KOMITE NASIONAL KESELAMATAN TRANSPORTASI
REPUBLIC OF INDONESIA

PRELIMINARY

KNKT.17.02.06.04

Aircraft Serious Incident Investigation Report

PT. Garuda Indonesia

Boeing 737-800; PK-GNK

Adisutjipto International Airport, Yogyakarta

Republic of Indonesia

1 February 2017

2017

This preliminary investigation report was produced by the Komite Nasional Keselamatan Transportasi (KNKT), Transportation Building, 3rd Floor, Jalan Medan Merdeka Timur No. 5 Jakarta 10110, Indonesia.

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

The preliminary report consists of factual information collected until the preliminary report published. This report will not include analysis and conclusion.

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ABBREVIATIONS AND DEFINITIONS

AC	:	Advisory Circular
AFTN	:	Aeronautical Fixed Telecommunication Network (AFTN)
AIP	:	Aeronautical Information Publication
AM	:	Aerodome Manual
AMC	:	Apron Movement Control
AOC	:	Aircraft Operator Certificate
ARFF	:	Airport Rescue & Fire Fighting
ATC	:	Air Traffic Control
ATIS	:	Aerodrome Terminal Information Services
ATPL	:	Airline Transport Pilot License
ATS	:	Air Traffic Services
AWOS	:	Automatic Weather Observation System
CASR	:	Civil Aviation Safety Regulation
C of A	:	Certificate of Airworthiness
C of R	:	Certificate of Registration
CPL	:	Commercial Pilot License
CVR	:	Cockpit Voice Recorder
DGCA	:	Directorate General of Civil Aviation
FDR	:	Flight Data Recorder
ILS	:	Instrument Landing System
KNKT	:	*Komite Nasional Keselamatan Transportasi* (National Transportation Safety Committee)
LT	:	Local Time
MOS	:	Manual Of Standard
OLS	:	Obstacle Limitation Surface
PAPI	:	Precision Approach Path Indicator
PF	:	Pilot Flying
PIC	:	Pilot in Command
PM	:	Pilot Monitoring
SI	:	Staff Instruction
SIC	:	Second in Command
SOP	:	Standard Operating Procedures
SSDFDR	:	Solid State Digital Flight Data Recorder
SSMCVR	:	Solid State Memory Cockpit Voice Recorder
UTC	:	Universal Time Coordinated

SYNOPSIS

On 1 February 2017, a B 737-800 aircraft registered PK-GNK was being operated by PT. Garuda Indonesia as a scheduled passenger flight from Soekarno-Hatta International Airport (WIII), Jakarta to Adisutjipto International Airport (WAHH), Yogyakarta with flight number GA 258. On board the aircraft were two pilots, five flight attendants and 119 passengers consisted of 115 adults and four infants.

At 1742 LT (1142 UTC), the aircraft departed Soekarno-Hatta International Airport and the Pilot in Command (PIC) acted as Pilot Flying (PF) and the Second in Command (SIC) acted as Pilot Monitoring (PM). There was no report or record of aircraft technical system abnormality prior to the departure until the time of occurrence.

During landing at Adisutjipto International Airport at 1250 UTC, the weather condition was slight rain, the aircraft touchdown runway 09 then veered to the left and stopped on the left shoulder of runway 09 at about 1,600 meters from begining runway 09 and 20 meters from the runway edge.

There was no injury to person and no damage to the aircraft.

The investigation is continuing and will include details information of flight recorders, related procedures, human factors issue, flight technique and aircraft system.

Prior to issue this preliminary report, Komite Nasional Keselamatan Transportasi (KNKT) has been informed safety actions taken by PT. Garuda Indonesia.

KNKT issued safety recommendation to PT. Angkasa Pura 1 Branch Office Adisutjipto International Airport, Yogyakarta to address the identified safety issues.

1 FACTUAL INFORMATION

1.1 History of the Flight

On 1 February 2017, a Boeing 737-800 aircraft registered PK-GNK was being operated by PT. Garuda Indonesia as a scheduled passenger flight from Soekarno-Hatta International Airport (WIII), Jakarta[1] to Adisutjipto International Airport (WAHH), Yogyakarta[2] with flight number GA 258. On board the aircraft were two pilots, five flight attendants and 119 passengers consisted of 115 adults and four infants.

In this flight Pilot in Command (PIC) acted as Pilot Flying (PF) and the Second in Command (SIC) acted as Pilot Monitoring (PM). There was no report or record of aircraft technical system abnormality prior to the departure until the time of occurrence.

At 1742 LT (1142 UTC[3]), the aircraft departed from Jakarta, until commencing approach was uneventful.

At 1243 UTC, Yogyakarta approach controller (approach controller) instructed the pilot to fly heading 280° for vectoring Instrument Landing System (ILS) runway 09 and acknowledged by the pilot. A few second later, the approach controller instructed to continue the right turn to fly heading 030° and issued clearance to follow ILS approach runway 09.

At 1245 UTC, the approach controller revised the instruction to maintain 050° and instructed to reduce the speed due to traffic. One minute later the pilot advised that the aircraft has established the ILS localizer and the approach controller instructed to contact Yogyakarta tower controller (tower controller).

At 1247 UTC, the pilot advised tower controller that the aircraft has established the ILS localizer and the tower controller informed that the surface wind direction was 230° with velocity of 7 knots, QNH was 1,010 mbs and instructed the pilot to report when the runway 09 has in sighted.

At 1249 UTC, and at about 1000 feet, the pilot advised the tower controller that the runway was in sight and the tower controller issued a landing clearance.

At about 1250 UTC, the aircraft touchdown and slightly on the right of runway centreline 09, and when approached taxiway N2 while applying the reverse thrusts, the aircraft veered to the left and stopped on the left shoulder of runway 09 at about 1,600 meters from begining runway 09 and 20 meters from the runway edge. The tower controller activated the crash bell then informed the Airport Rescue and Fire Fighting (ARFF) that there was an aircraft veered of runway 09 and stopped near the taxiway N2.

At 1252 UTC, the pilot asked the tower controller whether there was fire observed from the tower and was responded by other pilot of an aircraft that was pushing back near the occurrence location, and informing that there was no fire observed around

1 Soekarno-Hatta International Airport (WIII), Jakarta will be named as Jakarta for the purpose of this report.

2 Adisutjipto International Airport (WAHH), Yogyakarta will be named as Yogyakarta for the purpose of this report.

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

the aircraft and also was confirmed by the tower controller. At about the same time, the ARFF fire truck, ambulance and car arrived to the the occurrence location and prepared to spray the fire extinguisher.

Passenger evacuation completed at approximately 50 minutes after the aircraft stopped.

No one was injured and no damage to the aircraft in this serious incident.

Figure 1: The wheel marks on the shoulder and aircraft condition after stopped

1.2 Personnel Information

1.2.1 Pilot in Command

The pilot was 28 years old, joined the company since 2009 and held a valid Airline Transport Pilot License (ATPL). The medical certificate was first class that valid up to 25 July 2017 without any medical limitation.

The PIC qualified as a Boeing 737-800 aircraft pilot with flying experiences as follows:

Total hours	:	6,182 hours 21 minutes
Total on type	:	4,482 hours 32 minutes
Last 90 days	:	265 hours 43 minutes
Last 60 days	:	166 hours 2 minutes
Last 24 hours	:	4 hours 2 minutes
This flight	:	1 hour 34 minutes

The PIC had performed his last last line check on 14 January 2017 and last proficiency check on 14 December 2016.

1.2.2 Second in Command

The second in command was 23 years old, joined company since 2012 and held a valid Commercial Pilot License (CPL). The medical certificate was first class that valid up to 28 April 2017 without any medical limitation.

The SIC qualified as a Boeing 737-800 aircraft pilot with flying experiences as follows:

Total on type	:	2,217 hours 19 minutes
Last 90 days	:	248 hours 50 minutes
Last 60 days	:	168 hours 57 minutes
Last 24 hours	:	1 hour 34 minutes
This flight	:	1 hour 34 minutes

The SIC had performed his last last line check on 4 January 2015 and last proficiency check on 4 September 2016.

1.2.3 Flight Attendant

All flight attendants on this flight held valid certificate and medical licenses.

1.3 Aircraft and Engine Information

The aircraft was manufactured in United States of America by Boeing Company in 2014 with serial number 41798 and the type/model was B737-8UK. The aircraft registered PK-GNK and had valid Certificate of Airworthiness (C of A) and Certificate of Registration (C of R).

The engine of the aircraft was manufactured by CFM International in United States of America with type/model of CFM56-7B26E, the engine one had S/N 660246 engine two had S/N 660263

The total flight hour and cycle for both airframe and engines were 7,114 hours and 4,662 cycles.

