance did not include minimum altitude limit. The VFR Route of AIP Volume I described the minimum altitude for flying direct from point BRAVO to Nabire was 6,500 feet. The absence of the minimum altitude limit in the FlyingSAS flight guidance made the pilot did not follow the altitude restriction of the VFR route.

The aircraft was equipped with Ground Proximity Warning System (GPWS), and GPS that had TERRAIN feature. Prior the departure, there was no record or report of GPWS nor GPS malfunction. The availability of these equipment, might have made the pilot considered that the flying into clouds condition had a less risk as the GPWS or GPS would provide alerts which could increase pilot awareness of surrounding area.

When descending passed altitude of 4,000 feet, the aircraft was flying through clouds and when passing altitude of 3,500 feet the flight was returned to Visual Meteorological Condition (VMC), and the descend was continued. At this time, the pilot had experienced of regaining visual not more than a minute. As the flight plan was conducted under VFR, flying through clouds indicated that the VFR weather minimum requirement was not implemented properly, and made the pilot did not have clear visual to the surrounding area.

The Pilot Flying (PF) was aware of terrain area about 2,000 feet within radius 5 Nm of Nabire. Therefore, if due to the weather condition made the flight entered clouds again, the PF would maintain altitude 2,500 feet and flew toward the coast area at the north of airport as the area was flat. However, when the aircraft reached altitude of 2,500 feet, the flight remained in visual condition and the PF continued the descent.

About 5 Nm from NBR VOR/DME, after passed altitude 2,500 feet, the aircraft entered clouds again. After passed altitude 2,000 feet, the Pilot Monitoring (PM) advised to the PF related to the appearance of the “X” symbol on the GPS, which indicated potential impact point to the terrain. The PF was aware that the alert on the GPS was not intended to be used as a primary reference for terrain avoidance and did not relieve the pilot from the responsibility of being aware of surroundings during flight. This made the PF considered to have another reference of aural alert from GPWS, or having visual contact to the terrain. The PF then disengaged the auto pilot, reduced the rate of descend and continued the descend, which contrary to the PF plan to maintain altitude of 2,500 feet and flew toward the coast area.

The aircraft was descending and another “X” symbol appeared on the GPS, few seconds after, both pilots noticed terrain in front of the aircraft. The PM subsequently shouted terrain and pull up, then PF pulled the control column up to make the aircraft climb. The avoidance maneuver resulted in the left side of the aircraft impacted top of tree. The pilots did not recall any GPWS aural alert until the impact.

Based on the estimation of the terrain location and the GPWS alert range, the KGP 560 should provide aural alert, prior to the aircraft reached 1,600 feet as the terrain height ahead was about 1,600 feet. However, the pilots did not recall any aural alert sounded from the KGP 560.

There was no record or report of GPWS malfunction prior to the departure, however, the pilots did not perform checklist throughout the day which resulted in the self-test of the GPWS was not conducted prior the flight. Therefore, the serviceability of the GPWS was unable to be determined. The GPWS visual and aural alerts could be inhibited by pressing the "Terrain Inhibit" switch, which would inhibit the aural alert. Considering those conditions, the investigation was unable to determine the reason of the KGP 560 aural alert activation was not recalled by both pilots.

The consideration of less risk flying into clouds based on previous experiences of regaining visual after descend, and relying to the GPWS's aural alert or having visual contact to the terrain, resulted in the ignorance to the GPS alert and continuation of the descend while flying in clouds.

The occurrence flight was the six sectors for the pilots, this multiple takeoff and landing in a day might have created fatigue for the pilot. As the occurrence flight was the last flight of the day and was returning to the pilot's home base, the fatigue condition might increase the desire to reach the destination for finishing the duty. This condition might affect the pilot decision to continue the descend while flying in clouds and disregarded the alert from the GPS, which an indication that the pilot decision was succumbed to the press-on-itis.

