KOMITE NASIONAL KESELAMATAN TRANSPORTASI
REPUBLIC OF INDONESIA

FINAL

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Aircraft Serious Incident Investigation Report

PT. Garuda Indonesia

ATR 72-212A; PK-GAF

H. Hasan Aroeboesman Airport, Ende

Republic of Indonesia

19 October 2015

2021

This Final Report was published 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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Jakarta, 25 June 2021

KOMITE NASIONAL
KESELAMATAN TRANSPORTASI
CHAIRMAN

SOERJANTO TJAHJONO

TABLE OF CONTENTS

TABLES OF FIGURES

ABBREVIATIONS AND DEFINITIONS

AAL	:	Above Airport Elevation
ACARS	:	Aircraft Communications Addressing and Reporting System
ACO	:	Aeronautic Communication Officer
AOC	:	Air Operator Certificate
AOG	:	Aircraft on Ground
ATPL	:	Airline Transport Pilot License
BMKG	:	*Badan Meteorologi Klimatologi dan Geofisika* (Meteorological, Climatological and Geophysics Agency)
BOM	:	Basic Operation Manual
CASR	:	Civil Aviation Safety Regulation
CCP	:	Company Check Pilot
CPL	:	Commercial Pilot License
CRM	:	Crew Resource Management
CSN	:	Cycle Since New
CVR	:	Cockpit Voice Recorder
DA	:	Decision Altitude
daN	:	Dekanewton
DGCA	:	Directorate General of Civil Aviation
DGCP	:	Directorate General of Civil Aviation Check Pilot
EQ	:	Emotional Intelligence
EWD	:	Engine and Warning Display
FCOM	:	Flight Crew Operation Manual
FCTM	:	Flight Crew Training Manual
FDR	:	Flight Data Recorder
ft	:	Feet
IAS	:	Indicated Air Speed
ILS	:	Instrument Landing System
IMC	:	Instrument Meteorological Condition
kg	:	Kilogram
KNKT	:	*Komite Nasional Keselamatan Transportasi* (Indonesia accident investigation authority)
Lbs	:	Pound
M/W	:	Aircraft main wheel
MCDU	:	Multi-purpose Control Display Unit
MDA	:	Minimum Descent Altitude
MQ	:	Maintenance Quality

OM	:	Operation Manual
PF	:	Pilot Flying
PIC	:	Pilot in Command
PM	:	Pilot Monitoring
QRH	:	Quick Reference Handbook
RA	:	Radio Altitude
SIC	:	Second in Command
TQ	:	The rotational speed of the low speed spool which consists of the fan, the low-pressure compressor and the low-pressure turbine, all of which are connected by a concentric shaft
TSN	:	Time Since New
UTC	:	Universal Time Coordinated
VAPP	:	The target speed to be reached while the aircraft passes the runway threshold at 50 feet with refers to the existing aircraft weight and landing configuration.
VMC	:	Visual Meteorological Condition
VMCL	:	Minimum Control Speed during landing approach
VmHB	:	The final approach speed
Vref	:	1.3 times the stalling speed in the stated landing configuration and at the prevailing aircraft weight. This is the speed required as the landing runway threshold is crossed at a height of 50 feet in landing configuration if the calculated aircraft performance is to be achieved.

INTRODUCTION

SYNOPSIS

On 19 October 2015, an ATR 72-600 aircraft, registered PK-GAF was being operated by PT. Garuda Indonesia on a scheduled passenger flight from El Tari Airport (WATT), Kupang to H. Hasan Aroeboesman Airport (WATE), Ende.

At 0445 UTC, the aircraft departed from Kupang and the flight until commenced for approach to Ende was uneventful. The Pilot in Command (PIC) acted as pilot flying (PF) while Second in Command (SIC) acted as pilot monitoring (PM).

At 0537 UTC, the SIC advised to the Ende Aeronautic Communication Officer (ACO) that the aircraft was turning on final runway 27. The ACO responded that the wind direction was 150° with velocity of 18 knots and advised that the runway was clear. According to pilot observation, the weather was clear without scattered cumulus. On short final, the SIC checked the wind shock located on the right side of beginning runway and was coherent to the information of the wind condition from the ACO.

The aircraft touched down on the touchdown zone with nose wheel touched the runway first and bounced to the left of runway centerline. The aircraft then experienced the second touchdown on the left shoulder of the runway. During the second bounce, the master warning light illuminated consisted with the "Pitch Disconnect" warning on the Engine and Warning Display (EWD). The flight crew applied significant dual and opposite control columns inputs (leading to pitch uncoupling mechanism activation) - pitch down by the PIC on left seat and pitch up by the SIC on right seat (pitch up authority is higher).

After the second bounce, the Flight Data Recorder (FDR) recorded an increasing value of TQs. The pilot performed a go around and turned right to avoid obstacle at the end of the runway 27. Both pilots assessed situation and decided to divert to Labuan Bajo. The flight continued uneventfully and landed safely at Labuan Bajo.

The investigation determined that the aircraft airworthiness serviceability was not an issue on this occurrence. Therefore, the analysis discusses the landing technique and pilot coordination. The investigation concluded the contributing factors of the occurrence as follows:

- Continuation of unstabilized approach with too much speed and nose down attitude resulted in the nose wheel touched the runway first, and with the roll about 3° to the left made the aircraft bounce to the left of runway centerline.
- The absence of immediate go around initiation after the first bounce resulted in the aircraft made second touched down on the left shoulder of the runway.

The KNKT acknowledged the safety actions taken by the Garuda Indonesia and considered relevant to address the safety issue identified in this report. However, there were safety issue remains to be considered. Therefore, the KNKT issues safety recommendations to the Garuda Indonesia to address safety issues identified in this report.

1 FACTUAL INFORMATION

1.1 History of the Flight

On 19 October 2015, an ATR 72-600 aircraft, registered PK-GAF was being operated by PT. Garuda Indonesia on a scheduled passenger flight. The crewmember scheduled for six sectors on that day. The routes were from I Gusti Ngurah Rai International Airport (WADD), Bali[1] – Komodo Airport (WATO), Labuan Bajo[2] – H. Hasan Aroeboesman Airport (WATE), Ende[3] – El Tari Airport (WATT), Kupang[4] – Ende – Labuan Bajo – Bali.

The aircraft departed from Bali at 2205 UTC[5] and conducted three sectors flight uneventful. The aircraft landed at Kupang around 0245 UTC.

The aircraft departed from Kupang to Ende at 0445 UTC with flight number GIA7017 with intended cruising altitude of 12,500 feet. Prior to departure there was no report or record of aircraft system abnormality. On board the aircraft was two pilots, two flight attendants and 16 passengers. Both pilots were French, and rest of the occupants were Indonesian.

The Pilot in Command (PIC) acted as pilot flying (PF) while Second in Command (SIC) acted as pilot monitoring (PM). The flight from departure until commenced for approach to Ende was uneventful.

At 0515 UTC, the SIC made first contact with Ende Aeronautical Communication Officer (ACO) and informed that the aircraft altitude and Estimated Time of Arrival (ETA) at Ende. The ACO acknowledged the ETA and provided information of the runway in use was runway 27, weather was clear, wind direction varied from 140° until 180° with velocity of 13 knots gusty to 18 knots, cloud was scattered cumulus 1,500 feet, and temperature was 31°C. The SIC acknowledged the ACO information.

At 0537 UTC, the SIC advised to the ACO that the aircraft was turning on final runway 27. The ACO responded that the wind direction was 150° with velocity of 18 knots and advised that the runway was clear. According to pilot observation, the weather was clear without scattered cumulus.

During turning on final, approximately 400 feet, the PF increased the rate of descend to adjust the approach path. The speed increased to around 140 knots and the PIC reduced the power.

On short final, the SIC checked the wind shock located on the right side of beginning runway and was coherent to the information of the wind condition from the ACO.

The aircraft touched down on the touchdown zone with nose wheel touched the runway first and bounced to the left of runway centerline and the aircraft experienced the second bounce on the left shoulder of the runway. During the second bounce, the master warning light illuminated triggered by “Pitch Disconnect” warning light.

1 I Gusti Ngurah Rai International Airport (WADD), Bali will be named as Bali for the purpose of this report.

2 Komodo Airport (WATO), Labuan Bajo will be named as Labuan Bajo for the purpose of this report.

3 H. Hasan Aroeboesman Airport (WATE), Ende will be named as Ende for the purpose of this report.

4 El Tari Airport, Kupang will be named Kupang for the purpose of this report.

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

The SIC noticed that the right control column was functioning and took over the aircraft control while PIC was trying to check the left control column function. The functioning control column on the right side changed the pilot roles, the SIC acted as PF and the PIC acted as PM.

After the second bounce, the Flight Data Recorder (FDR) recorded increasing value of TQs[6]. The pilot made go around and turned to the right to avoid obstacle at the end of runway 27. After completed the go-around procedure, the PIC was aware of the severity of the occurrence then asked the ACO to check the possibility of debris leftover on the runway or left shoulder as result of aircraft bounced. The ACO then reported that there was no debris leftover on the ground.

After the pilots assessed the situation, they decided to divert to Labuan Bajo. During the flight, the pilot explained the situation to the flight attendant and also asked the passenger condition. There was no reported injury to the passenger nor the flight attendant. The flight continued and landed at Labuan Bajo.

1.2 Personnel Information

1.2.1 Pilot in Command

The PIC was 53 years old, France nationality who held valid Airline Transport Pilot License (ATPL) and qualified as ATR 72-600 aircraft pilot. The PIC also held valid first-class medical certificate.

The flying experience of the PIC was as follows:

Total hours : 9,701 hours 25 minutes
Total on type : 609 hours 34 minutes
Last 24 hours : 5 hours 23 minutes
This flight : 1 hour 35 minutes

The last recurrent training assessment for the PIC was performed on 9 May 2015, while the proficiency check was on 10 May 2015. The result of both checks was satisfactory without any remarks.

