KOMITE NASIONAL KESELAMATAN TRANSPORTASI
REPUBLIC OF INDONESIA

FINAL

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Aircraft Serious Incident Investigation Report

PT. Batik Air Indonesia

Boeing 737-900 ER; PK-LBO

Adisutjipto International Airport

Yogyakarta, Republic of Indonesia

6 November 2015

2016

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

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ABBREVIATIONS AND DEFINITIONS

AC	:	Advisory Circular
ADC	:	Aerodrome Control Tower
AFE	:	Above Field Elevation
AIP	:	Aeronautical Information Publication
AM	:	Aerodrome Manual
AOC	:	Airline Operator Certificate
APP	:	Approach Control Unit
ARFF	:	Airport Rescue and Fire Fighting
ATC	:	Air Traffic Control
ATIS	:	Automatic Terminal Information Service
ATPL	:	Airline Transport Pilot License
ATS	:	Air Traffic Service
AWOS	:	Automatic Weather Observation Sytem
BMKG	:	Badan Meteorologi Klimatologi Geofisika
°C	:	Centigrade
CAB	:	Company Airport Briefing
CASR	:	Civil Aviation Safety Regulation
CCTV	:	Close Circuit Television
CET	:	Crew Emergency Training
COM	:	Company Operation Manual
CPL	:	Commercial Pilot License
CRM	:	Crew Resource Management
CVR	:	Cockpit Voice Recorder
DGCA	:	Directorate General of Civil Aviation
EGPWS	:	Enhanced Ground Proximity Warning System
FA	:	Flight Attendant
FAM	:	Flight Attendant Manual
FCOM	:	Flight Crew Operation Manual
FCTM	:	Flight Crew Training Manual
FDR	:	Flight Data Recorder
FIR	:	Flight Information Region
FOD	:	Foreign Object Damaged

FPPM	:	Flight Planning and Performance Manual
ft	:	Feet
ICAO	:	International Civil Aviation Organisation
ILS	:	Instrument Landing System
IMC	:	Instrument Meteorological Condition
KNKT	:	Komite Nasional Keselamatan Transportasi
kts	:	Knots
LPPNPI / AirNav	:	Lembaga Penyelenggara Pelayanan Navigasi Penerbangan Indonesia
LT	:	Local Time
m	:	Meter
MAC LDG	:	Mean Aerodynamic Chord Landing
MAC TOW	:	Mean Aerodynamic Chord Take-off weight
MHz	:	Megahertz
MLW	:	Maximum Landing Weight
MTOW	:	Maximum Take-off Weight
NNC	:	Non Normal Checklist
NOTAM	:	Notice to Airmen
NTP	:	Notice to Pilot
OAT	:	Outside Air Temperature
OM	:	Operation Manual
PAPI	:	Precision Approach Path Indicator
PF	:	Pilot Flying
PIC	:	Pilot in Command
PKP-PK	:	Pertolongan Kecelakaan Penerbangan dan Pemadam Kebakaran (see ARFF)
PM	:	Pilot Monitoring
PMS	:	Pavement Management System
QFE	:	Altimeter setting based on aerodrome elevation air pressure
QNH	:	Altimeter setting based on mean sea level air pressure
RAAS	:	Runway Awareness Advisory System
RESA	:	Runway End Safety Area
SAI	:	Special Airport Information
SEP	:	Safety Emergency Procedure
SI	:	Staff Instruction

SIC	:	Second in Command
SMS	:	Safety Management System
SOP	:	Standard Operation Procedure
TALPA ARC	:	Take-off and Landing Performance Assessment Aviation Rules Committee
UTC	:	Universal Coordinated Time
VHF	:	Very High Frequency
VMC	:	Visual Meteorological Condition
VOR	:	Very High Frequency Omni-directional Range

INTRODUCTION

SYNOPSIS

On 6 November 2015, a Boeing 737-900ER registration PK-LBO was being operated by PT. Batik Air Indonesia on a scheduled passenger flight from Soekarno-Hatta International Airport, Jakarta (WIII) to Adisutjipto International Airport, Yogyakarta (WAHH) with flight number BTK 6380. The flight departed from Jakarta at 0713 UTC with total person on board of 168 people and the Pilot in Command (PIC) acted as Pilot Flying (PF) while the Second in Command (SIC) acted as Pilot Monitoring (PM). The flight from departure until commencing approach into Yogyakarta was uneventful and there was no report or record of aircraft system abnormality during the flight.

After received meteorological information from Aerodrome Terminal Information Services (ATIS) the pilot decided to land with configuration flaps 40 and auto-brake 3. While approaching Yogyakarta, the pilots noticed cumulonimbus cloud over Yogyakarta then decided to follow wind shear precaution recommendation to use flaps 30 for landing.

During Instrument Landing System (ILS) approach runway 09, the pilot received information that the runway was wet and decided to change the selection of the auto-brake from three to maximum.

The FDR data indicated that at altitude 10 feet the speed was 159 knots and floated for 6 seconds then touched down at 730 meters from beginning runway 09 on speed 154 knots. The aircraft stopped at about 84 meters from end of runway 09 and passenger evacuation initiated 9 minutes after. No one injured in this accident.

Four conditions affecting the landing distance, specifically the aircraft floated for about 6 seconds and touched down at 427 meter beyond the aim point, after bouncing once; the airspeed at touchdown was 13 knots above Vref, and there was average tailwind of 6 knots; the thrust reversers were stowed at a higher than recommended speed and there was little braking for about 305 meter after the autobrakes were disconnected; and the wet runway conditions resulted in less deceleration.
The investigation concluded the contributing factors to this accident are:

- The absence of landing distance calculation following landing reconfiguration and the higher speed with no reminder callout might have made the pilots decided to continue landing, and
- The conditions of the aircraft floated and eventually touched down at the end of the touchdown zone 13 knots above Vref with average 6 knots tailwind, lower brake pressure for 305 meter after the autobrakes were disconnected, and removal of the thrust reverser application at a higher than recommended speed along with medium braking action had extended the landing distance.

The investigation also considered the external factors such as runway condition might have contributed to the reducing of deceleration rate while the brake pressure and thrust reversers were close to maximum.

Following this accident PT. Batik Air Indonesia has issued 24 safety actions which considered relevant to improve safety. In addition, KNKT issued safety recommendations addressed to PT. Batik Air Indonesia, PT. Angkasa Pura Airport branch Adisutjipto International Airport, AirNav Indonesia district office Yogyakarta and the Directorate General of Civil Aviation.

1 FACTUAL INFORMATION

1.1 History of the Flight

On 6 November 2015, a Boeing 737-900ER registration PK-LBO was being operated by PT. Batik Air Indonesia on a scheduled passenger flight from Soekarno-Hatta International Airport, Jakarta (WIII) to Adisutjipto International Airport, Yogyakarta[1] (WAHH). The flight departed from Jakarta at 0713 UTC[2] with flight number BTK 6380 with total person on board of 168 people consists of two pilots, five flight attendants and 161 passengers. The Pilot in Command (PIC) acted as Pilot Flying (PF) and the Second in Command (SIC) acted as Pilot Monitoring (PM). The flight from departure until commencing approach into Yogyakarta was uneventful and there was no report or record of aircraft system abnormality during the flight.

Figure 1: The archive photo of the aircraft (copyright Planetspotters.net)

At 0736 UTC, the aircraft was over CLP VOR[3] and the pilot made first contact with Yogyakarta Approach controller (Yogya Director), and was informed that the flight was on sequence number 2 for landing.