2.3 Aircraft Operator Operational Control and Supervision

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

The OM – Part A subchapter 10.7 required pilot to perform departure and approach briefing at specified phase of flight, and the OM – Part B subchapter 1.4.10 required pilot to use available checklist. At the day of the occurrence there was no pilot briefing nor checklist reading that were required by the Operation Manuals.

The OM – Part A subchapter 8.5.1 described a basic Visual Flight Rules (VFR) weather minimum which prohibited pilot to operate the aircraft under VFR flew into cloud. In order to supervise the implementation of the VFR weather minimum requirement, the FlyingSAS relied upon their reporting system. Prior to the accident, there was no report or record of flight operation that did not implement the VFR weather minimum requirement. The absence of report or record might be an indication that the operation control and supervision system within the FlyingSAS was unable to identify the VFR flight that unable to implement the VFR weather minimum requirement.

The unidentified of flights that did not implement the procedure of the Operation Manuals indicated the operational control and supervision was not conducted effectively, to ensure the flight operation is conducted in safe and efficient manner.

3 CONCLUSIONS

3.1 Findings

Findings are statements of all significant conditions, events or circumstances in the occurrence sequence. The findings are significant steps in the occurrence sequence, but they are not always causal, or indicate deficiencies. Some findings point out the conditions that pre-existed the occurrence 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 controller held valid licenses and medical certificates.
2. The aircraft had valid Certificate of Airworthiness (C of A) and Certificate of Registration (C of R).
3. Prior to departure, there was no report or record of aircraft system malfunction. The aircraft was operated within the approved weight and balance envelope.
4. The first and the second flight had been conducted using different aircraft with different flight plan routes. The Pilot in Command (PIC) always followed the top of the list of the stored flight plan in the Global Positioning System (GPS). During the occurrence flight, the pilot flew the direct route from checkpoint BRAVO to the NBR VOR/DME.
5. The FlyingSAS Route and Airport Instruction required pilot to fly from checkpoint BRAVO to checkpoint TOPO then follows the tower controller instruction, and the FlyingSAS VFR chart provided direct route from checkpoint BRAVO to Nabire. The two different guidance provided by the company resulted in two different flight plan routes to Nabire stored in the aircraft GPS.
6. The AIP Volume I subchapter ENR 6-1-L described VFR route chart within Papua area. The VFR route chart described two available arrival routes to Nabire after checkpoint BRAVO, which were NABIRE ARRIVAL and VICTOR 20/27/30/32/33 route.
7. The NABIRE ARRIVAL route requires pilot to fly toward check point TOPO with minimum altitude limit of 6,500 feet and then toward ZR NDB with minimum altitude limit of 4,000 feet. The VICTOR 20/27/30/32/33 route was a direct route to ZR NDB with minimum altitude limit of 6,500 feet.
8. The FlyingSAS Operation Manual Part A (OM – Part A) subchapter 10.8 described that pilot who will be assigned as PIC must obtain adequate knowledge of the route to be flown, included the terrain and minimum safe altitudes. The subchapter 10.8 also described that the pilot can use the FlyingSAS Operation Manual – Part C (OM – Part C) and Operation Manual – Part D (OM – Part D) to get the complete explanation on area, route, and airport familiarization.
9. The OM – Part C and Part D did not provide information of terrain height and minimum safe altitude information for Nabire area.