1.4 Meteorological Information

The meteorological report in Yogyakarta was provided by the Indonesia Air Force Meteorological Unit utilizing visual observation and Automatic Weather Observation System (AWOS). The report was disseminated to the users through Aerodrome Terminal Information Services (ATIS) and Aeronautical Fixed Telecommunication Network (AFTN) at 30 minutes intervals or when a significant change occurs. The AWOS monitor display was located in the Air Force Meteorological Unit office and there was no display in the tower controller desk.

The meteorological report issued on 1 February 2017 was as follows:

	1230 UTC	1251 UTC	1300 UTC
Wind (°/knots)	200 / 04	250 / 05-08	270 / 06
Visibility (m)	1,000 (runway 27) 2,000 (runway 09)	1,000 (runway 27) 2,000 (runway 09)	1,000 m
Weather	Medium Rain	Slight Rain	Medium Rain
Cloud[4]	Broken 1,400 feet	Broken 1,400 feet	Broken 1,400 feet
TT/TD (°C)	24 / 24	24 / 24	25 / 25
QNH (mbs/in Hg)	1,010/29.83	1,010/29.83	1,010/29.84
QFE (mbs/in Hg)	997/29.45	997/29.45	997/29.45

1.5 Aids to Navigation

Runway 09 of Yogyakarta was equipped with an Instrument Landing System (ILS) approach guidance facilities operating on a frequency of 109.10 MHz. The last periodic calibration was performed on 22 October 2016. The next periodic calibration was scheduled to be performed on 22 April 2017. On the day of the occurrence, the ILS was serviceable and functioning properly. The ILS approach chart provided by Directorate General of Civil Aviation (DGCA) on Aeronautical Information Publication (AIP) Volume II shows as the figures below.

4 Cloud amount is assessed in total which is the estimated total apparent area of the sky covered with cloud. The international unit for reporting cloud amount for Broken is when the clouds cover 1/2 area of the sky.

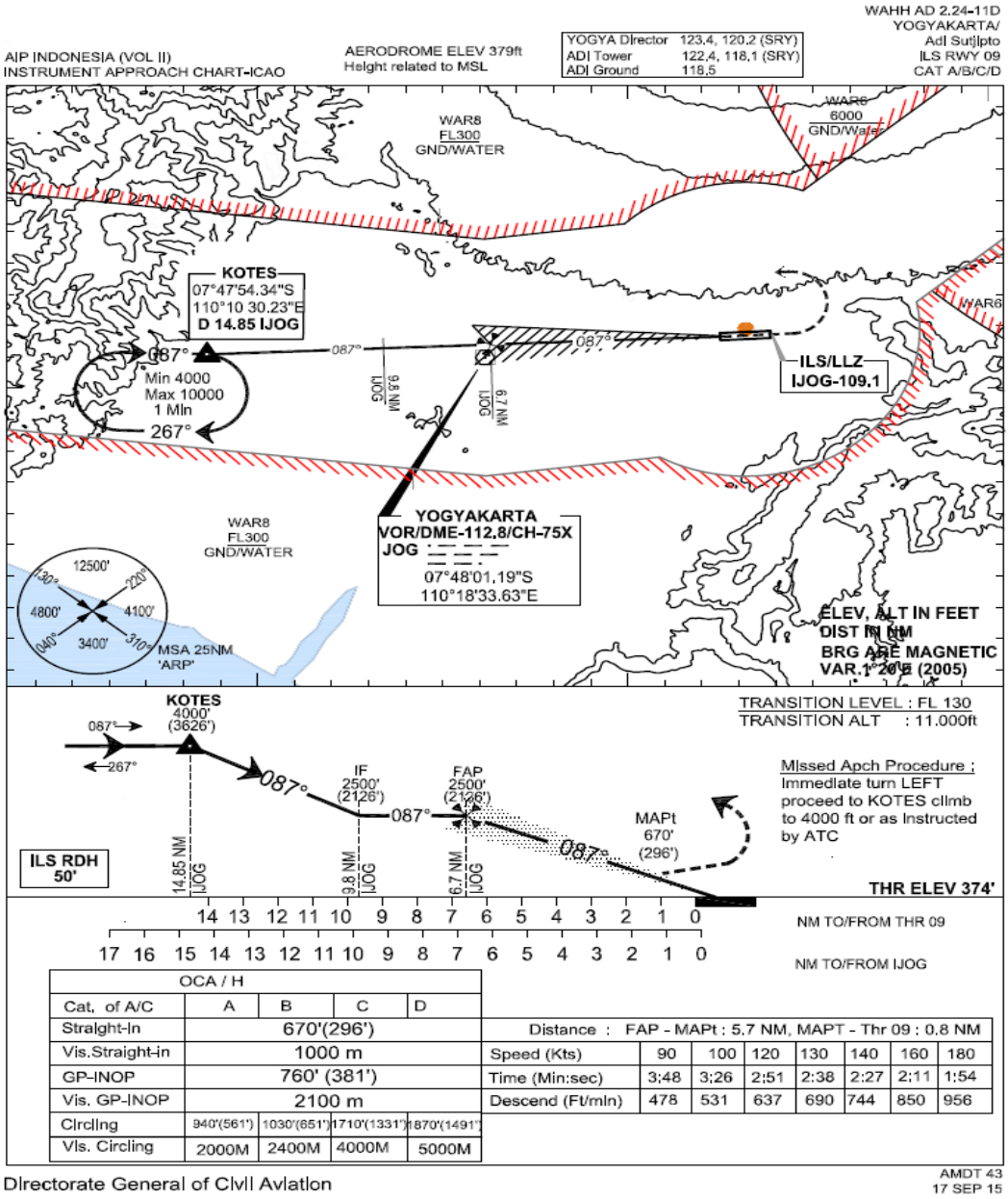


Figure 2: The ILS approach chart published in AIP Volume II

Approach guidance facilities such as Precision Approach Path Indicator (PAPI) lights and runway lights were all serviceable.

There was no report or record of the aircraft navigation system abnormality and was operated normally.

1.6 Communications

All communications between Air Traffic Services (ATS) and the crew were normal as recorded on ground based automatic voice recording equipment and Cockpit Voice Recorder (CVR) for the duration of the flight. The quality of the recorded transmissions was good.

The excerpt of the communication will be included in the final report.

1.7 Aerodrome Information

Airport Name	:	Adisutjipto International Airport
Airport Identification	:	WAHH / JOG
Airport Operator	:	PT. Angkasa Pura 1 (Persero)
Airport Certificate Number	:	018/SBU-DBU/XI/2015
Coordinate	:	07° 47’ 12” S; 110° 25’ 55”E
Elevation	:	350 feet / 20.2°
Runway Direction	:	09 – 27 / 087° - 267°
Runway Length	:	2,200 m
Runway Width	:	45 m
Surface	:	Asphalt
Fire fighting category	:	VII

There were several runway centerline markings on the touchdown area of runway 09 that were unclearly visible. (Figure 3).

Figure 3: The unclear runway centreline and touchdown bar markings

1.8 Flight Recorders

1.8.1 Flight Data Recorder

The aircraft was fitted with Honeywell SSDFDR (Solid State Digital Flight Data Recorder) HFR5-D model with part number 980-4750-009 and serial number 03088. The recorder was transported to KNKT recorder facility for data downloading process. The FDR recorded 1,262 parameters and approximately 53.46 hours of aircraft operation, which was containing 26 flights including the accident flight.