The occurrence flight was the first flight schedule after his annual leave. Prior to the occurrence, the PIC had flown with the SIC several times including flight to Ende. The PIC mentioned that the terrain condition on long final runway 27 at Ende prevented pilot to made straight in approach, and the atoll on final required the aircraft to fly at altitude of 400 feet. The PIC also mentioned that the wind condition was difficult to be predicted due to the atoll.

1.2.2 Second in Command

The SIC was 27 years old, France nationality who held valid Commercial Pilot License (CPL) and qualified as ATR 72-600 aircraft pilot. The SIC also held valid first-class medical certificate.

The flying experience of the SIC was as follows:

Total hours : 2,300 hours
Total on type : 335 hours 54 minutes

6 The TQ is the rotational speed of the low speed spool which consists of the fan, the low-pressure compressor and the low-pressure turbine, all of which are connected by a concentric shaft.

Last 24 hours : 5 hours 23 minutes

This flight : 1 hour 35 minutes

The last recurrent training assessment for the SIC was performed on 11 May 2015, while the proficiency check was on 12 May 2015. The result of both checks was satisfactory without any remarks.

The SIC had flown with the PIC for five times and include flight to Ende before the occurrence. The SIC assumed that the PIC seemed not comfortable to fly to Ende due to the terrain condition. The SIC was often assisted the PIC during the landing approach at Ende, however, the SIC mentioned that the PIC was type of person that resist to be assisted.

1.3 Aircraft Information

1.3.1 General

The PK-GAF is an ATR 72-600 aircraft which was manufactured at France by the ATR aircraft company on 2014 with serial number of 1152. The aircraft had total Time Since New (TSN) of 2,862 hours and total Cycle Since New (CSN) of 3,015 cycles.

The aircraft was fitted with two engines PW127M manufactured by Pratt & Whitney Canada and two propellers HS 568F manufactured by Collins. Both engines and propellers were installed on 18 March 2014 and had 2,862 hours in total (TSN) and 3,015 cycles in total (CSN).

1.3.2 Weight and balance

The weight and balance sheet issued by the Flight Operation Officer at Kupang prior to dispatch contained the following data:

- Zero Fuel Weight : 17,877 kg (maximum 21,000 kg)
- Takeoff weight : 20,514 kg (maximum 23,000 kg)
- Estimated Landing Weight : 19,961 kg (maximum: 22,350 kg)

The weight and balance sheet indicating that the aircraft was operated within the approved weight and balance envelope.

1.3.3 Aircraft Flight Control System - Pitch

The FCOM part 2, chapter 02, and section 06 (2.02.06) page 2 described the peculiarities of the flight control as follows:

PITCH: Both elevators are connected through a pitch uncoupling device, in order to leave sufficient controllability in case of mechanical jamming of one control surface.

Activation of this device:

- *requires heavy forces (52 daN/114 lbs) to be applied to the control columns, which minimizes the risk of untimely disconnection.*
- *indicated to the crew through the red warning « PITCH DISC » on the EWD.*
- *allows the flight to be safely achieved: refer to procedures following failures.*

Note 1: WHEN PITCH DISCONNECT takes place WITHOUT REAL JAMMING, speed has to be limited to 180 kt and bank angle to 30° until flaps extension to avoid overstressing the stabilizer.

Note 2: The TWO yokes must be held once the aircraft is landed.

Activation of the Pitch Uncoupling Mechanism allowed the flight crew to regain pitch authority of the aircraft.

1.4 Meteorological Information

The satellite weather image was provided by *Badan Meteorologi Klimatologi dan Geofisika* (BMKG) on the day of the occurrence at 0510 UTC and 0610 UTC indicated that the weather over Ende (red circles) was clear.

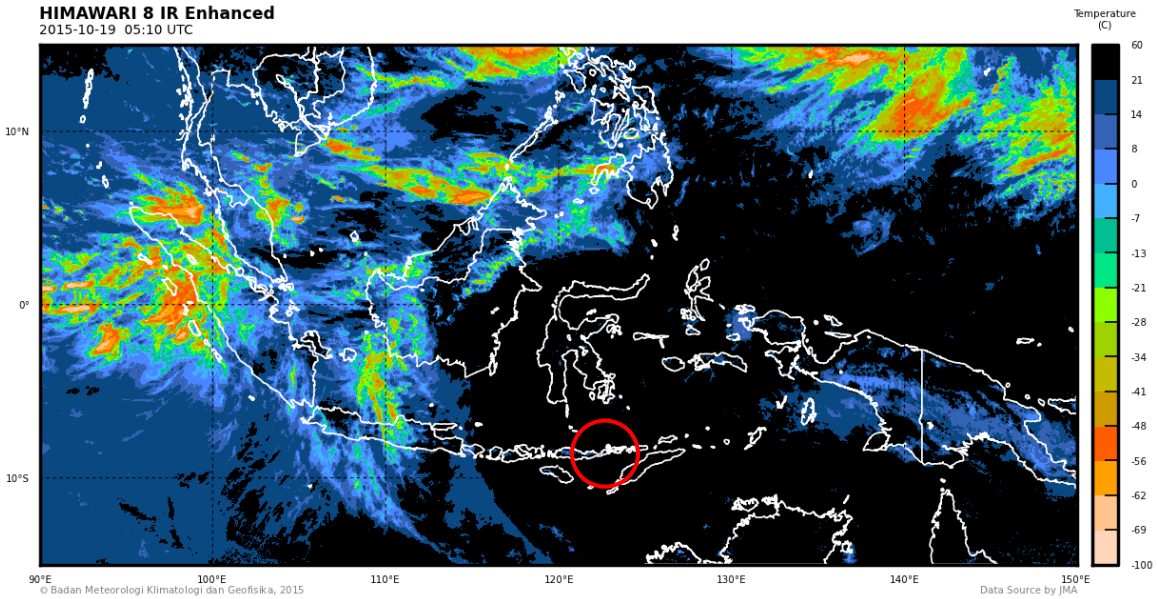


Figure 1: The satellite image at 0510 UTC

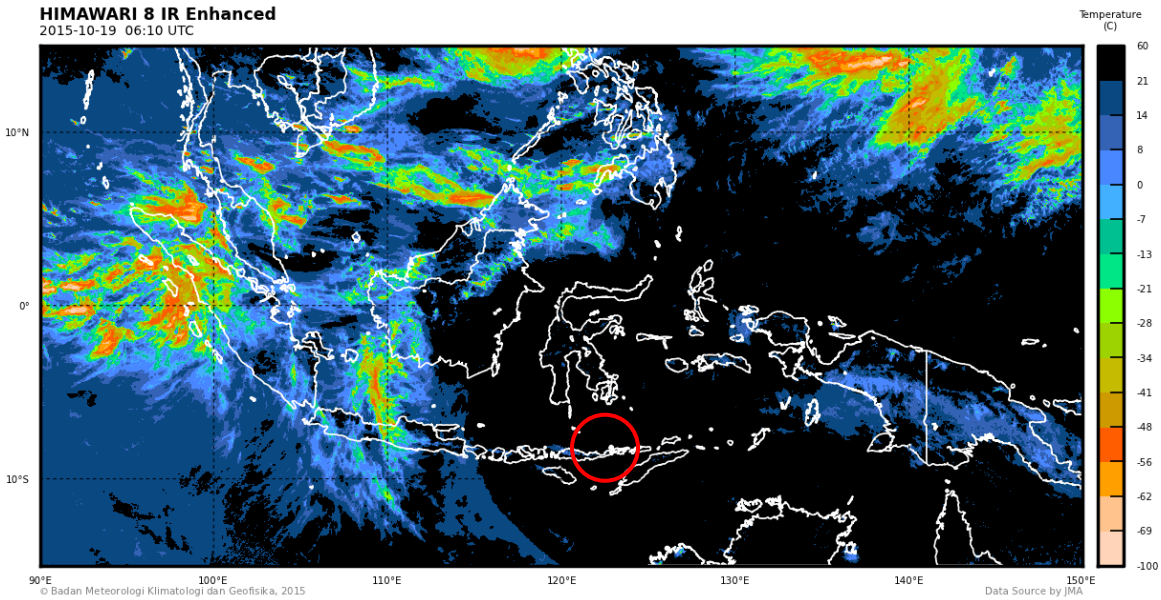


Figure 2: The satellite image at 0610 UTC

1.5 Aids to Navigation

The aircraft operator developed visual maneuvering chart to Ende that had been approved by the Directorate General of Civil Aviation (DGCA) as follows:

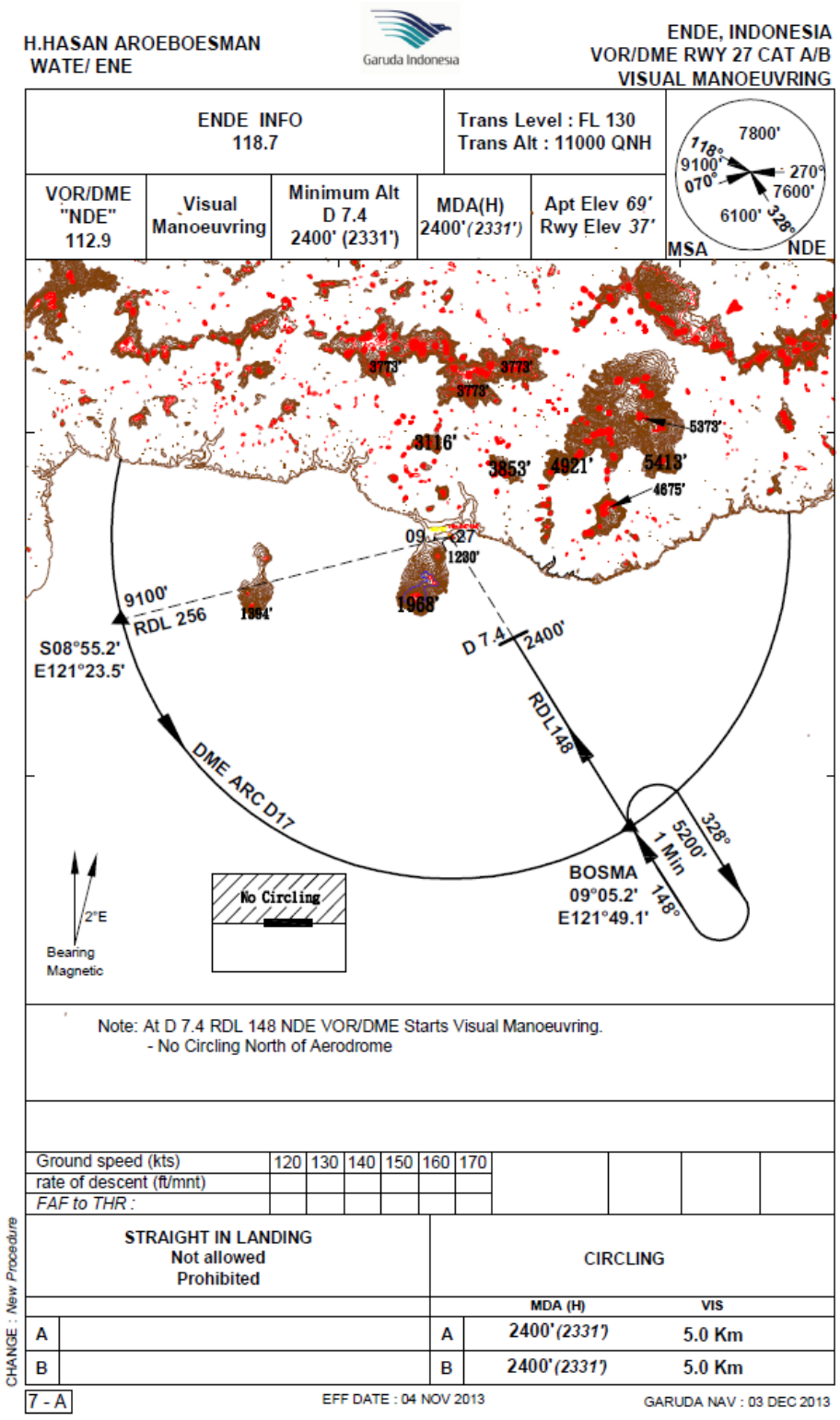


Figure 3: Visual manoeuvring chart of runway 27

1.6 Aerodrome Information

H. Hasan Aroeboesman Airport (WATE) located on Ende, Nusa Tenggara Timur with coordinate 08°50'53" S and 121°39'48" E and operated by Directorate General of Civil Aviation. The airport elevation was 15 feet above mean sea level. The runway dimension was 1,650 meters long and 30 meters wide.

There was an atoll on final path runway 27 (figure 4 and 5), which was about 1,150 meters (0.62 Nm) from beginning of runway 27 and the height of atoll was approximately 180 feet.

Figure 4: Atoll on final path Runway 27

Figure 5: The atoll position to final runway 27

1.7 Flight Recorders

The aircraft was equipped with FA2100 model of Flight Data Recorder (FDR) and Cockpit Voice Recorder (CVR) that manufactured by L3-Comm. Both flight recorders were transported to KNKT recorder facility for data downloading process. The FDR recorded 745 parameters and approximately 76 hours of aircraft operation, which was containing 57 flights including the serious incident flight. The CVR data had overwritten with the subsequent flight due to the aircraft continued the flight from Labuan Bajo to Bali.

The significant parameters of the FDR data showed on the following figures.

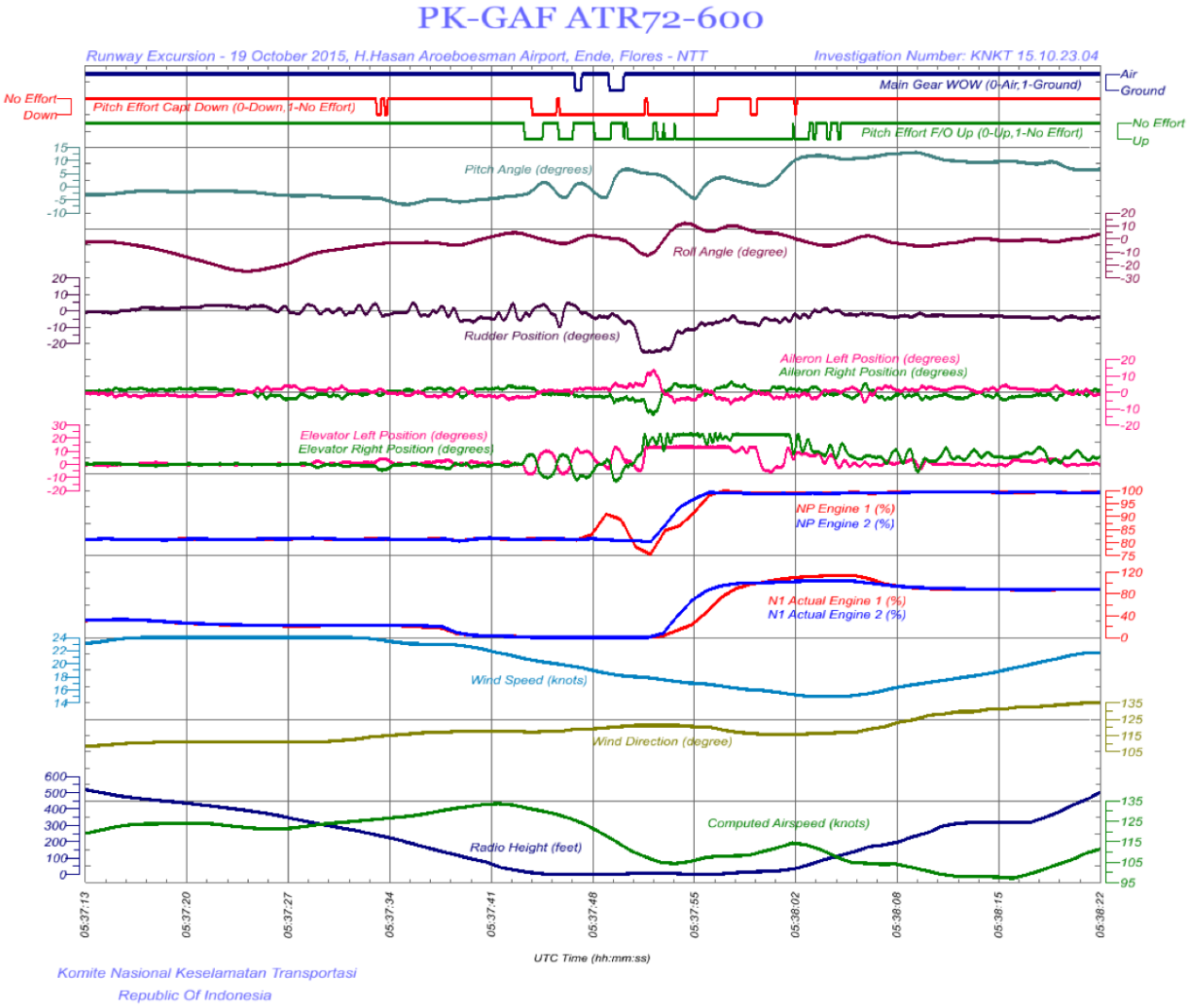


Figure 6: The significant parameters of FDR data during approach and go around

The significant FDR data were as follows:

- The aircraft configured with flaps 30 for the landing approach.
- 05:37:02 UTC, at 654 feet Radio Altitude (RA), the autopilot was disconnected.
- 05:37:27 UTC, at 358 feet RA, the aircraft was over atoll, the Indicated Air Speed (IAS) was 121 knots, the TQs at 21%, and pitch angle -3.4° (pitch down).

- 05:37:33 UTC, at 252 feet RA, the IAS was 125 knots and increasing, the TQs maintained at 21%, the parameter of Pitch Effort on PIC side indicated DOWN for two seconds, and pitch angle was -4.4° (pitch down).
- 05:37:36 UTC, at 187 feet RA, the IAS was 127 knots, the TQs decreased to 20% and continued decreasing to 0% at 05:37:45 UTC, and the pitch angle was reached a local minimum at -6.5° (pitch down).
- 05:37:43 UTC, at 26 feet RA, the IAS was 133 knots and decreasing, the parameter of Pitch Effort on SIC side indicated UP for 23 seconds, the rate of descend was 1,000 feet/minute, and pitch angle was -3.3° (pitch down).
- Since the aircraft had passed 26 feet RA until time 05:37:55 UTC, the average recorded wind direction was 119° (from the aft left of the aircraft) and the average wind velocity was 18 knots. This value came from FMS and thus shall be used for trend purpose.
- 05:37:44 UTC, at 11 feet RA, the IAS was 131 knots, and pitch angle was on increasing value from -2.16° up to +1.38° (pitch up). The parameter of Pitch Effort on PIC side indicated DOWN for 13 seconds while the parameter of Pitch Effort on SIC side was still UP.
- 05:37:45 UTC, at 3 feet RA, the IAS was 130 knots and decreasing, the TQs reached 0% and was maintained for 7 seconds, and the pitch angle reached a local maximum at +1.6° (pitch up).
- 05:37:46 UTC, the IAS was 128 knots, pitch angle was -4.16° (pitch down), and the roll angle was -3.3 (roll to the left).
- 05:37:47 UTC, the vertical acceleration was 1.6 g. Pitch angle was increasing to +1.3° and roll angle was -1.4° and the parameters of "both main landing gear" also "all gears" were recorded "on ground" for half a second. Power levers 2 started to be reduced to Ground Idle while Power Lever 1 remained at Flight Idle.
- 05:37:48 UTC, the IAS was 123 knots, the pitch angle was -3.76° (pitch down), and the roll angle was 2.2° (roll to the right).
- 05:37:49 UTC, the vertical acceleration was 2 g, pitch angle was -4.2° (pitch down), the IAS was 119 knots and the roll angle was 0, the weight on wheel sensors recorded aircraft on ground for one second.
- 05:37:50 UTC, the IAS was 115 knots and the pitch angle was 6.6 (pitch up) and the roll angle was -1.6° (roll to the left) and the roll angle continued increasing.
- 05:37:51 UTC, both elevators were recorded in opposite directions meaning the pitch coupling mechanism disconnected. Power levers were moved to the RAMP.
- 05:37:52 UTC, the IAS was 107 knots, the TQs increased from 0 to 1% and continued increasing, the pitch angle was +5° (pitch up), and the roll angle was -12.9° (roll to the left).
- 05:37:53 UTC, the Pitch Disconnect Warning triggered, the IAS was 105 knots, and the pitch angle was decreasing to +4.1° (pitch up). The parameter of Pitch Effort on PIC side was still maintained DOWN while the parameter of Pitch Effort on SIC side was still UP.
- 05:37:55 UTC, the vertical acceleration was +1.9 g, the IAS was 100 knots and the pitch angle reached a minima at -4.6° and the roll angle reached a maxima at +11.1°.