10. The FlyingSAS flight guidance to Nabire did not include minimum altitude limit described in the VFR Route of AIP Volume I. This made the pilot did not follow the altitude restriction of the VFR route.
11. On the occurrence flight, when the aircraft position about 20 Nm from the checkpoint BRAVO which was about 40 Nm from NBR VOR/DME, the pilot noticed development of clouds along the route and decided to avoid the clouds by deviating the aircraft track to the right of the GPS route.
12. Deviating to the right from a direct route to NBR VOR/DME resulted in the aircraft flew toward higher terrain area which located within radius of 5 Nm from the airport. This high terrain area required pilot awareness.
13. According to the Operations Specification issued by the DGCA, the FlyingSAS flight operation was limited on Visual Flight Rules (VFR) during day light condition only.
14. The FlyingSAS Operation Manual – Part A (OM – Part A) and Civil Aviation Safety Regulation (CASR) Part 91 prohibited pilot operates aircraft under VFR flew into clouds.
15. When descending passed altitude of 4,000 feet, the aircraft was flying through clouds and when passing altitude of 3,500 feet the flight was returned to Visual Meteorological Condition (VMC), and the descend was continued.
16. As the flight plan was conducted under VFR, flying through clouds indicated that the VFR weather minimum requirement was not implemented properly, and made the pilot did not have clear visual to the surrounding area.
17. The availability of equipment that could increase pilot awareness of surrounding area such as GPWS and GPS that had TERRAIN feature, might have made the pilot considered that the flying into clouds condition had a less risk as the GPWS or GPS would provide alert which could increase pilot awareness of surrounding area.
18. The Pilot Flying (PF) was aware of terrain area about 2,000 feet within radius 5 Nm of Nabire. Therefore, if due to the weather condition made the flight entered clouds again, the PF would maintain altitude of 2,500 feet and fly toward the coast area in the north of airport as the area was flat. However, when the aircraft reached altitude of 2,500 feet, the flight remained in visual condition and the PF continued the descent.
19. About 5 Nm from NBR VOR/DME, when passed altitude 2,500 feet, the aircraft entered clouds again. After passed altitude 2,000 feet, the Pilot Monitoring (PM) advised the PF related to the appearance of the “X” symbol on the GPS, which indicated potential impact point to the terrain.
20. The PF was aware that the alert on the GPS was not intended to be used as a primary reference for terrain avoidance and did not relieve the pilot from the responsibility of being aware of surroundings during flight. This made the PF considered to have another reference of aural alert from GPWS, or having visual contact to the terrain and continued the descend. The continuation of the descend was contrary to the PF plan to maintain altitude of 2,500 feet and flew toward the coast area.

21. The aircraft was descending and another “X” symbol appeared on the GPS, few seconds after, both pilots noticed terrain in front of the aircraft. The PM subsequently shouted terrain and pull up, then PF pulled the control column up to make the aircraft climb. The avoidance maneuver resulted in the left side of the aircraft impacted top of tree. The pilots did not recall any GPWS aural alert until the impact.

22. The occurrence flight was the six sectors for the pilots, this multiple takeoff and landing in a day might have created fatigue for the pilot. As the occurrence flight was the last flight of the day and was returning to the pilot’s home base, the fatigue condition might increase the desire to reach the destination for finishing the duty.

23. The consideration of less risk flying into clouds based on previous experiences of regaining visual after descend, and relying to the GPWS’s aural alert or having visual contact to the terrain, resulted in the ignorance to the GPS alert and continuation of the descend while flying into clouds.

24. Receiving visual contact to the terrain after the aircraft was descended below the terrain height, resulted in the avoidance maneuver was unable to avoid left side of the aircraft impacted top of tree.

25. Based on the estimation of the terrain location and the GPWS alert range, the KGP 560 should provide aural alert to the pilot, prior to the aircraft reached 1,600 feet as the terrain height ahead was about 1,600 feet. However, the pilots did not recall any aural alert sounded from the KGP 560.

26. There was no record or report of GPWS malfunction prior to the departure, however, the pilots did not perform checklist throughout the day which resulted in the self-test of the GPWS was not conducted prior the flight. In addition, the GPWS visual and aural alerts could be inhibited by pressing the "Terrain Inhibit" switch. Considering those conditions, the investigation was unable to determine the reason of why the KGP 560 aural alert was not recalled by both pilots.

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

28. The OM – Part A subchapter 10.7 required pilot to perform departure and approach briefing at specified phase of flight, and the OM – Part B subchapter 1.4.10 required pilot to use available checklist. At the day of the occurrence there was no pilot briefing nor checklist reading that were required by the Operation Manuals.