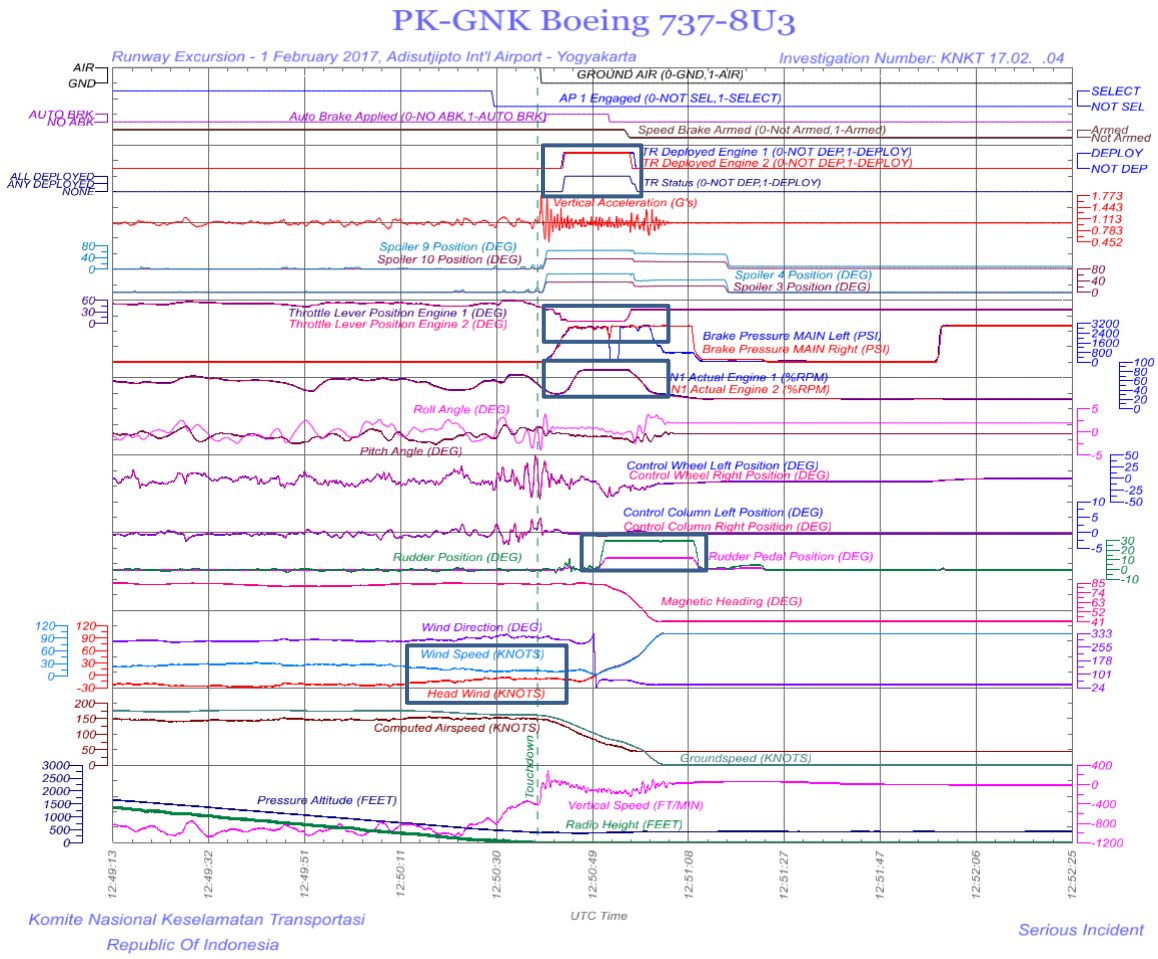


Figure 4: The significant FDR parameters

The FDR graph showed significant parameters prior touchdown and while landing roll which are shown in the boxes, such as wind speeds and directions, aircraft speeds, reversers, break pressures and rudder deflection that will be examined specifically in the final report.

1.8.2 Cockpit Voice Recorder

The aircraft was fitted with Honeywell SSMCVR (Solid State Memory Cockpit Voice Recorder) model with part number 980-6022-00 and serial number 120-09138. The recorder was transported to KNKT recorder facility for data downloading process. The CVR recorded 124.2 minute of good quality recording data including the serious incident flight. The significant excerpts from the CVR will be included in the final report.

1.9 Wreckage and Impact Information

The aircraft stopped on the left shoulder runway 09 on heading 43°at about 1,600 meters from begining runway 09 and 20 meters on the left of the runway edge. There was tire marks of the nose wheel, left and right main landing gear started from the left runway 09 edge marking until the aircraft stopped (Figure 4).

Figure 5: The tire marks on runway and on shoulder

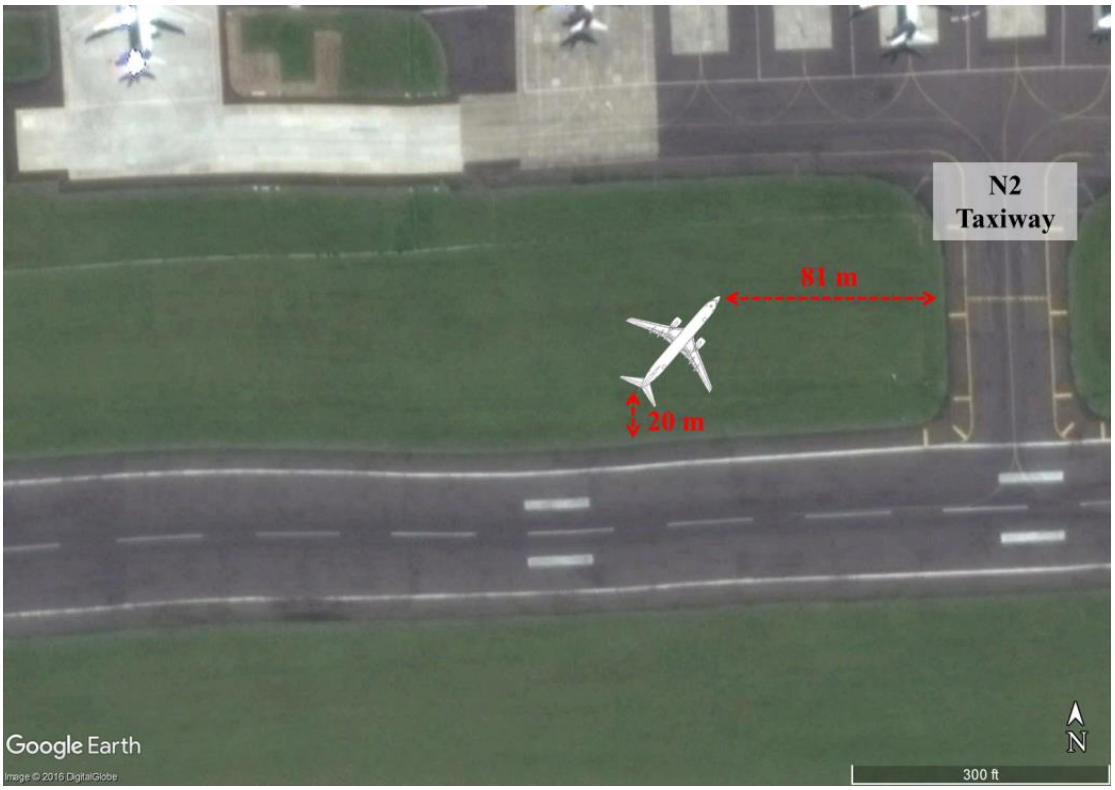


Figure 6: The location of aircraft stopped

1.10 Organizational and Management Information

1.10.1 The Aircraft Operator

Aircraft Owner	:	FLIP No. 110 Co., Ltd.
Address	:	7-2 Marunouchi 2 Chome, Chiyoda-ku, Tokyo 100-7029, Japan
Aircraft Operator	:	PT. Garuda Indonesia Airways
Address	:	Jl. Kebun Sirih No. 17, Jakarta Pusat, Indonesia

PT. Garuda Indonesia had a valid Air Operator Certificate (AOC) number 121-001 to conduct a scheduled passenger transport. The operator had operated 13 Airbus A330-300 aircraft, 9 Airbus A330-200 aircraft, 9 Boeing 777-300ER aircraft, 2 Boeing 747-400, 81 Boeing 737-800NG, 11 ATR 72-600 and 18 CRJ 1000 NexGen aircraft.

1.10.2 The adverse weather operational manuals related

Some parts of adverse weather operational, limitations including landing technique on a cross wind landing are showed in the following subchapter below.

1.10.2.1 Garuda Operation Manual Part A (OM-A)

14. ALL WEATHER OPERATION

14.1. Adverse Weather / Hazardous Atmospheric Conditions

Following are compilations of adverse weather / hazardous atmospheric conditions and recognitions and recommended practice and procedures for operating in and / or avoiding those conditions.

The background information on various meteorological phenomena is found in FRG chapter 5.

Flight crewmember is to refer to FCOM/AOM type for technical or avoidance procedures regarding adverse weather operations.

14.1.1 Slippery, Wet and Contaminated Runway

Flight crew shall assess the runway conditions, before Takeoff or Landing, including the effect of type and depth of contaminants on airplane performance. (See OM-A Chapter 14 the general idea of the braking conditions).