Based on the FDR data, a wind computation can be made as follows:

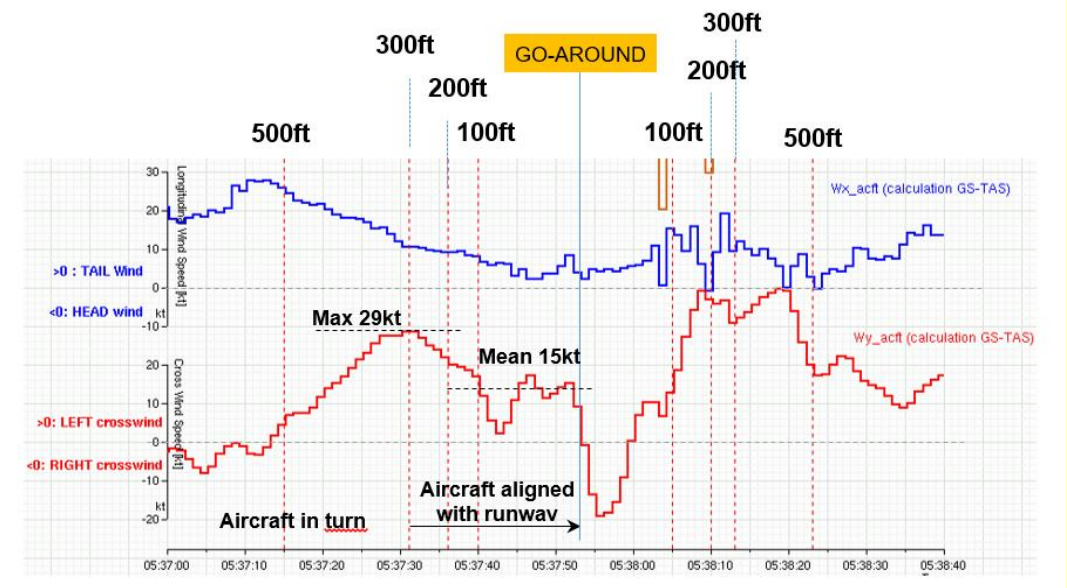


Figure 7: The wind computation

From 500 feet RA to the touchdown, the mean wind direction was around 140°, the wind speed varied between 7 knots and 33 knots (mean value 24 knots).

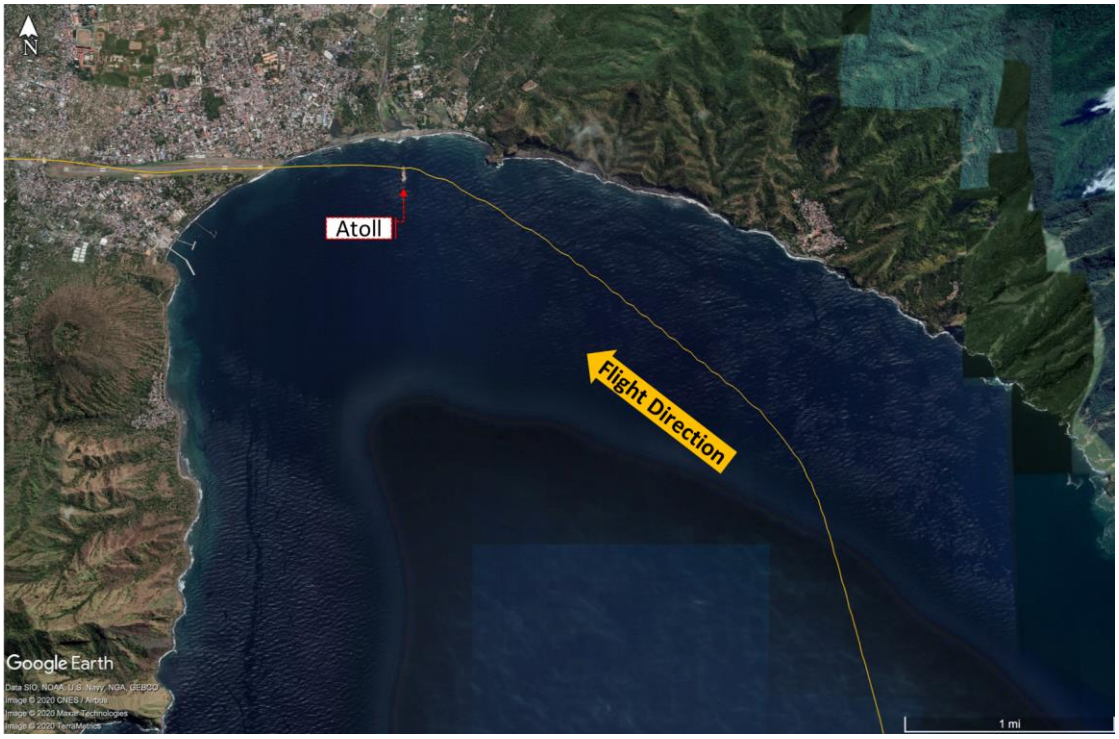


Figure 8: The flight profile (yellow line) based on FDR data

1.8 Test and Research

The investigation calculated the final approach speed using the reference from the aircraft manuals (see subchapter 1.9.4) and the available data.

The calculation was based on the landing weight stated on the weight and balance sheet (19,961 kg which then rounded up to 20,000 kg). The V_{mHB}[7] for flaps 30° for the landing weight based on the Quick Reference Handbook (QRH) would be 105 KIAS and based on the Flight Crew Operating Manual (FCOM), the V_{APP} would be 105 KIAS (V_{mHB}) As the aircraft did not experience headwind, there is no wind factor to add to the V_{mHB}.

Figure 9: The indicated airspeed and radio altitude profile

The figure above indicated that while on final, the aircraft speed was high and after passed the atoll, the speed exceeded the calculated final approach speed (105 knots).

1.9 Organizational and Management Information

1.9.1 Aircraft Operator

PT. Garuda Indonesia (Garuda Indonesia) had a valid Air Operator Certificate (AOC) number 121-001 to conduct a scheduled passenger transport. The operator operated several fixed-wing aircraft included Airbus A330-300, Airbus A330-200, Boeing 777-300ER, Boeing 747-400, Boeing 737-800NG, ATR 72-600 and CRJ 1000.

7 VmHB is the final approach speed.

The aircraft operator had several operation documents approved by the Directorate General of Civil Aviation (DGCA) as follows:

- Basic Operation Manual (BOM) which contains company policy and procedure. After the occurrence, the BOM had been amended into several Operation Manuals (OMs);
- Flight Crew Operating Manual (FCOM) of ATR 72 which provides pilot with information technical description, procedures, and performances characteristic of the ATR 72 aircraft;
- Quick Reference Handbook (QRH) of ATR 72 which can used as checklist to be followed by pilot during the aircraft non-normal operation; and
- Flight Crew Training Manual (FCTM) of ATR 72 which provides standard baseline for all ATR flight crew training.

1.9.1.1 Stabilized Approach Criteria

The BOM subchapter 4.4.4.07 described approach stability criteria as follows:

All flight must be stabilized by 1000 feet above airport elevation in IMC and by 500 feet above airport elevation in VMC.

An approach is stabilized when all of the following criteria are met:

1. *The aircraft is in the correct flight path.*
2. *Only small changes in heading / pitch are required to maintain the correct path.*
3. *The aircraft speed is not more than Vref*[8] *+20 indicated airspeed and not less than Vref.*
4. *The aircraft is in the correct landing configuration.*
5. *Sink rate not more than 1000 fpm; if an approach require sink rate greater than 1000 fpm, special briefing shall be conducted.*
6. *Thrust setting is appropriate for the aircraft configuration and is not below the minimum thrust for approach as defined by the aircraft operating manual.*
7. *All briefing and checklist have been conducted.*
8. *Specific type of approach:*

   ILS : within one dot of the glide slope and localizer.

   CAT II or III ILS : within the expanded localizer.

   Circling approach : wings level on final when the aircraft reaches 300 feet above airport elevation.
9. *Unique approach procedure or abnormal condition requiring a deviation from the above elements of a stabilized approach requires special briefing / training.*

8 Vref is the speed required as the landing runway threshold is crossed at a height of 50 feet in landing configuration if the calculated aircraft performance is to be achieved. The value normally is 1.3 times the stalling speed in the stated landing configuration and at the prevailing aircraft weight.

If the aircraft is not stabilized below 1000 feet above airport elevation in IMC and by 500 feet above airport elevation in VMC in accordance with the criteria, the PIC or PF shall go around.