29. In order to supervise the implementation of the VFR weather minimum requirement, the FlyingSAS relied upon their reporting system. Prior to the accident, there was no report or record of flight operation that did not implement the VFR weather minimum requirement. The absence of report or record might be an indication that the operation control and supervision system within the FlyingSAS was unable to identify the VFR flight that unable to implement the VFR weather minimum requirement.

30. The unidentified of flight operation that had not implemented the procedure from Operation Manuals indicated the operational control and supervision was not conducted effectively, to ensure the flight operation is conducted in safe and efficient manner.
31. The current AIP Volume IV subchapter WABI AD 2-6 at the day of the occurrence described the location of the NBR VOR/DME was about 1.6 Nm from aerodrome reference point (ARP) of Nabire on bearing 169°. Meanwhile, the in the subchapter WABI AD 2.24-11 (the instrument approach chart) the coordinate of NBR VOR/DME was about 0.43 Nm from Nabire ARP on bearing 185°.
32. After the occurrence, the AirNav Indonesia rechecked the NBR VOR/DME location and updated the actual location in the AIP Volume IV.

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 made the pilot did not have clear visual of the surrounding area.
- The consideration of less risk of flying into clouds and relying to the GPWS's aural alert or having visual contact to the terrain, resulted in the ignorance to the GPS alert and continuation of the descend while flying into clouds.

4 SAFETY ACTION

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

4.1 FlyingSAS

On 20 June 2018, the FlyingSAS issued Operation Notice with subject of VFR Stabilized Approach Checklist for Mountainous Flying. The detail notice can be found on the appendices and the highlight of the notice was as follows:

- Instructed all pilots to perform descend, approach and landing process in accordance with the VFR stabilized approach criteria for mountainous area.
- Reminded all pilots to follow the VFR stabilized approach checklist for mountainous flying.

On 26 June 2018, the FlyingSAS issued Operation Notice with subject of Crew Cockpit Resource Management (CRM) and Confidence Level. The detail notice can be found on the appendices and the highlight of the notice was as follows:

- Instructed all pilots to improve the CRM level during approach and landing by following certain guidance.
- Reminded all pilots to avoid over confidence to continue an approach and landing which could lead to an incident or accident.

The FlyingSAS also had conducted corrective action to address the following KNKT safety recommendation in preliminary report:

04.O-2018-24.1

The stored GPS flight plan route on PK-FSP aircraft and the Route Information published by FlyingSAS on OM – Part C contained checkpoint TOPO for route Bilorai to Nabire while the stored GPS flight plan route on the PK-FSL aircraft and VFR Route Chart published on OM – Part C was not containing checkpoint TOPO.

KNKT recommends the FlyingSAS to ensure the route guidance for pilot contains same information.

Responding to those safety recommendation number 04.O-2018-24.1, the FlyingSAS had revised the VFR Route Chart in the OM – Part C to include the checkpoint TOPO for arrival route to Nabire, and update all stored GPS flight plan route in accordance with the revised route.

4.2 AirNav Indonesia

The AirNav Indonesia had conducted corrective action to address the following KNKT safety recommendation in preliminary report:

04.A-2018-24.2

The AIP Volume IV of Nabire published by the DGCA contained different coordinate of the NBR VOR/DME location.

KNKT recommends the AirNav Indonesia to provide correct information of the NBR VOR/DME location to the DGCA and also review the possibility of other incorrect coordinate of navigation aid prior to publish in the AIP.

Responding to those safety recommendation number 04.A-2018-24.2, the AirNav Indonesia rechecked the actual location of the NBR VOR/DME location, and updated the actual location in the new amendment of AIP Volume IV for Nabire.

The AirNav Indonesia also developed Standard Operating Procedure (SOP) of Aeronautic Information Publication which included verification phase of the raw data provided by the source data provider.