During approach to Yogyakarta, the pilots received meteorological information from Aerodrome Terminal Information Services (ATIS) that was issued at 0730 UTC which contained information of wind 210° / 10 knots, visibility 7 km, weather nil, cloud scattered[4] 1,700 feet, temperature 35°C, dew point 22°C and QNH 1005 mbs. Referred to the ATIS information, the pilot decided to land with configuration flaps 40 and auto-brake 3.

1 Adisutjipto International Airport, Yogyakarta will be named Yogyakarta for the purpose of this report.

2 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 Barat (WIB) which is UTC + 7 hours.

3 CLP VOR is VHF Omni Directional Radio Range located in Cilacap – 75 nm from Yogyakarta on bearing 275°.

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 Few (FEW) is when the clouds cover 1/8 area of the sky, scattered (SCT) is when the clouds cover 3/8 to 4/8 area of the sky and Broken (BKN) is when the clouds cover more than half (5/8 up to 7/8) area of the sky.

While approaching Yogyakarta, the pilots noticed cumulonimbus cloud over Yogyakarta as indicated by magenta figure on the weather radar and decided to follow windshear[5] precaution recommendation as described on the Flight Crew Operations Manual (FCOM) to use flaps 30 for landing[6].

At 0754 UTC, the aircraft established on the localizer runway 09 and the flight was transferred to Adisutjipto Tower controller (Adi Tower).

At 0756 UTC, the pilot asked the Adi Tower whether the runway was wet and it was affirmed by Adi Tower. Referring to the runway condition, the pilots decided to change the selection of the auto-brake to maximum.

At 0758 UTC, the Adi Tower had visual contact with the aircraft and asked the pilot whether runway was insight, and was confirmed by the pilot. Adi Tower issued landing clearance followed by additional information of wind condition was calm and runway was wet.

At 0800 UTC, the aircraft touched down, and according to the pilot statement during the interview that during flare out the aircraft floated and touched down beyond touchdown zone. The pilot immediately applied maximum reverse thrust after touchdown. When the aircraft decelerating and passed abeam N2 taxiway, the PIC realized that the aircraft would not be able to stop at the end of runway, then the PIC overrode the auto-brake to maximum manual brake. At approaching the end of runway, the PIC turned the aircraft to the left and stopped at about 84 meters from end of runway 09 and about 80 meters on the left of runway centerline extension.

At 0800 UTC, Adi Tower provided the landing time and instructed the pilot to exit the runway via taxiway N3 and proceed to parking stand number 2. Thereafter, the controller noticed that the aircraft overrun and pushed the crash bell to inform the Airport Rescue and Fire Fighting (ARFF).

After the aircraft stopped, the SIC requested the Adi Tower whether there was fire seen from the tower and replied that there was no sign of fire around the aircraft. The PIC then commanded to perform slow evacuation using the escape slides.

Figure 2: The aircraft condition just after stopped

5 Windshear is a change of wind speed and/or direction over a short distance along the flight path (B737-800/900ER FCOM chapter SP.16.26).

6 B737-800/900ER FCOM Supplementary Procedures – Adverse Weather, Windshear Precautions for landing (SP.16.27).

1.2 Injuries to Persons

There was no injury to person as a result of this occurrence and all occupants were Indonesian.

1.3 Damage to Aircraft

The aircraft damaged on its belly. The observation found that the lock pin of the nose gear that provides structural support for the nose gear broken into three pieces and caused the nose wheel folded backward then damaged the forward belly.

Figure 3: The aircraft after the impact with the nose wheel folded backward

1.4 Other Damage

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

1.5 Personnel Information

1.5.1 Pilot in Command

Gender	:	Male
Age	:	45 years
Nationality	:	Indonesian
Marital status	:	Married
Date of joining company	:	25 March 2009
License	:	ATPL
Date of issue	:	10 August 2014
Validity	:	30 April 2016
Aircraft type rating	:	MD-80; MD-90; B737-NG
Instrument rating validity	:	31 October 2016
Medical certificate	:	First Class
Last of medical	:	31 July 2015
Validity	:	31 March 2016
Medical limitation	:	The holder shall possess glasses that correct for near vision.

Last line check	:	7 March 2015
Last proficiency check	:	23 November 2015
Flying experience		
Total hours	:	3,628 hours 26 minutes
Total on type	:	2,661 hours 40 minutes
Last 90 days	:	85 hours 36 minutes
Last 60 days	:	42 hours 36 minutes
Last 24 hours	:	4 hours 6 minutes
This flight	:	58 minutes
Last emergency training	:	May 2015

1.5.2 Second in Command

Gender	:	Male
Age	:	22 years
Nationality	:	Indonesian
Marital status	:	Single
Date of joining company	:	3 November 2013
License	:	CPL
Date of issue	:	10 June 2013
Validity	:	30 April 2016
Aircraft type rating	:	B737-NG
Instrument rating validity	:	30 April 2016
Medical certificate	:	First Class
Last of medical	:	5 November 2015
Validity	:	31 May 2016
Medical limitation	:	None
Last line check	:	Not applicable
Last proficiency check	:	1 May 2015
Flying experience		
Total hours	:	1,787 hours 55 minutes
Total on type	:	1,596 hours 50 minutes
Last 90 days	:	246 hours 18 minutes
Last 60 days	:	179 hours 46 minutes

Last 24 hours	:	4 hours 6 minutes
This flight	:	58 minutes
Last emergency training	:	October 2015

1.5.3 Flight Attendant

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

1.6 Aircraft Information

1.6.1 General

Registration	:	PK-LBO
Manufacturer	:	Boeing Aircraft Company
Country of Manufacturer	:	United States of America
Type/ Model	:	737-9GPER
Serial Number	:	38731
Year of manufacture	:	2013
Certificate of Airworthiness		
Issued	:	28 May 2015
Validity	:	27 May 2016
Category	:	Transport
Limitations	:	None
Certificate of Registration		
Registration Number	:	3306
Issued	:	28 May 2015
Validity	:	27 May 2016
Time Since New	:	9,185 hours 7 minutes
Cycles Since New	:	4,691 cycles
Last Major Check	:	Nil
Last Minor Check	:	14 August 2015 (P09)

1.6.2 Engines

Manufacturer	:	CFM International
Type/Model	:	Turbo Fan / CFM56-7B26E
Serial Number-1 engine	:	963832
Time Since New	:	7,693 hours 12 minutes
Cycles Since New	:	3,915 cycles
Serial Number-2 engine	:	962841

Time Since New	:	9,185 hours 7 minutes
Cycles Since New	:	4,691 cycles

1.6.3 Weight and Balance

The aircraft departed Jakarta for Yogyakarta within the proper weight and balance envelope, as shown in the following table:

Maximum Take-off weight	:	78,017 kg
Actual take-off weight	:	66,110 kg
Maximum landing weight	:	71,350 kg
Estimated landing weight	:	63,910 kg
MAC TOW	:	25.03 %
MAC TOW Limit	:	13.1 – 30.3 %
MAC LDG	:	25.55 %

According to Operator Flight Crew Operations Manual (FCOM) Chapter PI.20.5, for configuration of flap 30 at landing weight of 65,000 kg, the Vref was 142 knots and at landing weight 60,000 kg, the Vref was 136 knots. Based on these data, the interpolation for landing weight 63,910 kg, Vref landing with configuration of flap 30 was 141 knots.

1.6.4 Runway Awareness and Advisory System

The aircraft equipped with Honeywell SmartRunway®/SmartLanding® as a Runway Awareness and Advisory System (RAAS) which provides information associated with landing configuration and or profiles. One of the features is providing aural warning about distance remaining during landing role. Several descriptions of the RAAS features taken from Honeywell Product Description - SmartRunway®/SmartLanding® are as follows:

4.2.4 Distance Remaining – Landing Roll-Out Advisory

The purpose of the Distance Remaining advisories is to enhance crew awareness of aircraft along-track position relative to the runway end.