The FCTM subchapter 02.01.10 described general procedure and policy for stabilize approach as follows:

10.2. Stabilization criteria

Approaches must be stabilized:

- *1000 ft AAL in IMC conditions*
- *500 ft AAL in VMC conditions*
- *300 ft AAL following circle-to-land*

An approach is considered stabilized when all of the following criteria are met:

- *Lateral path (Loc, Radial or RNAV path) is tracked*
- *Landing configuration is established*
- *Energy management:*
  - *Vertical path (Glide, Altitude versus Distance or RNAV path) is tracked*
  - *Power setting is consistent with appropriate aircraft weight, Head/Tail wind component and vertical guidance requirements*
  - *Speed and pitch attitude are relevant to actual conditions*
- *Briefing and checklists are completed*

10.3. Deviations

Only small deviations are allowed if immediately called out and corrected:

- *Altitude during initial approach: ± 100 ft*
- *Lateral guidance on final approach segment: half LOC scale deviation for precision approach or ± 5° on radial for conventional non precision approach or 0.15 NM for RNAV approaches*
- *Vertical path on final approach segment: half GS scale deviation or + 200/–0 ft for non precision approaches*
- *Altitude deviation at DA or MDA: 0 ft*
- *Speed 0/+10 kt*

Only small adjustments in pitch and/or heading are allowed to stay on track:

- *Maximum sink rate is 1000 ft per minute*
- *Maximum rate of descent adjustments are ±300 ft per minute from target rate*
- *Bank angles are no more than 15°*
- *Localizer guidance adjustments are done within heading bug width*
- *GS guidance adjustments must be within ±2° of pitch change*

All deviations must be called out by PM or PF (whoever identifies deviation first) using the following Call-outs:

"SPEED" "LOC" "GLIDE" "VERTICAL SPEED"

After immediate correction, PF must answer ***"CORRECTING …"***

Flight events	***Situation***	***PM call outs***	***PF orders***
1000 ft AAL IMC	*STABILIZED*	*"1000 FT, STABILIZED"(1)*	*"WE CONTINUE"*
	UNSTABILIZED	*"1000 FT, GO AROUND"(1)*	*"GO-AROUND, SET POWER, FLAPS ONE NOTCH"*
500 FT AAL VMC	*STABILIZED*	*"500 FT, STABILIZED" (1)*	*"WE CONTINUE"*
	UNSTABILIZED	*"500 FT, GO AROUND" (1)*	*"GO-AROUND, SET POWER, FLAPS ONE NOTCH"*
300 FT AAL CIRCLE-TO-LAND	*STABILIZED*	*"300 FT, STABILIZED" (1)*	*"WE CONTINUE"*
	UNSTABILIZED	*"300 FT, GO AROUND" (1)*	*"GO-AROUND, SET POWER, FLAPS ONE NOTCH"*

(1) This is read on the altimeter when passing 1000/ 500/ 300 ft Above Airport Level (AAL).

1.9.1.2 Procedure and Technique for Landing

The FCOM part 2, chapter 02, and section 12 (2.02.08) page 5 described procedure and technique for landing as follows:

<u>LANDING</u>

In order to minimize landing distance variation the following procedure is recommended:

- *Maintain standard final approach slope (3°) and final VAPP until 20 ft is called on radio altimeter.*
- *At« 20ft » call by PM, reduce to FI and flare visually as required.*

  Note: 20 ft leaves ample time for flare control from a standard 3° final slope.

  − *During this flare the airspeed will necessary decrease, leading to a touch down speed of 5 to 10 kt lower than the stabilized approach speed.*

The procedure also described:

In case of a significant bounce, a go around must be initiated.

1.9.1.3 Operation in Windy Conditions

The FCOM part 2, chapter 02, and section 08 (2.02.08) page 21 described the operation in windy conditions as follows:

Landing

The recommended landing flap configuration is the same as the standard landing flap setting, even with strong crosswind. Large flaps extension does not impair the controllability in any manner. Moreover minimizes the flare duration and allows a quicker speed decrease down to the taxi speed.

1.9.1.4 Final Approach Speed

The FCOM part 3, chapter 08, and section 02 (3.08.02) page 1 described the final approach speed as follows:

V_{APP} = VmHB + WIND FACTOR

Wind factor:

The highest of

- *1/3 of the reported head wind velocity*

  -or-

- *the gust in full*

with a maximum wind factor of 15 kt.

Wind factor is added to give extra margin against turbulence, risk of windshear etc...

FLAPS 30°

Weight (1000 kg)	*VmHB IAS limited by VMCL*	
	Normal conditions	*Icing conditions*
13	*95*	*95*
14	*95*	*95*
15	*95*	*97*
16	*95*	*100*
17	*96*	*104*
18	*99*	*107*
19	*102*	*110*
20	*105*	*114*
21	*108*	*117*
22	*111*	*120*
22.5	*113*	*122*
23	*115*	*124*

The QRH part 4, page 4.38 described the operation data for aircraft with calculated landing weight of 20 ton as follows:

Garuda Indonesia	OPS DATA **20 t**	4.38 NOV 14 | 001

	Speeds	Normal	Icing
NON LIMITING RWY TAKE-OFF (Flaps 15)	V1 = VR V2	105 110	114 118
FINAL TAKE OFF	VFTO	132 (Flaps 0)	122 (Flaps 15)
DRIFT DOWN	VmLB	132 (Flaps 0)	125 (Flaps 15)
MINI EN ROUTE			157 (Flaps 0)
FINAL APPROACH	VmHB (Flaps 30)	105	114
GO AROUND	VGA (Flaps 15)	117	118

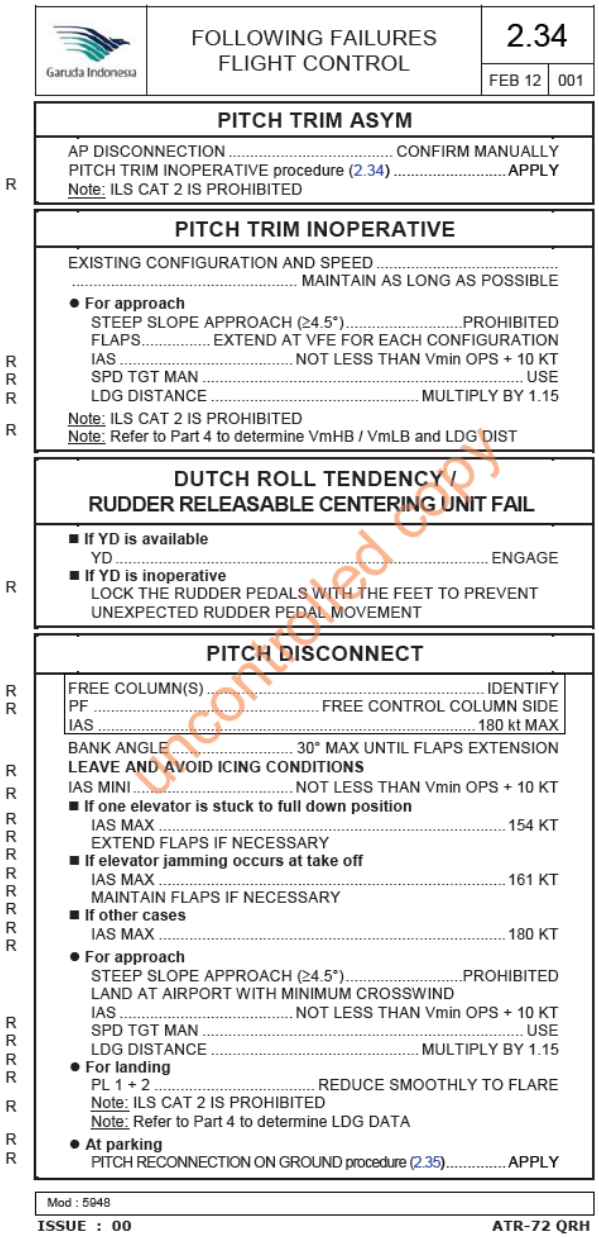
Precise that in the current situation and based on this information, there is no wind correction to apply.

1.9.1.5 Pitch Disconnect Procedure

The following QRH part 2 page 2.34 provided procedures for pitch disconnect.

Note:

- the text with box in the procedure correspond to pilot action performed by memory within a minimum period of time
- the "●" symbol highlights a precondition to apply an action, while the "■" symbol highlights the moment when an action is to be applied.



Garuda Indonesia

FOLLOWING FAILURES
FLIGHT CONTROL

2.34
FEB 12 | 001

PITCH TRIM ASYM

AP DISCONNECTION ..... CONFIRM MANUALLY
R PITCH TRIM INOPERATIVE procedure (2.34) ..... APPLY
Note: ILS CAT 2 IS PROHIBITED

PITCH TRIM INOPERATIVE

EXISTING CONFIGURATION AND SPEED .....
..... MAINTAIN AS LONG AS POSSIBLE

● **For approach**
STEEP SLOPE APPROACH (≥4.5°) ..... PROHIBITED
FLAPS ..... EXTEND AT VFE FOR EACH CONFIGURATION
R IAS ..... NOT LESS THAN Vmin OPS + 10 KT
R SPD TGT MAN ..... USE
R LDG DISTANCE ..... MULTIPLY BY 1.15

R Note: ILS CAT 2 IS PROHIBITED
Note: Refer to Part 4 to determine VmHB / VmLB and LDG DIST

DUTCH ROLL TENDENCY /
RUDDER RELEASABLE CENTERING UNIT FAIL

■ **If YD is available**
YD ..... ENGAGE
R ■ **If YD is inoperative**
LOCK THE RUDDER PEDALS WITH THE FEET TO PREVENT
UNEXPECTED RUDDER PEDAL MOVEMENT

PITCH DISCONNECT

R FREE COLUMN(S) ..... IDENTIFY
R PF ..... FREE CONTROL COLUMN SIDE
IAS ..... 180 kt MAX

BANK ANGLE ..... 30° MAX UNTIL FLAPS EXTENSION
R **LEAVE AND AVOID ICING CONDITIONS**
R IAS MINI ..... NOT LESS THAN Vmin OPS + 10 KT
R ■ **If one elevator is stuck to full down position**
R IAS MAX ..... 154 KT
R EXTEND FLAPS IF NECESSARY
R ■ **If elevator jamming occurs at take off**
R IAS MAX ..... 161 KT
R MAINTAIN FLAPS IF NECESSARY
R ■ **If other cases**
R IAS MAX ..... 180 KT

● **For approach**
STEEP SLOPE APPROACH (≥4.5°) ..... PROHIBITED
LAND AT AIRPORT WITH MINIMUM CROSSWIND
R IAS ..... NOT LESS THAN Vmin OPS + 10 KT
R SPD TGT MAN ..... USE
R LDG DISTANCE ..... MULTIPLY BY 1.15
R ● **For landing**
PL 1 + 2 ..... REDUCE SMOOTHLY TO FLARE
R Note: ILS CAT 2 IS PROHIBITED
Note: Refer to Part 4 to determine LDG DATA

R ● **At parking**
R PITCH RECONNECTION ON GROUND procedure (2.35) ..... APPLY

Mod : 5948

ISSUE : 00 ATR-72 QRH

1.9.1.6 Bounce Landing

The FCTM subchapter 03.01.04 described bounce landing procedure as follows:

4.1.1. Description

Bounce landing results from either too much speed or too high slope, or both of them, on final approach.

