FINAL
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KOMITE NASIONAL KESELAMATAN TRANSPORTASI

Aircraft Accident Investigation Report

PT.Elang Nusantara Air (ENA)
S2R-T34 Thrush; PK- ELR
Near Manado;
North Sulawesi
Republic of Indonesia
30 November 2014

KOMITE NASIONAL KESELAMATAN TRANSPORTASI
REPUBLIC OF INDONESIA
2015

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

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

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ABBREVIATIONS AND DEFINITIONS

AGL	:	Above Ground Level
ALAR	:	Approach and landing accident reduction
ATS	:	Air Traffic Service
°C	:	Degrees Celsius
CASR	:	Civil Aviation Safety Regulation
Cm	:	Centimetre (S)
CPL	:	Commercial Pilot License
DGCA	:	Directorate General of Civil Aviation
ENA	:	Elang Nusantara Air
ICAO	:	International Civil Aviation Organization
IIC	:	Investigator In Charge
IMC	:	Instrument Meteorological Condition
KNKT/ NTSC	:	Komite Nasional KeselamatanTransportasi/ National Transportation Safety Committee
Kgs	:	Kilogram
Kts	:	Knots
LT	:	Local time
MPH	:	Mile Per Hour
NDB	:	Non Directional Beacon
Nm	:	Nautical mile
QNH	:	Height above mean sea level based on local station pressure
SMS	:	Safety Management System
S/N	:	Serial Number
UTC	:	Universal Time Coordinate
VFR	:	Visual Flight Rules
VOR	:	Very high frequency Omni directional Range
BAKAMLA	:	Badan Keamanan Laut/Indonesia Coast Guard

SYNOPSIS

Based on the Komite Nasional Keselamatan Transportasi (KNKT) Policies and Procedures Manual, reporting for an accident involving fatality shall be publish in full report. However, limited information available for this accident and to prevent several sub-headings with no information, KNKT publish the investigation report for this accident in short report format. The purpose of the investigation to determine the contributing factor and improve safety is maintained.

A S2R-T34 Thrush (Thrush 510) was being operated by PT. Elang Nusantara Air (ENA) on a positioning flight from Batu Ampar, South Kalimantan with intended final destination was Cendrawasih Airstrip, Papua. The first flight departed Batu Ampar on 30 November 2014. On 1 December 2014, the flight was cancelled due to weather condition.

On 2 December 2014 the flight continued from Djalaluddin Airport, Gorontalo with intended destination Baabulah Airport of Ternate, North Maluku. The flight departed Gorontalo at 2323 UTC (0723 LT) and was conducted under Visual Flight Rules (VFR) at altitude 7000 feet. The flight time estimated to be 2 hours 24 minutes and fuel onboard was suitable for 4 hours and 30 minutes flight time.

At 0138 UTC, the pilot contacted to Manado Approach controller informed that the flight was diverted to Sam Ratulangi Airport of Manado. The aircraft position was 62 Nm on radial 136 from MNO VOR at 8500 feet altitude.

At 0200 UTC (1000 LT), the Manado Approach controller asked the pilot the position was replied by the pilot that position was 17 Nm from MNO VOR.

At 0205 UTC (1005 LT), the Manado Approach controller called the pilot but there was no reply. The last position of the aircraft displayed on the Manado Approach controlled radar screen was at coordinate 01 20 55 N 125 07 37 E at approximately 2 miles from the nearest coast line.

Weather condition on the area of last contact at 0900 - 1100 LT, based on the satellite weather image indicated formations of cumulus and cumulonimbus clouds. The satellite image indicated that between 0940 to 1010 LT showed rain with intensity moderate to heavy.

The occupants and the main aircraft wreckage were not recovered. Parts recovered were left main landing gear, nose and right main wheel tires, outboard part of left elevator and two bags. Investigation utilizes all relevant available information.

The contributing factors of this accident was the aircraft entered into unrecoverable condition that might caused by pilot disorientation when flying in Instrument Meteorological Condition (IMC).