The assessment shall include:

- *Effect of Slippery/Wet on runway surface.*
- *Effect of slush, standing water, ice or snow on runway surface.*
- *Cross wind and tail wind limit for take-off and landing.*

01. Definition and Characteristic of runway conditions

Dry :

- *No visual indication of moisture or contamination on the runway surface.*
- *Properly maintained runways with grooves or porous pavement have been shown to provide braking action approximately equivalent to a dry runway when they are wet.*

Damp :

- *Surface is not dry but slightly wet; moisture on the surface does not give a shiny appearance.*
- *Visual moisture conditions are present on runway surface (water spots or surface discoloration) but not fully soak.*

Wet :

- *Runway is completely soaked with water and surface reflection may be present. Wet runway has water depth of less than 3mm (1/8 inch).*
- *Runway should be considered Wet if:*
  - *It is raining (Light or moderate rain).*
  - *It has stopped raining recently but runway surface is soaked with water and / or surface reflection is present.*
  - *Reduce tire to ground friction, deceleration is affected.*
- *Following table is wet runway equivalent for slush, wet snow and dry snow and same performance will be applied with wet runway:*

	Boeing	Airbus
Water	3 mm	3 mm
Slush	3 mm	2 mm
Wet Snow	3 mm	4 mm
Dry Snow	25 mm	15 mm

Slippery runway :

- *Condition of a runway that reduced Tire to ground friction, airplane deceleration is affected.*
- *Includes wet, ice or compacted snow.*

Contaminated Runway :

- *A runway is considered to be contaminated when more 25% of the Runway surface area within the required length and width being used, is covered by surface of water, more than 3mm deep or by slush, or loose snow, equivalent to more than 3mm of water.*
- *The contaminants are lying on that portion of the runway where the high speed part of the take off roll will occur.*
- *A Runway that has an accumulation of snow or ice.*
- *Reduce tire to ground friction and additional drag force (resist ability to accelerate) due to contaminant therefore affects acceleration and deceleration.*

Slush :

- *Snow saturated with water that will splatter when stepped on. (approximate density = 0.85 kg/liter.*

Wet Snow :

- *If compacted by hand, snow will stick together and tend to form snowball. (approximate density=0.4 kg/liter).*
- *Snow with high water contents when compacted by hand with gloves, snowball is formed and water droplets may appear on the surface.*
- *If the temperature is at or above -1°C (30°F), the snow is considered wet.*

Dry Snow :

- *Snow can be blown if loose, or if compacted by hand will fall apart again upon release. (density = 0.2 kg/liter).*
- *If the temperature is below -1°C (30°F), the snow is considered dry.*

Compacted Snow :

- *Snow has been compressed (Friction coefficient typically = 0.2).*

Icy :

- *A condition that friction coefficient is 0.05 or below.*

02. Performance on Slippery, Wet or Contaminated Runway

The performance corrections on contaminated runway are usually provided for 3mm, 6mm, and 13mm contaminant (standing water/slush) or Slippery/Wet runway (Good, Medium, Poor). For contaminant over 6mm and at or below 13 mm, apply whichever is the lower figure of the allowed take off weight between the two data.

When runway conditions are reported for each third portion, average friction coefficient or contaminant depth of the last two third runways should be applied for take off/landing performance.

The take off performance data can be given based on Braking Action or based on Runway Conditions. Refer to Aircraft Operating Manual for particular type of aircraft.

Slippery/Wet Runway and equivalent table:

STANDING WATER	SLUSH	WET SNOW	DRY SNOW
< 3mm (Air Bus)	< 2mm (Air Bus)	< 4mm (Air Bus)	<15mm (Air Bus)
< 3mm (Boeing)	< 3mm (Boeing)	-	-

Contaminated Runway:

STANDING WATER	SLUSH	WET SNOW	DRY SNOW
≥ 3mm (Air Bus)	≥ 2mm (Air Bus)	≥ 4mm (Air Bus)	≥ 4mm (Air Bus)

A linear equivalence between depth of slush and snow:

SLUSH	WET SNOW	DRY SNOW
2mm (0.08 inch)	4mm (0.16 inch)	15mm (0.59 inch)
6mm (1/4 inch)	13mm (1/2 inch)	50mm (2 inch)

03. Determining Runway Condition

General :

- *Only the runway within 75 feet of either side of the runway centerline is used in the determination of contamination type.*

- *If the PIC determined that contaminant covers a portion of the runway which will not be needed for take off, including distance for rejected or an engine fail during take off, that runway need not be considered contaminated.*
- *The PIC has final authority and discretion with respect to the determination of contaminant type.*

Table: mm to inches conversion:

Contaminated mm to Inches conversion								
mm	0	6.35	10	12.7	25.4	50.8	101.6	152.4
inches	0	0.25	0.4	0.5	1	2	4	6

Table: Runway Braking Action (ICAO)

Measured Coefficient (μ)	Estimated Braking Action
≥ 0.4	Good
0.39 to 0.36	Medium to Good
0.35 to 0.30	Medium (or Fair)
0.29 to 0.26	Medium to Poor
≤ 0.25	Poor

During approach, when runway is reported wet or rain, PIC shall request runway braking actions or braking coefficient for determining the flight techniques and limitation course of action in accordance with the procedure stated in the AOM/FCOM (Braking action effect on landing distance).

If PIC cannot obtain runway braking action/ braking coefficient, the table below should be utilized to obtain the braking conditions. If doubted, select other R/W, Hold or divert to Alternate.

Runway Surface Condition		**Braking Action**
DRY		-
Damp		Normal
Wet	Light RA, Light SN [1]	Good
	RA, SN [2] Water < 3 mm Slush < 2 mm Wet Snow < 3 mm Dry Snow < 15 mm	Medium [or fair]
	Water ≥ 3 mm Slush ≥ 2 mm Wet Snow ≥ 3 mm Dry Snow ≥ 15 mm Heavy Rain	Poor
ICE		NIL (or Unreliable)
NOTE: When runway is wet, grooved RWY or RWY with porous pavement has been shown to provide braking action approximately equivalent to the following: [1] Light Rain : Braking Action Normal [2] Rain : Braking Action Good		

Taxi Consideration :

- *Exercise extreme caution; Ramp and taxiways may be very slippery.*
- *Jet blast consideration; may result ground personnel injury and equipment damage.*
- *Taxi speed shall be reduced to minimum, especially vacating the runway and taxi lining up.*

Landing Consideration :

- *Firm touch down within the touch down zone, avoid floating.*
- *Ensure ground spoilers are fully extended at touch down.*
- *To achieve minimum landing distance, consider using maximum manual braking and maximum thrust reverser.*
- *Never assume that the last 2,000 feet of the runway have the same braking action as the touch down zone.*

04. Slippery/Wet or Contaminated Runway Limitations

- *Takeoff and Landing Limitation : - Takeoffs are prohibited under the following conditions,*
  - *When reported braking action is Unreliable/NIL.*
  - *When depth of slush or snow exceeds the following:*

Conditions	Values
Slush/Standing water	13mm
Wet Snow	25.4mm
Dry Snow	50.8mm
Icy	Do not T/O or Landing.

- *Wind Limitation : - For wind limitation, use wind data provided by tower.*
  - See FCOM/AOM.

05 Braking Action Definition

- *Normal : Maximum energy stops possible with little deterioration in certified stopping distance. Includes maximum braking and use of speed brakes; does not include reverse thrust.*
- *Good : More braking is available than will be used in an average airline type deceleration. If maximum energy stop were attempted, some distance in excess of certified stopping distance would be expected.*
- *Fair/Medium : Sufficient braking and cornering force is available for a well-flown approach and landing using light braking. However, excess speed or long touch down would result in an extremely low safety factor depending on runway length and crosswind component. Careful planning and good judgment are required.*
- *Poor : Very careful planning, judgment and execution are absolutely essential. Crosswind becomes a primary consideration. While a safe and successful approach, landing and stop can be accomplished if all factors are favorable, it is necessary that care be exercised in every facet of the operation.*
- *Unreliable/Nil : Operations not recommended. Extremely slippery with poor directional control even while taxiing. This is the kind of report that could be*

envisioned during a freezing rain condition if nothing were done to the runways or taxiways.

11.5. APPROCH AND LANDING
11.5.7. Use of Reverse Thrust and/or Brakes
01. General

The take-off and landing runway length requirements have been determined, during certification of the aircraft by the use of wheel brakes only, with engines delivering forward idle thrust.

The use of reverse thrust system, as laid down in the FCOM/AOM increases the operational safety margins, and considerably increases the brakes and tire life, with no adverse effects to the engines.

The use of Auto Brake System (as installed) has its advantages on wet and contaminated runways (except if crosswind is close to FCOM/AOM limits) as well as in cases where minimum runway length is available only.

Its use is at PiC's discretion.

Excessive use of wheel brakes to gain an early runway turn-off point is undesirable, unless urgent operational reasons are involved.

02. Reverse on Slippery and Snow-Covered Runways

Should directional problems occur on a slippery runway, differential application of reverse thrust must not be used in an attempt to regain directional control. Reverse thrust must be reduced to idle reverse, until the aircraft is under control.

Reverse thrust when continued below 60 knots on powdery snow can result in the loss of forward visibility.

1.10.2.2 Flight Crew Training Manual

Reverse Thrust Operation (6.40)

Awareness of the position of the forward and reverse thrust levers must be maintained during the landing phase. Improper seat position as well as long sleeved apparel may cause inadvertent advancement of the forward thrust levers, preventing movement of the reverse thrust levers.

The position of the hand should be comfortable, permit easy access to the autothrottle disconnect switch, and allow control of all thrust levers, forward and reverse, through full range of motion.

Note: *Reverse thrust is most effective at high speeds.*

After touchdown, with the thrust levers at idle, rapidly raise the reverse thrust levers up and aft to the interlock position, then to the number 2 reverse thrust detent. Conditions permitting, limit reverse thrust to the number 2 detent. The PM should monitor engine operating limits and call out any engine operational limits being approached or exceeded, any thrust reverser failure, or any other abnormalities.