4.1.2. Defence

To avoid bounce landing, decide to go-around if the plane is not stabilized. Refer to 02.01.09. Stabilization policy for detailed stabilization criteria.

4.1.3 Procedure

- *Apply a immediate go-around*
- *Never try to land*
- *Never push the control column forward*

1.9.1.7 Go-around Procedures

The FCTM subchapter 02.02.19 described the go-around procedures as follows:

Flight events	PM	PF
DA/MDA +30	▶ CALL **"MINIMUM"**	
RUNWAY OR APPROACH LIGHTS NOT IN SIGHT OR ANY OTHER UNEXPECTED EVENTS	▶ DO FLAPS ..... 15° (25°) PL 1 & 2 ..... ADJUST TO GA TQ	▶ CALL & DO **"GO-AROUND, SET POWER, FLAPS ONE NOTCH"** GA PB ON PL ..... DEPRESS PITCH ..... ROTATE TO +8° NOSE UP PL 1 & 2 ..... ADVANCE TO RAMP CAVALRY CHARGE ..... CANCEL
FLAPS 15° (25°) INDICATED	▶ CALL **"POWER SET, FLAPS 15 (25)"**	
POSITIVE RATE	▶ CALL **"POSITIVE RATE"** ▶ DO & CALL LANDING GEAR ..... UP YAW DAMPER ..... ENGAGE Check green arrows illuminated. TAXI & T.O. LIGHTS ..... OFF FGCP: PF NAV SOURCE ..... SET ON FMS FGCP: NAV MODE ..... SET SPEED BUG ..... CHECK VGA FGCP: IAS ..... SET **"FMS, NAV, IAS SET"**	▶ COMMAND **"GEAR UP, FMS, NAV, IAS"** [1] **NOTE:** For ATR 42, when using VGA flaps 25, 1,1 Vmca values are higher than in the table in 4.64, which is for VGA flaps 15.
ALL LDG GEAR LIGHTS EXTINGUISHED	▶ CALL **"GEAR UP"**	▶ CALL **"CHECK"** ▶ DO & CALL FMA MODE ..... CHECK AND ANNOUNCE **"LNAV,IAS,SPEED XXX"** Read the FMA.
PASSING ACCELERATION ALTITUDE (mini 1000 ft AAL or higher if requested)	▶ CALL **"ACCELERATION ALTITUDE"** ▶ DO & CALL PL 1 & 2 ..... CHECK IN THE NOTCH PWR MGT ..... CLB TQ / NP ..... CHECK CLIMB SETTING **"CLIMB PROCEDURE COMPLETE"** ▶ CALL **"CHECK"**	▶ DO PL 1 & 2 ..... RETARD TO THE NOTCH ▶ COMMAND **"CLIMB PROCEDURE"** ▶ DO & CALL FMA ..... CHECK AND ANNOUNCE **"SPEED 170 (160)"**
	Continue with "Reaching white or icing bug" event of After Take-off procedure.	

[1] If FMS missed approach is not suitable: use HDG mode (the call-out becomes: **"GEAR UP, HDG SEL, IAS"**).

1.9.1.8 Crew Resource Management

The Garuda Indonesia BOM subchapter 1.4.2 described Crew Resource Management as follows:

1.4.2.1 Principles

One principle, thoroughly understood, can help solve many problems.

Crewmembers should think deeply about this idea, particularly in light of the Garuda Indonesia CRM principles.

(a). Safety is my duty.

(b). No one is perfect, everybody makes mistakes.

(c). CRM is the way to correct mistakes.

(d). Teamwork is the result of cooperation, not competition.

(e). It is what is right, not who is right, that matters.

(f). Do first things first.

(g). Encourage open discussion

(h). Be self-critical and self-correcting.

(i). Good EQ (emotional intelligence) enhances crew performance.

(j). When in doubt, check it out.

(k). Don't rush! Stay cool! Think it out!

(l). Take care of each other.

1.4.2.2 CRM Philosophy

(a). CRM is the effective use of all available resources – people, equipment, and information – to achieve the highest possible levels of safety and efficiency.

(b). CRM ability and a facility for teamwork shall be selection criteria for all crewmembers.

(c). CRM is based on the principle of synergy (teamwork) functioning within a cultural environment that supports and encourages human growth and commitment.

(d). CRM involves the continuous improvement of procedures, attitudes, and behaviours, applying human factor concepts to enhance individual and crew performance.

(e). CRM training is focused on specific teamwork, communication, decision-making, and workload management behaviours that have been proven to enhance personal effectiveness and job satisfaction. As a result of CRM training, employees will be better able to function as members of self-criticizing, self-correcting teams.

1.4.2.3 CRM Policy

(a). CRM principles and behaviours must be fully integrated into all aspects of flight operations training.

(b). Periodic CRM assessments and performance feedback will be conducted for all flight crewmembers, flight attendants, and dispatchers, in order to assure effective teamwork.

(c). Flight schedules for crewmembers will be prepared and administered to assure adequate rest and safe crew pairings (i.e., new captains will not be scheduled with new first officers unless a DGCP/CCP or FIA is part of the crew).

(d). The PIC shall be responsible for establishing an environment of trust and mutual-commitment prior to each flight, encouraging his fellow crewmembers to speak up and to accept mutual responsibility for the safety and well-being of the passengers, cargo, and equipment entrusted to them. "What's right, not who's right" shall be the motto of all members of the Garuda Indonesia operating team.

(e). Each Garuda Indonesia crewmember shall be responsible for notifying the pilot-in-command of any condition or circumstance that might endanger the aircraft or impair the performance of any flight crewmember.

(f). CRM skills and performance will be periodically evaluated at all organizational levels to provide regular feedback and ensure continuous improvement.

(g). CRM skills and performance will be a factor in the promotion of all Garuda Indonesia crewmembers.

After the occurrence, the BOM was replaced with several Operation Manuals (OMs). The latest OM-part A subchapter 11.1.1 described the Crew Resource Management as follows:

One of the basic fundamental of the Crew Resource Management is that each crewmember must be able to supplement or act as a back-up for the other crewmember. Proper adherence to Standard Operating Procedures and Standard Call Outs are an essential element of well managed Flight Deck.

...

To enable subordinate flight crewmembers to intervene effectively, a structured intervention models using a precise language shall be used to successfully cope with the extremely rare but potentially lethal performance break down of the Captain.

...

The following are the recommended procedural steps and progressions of inquiries which considered being effective to be used by all subordinates:

Step 1. Probing for better understanding;

- *I.e. statement;*

  "Captain, I need to understand why we are flying like this."

Step 2. Alerting Captain of the anomalies;

- *I.e. statement;*

  "Captain, it appears to me that we are on a course that is drastically reducing our safety margins and is contrary to both your briefing and to company's SOP."

Step 3. Challenging suitability of present strategy;

- *I.e. statement;*

  "Captain, you are placing the passengers and aircraft in irreversible and immediate danger. You must immediately choose a course of action that will reduce our unacceptability high risk levels."

Step 4. Emergency warning of critical and immediate dangers.

- *I.e. statement;*

  "Captain, if you don't immediately increase our safety margins, it is my duty and responsibility to immediately take over control of the airplane."

1.9.1.9 Pilot Flying and Monitoring Task

The BOM subchapter 4.1.1.05 described the flying task as follows:

Pilot Flying

One of the pilots shall have full access to the flight control and maintain constant vigilance during flight.

Pilot Monitoring

The pilot duties, who is performing tasks during flight time in support of the pilot flying.

Command and selections given by Pilot Flying, shall be acknowledged and carried out by pilot monitoring.

Such duties of PM are Check list task sharing, ATC communications and administrative duties (filling landing data card etc.).

1.9.1.10 Accident and Incident Handling

The BOM subchapter 4.1.1.17 described flight crew must pull the Circuit Breaker (CB) of Cockpit Voice Recorder (CVR) following ground incident or accident as follows:

- *Overweight / Heavy / Hard Landing;*
- *Tail Strike during landing;*
- *High Speed Rejected Take Off;*
- *Runway / Taxiway excursion (Incursion);*
- *Tire Blown out / Failure due to brake overheat;*
- *Unscheduled stop due to airworthiness degradation (AOG);*
- *Any events incurring significant structural damage to the aircraft on the ground (as caused by others not mentioned above, if any).*
- *Any other event that would require the CVR data for investigation purposes (Landing due to: Flight-crew incapacitation, unlawful interference, etc.)*

The BOM subchapter 6.2 stated procedure to handle accident and other occurrence of flight operation. The subchapter 6.2.2 described serious incident as follows:

An incident involving circumstances indicating that an accident nearly occurred. The difference between an accident and a serious incident lies only in the result.

The definition of serious incident in the BOM did not include the list example of serious incident mentioned in the CASR part 830. However, excursion event from paved surface during taxi, takeoff or landing was classified as operational incident.

After the occurrence, the definition of serious incident had been amended on the Operation Manual Part A (OM-part A) subchapter 23.2.2 as follows:

> *An incident involving circumstances indicating that there was a high probability of an accident and associated with the operation of an aircraft which takes place between the times any person boards the aircraft with the intention of flight until such time as all such persons have disembarked.*

The serious incident definition on the OM-part A above also mentioned that takeoff or landing incidents such as undershooting, overrunning or running off the side of runways, were included as serious incident. The definition of operational incident which included excursion event from paved surface during taxi, takeoff or landing had been deleted.