Based on this investigation, KNKT issue recommendation to PT. Elang Nusantara Air and DGCA.

1. FACTUAL INFORMATION

1.1 History of Flight

On 30 November 2014 a S2R-T34 Thrush (Thrush 510) was being operated by PT. Elang Nusantara Air (ENA) on a positioning flight from Batu Ampar, South Kalimantan with intended final destination was Cendrawasih Airstrip, Papua. The flights were operated under Visual Flight Rules (VFR). The flight departed Batu Ampar to Mutiara Airport and continued to Jalaludin Airport, Gorontalo.

Figure 1: The archive photo of the aircraft

On 1 December 2014, the flight was cancelled as the weather did not meet the requirement for VFR.

Figure 2: The planned route for positioning flights

On 2 December 2014 the flight continued from Djalaluddin Airport, Gorontalo with intended destination Baabulah Airport of Ternate, North Maluku. Total distance of the flight was 281 Nm and estimated to be taken in 2 hours and 24 minutes. The flight departed Gorontalo at 2323 UTC (0723 LT), on board on this flight were one pilot and one engineer. Total fuel on board was suitable for 4 hours and 30 minutes flight time with cruising altitude of 7000 feet.

After takeoff, the flight took visual flight route to the south of Gorontalo and then flew

direct to Baabulah Airport. The pilot reported that the estimated time of arrival at Ternate was 0125 UTC (1025 LT).

Figure 2: The flight plan route

At 0138 UTC, the pilot contacted to Manado Approach controller informed that the flight was diverted to Sam Ratulangi Airport of Manado. The aircraft position was 62 Nm on radial 136 from MNO VOR at 8500 feet altitude. The pilot reported that the estimated arrival at Manado was 0215 UTC (1015 LT). The pilot also asked for weather condition at Manado which was reported suitable for VFR flight. The detail weather information was wind calm, visibility 8 km, cloud base ceiling 1600 feet, temperature 26, dew point 25 and altimeter setting (QNH) 1009 mbs. The Manado Approach controller informed that the runway in use was 36 and requested the pilot to report when ready for descend and was acknowledged by the pilot.

At 0200 UTC (1000 LT), the Manado Approach controller asked the pilot the position and route intention was via Airmadidi and was replied by the pilot that position was 17 Nm from MNO VOR and intended route was via MD NDB. The Manado Approach controller requested the pilot when position over MD NDB and to report when ready for descend.

The Baabulah Tower controller stated that the pilot did not make communication with Baabulah Tower.

At 0205 UTC (1005 LT), the Manado Approach controller called the pilot but there was no reply. The last position of the aircraft displayed on the Manado Approach controlled radar screen was at coordinate 01 20 55 N 125 07 37 E at approximately 2 miles from the nearest coast line.