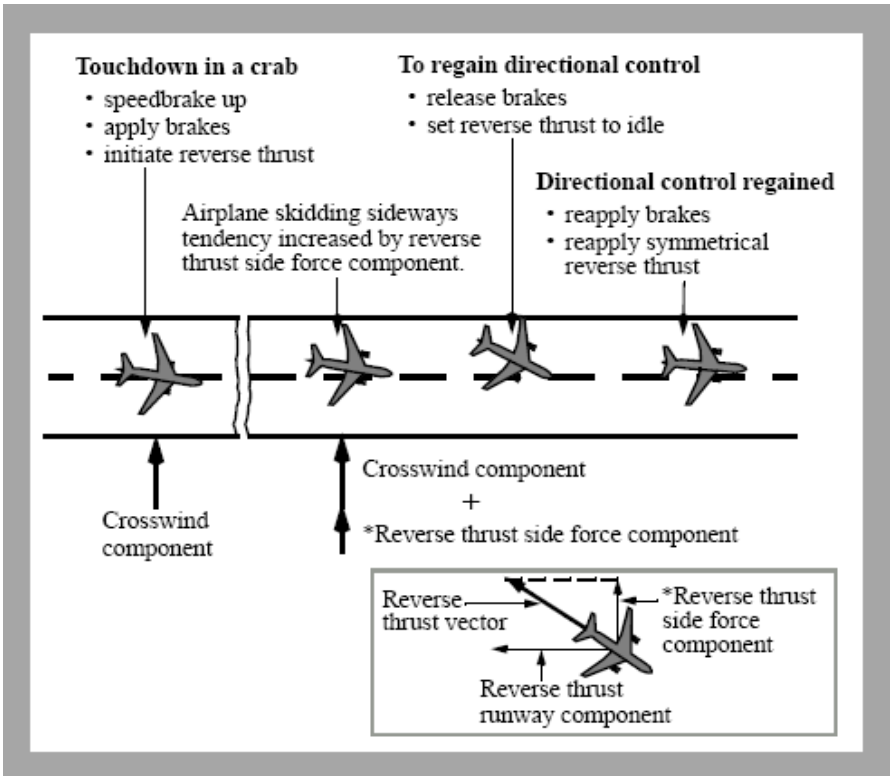
Maintain reverse thrust as required, up to maximum, until stopping on the remaining runway is assured.

When stopping is assured and the airspeed approaches 60 KIAS start reducing the reverse thrust so that the reverse thrust levers are moving down at a rate commensurate with the deceleration rate of the airplane. The reverse thrust levers should be positioned to reverse idle by taxi speed, then to full down after the engines have decelerated to idle. Reverse thrust is reduced to idle between 60 KIAS and taxi speed to prevent engine exhaust re-ingestion and to reduce the risk of FOD. It also helps the pilot maintain directional control in the event a reverser becomes inoperative.

***Note:** If an engine surges during reverse thrust operation, quickly select reverse idle on both engines.*

The PM should call out 60 knots to assist the PF in scheduling the reverse thrust. The PM should also call out any inadvertent selection of forward thrust as reverse thrust is canceled.

Reverse Thrust Operation and Crosswind (all engine) (6.43)



This figure shows a directional control problem during a landing rollout on a slippery runway with a crosswind. As the airplane starts to weathervane into the wind, the reverse thrust side force component adds to the crosswind component and drifts the airplane to the downwind side of the runway. Also, high braking forces reduce the capability of the tires to corner.

To correct back to the centerline, release the brakes and reduce reverse thrust to reverse idle. Releasing the brakes increases the tire-cornering capability and contributes to maintaining or regaining directional control. Setting reverse idle reduces the reverse thrust side force component without the requirement to go through a full reverser actuation cycle. Use rudder pedal steering and differential braking as required, to prevent over correcting past the runway centerline. When

directional control is regained and the airplane is correcting toward the runway centerline, apply maximum braking and symmetrical reverse thrust to stop the airplane.

Note: Use of this technique increases the required landing distance.

1.10.3 Airport Operator

The Adisutjipto International Airport was military airbase and since 1975 the function was changed to enclave civil and military operation. The airport was operated by PT. Angkasa Pura 1, a state owned enterprise that operated 13 airports in Indonesia.

The operating hours of Adisutjipto International Airport was started on 23.00 UTC until 14.00 UTC (extra flight on request), with the frequency of landing aircraft in average was 140 aircraft per day, including the military training movement.

The PT. Angkasa Pura 1 branch Adisutjipto International Airport has an Aerodrome Manual (AM) as general guidelines in the airport operation. Furthermore, the detail guidelines were described on Standard Operating Procedures (SOPs). The AM and SOPs are presented only in *Bahasa Indonesia* and translated to English on this investigation report.

Some parts of the current Aerodrome Manuals and the Standard Operating Procedures such as, runway operation and maintenance programs are shown in the following subchapter below.

1.10.3.1 Aerodrome Manual

Bab 4 Prosedur Pengoperasian Bandar Udara	***Chapter 4 Airport Operational Procedure***
4.5 Pemeriksaan di Daerah Pergerakan dan Obstacle Limitation Surface	***4.5 Inspection of Movement Area and Obstacle Limitation Surface***
4.5.1 Tujuan	***4.5.1 Scope***
Tujuan dari prosedur ini adalah untuk memastikan bahwa seluruh fasilitas yang terdapat di daerah pergerakan (movement area) selalu dalam kondisi terperiksa secara rutin dan teruji dengan baik, serta dalam kondisi memenuhi standar keselamatan penerbangan.	*The objective of this procedure is to ensure that all facilities in the movement area is examined regularly and well tested, and the meet aviation safety standards*
4.5.2 Tanggung Jawab	***4.5.5 Responsibility***
4.5.2.1 General Manager memiliki tanggung jawab keseluruhan untuk memastikan bahwa prosedur yang ditetapkan dan sumber daya yang disediakan untuk inspeksi Bandar udara Adisutjipto terpenuhi sesuai standar Direktorat Jenderal Perhubungan Udara.	*4.5.2.1 General Manager is responsible to ensure that the approved procedure and the available resources to conduct airport inspection met the Directorate General of Civil Aviation standard.*

4.5.2.4 Personel Airport Equipment Readiness dan Airport Facilities Readiness yang sudah terlatih bertanggung jawab untuk menjalankan inspeksi di Daerah Pergerakan dan Obstacle Limitation Surface (OLS).

4.5.2.4 The trained personnel of Airport Equipment Readiness and Airport Facilities Readiness responsible for the daily inspection of the movement area and Obstacle Limitation Surface (OLS)

4.5.5 Pemeriksaan kelayakan keselamatan operasi Bandar udara dilaksanakan sebagai berikut :

4.5.5 Inspection of Airport safety is performed as follows:

1. Setelah hujan deras, angin kencang atau fenomena lainnya yang berpengaruh terhadap operasi penerbangan;

1. After heavy rain, strong wind or other phenomena that may affect the flight operation;

2. Ketika diminta oleh ATC (setelah ada pendaratan yang tidak normal); atau

2. If requested by ATC (after an abnormal landing event); or

3. Jika diminta oleh sebuah sumber terpercaya seperti staf darat, pilot pesawat, atau perwakilan perusahaan penerbangan, bahwa ada kemungkinan masalah di wilayah pergerakan.

3. If requested by other trusted sources such as ground staff, pilot or airline representative related to the possibility of abnormal event in movement area.

4.5.8 Frekuensi dan Prosedur Inspeksi

4.5.8 Inspection Frequency and Procedure

1. Inspeksi harian dilakukan sebelum operasi penerbangan dilaksanakan (sekitar pukul 05.00 – 05.30 WIB); dan pada siang hari; serta setelah kegiatan operasi penerbangan selesai;

1. Daily inspection is performed before flight operation (on 05.00 – 05.30 LT); and on the midday and after flight activities terminated;

2. Inspeksi bulanan fasilitas Bandar Udara dilakukan oleh Airport Ops & Readiness Dept Head atau personil yang ditunjuk untuk mengukur keefektifan inspeksi harian yang dilakukan oleh petugas. Inspeksi ini harus menggunakan prosedur dan daftar check, sama seperti yang digunakan untuk inspeksi harian.

2. Monthly inspections of airport facilities carried out by Airport Ops & Readiness Dept. Head or personnel designated to measure the effectiveness of daily inspections conducted by assigned officers. This inspection should utilize the procedures and check lists of daily inspection

4.7 Pemeliharaan Daerah Pergerakan

4.7 Maintenance of Movement Area

4.7.2 Tanggung Jawab

4.7.2 Responsibility

1. General Manager bertanggung jawab sepenuhnya terhadap ketentuan tentang prosedur pemeliharaan di daerah pergerakan di bandar udara.

1. General Manager is fully responsible to the provision of maintenance procedure of the movement area in airport.

2. Airport Operation & Readiness Dept. Head bertanggungjawab untuk memastikan pemeliharaan dan inspeksi teknis yang tepat di fasilitas daerah pergerakan bandar udara telah dilaksanakan dan tercatat menurut yang dipersyaratkan.