4.2.4.1 Annunciation Criteria

The Distance Remaining advisory is generated when the following conditions are met: Aircraft is within 100 feet of the ground, over the last half of the runway or a specified distance from the runway end; or Aircraft is on the ground, on the last half of the runway (default) or a specified distance from the runway end, and Aircraft ground speed is above 40 knots.

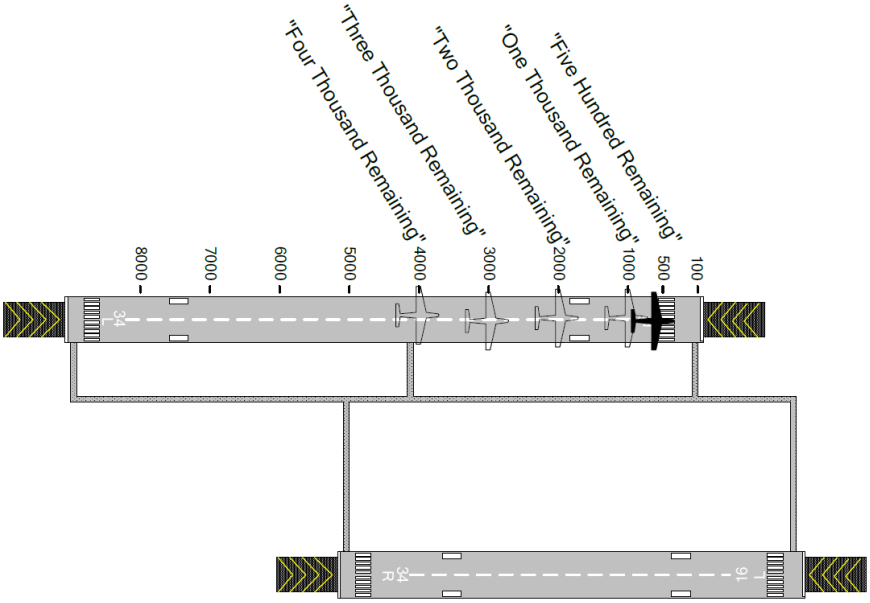


Figure 4-4: Distance Remaining – Landing and Roll – Out (in feet) Advisory

Refer to Figure 4-4. If the crew elects to go-around after the Distance Remaining advisories are triggered, the advisories continue to be annunciated at the appropriate distances along the runway. The Distance Remaining advisories are inhibited once the aircraft climbs above 100 feet Radio Altitude or aircraft climb rate is greater than 450 fpm.

1.7 Meteorological Information

The weather data for Adisutjipto International Airport was provided by the Air Force Meteorological Unit at thirty minutes intervals or when a significant weather changes occurs, with the weather observation being performed ten minutes prior to the issuance.

The meteorological unit utilizes Automatic Weather Observation System (AWOS) and Aerodrome Terminal Information Services (ATIS). The AWOS monitor display was located in the Air Force Meteorological Unit office and there was no display in the tower controller desk. In order to have the AWOS information, a CCTV camera was provided to relay the AWOS display to a monitor display in tower desk controller. The visual quality of the monitor display in desk controller became unclear and therefore, the tower controller has to call meteorology officer to get the latest information from AWOS.

The weather reported by Yogyakarta ATIS on 6 November 2015 was as follows:

	0730 UTC	**0734 UTC**	**0800 UTC**	**0830 UTC**
Wind	200° / 10 knots	220° / 6 knots	300° / 3 knots	240° / 2 knots
Visibility	7 km	7 km	3 km	3 km
Weather	NIL	NIL	Slight Rain	Slight Rain
Cloud	Scatter 1,700 ft	Scatter 1,700 ft	Scatter 1,700 ft	Scatter 1,700 ft
Temp. / Dew point	35° C / 22° C	35° C / 22° C	32° C / 23° C	32° C / 23° C
QNH	1,005 mbar / 70 inHg	1,009 mbar / 29.80 inHg	1,006 mbar / 29.71 inHg	1,006 mbar / 29.71 inHg
QFE	993 mbar / 233 inHg	993 mbar / 29.33 inHg	993 mbar / 29.34 inHg	994 mbar / 29.35 inHg
Remarks	No significant	Rain in North Area	No significant	No significant

The satellite weather image provided by *Badan Meteorologi Klimatologi dan Geofisika* (BMKG – Bureau of Meteorology, Climatology and Geophysics) at 0820 UTC, which was about 20 minutes after the occurrence, showed the clouds formation on the west of the Yogyakarta.

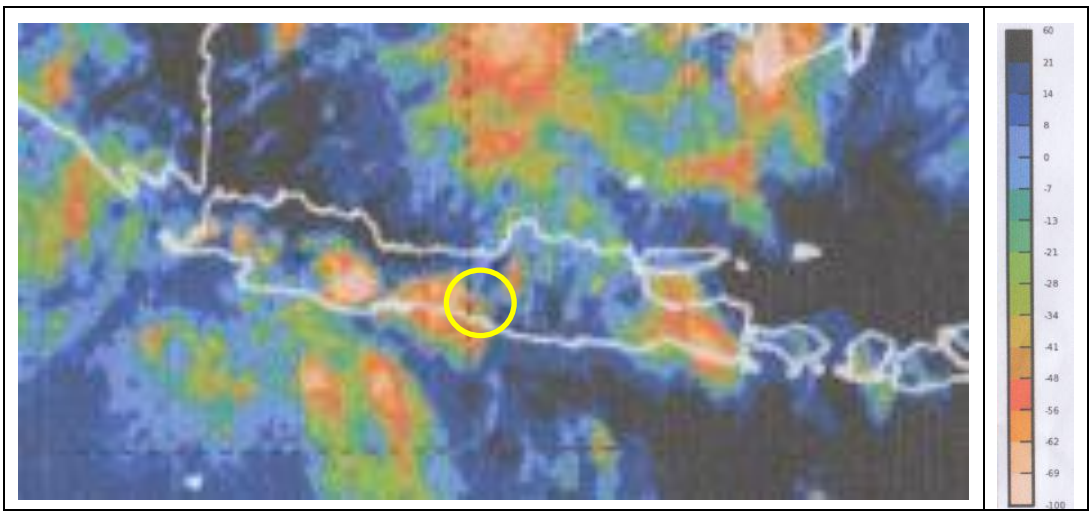


Figure 4: Satellite image at 0820 UTC provided by BMKG

1.8 Aids to Navigation

Runway 09 Yogyakarta was equipped with an Instrument Landing System (ILS) approach guidance facilities, operating on frequency 109.1 MHz. The last calibration was performed on 31 October 2015 and the next periodic calibration should be performed on 30 April 2016. On the day of the accident, the ILS was serviceable and functioning properly.

1.8.1 The ILS Approach Profile

The current ILS approach profile for runway 09 provided by Directorate General of Civil Aviation on Aeronautical Information Publication (AIP) Volume II showed on the following figure.