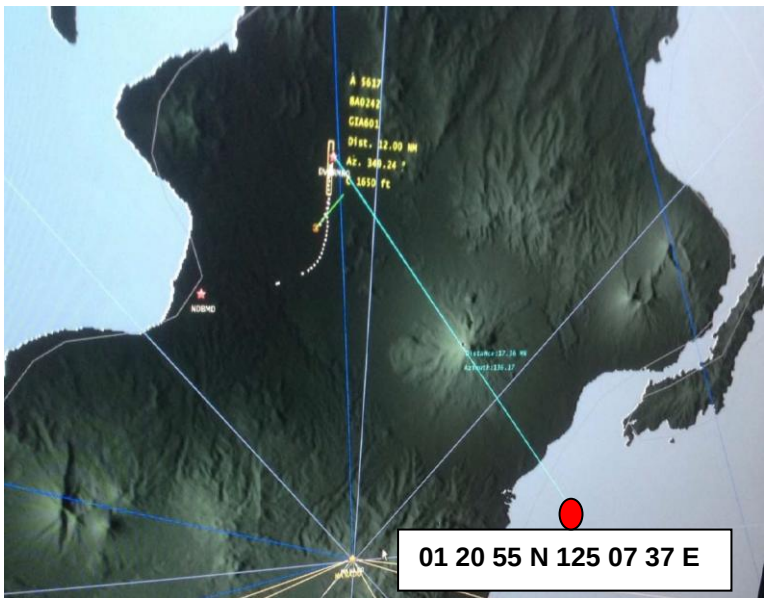


Figure 3: The estimated last point recorded on radar screen

At 1000 LT, a fisherman was fishing on a small boat at approximately 1 km from the coast. He noticed that there was grey cloud on the area and shower rain. At that time he heard the sound of aircraft engine. The area was on the route for VFR flight to or from Manado for eastbound flight. He stated that he was familiar with aircraft engine sound. This time, he noticed that the engine sound was different, as the sound of the engine was higher than normal. He mentioned that the sound was like the sound of aircraft diving as he seen on the movie. He looked up to see the aircraft but could not see the aircraft. Few moments later he saw a small white aircraft descending out of the grey cloud with an angle as he predicted around 60° down. The aircraft ditched to the water at a distance - based on his estimation, was 1 km from his position.

The fisherman immediately went to the shore. He reached the shore approximately 30 minutes later. He met some villagers and was suggested to inform the *Badan Keamanan Laut* (BAKAMLA, Bureau of Coordination for Marine Security) at Kema, North Minahasa office which was near the village.

The BAKAMLA officer immediately informed the Search and Rescue Agency Office of North Sulawesi who then deployed search and rescue boat.

The villagers and the SAR staff with the witness immediately went to the area. They found landing gear and some bags floated. Team on another boat recovered part of elevator.

The Search and Rescue operation continued without significant result and was terminated after seven days.

The occupants and the main aircraft wreckage were not recovered. Parts recovered were left main landing gear, nose and right main wheel tires, outboard part of left elevator and two bags.

Figure 4: Outboard part of elevator

Figure 5: Random damage on the inboard hinge of the elevator

Figure 6: Outboard part of elevator

1.2 Personnel Information

1.2.1 Pilot

Gender	:	Male
Age	:	40 years
Nationality	:	Indonesia
Marital status	:	Married
License	:	PPL (Private Pilot License)
Date of issue	:	19 April 2010
Aircraft type rating	:	Cessna 172, FU 24 950 (Fletcher), S2R-T34 (Thrush)
Instrument rating	:	None
Medical certificate	:	Class II
Last of medical	:	02 September 2014
Validity	:	02 September 2015

Medical limitation	:	None
Last proficiency check	:	05 January 2013
Valid until		31 January 2015

Flying experience

Total hours	:	1832 hours
Total on type	:	914 hours
Last 90 days	:	30 hours 34 minutes
Last 28 days	:	8 hours 36 minutes
Last 24 hours	:	1 hour 43 minutes (approximately)
This flight	:	1 hour 43 minutes (approximately)

1.2.2 Engineer

Gender	:	Male
Age	:	27 years
Nationality	:	Indonesia
License	:	Airframe A1 Turbine engine A4
Aircraft Maintenance Engineer;Type Rating	:	FU 24 950 (Fletcher), S2R-T34 (Thrush); PT6A Series

1.3 Aircraft Information

The Thrush is a single engine agricultural aircraft. The engine installed was Pratt and Whitney PT6 A – 34AG. The aircraft was not certified for instrument flight. For the purpose of the positioning flight, the pilot carried additional Global Positioning System (GPS) which contain instrument route and approach procedures for airports along the planned trip and alternate airports.

Airspeed limitation

- Never exceed speed (VNE) – 159 MPH
- Maximum Structural Cruising (VNO) – 126 MPH
- Maneuvering speed (VA) – 126 MPH
- Over speed vibration speed - 204 knots (refer to the manufacturer information)

1.2.3 Weight and Balance

The aircraft weight and balance documents did not recover from the accident site. The calculation of aircraft weight is based on basic empty weight as 4900 pounds or 2223 kilograms, maximum fuel capacity 228 gallons (863 liters) equal to 673 kg and the weight of occupants and their luggage approximately 200 kgs. Predicted aircraft takeoff weight was 3096 kgs.