2. Airport Operation & Readiness Dept. Head is responsible to ensure the maintenance and a proper technical inspection of the facilities in movement area are performed and recorded according to the requirement.

3. Airport Facilities & Readiness Section Head bertanggungjawab untuk memastikan Personil yang ditunjuk melaksanakan dan mencatat setiap hari pekerjaan inspeksi pada sistem daerah pergerakan di bandar udara.

3. Airport Facilities & Readiness Section Head is responsible to ensure the designated personnel to perform and record the daily inspection of the airport movement system.

4.7.4 Prosedur Pemeliharaan yang selengkapnya tertuang dalam Petunjuk Pelaksanaan Pemeliharaan dalam kumpulan SOP Facilities & Readiness Section, berisi antara lain :

4.7.4 The Detail Maintenance Procedure can be found on compiled SOP of Facilities & Readiness Section, that consist of:

1) Tingkat I : Pemeliharaan preventif secara periodik meliputi pembersihan, inspeksi marka dan struktur trotoar yang dilakukan oleh teknisi, seperti:

a. *Pembersihan dengan runway sweeper dan secara manual serta dengan mengawasi movement area meliputi drainase;*
b. *Setiap saat apabila terdapat FOD;*

1) Level I : Periodic preventive maintenance consist of cleaning, inspection of marking and structure that performed by technician, such as:

a. *Cleaning using runway sweeper and manually means also monitoring the movement area including drainage;*
b. *Every time if there is FOD;*

2) Tingkat II : Pemeliharaan dilakukan bila dibutuhkan, Ini adalah pemeliharaan korektif yang meliputi recondition dan pengecatan kembali permukaan trotoar yang rusak ringan, misalnya karena rubber deposit, seperti:

a. *Membersihkan rubber deposit di landasan dan taxiway, sekali dalam setiap 4 bulan.*
b. *Mengecat kembali marking line pada runway, taxiway dan apron sesuai kebutuhan.*

2) Level II : Maintenance that performed if needed. It is a corrective maintenance which consists of recondition and repainting the surface which have minor damaged as a result of rubber deposit, such as:

a. *Cleaning the rubber deposit on runway and taxiway, once every four months.*
b. *Repainting the marking line on runway, taxiway and apron if required.*

3) Tingkat III : Diklasifikasikan sebagai perbaikan dan akan dilakukan bila terjadi malfunction yang tidak dapat diperbaiki oleh Pemeliharaan Tingkat II. Perawatan dilakukan dengan khusus,

3) Level III : Classified as repairation that will be performed if there is malfunction which cannot be repaired on Level II Maintenance. This maintenance is specially performed, such as:

seperti:

a. *Tes friction runway dilakukan tahunan oleh penguji khusus.*
b. *Jika hasil tes menunjukkan perlu perbaikan, maka overlay akan dilakukan.*
c. *Pengukuran kedalaman air tidak pernah dilakukan dengan alat khusus tetapi diukur secara manual dengan penglihatan.*

Prosedur Pemeliharaan Daerah Perkerasan

a. Kebersihan permukaan dari FOD

- *Pemeliharaan daerah pergerakan dilakukan oleh Civil Airside Technician/Team Leader.*
- *Unit lain seperti petugas PKP-PK, dan AMC,akan memeriksa daerah pergerakan dan akan berkoordinasi dengan Civil Airside Technician apabila terdapat temuan apapun yang dapat mempengaruhi keselamatan penerbangan.*

b. Rubber deposit

- *Jika menemukan deposit ekstrem pembersihan dilakukan segera dan tanpa mengganggu operasi penerbangan.*
- *Pembersihan rubber deposit rutin dilakukan per empat bulan tanpa mengganggu operasi penerbangan (setelah tidak ada lagi penerbangan).*
- *Pembersihan rubber deposit menggunakan cairan kimia dan disikat dengan sikat khusus.*

c. Pengecatan Marka

- *Pengecatan ulang dilakukan secara rutin tiap satu tahun satu kali, khusus untuk centerline dilakukan dua kali dalam setahun dan pada bagian bagian tertentu dapat dicat ulang setiap dibutuhkan seperti Lead In Lead Out marka Apron atau disesuaikan dengan kondisi lapangan.*
- *Pelaksanaan pengecatan marka*

a. *Friction test that performed annually by special examiner.*
b. *If the test result indicates repair is required, then the overlay will be performed.*
c. *Measurement of water depth is conducted manually by visual observation.*

Pavement Maintenance Procedures

a. Surface cleanliness from FOD

- *Maintenance of the movement area carried out by the Civil Airside Technician / Team Leader.*
- *Other units such as PKP-PK, and AMC, will examine the movement area and will coordinate with the Civil Technician Airside if there are any findings that could affect flight safety.*

b. Rubber deposit

- *If extreme deposit is detected the cleaning should be performed immediately without disrupting flight operations.*
- *Routinely rubber deposit cleaning is conducted every four months without disrupting flight operations (after flight operation terminated).*
- *Cleaning rubber deposit uses a chemical liquid and brushed with a special brush.*

c. Painting Marking

- *Repainting conducted annually, special for the centerline conducted twice a year and at certain parts can be repainted as required such as Lead In and Lead Out Apron marking or depends on the conditions.*
- *Painting of marking conducts in the*

dilaksanakan pada malam hari, setelah selesai penerbangan.

- *Pengecatan marka dilakukan dengan menggunakan cat marka khusus jalan dicampur afduner yang dicatkan pada permukaan tanda tanda marka yang telah kabur ataupun hilang.*

4.7.5 Fasilitas/Peralatan

1. Pembersihan permukaan daerah pergerakan menggunakan Runway Sweeper setiap hari dan bila diperlukan

5. Pengukuran kedalaman air tidak dilakukan dengan alat khusus tetapi diukur secara manual dengan penglihatan.

evenings, after completion of the flight.

- *Painting of marking is conducted by using a special road marking paint that mixed with afdurner and painted on the blur or disappear marking surface.*

4.7.5 Facility/Equipment

1. Clean the surface movement using Runway Sweeper conducted daily and when needed

5. Measurement of water depth is conducted manually by visual observation.

1.10.3.2 Runway, Taxiway and Apron Inspection Procedure

5.0 URAIAN PROSEDUR

5.1 Prosedur Inspeksi Runway, Taxiway dan Apron

5.1.1 Pelaksanaan Inspeksi Runway, Taxiway dan Apron dilakukan oleh team terdiri dari:

5.1.1.1 Non Terminal Airside Section;

5.1.1.2 Airport Rescue & Fire Fighting Section;

5.1.1.3 Apron Movement Control (AMC);

5.1.1.4 SMS & Occupational Safety Health Section (pada waktu tertentu)

5.1.2 Pelaksanaan Inspeksi Runway, Taxiway dan Apron dilakukan pada saat:

5.1.2.1 Dilaksanakan inspeksi pada saat bandara akan dioperasikan (satu jam sebelum operasi);

5.1.2.2 Dilaksanakan inspeksi pada saat Bandar udara selesai operasi;

5.1.2.3 Dilaksanakan inspeksi khusus pada saat penomena alam seperti angin kencang, hujan badai,

5.0 PROCEDURE DESCRIPTION

5.1 Runway, Taxiway and Apron Inspection Procedure

5.1.1 Runway, Taxiway and Apron Inspection is performed by a team consisted of:

5.1.1.1 Non Terminal Airside Section;

5.1.1.2 Airport Rescue & Fire Fighting Section;

5.1.1.3 Apron Movement Control (AMC);

5.1.1.4 SMS & Occupational Safety Health Section (at certain time)

5.1.2 The Runway, Taxiway and Apron Inspection is performed on:

5.1.2.1 One hour before airport operation;

5.1.2.2 After the airport closed;

5.1.2.3 Special inspection performs if there are significant phenomena such as strong wind condition, heavy

gempa bumi atau ketika diminta oleh Air Traffic Control (ATC);

rain and earthquake or if requested by Air Traffic Control (ATC);

5.2 Tindakan yang dilakukan bila menemukan hal-hal Sbb:

5.2 The required action on the following circumstances:

5.2.2 Terdapat genangan air, minyak dan atau oli.

5.2.2 If there is water ponding, fuel and/or oil.

5.2.2.1 Genangan air segera dikeringkan atau dialirkan ke tepi landasan;

5.2.2.1 The water ponding shall be dried or streamed to runway edge;

5.2.2.2 Bila genangan air mencapai 3 mm dan cukup luas, perlu waktu dan tenaga untuk mengeringkannya, segera hubungi Operator Runway Sweeper dan atau PKP-PK;

5.2.2.2 If the water ponding reaches 3 mm depth and spread on wide location, it will require more effort and time to dry, therefore, Runway Sweeper Operator and/or ARFF shall be contacted;

5.2.2.3 Menginformasikan pada Tower bahwa terdapat genangan air, minyak dan atau oli sehingga operasional penerbangan perlu ditunda untuk sementara waktu untuk proses pengeringan dan pembersihan (apabila diperlukan);

5.2.2.3 Informs to Tower if any water ponding, fuel or oil and if require to postpone the airport operation for the drying or cleaning process (if necessary);

1.10.3.3 Runway Inspection

The daily inspection of runway, taxiway and apron inspection in Yogyakarta performs before the airport open and after the airport closed. At the day of the occurrence, the results of the daily inspection before the airport opened was reported that the runway and its facilities were on good condition. Prior to the occurrence, the airport was reopened after being closed due to weather was below minima and thereafter the ARFF personnel performed runway inspection and reported to the tower controller that the runway was clear.