4.3 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-2018-24.3***

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

  During this occurrence, the AIP Volume IV did not include approach guidance for Nabire. The FlyingSAS issued route information of Nabire and Visual Flight Rules (VFR) chart for route Nabire – Sugapa (Bilorai) and return, this guidance was used for internal purpose.

  KNKT recommends the DGCA to ensure that the safety recommendation number 04.R-2015-17.6 which published in 2017 is performed for all Indonesian airports without instrument approach procedure.

Responding to the safety recommendation number 04.R-2018-24.3 above, the DGCA with the AirNav Indonesia and aircraft operator had drafted departure and arrival route guidance for several airport at Papua.

- ***04.R-2018-24.4***

  The AIP Volume IV of Nabire published by the DGCA contained different coordinate of the NBR VOR/DME location.

  KNKT recommends the DGCA to determine the correct coordinate of NBR VOR/DME and also review the possibility of other incorrect coordinate of navigation aid in the AIP.

Responding to the safety recommendation number 04.R-2018-24.4 above, the DGCA had been amended the NBR VOR/DME location information in the AIP Volume IV.

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 aircraft operator.

5.1 FlyingSAS

- **04.O-2018-24.5**

  During the descend, two X symbols appeared on the GPS, indicated potential impact points. The pilot aware that the GPS alert was not intended to be used as a primary reference for terrain avoidance and did not relieve the pilot from the responsibility of being aware of surroundings during flight. The pilot waited for aural warning/alert from GPWS or having visual contact to the terrain. The pilot continued the descend and made the aircraft flown toward the terrain and impacted the tree top. Even tough GPS was not primary reference, the information is useful and should be taking into account for decision making.

  Therefore, the KNKT recommends the FlyingSAS to ensure all pilot taking into account the GPS information as additional reference for the decision making.

- **04.O-2018-24.6**

  The AIP Volume I subchapter ENR 6-1-L described two available arrival VFR routes to Nabire after checkpoint BRAVO, which were NABIRE ARRIVAL and VICTOR 20/27/30/32/33 route. The NABIRE ARRIVAL route requires pilot to fly toward check point TOPO with lowest altitude of 6,500 feet and then toward ZR NDB with lower altitude limit of 4,000 feet. The VICTOR 20/27/30/32/33 route was a direct route to ZR NDB with lowest altitude limit of 6,500 feet.

  The FlyingSAS flight guidance to Nabire did not include lowest altitude limit described in the VFR Route of AIP Volume I. This made the pilot did not follow the altitude restriction of the VFR route.

  Therefore, the KNKT recommends the FlyingSAS to ensure the current publication of VFR routes in the AIP includes the altitude restriction were adopted in the FlyingSAS flight guidance.

- **04.O-2018-24.7**

  According to the OM – Part A subchapter 3.3, the FlyingSAS developed operational control system to ensure the operation of the flight is conducted in safe and efficient manner. However, the FlyingSAS was unable to identified the several unimplemented procedures from Operation Manuals. This indicated that operational control and supervision within the aircraft operator was not conducted properly, and made the operational control and supervision system was unable to ensure the flight operation is conducted in safe and efficient manner.

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

6 APPENDICES

6.1 FlyingSAS Operation Notice

FlyingSAS	OPERATIONS DEPARTEMENT	36/OD/ON/VI/2018
		20/JUNE/2018
	OPERATION NOTICE	Page 1/1

DATE OF EFFECTIVENESS :	20 JUNE 2018
DISTRIBUTION :	DX, DB, DD, DF, FX, FO, FS, OP
APPLICABILITY :	**All PT. SAS PILOTS**
PREPARED BY :	
VERIFIED BY :	
APPROVED BY :	
SUBJECT :	**VFR STABILIZED APPROACH CHECKLIST FOR MOUNTAINOUS FLYING**