The aircraft fuel consumption according to the aircraft manual was 40 -50 gallon/hour (170 – 189 liter/hour) or approximately 136 kg/hour. The aircraft has been flown for 1 hour and 48 minutes and estimated fuel burn was 245 kg.

The predicted aircraft weight at the time of accident was 2850 kg.

1.4 Weather information

The Badan Meteorologi, Klimatologi dan Geophisika (BMKG – Bureau of Meteorology, Climatology and Geophysics) issued weather information for Sam Ratulangi Airport Manado as follows:

	0100 UTC	0130 UTC	0200 UTC	0230 UTC
Wind	200 /5	190/04	200/04	170/05
Visibility	5 km	8 km	10 km	10 km
Present weather	Rain	Nil	Nil	Nil
Cloud	SCT 1700	SCT 1800	SCT 2000	SCT 2000
Temperature / Dew point	26/24	27/24	27/25	27/25
QNH	1010	1010	1010	1009
Trend forecast	TEMPO RA	NO SIG	NO SIG	NO SIG

The satellite weather image indicated as follows:

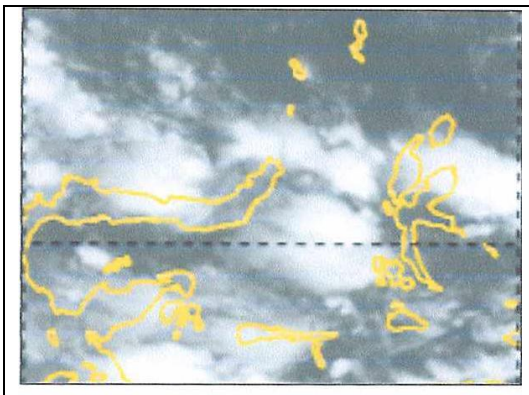


Figure 7: Satellite weather image 0100 UTC

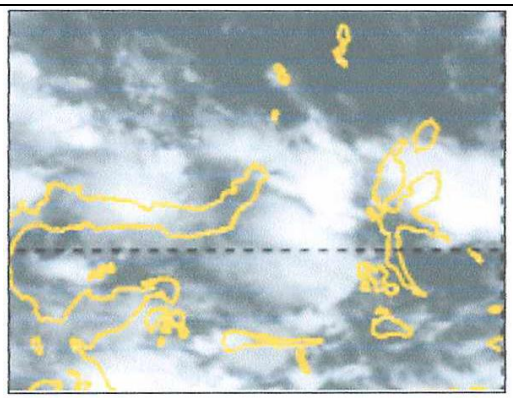


Figure 8: Satellite weather image 0200 UTC