1.10.3.4 Runway Friction Test Procedure

5.0 URAIAN PROSEDUR

5.0 PROCEDURE DESCRIPTION

5.1 Prosedur Pengetesan Kekesatan Landasan

5.1 Runway friction test Procedure

5.1.1 Pelaksanaan Pengetesan Kesesatan Landasan dilakukan oleh personil terdiri dari:

5.1.1 Runway friction test is performed by team that consisted of:

5.1.1.1 Non Terminal Airside Section;

5.1.1.1 Non Terminal Airside Section;

5.1.1.2 Safety Management System

5.1.1.2 Safety Management System &

& Occupational Safety Health Section;	*Occupational Safety Health Section;*
5.1.1.3 Tim Konsultan atau Tenaga Ahli yang ditunjuk untuk melaksanakan pengetsan kekesatan.	*5.1.1.3 Consultant or Expert that appointed to conduct friction test.*
5.1.2 Pengujian kekesatan dilaksanakan minimal 2x dalam setahun dikarenakan keterbatasan alat.	*5.1.2 Roughness testing carried out at least 2x a year due to the limitations of the tool.*

The last runway friction check was performed on 3 February 2016.

1.10.3.5 Rubber Deposit Cleaning Procedure

3.0 DEFINISI	***3.0 DEFINITION***
3.1 JOG.FN (Non Terminal Airside Section Head) adalah seorang pejabat yang membawahi Civil Airside Technician yang bertanggung jawab terhadap seluruh fasilitas sipil sisi udara di Bandar Udara.	*3.1 JOG.FN (Non Terminal Airside Section Head) is an officer that supervises the Civil Airside Technician that responsible to all civil airside facilities in airport.*
5.0 URAIAN PROSEDUR	***5.0 PROCEDURE DESCRIPTION***
5.1 Dengan mendasari laporan hasil inspeksi, JOG.FN menginstruksikan kepada kontraktor untuk pelaksanaan pembersihan Rubber Deposite sesuai dengan permintaan dari User (Airport Operation Airside Section).	*5.1 Based on the inspection report, JOG.FN instructs the contractor to implement the Rubber Deposit cleaning according to the user request (Airport Airside Operations Section).*

The investigation found that the last rubber deposit cleaning was performed on 5 - 7 October 2016.

1.10.4 Air Traffic Services Provider

The air traffic services in Yogyakarta are provided by AirNav Indonesia branch office Yogyakarta which held a valid Air Traffic Services Provider certificate number 016/ATP-ATC/III/2016. The services provided by Yogya Director (Approach Control/APP) and Adi Tower (Aerodrome Control/ADC).

1.10.5 Indonesia Regulations

Regulations and standards related to the runway operation and maintenance is described in the Civil Aviation Safety Regulation (CASR) Part 139, Manual of Standard (MOS) CASR Part 139, Advisory Circular (AC) CASR Part 139 and Staff Instruction (SI) 139-01. The relevant regulations and standards are summarized as follow.

1.10.5.1 Advisory Circular CASR Part 139-23

5.1 Jadwal Evaluasi Kekesatan Perkerasan

Pelaksana bandar udara dan pengguna lalu lintas udara harus menjadwalkan periode pemeliharaan kekesatan permukaan perkerasan.

Dalam pelaporan hasil pengukuran kekesatan harus berisikan informasi sebagai berikut:

a) Lokasi bandar udara
b) Waktu pelaksanaan pengukuran (tanggal dan jam)
c) Landas pacu yang diukur (disertai sketsa layout landas pacu dan nomor dan arah landas pacu)
d) Jarak jalur lintasan pengukuran terhadap runway
e) Kecepatan pengukuran yang diterapkan
f) Kondisi permukaaan perkerasan landas pacu
g) Rata-rata tingkat kekesatan per jalur untuk masing-masing pengukuran.
h) Hasil semua pengukuran kekesatan untuk masing-masing jalur pengukuran.

5.1 Schedule of Pavement Friction Evaluation

The airport operator and air traffic user shall schedule the periodic of pavement friction maintenance.

The report of friction measurement shall include the following information:

a) Airport location
b) Time of measurement (date and time)
c) The measured runway (including runway layout and runway designation number and runway direction)
d) The distance measurement track to the runway
e) The speed of measurement
f) The condition of runway pavement surface
g) The average of friction level on each track
h) The result of all friction measurement on each track

5.1 Jadwal Evaluasi Kekesatan Perkerasan

Tabel 5.1. Frekuensi survey pengecekan kekesatan

Frekuensi Pendaratan Per Hari	*Pengecekan Rutin*
< 15	*1 tahun*
16 – 30	*6 bulan*
31 – 90	*3 bulan*
91 – 150	*1 bulan*
151 – 210	*2 minggu*
>210	*1 minggu*

5.1 The Schedule of Pavement Friction Evaluation

Table 5.1. Frequency of friction check survey

Landing Frequency Per Day	*Schedule*
< 15	*1 year*
16 – 30	*6 months*
31 – 90	*3 months*
91 – 150	*1 months*
151 – 210	*2 weeks*
>210	*1 weeks*

5.2. Evaluasi Kekesatan perkerasan tanpa bantuan alat

Evaluasi secara visual mengenai tingkat kekesatan permukaan perkerasan prasarana sisi udara tidak dapat diandalkan secara penuh untuk menilai tingkat kekesatan permukaan prasarana sisi udara tersebut.

Pelaksana bandar udara yang mengoperasikan pesawat jenis jet harus mengatur jadwal pengujian kekesatan dengan menggunakan peralatan.

Pada prinsipnya, inspeksi secara visual hanya dilakukan untuk menilai dan mencatat kondisi permukaan seperti terdapatnya genangan air, alur kerusakan serta kondisi struktur perkerasan.

Dari uraian ini dapat disimpulkan bahwa penilaian kekesatan secara visual semata hanya dilakukan sebagai langkah inspeksi dan bukan merupakan suatu kesimpulan dari kondisi permukaan perkerasan.

Pengujian dengan peralatan dan teknisi yang berpengalaman harus tetap dilakukan sesuai jadwal pada tabel 5.1 diatas dengan gambaran pengujian sebagaimana disajikan dalam Appendiks B.

5.2. Evaluation of pavement friction without equipment

A visual evaluation of friction level on pavement surface is not reliable to measure the friction level of airside area.

The airport operator with jet aircraft operation shall schedule a friction measurement using equipment.

In principle, the visual evaluation only conducts for the purpose of evaluating and documenting the surface condition if water ponding exists and sign of pavement damage.

According to the explanation, it can be concluded that the visual measurement of friction is conducted only for inspection and not as a result of the pavement surface condition.

A test using equipment and experienced technician shall be conducted as scheduled in table 5.1 and test illustration as described on appendix B.

Tabel 5.2. Klasifikasi tingkat kekesatan permukaaan perkerasan landas pacu untuk berbagai alat ukur yang digunakan.

Jenis Alat Uji	*65 km/h (40 mph)*			*95 km/h (40 mph)*		
	Minimal	*Perawatan*	*Konstruksi Baru*	*Minimal*	*Perawatan*	*Konstruksi Baru*
Mu(myu)- Meter	*0.42*	*0.52*	*0.72*	*0.26*	*0.34*	*0.66*
Dynatest Consulting, Inc. Runway Friction Tester	*0.50*	*0.60*	*0.82*	*0.41*	*0.54*	*0.72*
Airport Equipment Co. Skiddometer	*0.50*	*0.60*	*0.82*	*0.34*	*0.47*	*0.74*
Airport Surface Friction Tester	*0.50*	*0.60*	*0.82*	*0.34*	*0.47*	*0.74*

Jenis Alat Uji	*65 km/h (40 mph)*			*95 km/h (40 mph)*		
	Minimal	*Perawatan*	*Konstruksi Baru*	*Minimal*	*Perawatan*	*Konstruksi Baru*
Airport Technology USA Safegate Friction Tester	*0.43*	*0.60*	*0.82*	*0.34*	*0.47*	*0.74*
Findlay, Irvine, Ltd. Griptester Friction Meter	*0.48*	*0.53*	*0.74*	*0.24*	*0.36*	*0.64*
Tatra Friction Tester	*0.48*	*0.57*	*0.76*	*0.42*	*0.52*	*0.67*
Norsemeter RUNAR (operated at fixed 16% slip)	*0.45*	*0.52*	*0.69*	*0.32*	*0.42*	*0.63*

The translation is as follows:

Table 5.2. Friction level classification for runway pavement surface using different device measurement.