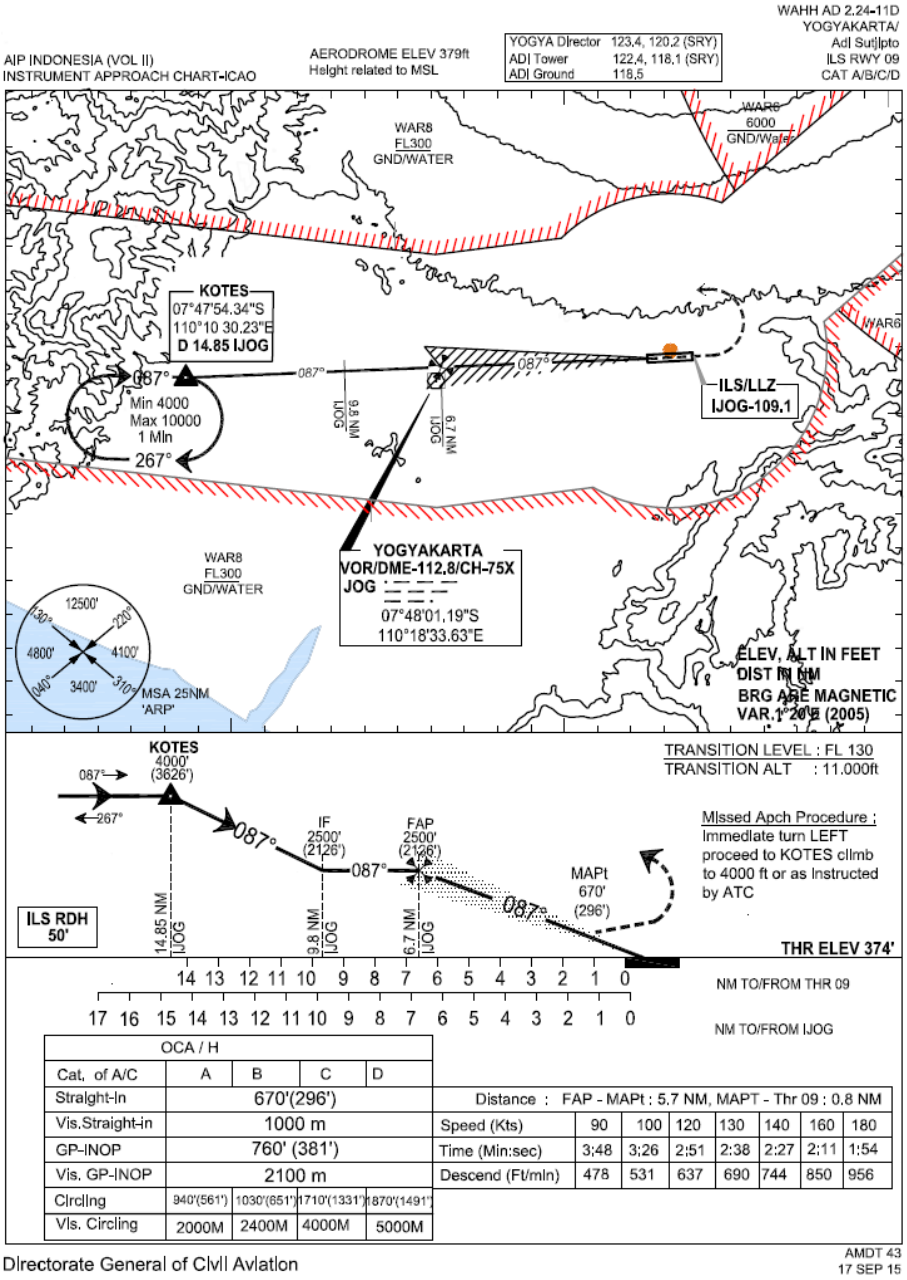


Figure 5: The ILS approach chart published in AIP Volume II

Approach guidance facilities such as approach light, 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.

1.9 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.

1.10 Aerodrome Information

Airport Name	:	Adisutjipto International Airport
Airport Identification	:	WAHH / JOG
Airport Operator	:	PT. Angkasa Pura Airport (Persero)
Airport Certificate	:	018/SBU-DBU/XI/2015
Validity	:	30 July 2020
Coordinate	:	07°47'12"S 110°25'55"E
Elevation	:	350 feet
Runway Direction	:	09 – 27 / 087° – 267°
Runway Dimension	:	2,200 x 45 meters
Runway Strip Dimension	:	2,285 x 300 meters
Runway End Safety Area		
• Runway 09	:	90 x 90 meters
• Runway 27	:	Not available with exemption
Surface	:	Asphalt
Fire fighting category	:	VII
Remarks	:	The airport was military airbase, and on 1975 the function was changed to enclave civil and military airport that served military training flight, domestic and international passenger flight.

The last rubber deposit cleaning was performed on 29 October 2015 by using chemical liquid (Magnus 758) on touchdown runway 09 area of 1,500 m^2 (figure 6).