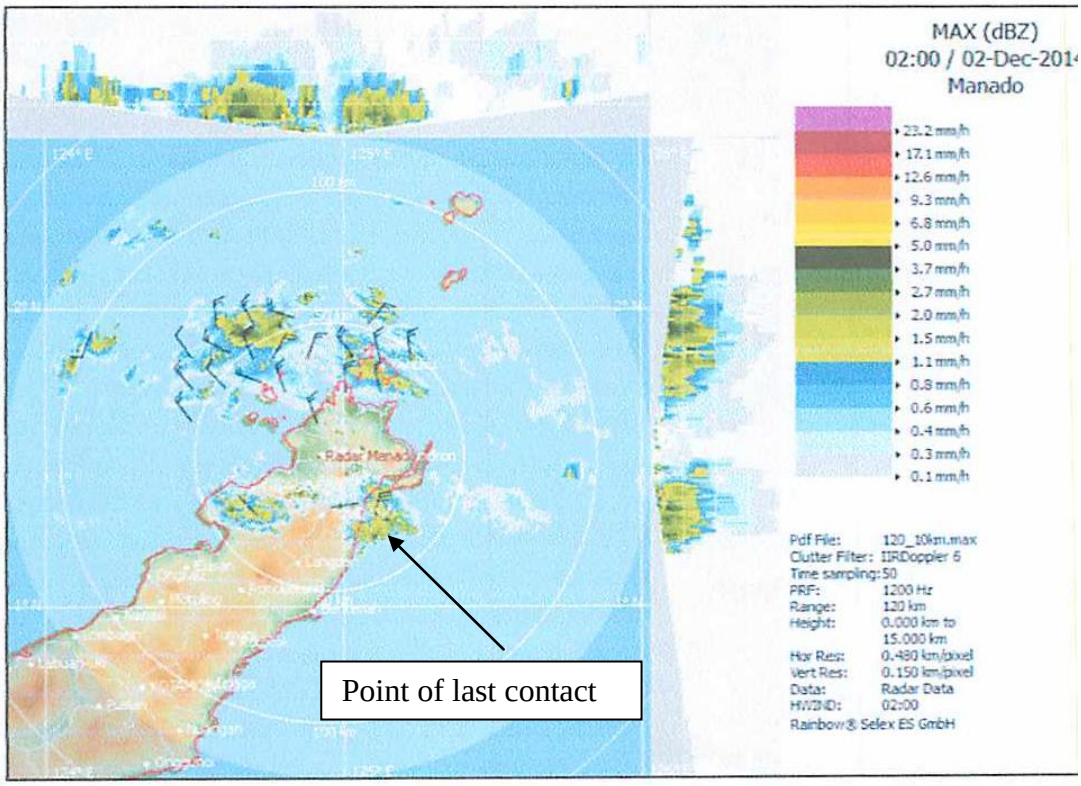


Figure 9 : Satellite weather image on Manado area at the time of occurrence

BMKG weather analysis on the day of occurrence stated:

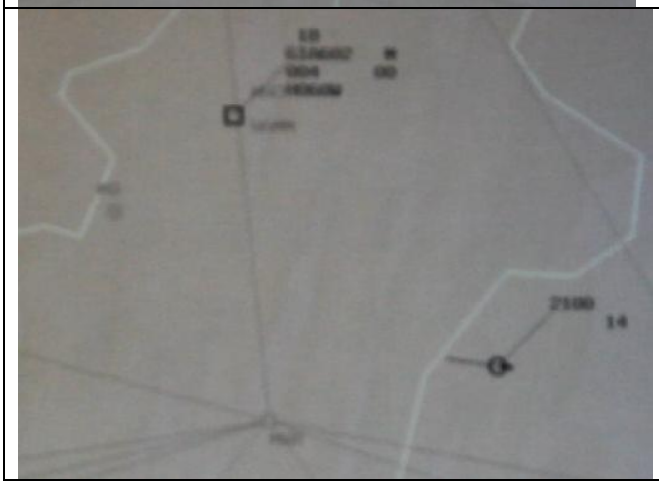
1. With the existing of "Hagupit" tropical storm on Pacific Ocean, north east of Papua has made the air movement over Manado area at 300 feet was westerly to northerly with speed between 10 to 20 knots. Weather at North Sulawesi generally moderate rain all day.
2. Weather at Sam Ratulangi Airport Manado between 0900 – 1100 LT. Mostly cloudy with occasionally light rain, the visibility between 5 to 10 km, and wind velocity 4 – 5 knots. Low cloud 3 to 4 octas (3/8 to 4/8 part) at cloud base between 1700 – 2000 feet.
3. Weather condition near Kema at 0900 - 1100 LT, based on the satellite weather image indicated formations of cumulus and cumulonimbus clouds. At 0900 LT the formation has not appeared and at 1100 LT has been dissipated. The satellite image indicated that between 0940 to 1010 LT showed rain with intensity moderate to heavy.