1. THIS NOTICE TO **PILOT** WAS ISSUED BASED ON SERIOUS INCIDENT PK-FSL AT NABIRE ON 18 JUNE 2018.

2. TO ALL PT. SPIRIT AVIA SENTOSA PILOTS, MANAGEMENT INSTRUCTION **TO ALL PILOTS TO PERFORM DESCEND, APPROACH AND LANDING PROCESS ACCORDING TO FLYINGSAS VFR STABILIZED APPROACH CHECKLIST FOR MOUNTAINOUS FLYING.**

3. TO ALL PT. SPIRIT AVIA SENTOSA **PILOTS**, BELOW ARE **PT. SPIRIT AVIA SENTOSA ALAR VFR STABILIZED APPROACH CHECKLIST FOR MOUNTAINOUS AREA**:

   a. Pilot must get or have the **LATEST WEATHER REPORT** for destination and en route. This weather report at the destination must be at the same value or above the VFR requirement.
   b. Pilot must have **VISUAL (VFR) CHECKPOINT** the position of downwind, base leg, and final leg of the intended runway in use.
   c. Pilot must fly the aircraft at the **VISUAL (VFR) CHECKPOINT** at the **CORRECT POSITION, CORRECT PATH, CORRECT SPEED, CORRECT AIRCRAFT CONFIGURATION, NO HIGH RATE OF DESCEND, AND ALL CHECKLIST HAS BEEN DONE CORRECTLY AND AS APPLICABLE.**
   d. Pilot Flying must give the **DESCEND, APPROACH AND LANDING PROFILE BRIEFING** to the Pilot Monitoring before commencing descend.
   e. If all of **POINT a THROUGH POINT d** above **CAN NOT BE ACHIEVED**, then Pilot Flying **MUST ABORT DESCEND, or CANCEL APPROACH, or GO AROUND or MISS APPROACH AND LANDING and MUST RETURN TO THE SAFE ALTITUDE CHECKPOINT.**

4. PLEASE ACTKNOWLEDGE, FOLLOW SUIT AND DO ALL THIS INSTRUCTION WITH FULL RESPONSIBILITY AND PROFFESIONALISM. THANK YOU FOR YOUR COOPERATIONS.

**** WE CAN SAVE COMPANY'S MONEY BY JUST SIMPLY FOLLOW COMPANY'S S O P ****

FlyingSAS	OPERATIONS DEPARTMENT	37/OD/ON/VI/2018
		26/JUNE/2018
	OPERATION NOTICE	Page 1/2

DATE OF EFFECTIVENESS :	26TH JUNE 2018
DISTRIBUTION :	DX, DF, FX, FO, FS, OP
APPLICABILITY :	**All PT. SAS PILOTS**
PREPARED BY :	[redacted]
VERIFIED BY :	
APPROVED BY :	
SUBJECT :	**CREW CRM AND CONFIDENCE LEVEL**

1. THIS NOTICE TO **PILOT** WAS ISSUED BASED ON ON SERIOUS INCIDENT PK-FSL AT NABIRE ON 18 JUNE 2018

2. TO ALL PT. SPIRIT AVIA SENTOSA **PILOTS**, MANAGEMENT INSTRUCTION **TO ALL PILOTS TO IMPROVE THE CREW CRM LEVEL DURING APPROACH AND LANDING EXECUTION**.