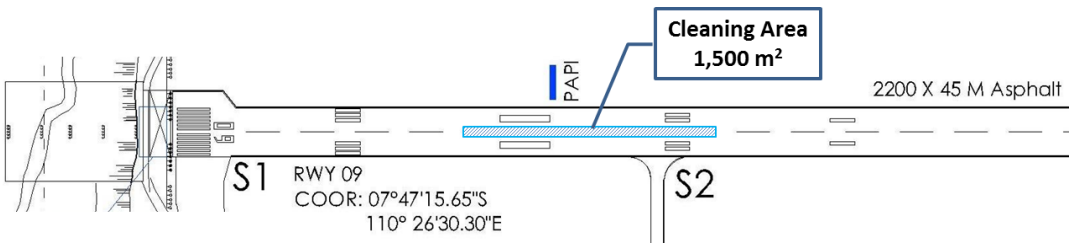


Figure 6: The last rubber deposit cleaning location

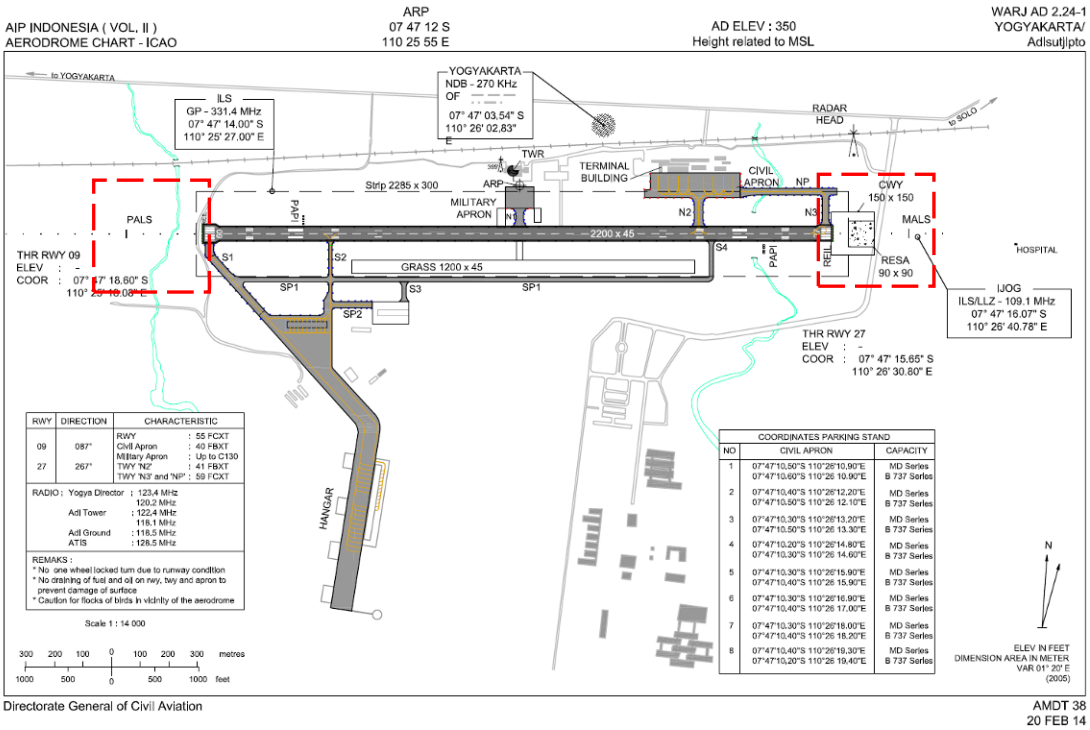


Figure 7: The airport layout published on Aeronautical Information Publication

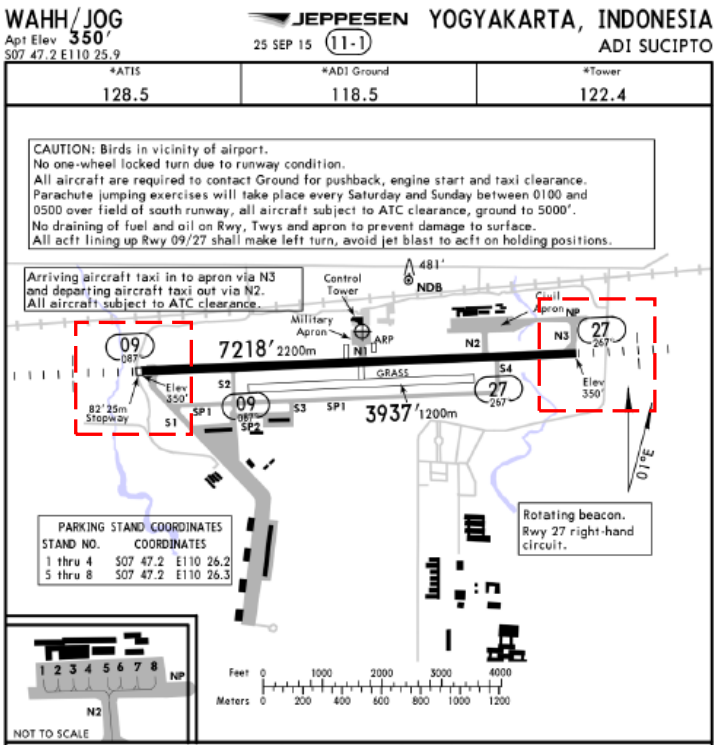


Figure 8: The airport layout published by Jeppesen

There was different information related to stopway, clearway and RESA between Aerodrome Information Publication (AIP) and Jeppesen publication.

1.11 Flight Recorders

1.11.1 Flight Data Recorder

The aircraft was fitted with Honeywell HFR5-D Flight Data Recorder (FDR) model with part number 980-4750-009 and serial number 02242. The recorder was transported to KNKT recorder facility for data downloading process. The FDR recorded 1,265 parameters and approximately 53 hours of aircraft operation, which was containing 31 flights including the accident flight.

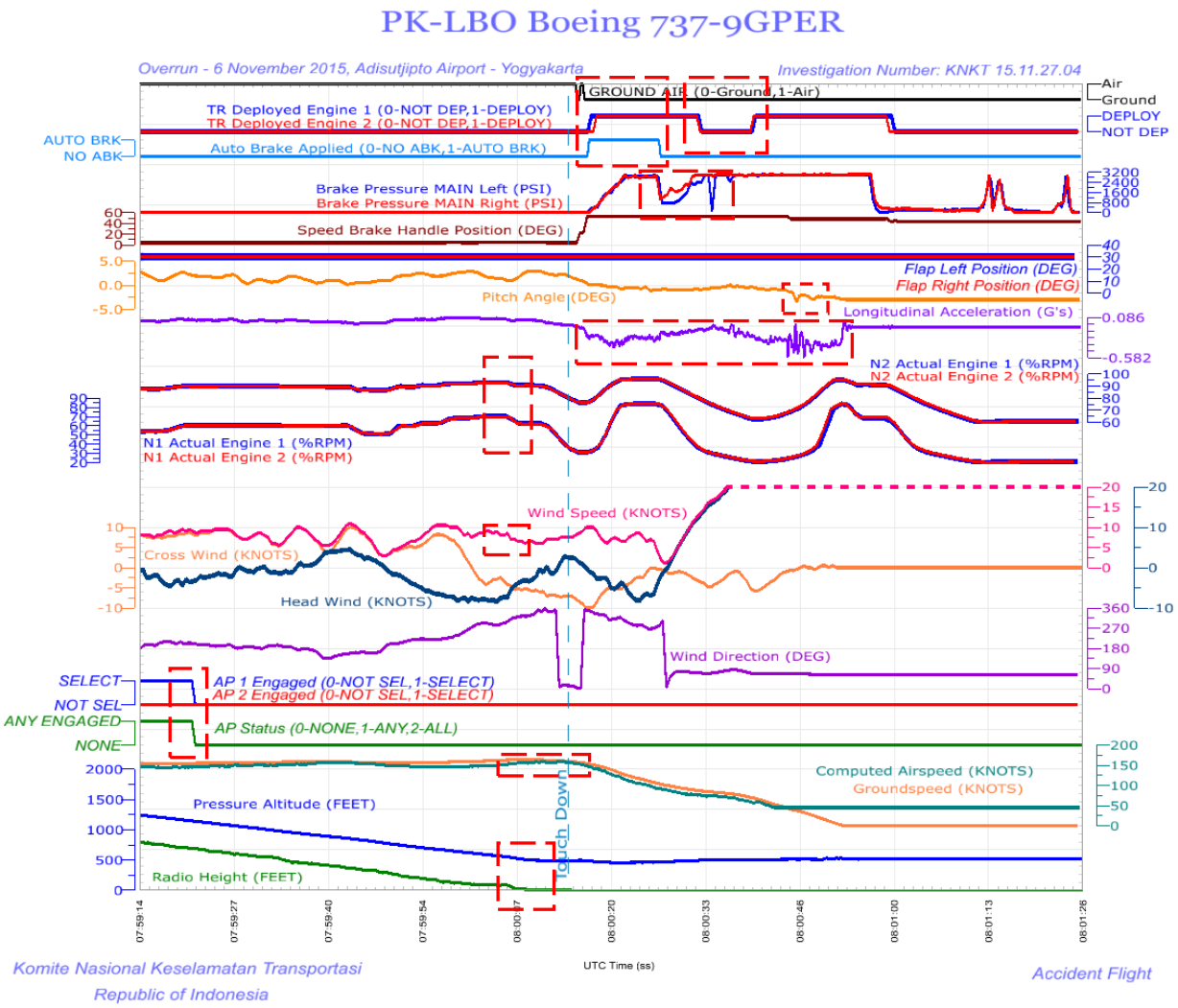


Figure 9: The significant FDR parameters

The red boxes on figure 9 showed significant event that will be described on chapter 1.11.3 (Recorders Significant Events).