Measurement Device	*65 km/h (40 mph)*			*95 km/h (40 mph)*		
	Minimal	*Maintenance*	*New Construction*	*Minimal*	*Maintenance*	*New Construction*
Mu(myu)- Meter	*0.42*	*0.52*	*0.72*	*0.26*	*0.34*	*0.66*
Dynatest Consulting, Inc. Runway Friction Tester	*0.50*	*0.60*	*0.82*	*0.41*	*0.54*	*0.72*
Airport Equipment Co. Skiddometer	*0.50*	*0.60*	*0.82*	*0.34*	*0.47*	*0.74*
Airport Surface Friction Tester	*0.50*	*0.60*	*0.82*	*0.34*	*0.47*	*0.74*
Airport Technology USA Safegate Friction Tester	*0.43*	*0.60*	*0.82*	*0.34*	*0.47*	*0.74*
Findlay, Irvine, Ltd. Griptester Friction Meter	*0.48*	*0.53*	*0.74*	*0.24*	*0.36*	*0.64*
Tatra Friction Tester	*0.48*	*0.57*	*0.76*	*0.42*	*0.52*	*0.67*
Norsemeter RUNAR (operated at fixed 16% slip)	*0.45*	*0.52*	*0.69*	*0.32*	*0.42*	*0.63*

Tabel 5.3. Jadwal pembersihan endapan karet (Rubber Removal)

Frekuensi Pendaratan Per Hari	*Pembersihan Rutin*
≤ 5	*Setiap 2 tahun*
16 – 30	*Setiap 1tahun*
31 – 90	*6 bulan sekali*
91 – 150	*4 bulan sekali*
151 – 210	*3 bulan sekali*
≥ 210	*2 bulan sekali*

Table 5.3. Schedule of rubber removal

Land ng Frequency Per Day	*Schedule*
≤ 15	*Every 2 years*
16 – 30	*Every 1 years*
31 – 90	*Every 6 month*
91 – 150	*Every 4 month*
151 – 210	*Every 3 month*
≥ 210	*Every 2 month*

1.11 Additional Information

Investigation is continuing. KNKT plans to complete the investigation within 12 months since the day of the occurrence. Should any further relevant safety issues emerge during the course of the investigation, KNKT will immediately bring the issues to the attention of the relevant parties and publish as required.

1.12 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 FINDINGS[5]

According to factual information during the investigation, the Komite Nasional Keselamatan Transportasi identified initial findings as follows:

1. The aircraft was airworthy prior to the accident, there was no report or record of aircraft system abnormality during the flight.
2. The aircraft operator had a valid Air Operator Certificate (AOC) to conduct a scheduled passenger transport. The aircraft had a valid Certificate of Airworthiness (C of A) and Certificate of Registration (C of R).
3. The crew held valid licenses and medical certificates.
4. In this flight Pilot in Command (PIC) acted as Pilot Flying (PF) and the Second in Command (SIC) acted as Pilot Monitoring (PM).
5. The weather conditions during the occurrence were slight rain and runway was wet.
6. Prior to touchdown and on landing roll, the FDR data showed variation of wind speeds and directions, activation of reversers, asymmetry break pressures and rudder deflection.
7. The aircraft stopped on the left shoulder of runway 09 at about 1,600 meters from begining runway 09 and 20 meters on the left of runway edge.
8. The last runway friction check was performed on 3 February 2016 and the last rubber deposit cleaning was performed on 5 - 7 October 2016.
9. According Advisory Circular CASR Part 139-23, if the frequency of the landing aircraft was 140, the runway friction check shall be performed monthly and the rubber deposit cleaning shall be performed every 4 months.
10. There were several unclear runway centreline markings on the touchdown area of runway 09.
11. There was a difference of runway, taxiway and apron daily inspection schedule in the AM and SOP. In the AM mentioned that the inspection performed three times a day, while in the SOP mentioned that the inspection performed twice a day.

5 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.

3 SAFETY ACTION

At the time of issuing this preliminary report, the Komite Nasional Keselamatan Transportasi had been informed by PT. Garuda Indonesia for the issuance of safety actions resulting from this occurrence.

- On 16 February 2017, issued announcement to all cabin crew number JKTCC/PE/60009/17 to understand and implement several requirement on Operation Manual part B regarding the evacuation process during aircraft accident or incident.
- On 21 February 2017, issued Notice to Flight Crew number 011/2017 which contained reminder to maintain safety operation during rainy season.

4 SAFETY RECOMMENDATIONS

According to factual information and findings, the Komite Nasional Keselamatan Transportasi issued safety recommendations to address the early safety issues identified in this report.

PT. Angkasa Pura I branch office Adisutjipto International Airport

- **04.O-2017-06.1**

  The unclear runway centerline marking on the touchdown area on the reduced visibility could be possible increase a risk on aircraft operation. Therefore, KNKT recommends ensuring that the runway centerline marking is clearly visible during aircraft operation.

- **04.O-2017-06.2**

  There was a difference of runway, taxiway and apron daily inspection schedule in the AM and SOP. In the AM mentioned that the inspection performed three times a day, while in the SOP mentioned that the inspection performed twice a day. Therefore, the KNKT recommends reviewing and or amending the inspection schedule to ensure the implementation is consistent with such manuals,

5 APPENDICES

5.1 Notice to Flight Crew Number 011/17

Garuda Indonesia

FLIGHT OPERATION

Notice To : **Flight Crew**
Nr : **011 / 17**
Subject : Safety Reminder Wet Seasons

Date : 21 February 2017

Dear all Pilots,

To maintain safety in rainy condition, especially when TSRA is reported in the TAFOR and or METAR, or ATIS, or ATC reporting that there is "rain over the field", there are few things we would like to remind you:

1. Strictly observed & study weather of Departure, Destination & Alternate
2. Review fuel policy criteria
3. Review Taxi, Take Off & Landing technique and limitation (cross/tail wind)
4. Review adverse Weather limitation such as:
   a. Performance calculation (Take Off & Landing)
   b. Use of anti-ice
   c. Use of ignition
   d. Wind shear
   e. Use of weather radar requirement, etc.
5. Consider to delay the approach waiting for weather improvement.
6. To anticipate the possibility of hydroplaning, we urge to all flight crew to confirm with the ATC whether it is heavy rain or not. If heavy rain is stated, then:
   a. Choose poor braking action for landing distance calculation (see OM-A 14.1.1-03)
   b. Use maximum flaps setting and maximum auto brake.
   c. Strictly follow SOP and STABILIZED APPROACH criteria
   d. Perform landing in wet runway technique and procedure, as in AOM/FCOM flight technique.
7. Always exercise extreme caution and maintain situational awareness during approach and landing.
8. Assess environmental condition carefully as it may reduce the braking capability of the aircraft (hydroplaning)
9. Review use of reverse thrust, especially when landing in wet runway
10. When in doubt: **GO AROUND or Rejected Landing**

Thank you for your attention and cooperation.
Safe flight.

5.2 Announcement Number JKTCC/PE/60009/17

Garuda Indonesia

ANNOUNCEMENT
No. JKTCC/PE/60009/17

on

RAISING ALERTNESS AND AWARENESS ON FLIGHT DUTY

Referring to email from unit Incident Investigation (JKTDVI-2) on February 14th, 2017 about Follow up Action GA-258, in order to maintain safety and security aspect in performing flight duty, we hereby remind all Cabin Crew of several points below:

1. Cabin Crew are required to understand **OM B2 chapter 10.2.2** on Crew Action on Aircraft incidents/accidents.
2. Cabin Crew are required to understand **OM B2 chapter 10.3.4** and **chapter 10.3.5**, especially on "Flight attendants must be aware of all signals that warn of an emergency or potential emergency. Upon hearing an emergency call, flight attendant must proceed to cockpit or pick up the nearest handset, as soon as possible for further instructions".
3. Cabin Crew are required to understand **OM B2 chapter 10.4** on Cabin Preparations
4. Cabin Crew are required to understand **OM B2 chapter 10.5** on Escape the Aircraft, especially on "after evaluate situation, FA1 should report cabin condition to flight crew with interphone and ask for possibility of receiving further instruction from flight crew" and about "Flight attendant should notify the cockpit crew to coordinate evacuation if no word coming out from cockpit..."

In relation to the above, all FSM / FA-1 shall always remind in Pre-Flight Briefing and intensify control function on the implementation of above provisions in accordance with applicable SOP.

This information was delivered to be implemented with consistency and discipline manner, thank you for your attention and good cooperation. Have a safe flight.

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