3. HOW **TO IMPROVE THE CREW CRM LEVEL DURING APPROACH AND LANDING EXECUTION**:

   a. BEFORE DESCEND GIVE DESCEND AND APPROACH BRIEFING, SO BOTH PILOT SHOULD KNOW WHAT PERFORMANCE TO EXPECT FROM EACH OTHER WHEN CONDUCTING THE APPROACH UNTIL LANDING EXCECUTION.
   b. IF THERE IS A CHANGE FROM PREVIOUS BRIEFFED ACTION, AN UPDATE BRIEFFING MUST BE GIVEN.
   c. BOTH PILOTS MUST PERFORM STANDARD CALL OUT DURING ALL PHASE.
   d. THE APPROACH MUST BE CONDUCTED ACCORDING TO **THE FLYINGSAS VFR STABILIZED APPROACH CHECKLIST FOR MOUNTAINOUS FLYING**.
   e. BOTH PILOT MUST CHECK AND CROSS CHECK EVERY DECISION MADE DURING ALL PHASE.
   f. IF IN HIS/HER OPINION THE FIRST OFFICER / S I C / PILOT MONITORING DECIDE THAT THE MISS APPROACH OR GO AROUND MUST BE INNITIATE THEN THE "MISS APPROACH OR GO AROUND" CALL MUST BE GIVEN.
   g. THE CAPTAIN / P I C / PILOT FLYING MUST PERFORM THE MISS APPROACH OR GO AROUND INSTANTLY WITHOUT ANY HESITATE AFTER "MISS APPROACH OR GO AROUND" CALL BEING GIVEN.

4. TO ALL PT. SPIRIT AVIA SENTOSA **PILOTS**, MANAGEMENT INSTRUCTION **TO ALL PILOTS NOT TO OVER CONFIDENCE TO CONTINUE AN APPROACH AND LANDING IF THERE IS/ARE AN INFORMATIONS/EVIDENCES THAT IF YOUR APPROACH IS CONTINUED WILL LEAD TO AND INCIDENT OR ACCIDENT.**

5. "MISS APPROACH OR GO AROUND IS THE BEST OPTION THAN HAVING AND INCIDENT OR ACCIDENT. MISS APPROACH OR GO AROUND IS NON PUNITIVE ACTION".

"IT IS BETTER TO TRY AGAIN OR RTB THAN MAKE INCIDENT OR ACCIDENT TO YOUR AIRCRAFT"

CONSEQUENCES:

- *AIRCRAFT HAD INCIDENT, AIRCRAFT GROUNDED, LOST REVENUE, AIRCRAFT LEASE STILL TO BE PAYED, LOST OF COMPANY MONEY.*
- *AIRCRAFT HAD ACCIDENT, AIRCRAFT TOTAL LOST, LOST REVENUE, AIRCRAFT LEASE STILL TO BE PAYED, LOST OF COMPANY MONEY, LOST EVERYTHING.*
- *IF THERE IS EVIDENCE BRAKING OF COMPANY'S S O P, POSSIBLY NO INSURANCE COVER TO BE RELEASE.*
- *PILOT GROUNDED, ADMINISTRATIF PUNISHMENT, RE-TRAINING, LOST TIME AND INCOME.*
- *SPAREPART MUST TO BE CHANGED, LOST OF TIME AND COMPANY MONEY.*
- *DGCA INQUIRY, INSPECTION, ASSESSMENT, RECOMMENDATION, AND CORRECTIVE ACTION, LOST OF COMPANY MONEY.*
- *KNKT INQUIRY, INSPECTION, ASSESSMENT, RECOMMENDATION, AND CORRECTIVE ACTION, LOST OF COMPANY MONEY.*
- *COMPANY IMAGE RUINED. OPERATION COULD BE SUSPENDED.*
- *COMPANY AOC COULD BE REVOKED OR SUSPENDED.*
- *JOB LOST FOR EVERYONE.*

6. PLEASE ACKNOWLEDGE, FOLLOW SUIT AND DO ALL THIS INSTRUCTION WITH FULL RESPONSIBILITY AND PROFESIONALISM. THANK YOU FOR YOUR COOPERATIONS.