1.11.2 Cockpit Voice Recorder

The aircraft was fitted with Honeywell CVR 120 model with part number 980-6022-001 and serial number 15719. The recorder was transported to KNKT recorder facility for data downloading process. The CVR recorded 2 hours and 1 minute of good quality recording data. The significant excerpts from the CVR are as follows:

Note:
EGPWS is Enhanced Ground Proximity Warning System
P1 is PIC
P2 is SIC
TWR is Adisutjipto Tower controller
RAAS is Runway Awareness and Advisory System

Time (UTC)	From	Communication
8:00:10.567	EGPWS	Ten
8:00:16.000		Touchdown (from FDR data)
8:00:16.239	P2	Speed brake up
8:00:16.813	RAAS	Four Thousand Remaining
8:00:19.560	P2	Reverser normal
8:00:24.263	RAAS	Two Thousand Remaining
8:00:28.157	P1	Auto brake disarm
8:00:28.552	P2	Auto brake disarm
8:00:31.220	RAAS	One Thousand Remaining
8:00:33.572	TWR	Provided landing time and instructed to taxi via November 3 to parking stand number 2
8:00:34.046	P2	Brake
8:00:35.291	RAAS	Five Hundred Remaining
8:00:37.900		Noisy sound heard
8:00:51.458	P2	Speed brake
8:00:53.000		The aircraft stopped (from FDR data)
8:00:55.015	P2	Attention, attention crew on station
8:00:55.015	P1	Brace brace brace
8:00:57.426	P2	Capt , shutdown capt
8:01:07.110	P1	Brace brace brace
8:01:21.617		Chime

1.11.3 Significant Events from Recorders

The significant events recorded from 07:59:23 UTC at altitude 676 feet (all altitude on this sub chapter is based on radio height) until the aircraft stopped at 08:00:53 UTC were as follows:

- 07:59:23 UTC, Auto pilot and auto throttle disconnected at approximately 700 feet.
- At 500 feet, the speed brake was armed.
- The N1s value at 07:59:43 UTC, at altitude 381 feet was 60% and the speed was 157 knots, and at 08:00:06 UTC, at altitude 87 feet increased to 70% followed by speed increasing from 153 knots up to 159 knots at 10 feet.
- 07:59:52 UTC, at 229 feet the PM advised the PF to fly right and acknowledged by PF.
- From approximately 200 feet to 10 feet, the average tail wind was 6 knots.
- 08:00:07 UTC, the aircraft passed altitude 50 feet with speed of 153 knots.
- 08:00:10 UTC, the altitude was 10 feet at speed of 159 knots and touch down 6 seconds later. The average speed from altitude 10 feet to touchdown was 156 knots.
- 08:00:16 UTC, the aircraft touched down with the speed of 154 knots (Vref + 13), bounced briefly and touched down a second time followed by RAAS aural "Four Thousand Remaining".
- 08:00:18 UTC, the thrust reversers were deployed, followed by all spoiler deployment and auto-brake activation with the average brake pressure of approximately 2,494 psi and N1 84.8%. The average of longitudinal acceleration was -0.27 G for 8 seconds.
- 08:00:24 UTC, RAAS aural "Two Thousand Remaining".
- 08:00:28 UTC, the auto brake disarmed, the average brake pressure dropped to approximately 785 psi for 3 seconds, until manual braking was applied and the pressure increased to 3,000 psi again, the longitudinal acceleration increased.
- 08:00:33 UTC, the reverser stowed for approximately seven seconds at approximately 76 knots, although they had been reduced from the maximum setting at 91 knots.
- 08:00:37 UTC, noisy sound heard, the aircraft heading changed and the longitudinal acceleration was -0.03 G and then decreased on average -0.31 G.
- 08:00:45 UTC, the pitch angle changed from -0.88° to -1.41°.
- 08:00:53 UTC, the aircraft stopped.

1.12 Wreckage and Impact Information

After the aircraft leaving the pavement, there were no sign of nose wheel mark on the gravel instead of an indentation the gravel with the dimension approximately 50 cm in width and 150 cm in length. Subsequently, after the indentation, there was a long single scrath mark on the gravel until the aircraft final position.

The aircraft stopped at about 80 meters on the left of runway 09 centerline extension and about 84 meters from end of runway 09 with the nose landing gear collapsed.

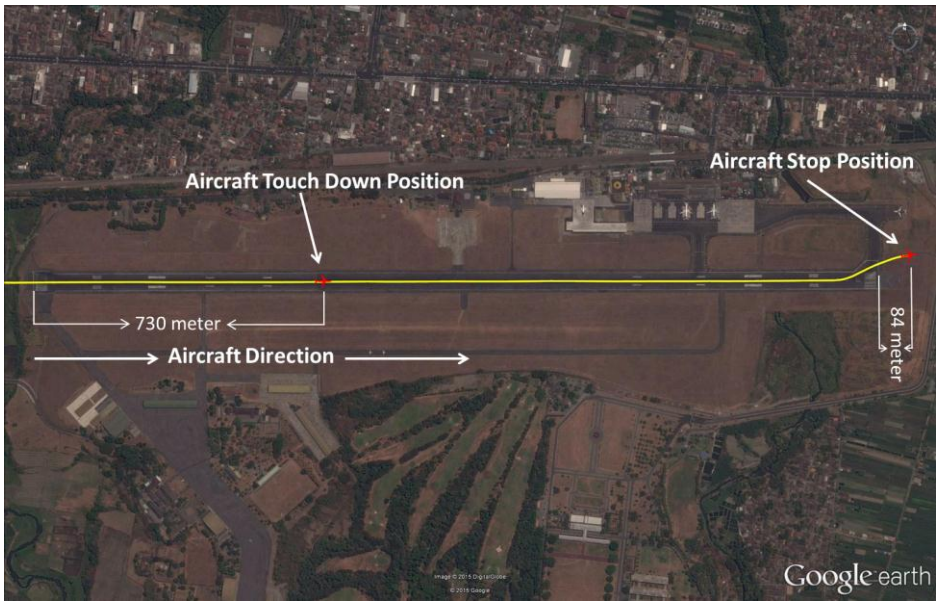


Figure 10: The aircraft movement based on FDR data

Figure 11: The main and nose wheel marks (indicated by arrows)

Figure 12: Nose wheel mark on the grass (left) and the Aircraft last position after passenger evacuated (right)

Figure 13: Auto brake selection at "MAX"

1.13 Medical and Pathological Information

No medical or pathological investigations were conducted as a result of this occurrence, nor were they required.

1.14 Fire

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

1.15 Survival Aspects

08:00:53 UTC, two seconds after the aircraft stopped, the SIC commanded "ATTENTION CREW ON STATION" and the PIC commanded "BRACE, BRACE, BRACE".

08:01:07 UTC, the PIC made another command "BRACE, BRACE, BRACE".

08:01:09 UTC, the SIC asked PIC to set the engine power to idle.

08:01:21 UTC, the pilot called flight attendant using chime and commanded the Flight Attendant 1 (FA-1) to check the possibility of fire and standby for further instruction through interphone.

The FA-1 and FA-4 positions were in forward area and the FA-2, FA-3 and FA-5 were in aft area.

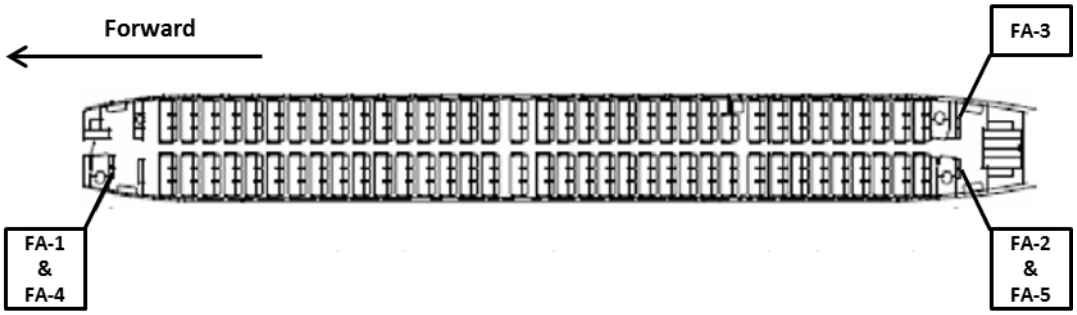


Figure 14: Flight attendant position

08:01:33 UTC, the crew started the APU.