The BMKG station at Ternate issued weather information as follows;

	0000 UTC	0200 UTC	0300 UTC
Wind	320 /5	330/10	310/07
Visibility	5 km	3 km	3 km
Present weather	Rain	Nil	Nil
Cloud	Few CB 1500 SCT 1800	Few CB 1500 SCT 1800	Few CB 1500 SCT 1800
Temperature / Dew point	26/24	27/24	27/23
QNH	1010	1010	1009
Remark	Precipitation in sight	Precipitation in sight	Precipitation in sight

1.5 Radar Data

The Manado Approach radar replay retrieved information.

	The radar display indicated the aircraft flew toward MD NDB.
	The aircraft turned further to the left.

	The aircraft flew further to the left to MWB VOR.
	8 seconds later, the aircraft flew eastward.
	The aircraft data started to disappear from the radar screen

	The aircraft target disappeared from the radar.

1.6 Organization Information

Aircraft Operator : PT. Elang Nusantara Air

Address : Gd. Plaza Permata Lt.11 Suite 1104
Jl. M.H Thamrin No.57, Gondangdia – Menteng
Jakarta Pusat 10350, Indonesia

AOC Number : AOC 135/053

PT. Elang Nusantara Air is authorized to conduct air transportation and aerial work for aircraft operation under CASR Part 135 to carriage of passengers and cargo in non-scheduled operation within and outside the contiguous Indonesia. The authorization to conduct aerial work is include agricultural operation under CASR 137 with the following type of aircraft:

No.	Make / Model	Manufacturer	Engine Make/model	Propeller
1.	Cessna C 208 Grand Caravan	Cessna Corp	PT6-114A	McCauley Propeller P7036368-0383
2.	Thrush S2R-T34	Ayres	PT6A-34AG	Hartzell Propeller Inc. HC-B3TN-3D

PT. Elang Nusantara Air has agreement with PT. Sinar Mas Group to provide agricultural services.

2.4.4. Chief Pilot

The Chief Pilots are directly responsible to the Operation Manager, He shall carry out those tasks delegated to him by the Operation Manager which shall include but are not limited to:

- Developing standard operating procedures;
- Developing and implementing all required approved training programs for the operator's flight crews;

- Issuing directives and notices to the flight crews as required; Company Flight Instructors are responsible to carry out Company Flight Crew Training
- Ensuring that all aerodromes and routes served by the operator are operationally suitable and meet company requirements;
- Taking action on and distributing accident, incident, and other occurrence reports;
- Processing and taking action on any flight crew reports;
- Supervising aircraft crews; and
- Assuming any responsibilities delegated by the Flight Operations Manage

2. ANALYSIS

The search and rescue operation for this accident recover minor part of the aircraft. Information required for the investigation such as aircraft engine, flight controls and other part that may contain significant information. Investigation utilizes all relevant available information.

2.1 Reason for divert

The pilot did not declare the reason for diversion to Sam Ratulangi Airport. The aircraft speed assumed in normal cruising speed of 126 MPH (108 Knots). The distance travelled since the airborne at 2323 UTC until the first contact to Manado Approach controller at 0138 was 243 miles.