The BOM subchapter 6.2.3 described requirement reporting of accident and occurrence during flight operation as follows:

> *6.2.3.1 GENERAL*
>
> *It is a legal requirement that all events (accidents and incidents) shall be reported to the Authority within 72 hours of the event. It can be very important in several cases to report as soon as possible (ACARS, Fax or SITA telex) in order to preserve significant data held with different parties about the flight concerned.*
>
> *…*
>
> *The Pilot in Command is required to notify the nearest authority, by the quickest means available:*
>
> - *In the event of any accident or serious incident resulting in injury, death, or substantial damage to aircraft.*
> - *In the event of any emergency situation that necessitated action in violation of local regulation and/or procedures.*
> - *For submitting, if required by the state of occurrence, a report to the appropriate Local Authority and also to the Indonesia DGCA.*
>
> *6.2.3.2 URGENT INFORMATION*
>
> *The PIC shall ensure that completed reports are kept on board the aircraft until its return to CGK*[9]*. Consequently, in the event of accident, incident or any other significant deviation from the normal routine which requires immediate action by the responsible operational or technical departments at CGK, valuable time is lost.*
>
> *During flight, the PIC shall consider to inform concerned parties before arrival, in order to obtain full cooperation in handling such event once the aircraft landed.*
>
> *To expedite handling in such cases all pertinent details must be sent to flight dispatch as soon as possible by telephone, ACARS, VHF/HF radio, fax or telex.*
>
> *Having completed any such message does not change the requirement to complete the specified reporting procedure.*

9 The CGK in the BOM referred to Soekarno-Hatta International Airport (WIII), Jakarta.

…

b. Hazardous Flight Condition

The PIC shall report any urgent information concerning hazardous flight condition (birds or bird strikes, obstacles, meteorological phenomena, irregularities of ground and navigational facilities, etc.) to the appropriate ATC facility without delay.

6.2.3.6 OPERATIONAL INCIDENTS

Reporting of Operational Incident:

- *If technical aspects are involved, refer to BOM 6.2.3.5*
- *If ATC aspects involved, refer to BOM 6.2.3.4*
- *If applicable inform Flight Dispatch / OCC by ACARS, VHF or HF radio. If this is not feasible, inform as soon as after landing.*
- *An ASR*[10] *must be filed.*

The BOM subchapter 6.2.5 provided guidelines for crew when experienced accident or incident during flight operation, which required crew to notify the company using several available means. After that, if necessary, the associated flight recorders are preserved and retained in safe custody. In regards with report, PIC must fill out an ASR within 72 hours which then amended within 24 hours.

1.9.2 Serious Incident within Indonesia

According to the Aviation Law Number 1 of 2009 and Government Decree Number 62 of 2013 described that KNKT has the responsibility to conduct investigation on serious incident of Indonesia civil aircraft occurred within and outside the territory of Republic of Indonesia.

The definition of serious incident is described in the Civil Aviation Safety Regulation (CASR) part 830 subpart 830.2 as follows:

> *An incident involving circumstances indicating that there was a high probability of an accident and associated with the operation of an aircraft which, in the case of a manned aircraft, takes place between the time any person boards the aircraft with the intention of flight until such time as all such persons have disembarked, or in the case of an unmanned aircraft, takes place between the time the aircraft is ready to move with the purpose of flight until such time as it comes to rest at the end of the flight and the primary propulsion system is shut down.*

The Appendix B of the CASR Part 830 described that take-off or landing incidents such as under-shooting, overrunning or running off the side of runways is included in the list examples of serious incident.

In the case of Indonesia civil aircraft experienced serious incident, the CASR Part 830 subpart 830.06 requires person, organization or enterprise engaged in or offering to engage in an aircraft operation, with minimum delay and by the most suitable and quickest means available, must report to the KNKT. The reporting of serious incident then enables the KNKT to initiate and conduct investigation as soon as possible, includes to protect the evidence and to maintain safe custody of the aircraft and its contents with purpose of avoiding loss of useful information.

10 The ASR in the BOM referred to Air Safety Report.

1.10 Additional Information

1.10.1 PK-GAF Runway Excursion Reporting

After aircraft stopped and passenger disembarked at Labuan Bajo, the pilots reported to the engineer that they conducted go around at Ende due to weather and experienced pitch disconnected. When walked around the aircraft, the engineer noticed several grass and dirt on the right side of the aircraft. The PIC advised the engineer that they bounced several times at Ende without mentioned experiencing runway excursion.

The engineer checked the Multi-purpose Control Display Unit (MCDU) and noticed that the engine parameter was on limit included the vertical acceleration of 2 g (the limit was 2.4 g). The PIC asked the engineer to reconnect the pitch referred to Quick Reference Handbook (QRH).

After conducted the maintenance action, the engineer reported the occurrence to Denpasar Maintenance Quality (MQ) to get approval to release the aircraft for fly. After received the approval, the aircraft continued the flight to Bali and landed safely about 0905 UTC. The pilots reported the occurrence to the chief pilot without mentioned that the aircraft experienced runway excursion. At 1130 UTC, the aircraft departed from Bali to continue the flight schedule by another set crewmember and landed safely at Lombok.

The DGCA received a report from the AirNav Indonesia, and confirmed to the Safety Department of Garuda Indonesia related to runway excursion occurrence at Ende. Until the DGCA confirmed to the Safety Department, the pilot had not reported the occurrence to the Safety Department. The Safety Department seek information of the occurrence and after it had been confirmed, the aircraft was grounded. Thereafter the Safety Department reported the occurrence to the KNKT.

1.11 Useful or Effective Investigation Techniques

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

2 ANALYSIS

Prior the departure there was no report or record of aircraft system abnormality and the investigation determined that the aircraft airworthiness serviceability was not an issue on this occurrence. Therefore, the analysis will discuss the following issues:

- Landing technique;
- Pilot coordination.

2.1 Landing Technique

Based on the FCOM, the final approach speed was Vref (V_{mHB}), with maximum correction of 15 knots for gusts. For the estimated landing weight during the occurrence, the V_{mHB} was 105 knots. Therefore, the maximum possible approach speed was 120 knots.

The FDR recorded that during the final approach, the aircraft speed was relatively high. After the aircraft passed the atoll and passed altitude of 358 feet, the pilot pitched down attitude while the engine power was maintained, these resulted in the aircraft speed increased. The engine power was reduced when the aircraft passed altitude of 187 feet. The aircraft speed reached the highest value of 133 knots below 50 feet Radio Altitude (RA), and IAS decreased to 128 knots prior to the first touchdown.

The Visual Maneuvering Chart of runway 27 Ende published by the Garuda Indonesia that had been approved by the DGCA did not mention the procedure to manage the flight in avoiding the atoll. The absence of procedure for specific approach condition may trigger the pilot to improvise the approach based on their knowledge, skill and experience that may deviate from the standard.

The FDR recorded that when the aircraft passed altitude of 26 feet, the aircraft was on nose down attitude with rate of descend was about 1,000 feet/minute. At this time, pitch UP input from the SIC was recorded. One second after, when passing an altitude of 11 feet, there was pitch input DOWN from PIC and input UP from the SIC, both opposite inputs were maintained, and the pitch angle increased up to +1° about 3 feet then decreasing about -4° at first touchdown.

The pitch input UP from the SIC as PM might indicate that the SIC intended to correct the aircraft profile in accordance with the procedure and landing technique described in the FCOM that at 20 feet, the flare out shall be initiated by visual reference. This effort might be based on experience that the SIC often assisted the PIC during the landing approach at Ende.

After that, when the aircraft passed altitude of 3 feet, the pitch input DOWN from the PIC and the pitch input UP from the SIC was still maintained. The pitch input DOWN resulted in the aircraft on nose down attitude again which most likely the nose wheel touched the runway first. One second later, the weight on wheel sensor recorded aircraft on ground as the sensor located on the main wheels. The speed recorded 128 knots and the vertical acceleration was 1.6 G. Landing with pitch down attitude was not in accordance with the procedure and landing technique described in the FCOM.

Based on the BOM and FCTM, one of stabilized approach criteria required the aircraft speed and pitch in accordance with the actual condition required by the landing procedure. The BOM stated that the maximum speed was Vref+20 in this case not more than 125 knots while the FCTM stated that the maximum approach speed was V_{mHB} + 15 knots and in this case not more than 120 knots. The highest speed recorded on the FDR was 133 knots. For a unique approach procedure or abnormal condition requiring a deviation from the one criteria of a stabilized approach requires special briefing or training. The approach would be considered stabilize when in accordance to the briefing. As there was no special briefing or training had been conducted, and the approach did not meet the criteria of stabilize approach, both BOM and FCTM stated that go around must be initiated.

The FCTM stated that bounce landing was resulted from either too much speed or too high slope, or both of them. The FDR recorded that at 3 feet RA, the speed was 130 knots and the pitch angle was about +1° then the dual opposite input on control column led the pitch angle to decreased down about -4° at runway contact.

Continuation of an unstabilized approach with too much speed and nose down attitude resulted in the nose wheel touched the runway first, and with the roll about 3° to the left made the aircraft bounce to the left of runway centerline.

Based on the FCTM, if a bounce landing occurred, pilot must apply an immediate go-around and never try to land nor push the control column forward.

After passed 3 feet RA prior to the first bounce until the second bounce, the TQs remained at 0% and started to increase two second after the second bounce. Propose: Prior to the first touchdown, the TQ set to 0% and remained until two seconds after second bounce. This indicated that the go around was not conducted immediately after the first bounce, resulted in the aircraft made second touchdown on the left shoulder of the runway.

The approach speed was higher than the requirement considered as un-stabilized approach and required go around. The high approach speed combined with the high slope approach resulted in the bounce landing which required immediate go around.

2.2 Pilot Coordination

The FDR recorded that after passed 26 feet, when the aircraft was on nose down attitude, pitch UP input was made by the SIC. One second later, the pitch DOWN input recorded made by the PIC and input UP from the SIC remained. The different pitch input continued and after the second bounce, the master warning light illuminated triggered by “Pitch Disconnect” warning light.

The pitch input by the SIC was conducted without advising the PIC as PF which made the PF did not aware of the different input. The continuation of different pitch input between left and right control columns uncoupled the elevator and triggered the “Pitch Disconnect” warning light.