After noticed the aircraft overrun, the Adi Tower controller (Adi Tower) pressed crash bell and informed the Airport Rescue and Fire Fighting (ARFF) that the aircraft had overrun. According to the airport CCTV, the ARFF arrived at accident site in approximately two and half minutes after the aircraft stopped. According to ARFF observation there was no sign of pre or post impact fire.

08:02:26 UTC, the SIC requested to Adi Tower for monitoring the possibility of fire and was replied that there was no sign of fire on the aircraft.

08:02:37 UTC, the FA commanded the passengers to stay on their seats.

08:03:08 UTC, the crew called the FA-1 by using chime and informed that the APU generator was available.

08:03:21 UTC, the crew turned on the air conditioning from the APU bleed-air.

08:03:49 UTC, the PIC asked SIC to read evacuation checklist.

08:04:03 UTC, the pilots started the evacuation checklist.

08:04:09 UTC, Adi Tower asked for the total person on board the aircraft.

08:04:59 UTC, the pilots finished the evacuation checklist.

08:05:02 UTC, the SIC informed the PIC that the ARFF provided a stair and asked to the PIC whether will use escape slide or stair. The PIC answered to use stair instead of escape slide.

08:05:11 UTC, the PIC invited the FA-1 into the cockpit and commanded to disarm the slide bar and to tell the passenger on emergency row not to open the emergency exit windows as the PIC seen ARFF personnel climbed to the left wing used stair. The FA-1 then informed to FA-4 to disarm the slide bar and then to pass the command to flight attendants on aft by using megaphone as the interphone system did not work.

08:06:12 UTC, the SIC asked the PIC to make announcement to calm down the passengers.

08:07:19 UTC, the FA-1 informed the pilot through interphone that the Public Address (PA) was not working, and the PIC commanded to arm the slide bar in order to expedite the evacuation. The FA-4 informed the PIC's command to arm the slide bar to flight attendants on the aft by using megaphone and was received by FA-5.

08:09:07 UTC, the SIC informed Adi Tower that the evacuation would use the escape slides. The escape slide on right forward passenger door was inflated by FA-4. The FA-2 and FA-3 armed and inflated the escape slide on the aft doors (3R and 4R) after received instruction from FA-5. The FA-1 was unable to open the left forward passenger (1L) door fully after several attempts. When the door was partially opened, the ARFF personnel approached carried a stair. The FA-1 then disarmed the slide bar and opened the 1L door. The passenger disembarked through 1L door used the stair.

08:09:14 UTC, the passenger evacuation initiated.

08:10:37 UTC, the crew discussed the equipment should be take by SIC during the evacuation.

08:11:11 UTC, the SIC asked the PIC of the fire extinguisher location.

08:11:36 UTC, the SIC informed the PIC that he would leave the cockpit.

08:13:24 UTC, the Adi Tower asked the pilot whether any injury to person and replied that most likely there was no injury.

08:16:59 UTC, the FA-1 came to cockpit and informed the PIC that all passengers have been completely evacuated.

08:18:52 UTC, the PIC informed Adi Tower that he was leaving the aircraft.

1.16 Tests and Research

There is no test or research was required to be conducted as a result of this occurrence.

1.17 Organizational and Management Information

1.17.1 Aircraft Operator

PT. Batik Air Indonesia (Batik Air) as an aircraft operator held valid Air Operator Certificate (AOC) number 121-050 that operated total of 33 fleets consisted of 13 Airbus A320, 14 Boeing 737-800 and 6 Boeing 737-900ER, which served 27 destinations and operated up to 160 flights daily.

The Batik Air had several manuals that were approved by Directorate General of Civil Aviation. The following are the relevant excerpts taken from operator manuals as reference for the investigation.

1.17.1.1 Operation Manual

Since 1 April 2015, PT. Batik Air changed the format of their Company Operation Manual (COM) to become Operation Manual (OM) that consisted into four parts.

The description of each part is as follows:

- OM Part A described general policies, rules, standards and procedures defining the manner of company operations are conducted.
- OM Part B described the aircraft operation information such as limitation, performance, normal, abnormal and emergency procedure.
- OM Part C described the necessary route and airport specific information with respect to company area of operation.
- OM Part D described information and instructions to all flight crew, flight attendants, flight operation officers, instructors and checkers, with procedures, instructions and information relative to the training of those personnel for the respective positions and aircraft type in which they are to serve.

OM Part A

CHAPTER 5 - QUALIFICATIONS REQUIREMENTS

5.1.5.2 CREWMEMBERS SAFETY AND EMERGENCY TRAINING

In addition to type-specific emergency training provided to flight crew member in the respective aircraft type qualification curriculum segments (emergency and abnormal procedures associated with aircraft systems, structural design, operational characteristics, etc.), all crewmembers receive "general" Safety and Emergency Training., addressing:

- *Instructions in emergency assignments and procedures, including coordination among crewmembers;*
- *Individual instruction in the location, function and operation of emergency equipment;*
- *Instruction in the handling of emergency situation;*
- *Review and discussion of previous aircraft accidents and incidents pertaining to actual emergency situation.*

Two distinct areas of training are required in the conduct of the "general" emergency training:

- *"Emergency drills" training;*
- *"Emergency evacuation" training (also referred to as "emergency evacuation (wet)" training).*

Both training areas are therefore addressed as part of each BATIK AIR initial training curriculum for crewmember. These personnel then receive subsequent training in these areas as part of their respective recurrent training (every year).

CHAPTER 8 – OPERATING PROCEDURES

8.1.4.5 LANDING LIMITATIONS

8.1.4.5.1 DEFINITIONS

CONTAMINATED RUNWAY - A runway is contaminated when more than 25 per cent of the runway surface area (whether in isolated areas or not) within the required length and width being used is covered by:

- *Water, or slush more than 3 mm (0.125 in) deep;*
- *Loose snow more than 20 mm (0.75 in) deep; or*
- *Compacted snow or ice, including wet ice.*

DRY RUNWAY - A dry runway is one which is clear of contaminants and visible moisture within the required length and the width being used.

WET RUNWAY - A runway that is neither dry nor contaminated.

8.1.4.5.3 AERODROME OF DESTINATION – WET AND CONTAMINATED RUNWAYS

When landing on WET or CONTAMINATED runway is anticipated, the LDA must be at least 115% of the required landing distance for landing on a DRY runway.

In a few words:

Required Landing Distance (WET or CONTA) = 115% Required Landing Distance (DRY) ≤ LDA

8.3.2.9 LANDING

8.3.2.9.1 SAFE LANDING GUIDELINES

The risk of approach and landing accident is increased if one of the following is not met. If more than one guideline is not met, the overall risk is increased:

- *Fly a stabilized approach;*
- *Height at threshold crossing is 50 ft.;*
- *Speed at threshold crossing is not more than VREF +10 kts and not less than VREF;*
- *Tailwind is not more than 10 knots on non-contaminated runway and not more than 0 knots on contaminated runway;*
- *Touchdown on runway centerline on touchdown aim point;*
- *After touchdown promptly transition to the desired configuration:*

- *Brakes;*
- *Spoiler/speed brakes;*
- *Thrust reverser (once thrust reverse is activated, go around is no longer an option);*
- *Speed is not more than 80 knots with 2000 ft. runway remaining.*

8.3.2.9.2 ACTUAL LANDING DISTANCE

Contrary to the dispatch phase, the actual execution of a landing is not governed by regulatory Required Landing Distance as detailed in OM Part A, Chapter 8.1.4.5 "Landing limitations".