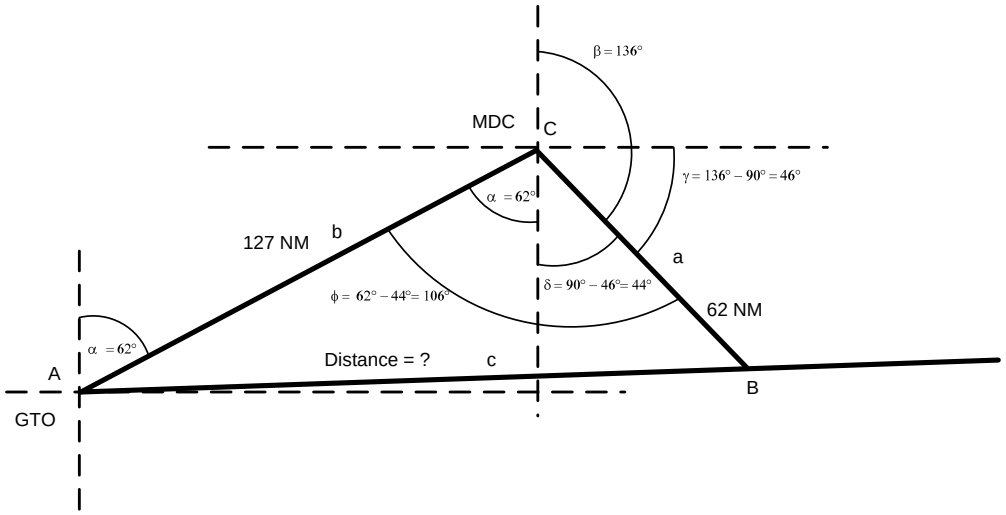


Figure 10 : Illustration for distance calculation

Manado is 127 NM at 062° from Gorontalo, so $\alpha_1 = \alpha_2 = 62°$

At 0138 the pilot reports the aircraft position was at radial 136 at 62 Nm, so β = 136°. Therefore, γ = 136° - 90° = 46°. Base on γ, we can obtain δ = 90° - 46° = 44°. The total angle for α_2 and δ = 62° + 44° = 106°.

The distance from GTO to MDC or from point A to C is 127NM. The distance from MDC to last pilot contact or point C to B is 62NM. Now the distance from point A to B is:

$$c^2 = a^2 + b^2 - 2ab\cos\phi$$

$$c^2 = 62^2 + 127^2 - (2 \times 62 \times 127 \times \cos(106))$$

$$c^2 = 3844 + 16129 - (2 \times 62 \times 127 \times (-0.28))$$

$$c^2 = 3844 + 16129 - (-4409.44)$$

$$c^2 = 24382.44$$

$$c = \sqrt{24382.44}$$

$$c = 156.15$$

So the distance of the aircraft when making a contact on 0138 (point A to B) is about 156 Nm from GTO.

Refer to the satellite weather image, the area of 50 Nm east of the first point of the first contact to Manado Approach controller was cloudy.

This can be assumed that the reason for diversion to Manado was due to weather.

2.2 Impact speed prediction

Based on the damage to the aircraft, indicated that the impact speed was significantly high. Refer to the statement of the witness; the aircraft descend with approximately 60° down. The calculation of the impact speed with assumption of: idle power and initial descend altitude 8500 feet (2580 m) and g = 9.8 m/s^2

Assumes the aircraft was diving with angle 60° related to vertical line

Vertical free fall formula:

$$v = \sqrt{2.g.h}$$

$$t = \sqrt{\frac{2.h}{g}}$$

Free fall speed is as follows:

$$v = \sqrt{2.g.h}$$

$$v = \sqrt{2 \times 9.8 \times 2580}$$

$$v = \sqrt{50568}$$

v= 224 m/s = 435.42 knot = 501 MPH

Since the aircraft making an angle of 60°, therefore the vertical axis speed calculation:

$$v = v.\sin\alpha$$

$$v = 224 \times \sin 60$$

V = 193.9 m/s = 433 MPH = 376 Knots

This calculation did not count the factor of engine power. The calculation of speed found that the aircraft speed was higher than the never exceed speed (VNE) of 159 MPH and the speed found vibration speed of 204 Knots.

This calculation was supported by the evidence of the random damage on the left elevator hinge that indication of vibration.

2.3 Ditching analysis

The witness statement that the aircraft was descend with angle approximately 60° down, the predicted impact speed and the level of damage to the aircraft indicated that the aircraft was not controllable during impact.

The possibilities of uncontrolled condition was result of pilot incapacitation, aircraft unable to be controlled due to damage or the condition that beyond the pilot capability to control.