** WE CAN SAVE COMPANY'S MONEY BY JUST SIMPLY FOLLOW COMPANY'S S O P **

6.2 TAWS Self-test in the Daily Normal Checklist of PK-FSL Aircraft

DAILY NORMAL CHECKLIST
C208B PK-FSL

BEFORE START

L	R	Pre-Flight Inspection	COMPLETED
L	R	W & B Inspection	COMPLETED
L	R	Doors	UNLOCKED
L	R	Cockpit Preparation	COMPLETED
PF		Passenger Briefing	COMPLETED
L	R	Cabin Doors	LATCHED
L	R	Crew Doors	UNLOCKED
L		Parking Brake	SET
L	R	Seats, Belts, Harnesses	ADJUSTED, SECURE, CHECK PIN
L		Switches	OFF
L		Ignition Switch	NORMAL
L		Circuit Breakers	CHECK IN
L	R	Fuel Tank Selectors	LEFT ON, RIGHT ON
L	R	Radar	OFF
L	R	Air Conditioner	OFF
L	R	Inverter	OFF
L	R	Bleed Air	OFF
L	R	Emergency Power Lever	NORMAL
L	R	Power Lever	IDLE
L	R	Propeller Lever	MAX
L	R	Fuel Condition Lever	CUTOFF
L	R	Rudder Lock	TURN and PUSH to UNLOCK
L	R	Fuel Shutoff	ON
L		Battery Switch	ON
L	R	Flaps	UP
L	R	No Smoking/Fasten Seat Belt Switches	ON
L		Fire Detector Test Switch	PRESS
L		Annunciator Panel Test Switch	TEST
L	R	T A W S	TEST
L	R	T C A S	CHECK ON
L	R	Panel Lights	ON AS REQUIRED
L	R	Fuel Quantity	CHECK
PF		Flight Controls	CHECK FULL AND FREE
L	R	COM / NAV	ON
L	R	A T I S / QAM	RECEIVED
L		De-Ice Switch	TEST / CHECK
L	R	Transponder	STANDBY
L		BEACON Light	ON
PNF		Start Clearance	REQUEST

START UP

L		Volt/Ammeter	24V OR ABOVE
L		Position Light	ON
L		Beacon	ON
L	R	Emergency Power Lever	NORMAL, ANNUNCIATOR CHECK OFF
L	R	Engine & Propeller Area	CLEAR
L		Fuel Boost Pump	ON
L		Starter Switch	START
L	R	Fuel Condition Lever	LOW IDLE
L		Starter Switch	OFF
L	R	Engine Instrument	CHECK
L		Power Lever	IDLE
L	R	Fuel Flow	ON
L	R	Oil Pressure	CHECK
L	R	Generator	ON, ANNUNCIATOR CHECK OFF
L	R	Fuel Boost Pump	NORMAL, ANNUNCIATOR CHECK OFF
L		Avionics Power Switches	ON
L	R	Suction Gage	CHECK
L	R	Feather/Un-Feather Propeller	CHECK
L		Loadmeter & Voltmeter	CHECK FOR CHARGE
L	R	Annunciator Lights	EXTINGUISHED
L		Taxi Light	ON

TAXI OUT

L	R	Brakes	CHECK
L	R	Flight Instruments	CHECK
L	R	Flaps	RETRACT
L	R	Elevator Trim	TAKE OFF SETTING
L	R	Avionics & Radios	CHECK & SET
L	R	Transponder	ON

BEFORE TAKEOFF

L		Parking Brake	SET
L	R	Seats, Belts, Harnesses	CHECK SECURE
PF		Flight Controls	CHECK FULL AND FREE
L	R	Flight Instruments	CHECK AND SET
L		Fuel Boost Pump	RECHECK NORMAL
L	R	Fuel Tank Selectors	RECHECK BOTH ON
L	R	Fuel Quantity	RECHECK
L	R	Fuel Shutoff	RECHECK FULLY ON
PNF		Flaps	SET FOR TAKE OFF
PF		Flight Controls Trims	SET FOR TAKE OFF
PF		Autopilot System	TEST
L	R	COM / NAV	CHECK SET
L	R	RADAR	STBY
L		Anti Collision/Strobes Light	ON
PF		Fuel Condition Lever	HIGH IDLE
L	R	Annunciator Lights	EXTINGUISHED
L		Brakes	RELEASE

Takeoff Speeds

ROTATE	**70 - 75 KIAS**
CLIMB SPEED	**85 - 95 KIAS**
FLAP RETRACTION	**90 KIAS**

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Prepared by : RCM

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