Based on BOM, the PF had full access to the flight control while the PM performed checklist task sharing, communication to the air traffic service and administrative duties.

The SIC provided input to the control as he assumed that the aircraft was not on proper condition for landing while the speed was 133 knots, the rate of descend was 1,000 feet/minute, and pitch angle was -3.3° (pitch down). Based on the previous experience when flying with the PIC to Ende, the SIC assumed that the PIC seemed not comfortable to fly to Ende due to the terrain condition and the SIC was often assisted the PIC during the landing approach at Ende. The SIC profiled the PIC as person that difficult to be assisted. These assumptions made the SIC voluntarily assisted the PIC without advising the PIC who was the PF.

Being unaware of the SIC input made the PIC assumed that he was the only one provided control to the aircraft. However, the aircraft might have been moved in a way that was not as expected by the PIC as another input to the control was provided by the SIC. Both pilots provided input to the control column also resulted in the pitch disconnected and triggered the master warning.

The last recurrent training assessment and the proficiency check result for both pilots were satisfactory without any remarks. However, the absence coordination from the PM to the PF when providing pitch input indicated that the Crew Resource Management (CRM) described in the BOM was not implemented properly. In addition, the analysis on subchapter 2.1 also indicated that the stabilized approach and bounce landing procedure described in the company procedure was not implemented properly. These might be an indication that the recurrent training and proficiency check were not sufficient to ensure the pilots implements the company procedures.

3 CONCLUSIONS

3.1 Findings

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

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

1. The aircraft had valid Certificate of Airworthiness (C of A) and Certificate of Registration (C of R). Prior to the departure, there was no record or report of aircraft system abnormality.
2. Both pilots held valid licenses and qualified as ATR 72-600 pilot, and held valid first-class medical certificates without any remarks.
3. During the flight to Ende, the PIC acted as Pilot Flying (PF) while the SIC acted as Pilot Monitoring (PM).
4. When the aircraft turning on final runway 27, the pilot received information of wind direction which was from 150° with velocity of 18 knots and coherent with the wind shock indication.
5. Based on the Flight Crew Operation Manual (FCOM), the recommended approach speed was Vref (V_{mHB}), with a maximum possible correction of 15 knots for gusts. For the estimated landing weight during the occurrence the V_{mHB} was 105 knots therefore, the maximum possible approach speed was 120 knots.
6. The Visual Maneuvering Chart of runway 27 Ende published by the Garuda Indonesia that had been approved by the DGCA did not mention the procedure to manage the flight in avoiding the atoll. The absence of procedure for specific approach condition may trigger the pilot to improvise the approach based on their knowledge, skill and experience that may deviate from the standard.
7. During the final approach, the aircraft speed was relatively high. After the aircraft passed the atoll and passed altitude of 358 feet, the pilot pitched down attitude while the engine power was maintained, these resulted in the aircraft speed increased.
8. The aircraft speed reached the highest value of 133 knots when passed the altitude of 26 feet, and then continued decreasing to 128 knots on the first touched down. The data indicated that the speed exceeded the maximum approach speed.
9. When the aircraft passed altitude of 26 feet, the aircraft was on nose down attitude with rate of descend was about 1,000 feet/minute. At this time pitch UP input from the SIC was recorded and the aircraft pitch changed to pitch up attitude for one second then returned to pitch down attitude again as there was pitch input DOWN from the PIC.

10. Based on the SIC experience of flying with the PIC to Ende and the existing condition, the SIC voluntarily assisted the PIC without advising the PIC as PF. This SIC input to the control without advising to the PIC who was the PF indicated that the Crew Resource Management (CRM) described in the BOM was not implemented properly.
11. The dual opposite inputs from the PIC and SIC resulted in uncoupling the elevators through the pitch uncoupling mechanism and triggered the "Pitch Disconnect" warning. Activation of the Pitch Uncoupling Mechanism allowed the SIC to regain pitch authority of the aircraft.
12. When the aircraft passed altitude of 3 feet prior to the first touchdown, the aircraft was on nose up attitude with pitch angle of +1.1. The dual inputs on the control column resulted in a nose down order and most likely the nose wheel touched the runway first. One second later, the main wheel touched the runway at aircraft speed recorded 128 knots and the vertical acceleration was 1.6 G.
13. The approach speed was higher than the requirement considered as unstabilized approach and required go around as stated in both BOM and FCTM.
14. The continuation of unstabilized approach with too much speed combined and nose down attitude and with the roll about 3° to the left resulted in the aircraft bounced to the left of the runway centerline.
15. Prior to the first touchdown, the TQ set to 0% and remained until two seconds after second bounce. This indicated that the go around was not conducted immediately after the first bounce.
16. The absence of immediate go around after the first bounce resulted in the aircraft made second touched down on the left shoulder of the runway.
17. The last recurrent training assessment and the proficiency check result for both pilots were satisfactory without any remarks. However, the occurrence flight indicated that the requirement of stabilize approach, bounce landing, and the Crew Resource Management (CRM) had not been implemented properly. These might be an indication that the recurrent training and proficiency check were not sufficient to ensure the pilot implements the company procedures.
18. After completed the go-around procedure, the PIC was aware of the severity of the occurrence. The PIC then assessed the severity by asking the ACO to check the possibility of debris leftover on the runway or left shoulder and the flight attendant to check the passenger condition as result of aircraft bounced.
19. The PIC advised the engineer and the chief pilot that they bounced several times at Ende without mentioned experiencing runway excursion. The information of runway excursion that classified as serious incident was also not immediately reported to the Safety Department, resulted in the serious incident was not timely handled and the CVR overwritten.
20. The BOM required pilot to pull the Circuit Breaker (CB) of Cockpit Voice Recorder (CVR) following runway or taxiway excursion, and the crew must notify the company using the available means.

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:

- Continuation of an unstabilized approach with high approach speed, nose down attitude and with the roll about 3° to the left resulted in the aircraft bounced to the left of the runway centerline.
- The absence of immediate go around after the first bounce resulted in the aircraft made second touched down on the left shoulder of the runway.

4 SAFETY ACTION

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

4.1 Garuda Indonesia

On 23 October 2015, the Flight Operation Division issued notice all ATR 72-600 pilots to reemphasize several existing procedures as follows:

- Ende airport requirement – *only using one way for Take Off RW 09 and Landing RW 27 and Captain Only for Take Off and Landing*;
- Approach stability criteria (BOM 4.4.4.07 and FCTM FLT 02.01.10);
- Go-around Procedure (FCTM FLT 02.02.19);
- Pitch Disconnected Procedure (FCOM 2.02.06 P2 and QRH 2.34).

4.2 ATR

The ATR has developed materials to support the operators in preventing landings after unstabilized approaches and bounce at landing occurrences:

- "Watch you speed in approach" presentation was performed during ATR 2016 Safety Conference in Bangkok and is available both on ATR Active Portal and on ATR Flight Safety Website;
- FCTM – ABNORMAL SITUATIONS – 64 BOUNCE LANDING has been updated;
- Flight Simulators Package for Upset Prevention and Recovery Training (UPRT) includes new module for bounce landing, as described in FOIM 2019-09 Issue1.

5 SAFETY RECOMMENDATIONS

The KNKT acknowledged the safety actions taken by the Garuda Indonesia and considered relevant to address the safety issue identified in this report. However, there were safety issue remains to be considered. Therefore, the KNKT issues safety recommendations to the Garuda Indonesia to address safety issues identified in this report.

- **04.O-2015-23.01**

  After completed the go-around procedure, the PIC was aware of the severity of the occurrence. The PIC then assessed the severity by asking the ACO to check the possibility of debris leftover on the runway or left shoulder and the flight attendant to check the passenger condition as result of aircraft bounced. After arrived at Labuan Bajo, the pilot reported to the engineer several bounces while landing at Ende without mentioning the runway excursion.

  When walked around the aircraft, the engineer noticed several grass and dirt on the right side of the aircraft. The engineer and the pilot did not report the occurrence to the Safety Department until the DGCA confirming the occurrence.

  The BOM required pilot to pull the Circuit Breaker (CB) of Cockpit Voice Recorder (CVR) following runway or taxiway excursion, and the crew must notify the company using the available means.

  The occurrence flight reported to the KNKT after the aircraft had flown for two sectors flight resulted in the CVR data was overwritten with the subsequent flights conversation.

  Therefore, the KNKT recommend the Garuda Indonesia to review the implementation of serious incident handling to ensure the serious incident is reported as soon as possible and to prevent the loss of useful information for the investigation.

- **04.O-2015-23.02**

  The FDR recorded that after passed the atoll on short final runway 27, the pilot pitched down the aircraft and resulted in increasing approach speed.

  The Visual Maneuvering Chart of runway 27 Ende published by the Garuda Indonesia did not mention the procedure to manage the flight in avoiding the atoll. The absence of procedure for specific approach condition may trigger the pilot to improvise the approach based on their knowledge, skill and experience that may deviate from the standard.

  Therefore, the KNKT recommend the Garuda Indonesia to review the Visual Maneuvering Chart of runway 27 Ende to prevent pilot improvisation that may deviate from standard.

- **04.O-2015-23.03**

  The SIC voluntarily assisted the PIC without advising the PIC as PF as result from his assumptions. Being unaware of the SIC input made the PIC assumed that he was the only one provided control to the aircraft. However, the aircraft might have been moved in a way that was not as expected by the PIC as another input to the control was provided by the SIC.

  The different pitch input from the PIC and SIC remained and the continuation of different pitch input between left and right control columns resulted in uncoupled the elevator and triggered the "Pitch Disconnect" warning light.

  The last recurrent training assessment and the proficiency check result for both pilots were satisfactory without any remarks. However, the absence coordination from the PM to the PF when providing pitch input indicated that the Crew Resource Management (CRM) described in the BOM was not implemented properly. These might be an indication that the recurrent training and proficiency check were not sufficient to ensure the pilots implement the company procedures.

  Therefore, the KNKT recommend the Garuda Indonesia to review the training method to ensure the Crew Resource Management is implemented in accordance with the company procedure.

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