At 0200 UTC, the communication between pilot and controller was normal and there was no information concerning to the health issue or other pilot condition. At 0205 UTC, the controller called the pilot but was not replied. This indicated that health issue or pilot incapacitation was less likely to occur.

The aircraft maintenance record did not indicate any malfunction or problem recorded. The witness stated that he heard engine sound was higher than normal. He mentioned that the sound was like the sound of aircraft diving as he seen on the movie. The combination of nose down with high engine sound indicated that the engine was running. This can be concluded that the engine was operating prior to impact. The investigation could not find any evidence of aircraft malfunction.

The satellite weather image on Manado area, weather analysis of BMKG and witness statement indicated that the area was raining with intensity of moderate to heavy with cumulonimbus cloud during the occurrence. The witness also stated that he saw the aircraft descend out of cloud.

The pilot was not qualified for instrument rating. The routine pilot operation was conducting agricultural visual flight. This can be concluded that the pilot was not familiar in Instrument Meteorological Condition (IMC).

The weather information stated that cumulonimbus and cumulus cloud formations existed on the area of the last contact, which likely created turbulence.

A pilot with less experience of instrument flying might not familiar with instrument reading and might disorientation especially after changing in aircraft attitude that caused by turbulence.

3. CONCLUSION

According to information and analysis of this investigation, the Komite Nasional Keselamatan Transportasi (KNKT) describes as follows:

3.1 Finding

1. The aircraft was airworthy prior to departure. There was no report related to the aircraft system malfunction or abnormality.
2. The crew has valid license and medical certificate. The pilot did not certify for instrument rating.
3. The flight was positioning flight from Batu Ampar, South Kalimantan with intended final destination was Cendrawasih Airstrip, Papua conducted under Visual Flight Rules.
4. This flight was the first flight on the third day when the first day flights were normal and the second day flight was cancelled due to weather.
5. The flight from Jalaludin Airport, Gorontalo with intended destination of Baabulah Airport, Ternate cruise at 7000 feet and diverted to Sam Ratulangi Airport, Manado.
6. First communication with Manado Approach controller, the aircraft was on radial 136 at 62 Nm. This indicated that the aircraft had flown close to Ternate and returned.
7. There was no pilot statement to inform the reason for diversion. Investigation assumed the diversion was due to weather on the route.
8. Last contact was at 0200 UTC and the pilot reports position was at 17 Nm from MNO VOR. The weather on the area of the last contact indicated formations of cumulus and cumulonimbus clouds. The satellite image indicated that between 0940 to 1010 LT showed rain with intensity moderate to heavy.
9. The Search and Rescue operation recovered left main landing gear, left elevator, all tires and luggage.

3.2 Contributing Factors[1]

Based on available data, investigation concluded that the contributing factors for this accident was the aircraft entered into unrecoverable condition that might caused by pilot disorientation when flying in Instrument Meteorological Condition (IMC).

1 "Contributing Factors" is defined as events that might cause the occurrence. In the case that the event did not occur then the accident might not happen or result in a less severe occurrence.

4. SAFETY ACTION

At the time of issuing this report, Komite Nasional Keselamatan Transportasi (KNKT) has not received any safety actions resulting from this occurrence.

5. SAFETY RECOMMENDATIONS

Base on the examination of the factual data and the findings that contributed to the accident, Komite Nasional Keselamatan Transportasi (KNKT) recommends:

5.1 PT. Elang Nusantara Air (ENA)

- To ensure that even though the flight is planned for Visual Flight Rule (VFR) for the positioning flight purposes, the positioning flight should be conducted by the pilot who held Instrument Rating and the aircraft should be equipped with minimum requirement for instrument flight.
- As required by the operator's Agricultural Manual of the "Agricultural Aircraft Controls" procedure, all pilots are required to hold a current CPL (A), an Agricultural Rating (and Chemical Rating if applicable).

5.2 Directorate General of Civil Aviation (DGCA)

To ensure that the recommendations address to PT. Elang Nusantara Air are well implemented.