The only requirement is that the landing must be conducted in a safe manner and the aircraft can be brought to a full stop within the Landing Distance Available (LDA). The actual landing distance information in the FCOM/QRH is provided to guide the PIC in his assessment of the possibly critical nature of a particular landing. It should be realized that the figures in the FCOM/QRH are based on stated reference conditions. If these reference conditions cannot be exactly duplicated, the accuracy of the given figures is invalidated.

The decision to land basically remains with the PIC, who must take the following into account:

- *The actual landing distance figure, corrected as applicable must carefully be weighed for its realism under the prevailing operating conditions. If considered necessary, the landing distance must be increased arbitrarily;*
- *If the (increased) landing distance plus any margin specified in the FCOM/QRH is not available, a landing is not permitted.*
- *The margin is intended to cover minor imperfections in flight handling and judgment. If deviations occur, the pilot must not hesitate in executing go-around.*

8.3.2.9.3 USE OF THRUST REVERSERS AND/OR BRAKE

The use of reverse thrust as laid down in the FCOM increases the operational safety margins and considerably increases the brakes and tires life, with no adverse effects to the engines. Excessive use of wheel brakes to gain an early runway turn-off point is undesirable, unless urgent operational reasons are involved.

IDLE reverse must be selected immediately after main gear touchdown. MAX reverse is available and should be used if required. If MAX reverse is used it should be reduced to IDLE reverse when reaching 60-70 kts in deceleration (depending on the aircraft, refer to respective aircraft type FCOM for specific value). IDLE reverse must then be used until reaching taxi speed.

8.3.2.9.4 BOUNCED LANDING / LONG FLARE

If a hard and/or high bounce occurs, a go-around must be initiated.

If landing within the touchdown zone is not ensured and the remaining runway is insufficient to stop safety, a go-around must be initiated.

8.3.20.12 EMERGENCY LANDING ON LAND

8.3.20.12.3 EVACUATION OF THE AIRCRAFT

When the command "EVACUATE" has been given by the PIC or, in the case of unexpected landings, by the SFA/FA-1, or when the aircraft has come to rest, all occupants must leave the aircraft as quickly as possible and in an orderly manner.

Crewmembers present in the cabin shall direct the evacuation procedure. In general, all the available exits shall be used as well as the assisting means as, e.g. ropes, evacuation chutes etc. All occupants must direct to leave the aircraft and move far away from it.

No one shall be allowed to re-enter the aircraft until sometime it has become quite clear, that there is no danger of fire or explosion. Wounded and disabled occupants shall be assisted by the unhurt, but this must not delay the evacuation process. The PIC is the last to leave the aircraft after having checked that everyone has escaped.

8.3.20.14 EVACUATION DIRECTIVES

8.3.20.14.1 GENERAL

Most emergency situations develop during the initial or final stage of the flight. It must be realized that the preparation phase may be varying brief or even non-existent. Flight crew and Flight attendants should be prepared for expected and specially unexpected emergencies.

8.3.20.14.4 INITIATION OF THE EVACUATION

When the aircraft comes to a full stop under abnormal conditions the PIC after give a command "ATTENTION FLIGHT ATTENDANT ON STATION" twice and evaluate situation will decide whether evacuation is required or not, and contact the FA-1. In this case, FA-1 will check the outside conditions and coordinated with other FA. If there is no command from the PIC, FA-1 will immediately check the PIC to ensure if evacuation is required.

Criteria for initiating evacuation:

- *The PIC has the prime responsibility for initiating a passenger evacuation;*
- *If a Flight Attendant consider an evacuation is necessary he must advise the PIC of the situation and await the PIC decision;*
- *The Flight Attendants may take full responsibility for initiating the evacuation, in the following cases:*
  - *It is obvious an evacuation is imperative;*
  - *No contact with the flight crew/PIC has been possible;*
  - *The safety of people is in jeopardy such as:*
    - *Heavy smoke inside or outside the aircraft;*
    - *Fire;*
    - *Severe Structural damage.*
    - *Another Flight Attendant has started evacuating passengers. If an evacuation is initiated by a Flight Attendant, inform the Flight Crew that an evacuation is in progress.*

In case of evacuation required the PIC command: "EVACUATE" (repeated command). If evacuation is not required, the PIC should immediately make the following PA announcement: "FLIGHT ATTENDANT AND PASSENGER KEEP YOUR SEAT".

After check out side conditions and coordinate with other FA and the condition are judged safe, FA-1 will make the following Public Address announcement:

Para tamu yang terhormat *Captain sedang mengevaluasi keadaan.* *Tetaplah duduk dengan tenang di kursi masing.* *Pengumuman selengkapnya akan kami berikan secepatnya*	*Ladies and Gentlemen* *Captain is evaluating the situation.* *Please keep calm and remain seated.* *Further information will be given to you as soon as possible.*

If conditions are judge unsafe, FA-1 will report to the cockpit immediately. The PIC will command via PA: "EVACUATE". In this case, the PIC and the FA will immediately execute their own procedures. If conditions are judge safe and the evacuation is not required, the PIC will immediately make PA announcement: "FLIGHT ATTENDANTS AND PASSENGERS KEEP YOUR SEAT"

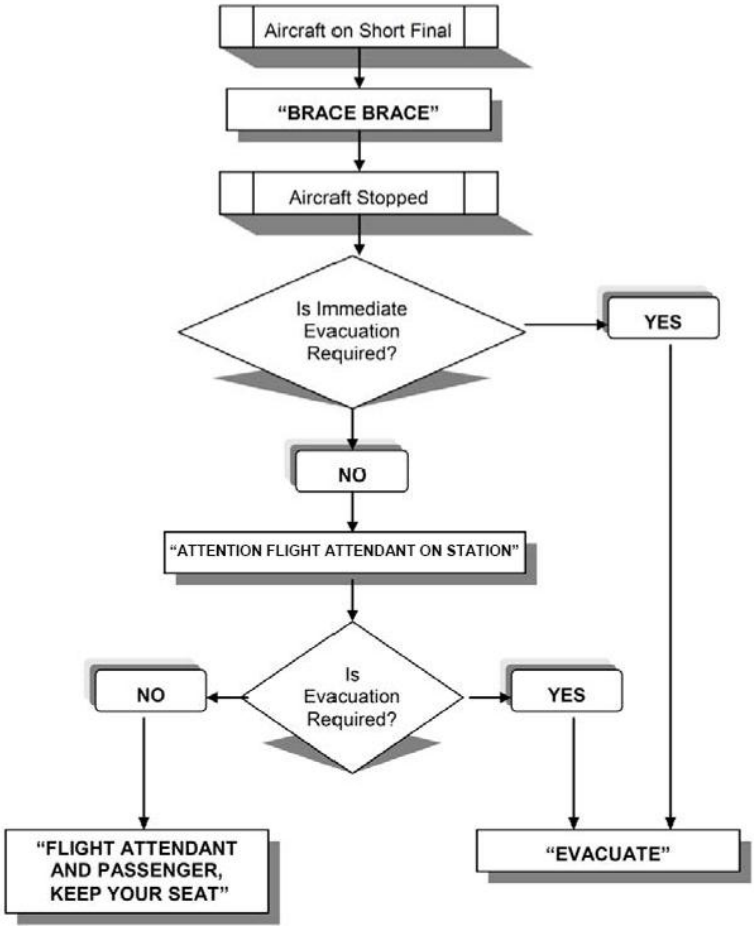
In this case, FA-1 will make announcement via PA

Para tamu yang terhomat *Keadaan pesawat sudah dapat dikendalikan.* *Anda kami minta agar tetap duduk dengan tenang.*	*Ladies and Gentlemen* *Everything is under controlled.* *Please keep calm and remain seated.*

When the aircraft comes to full stop under abnormal condition and the aircraft conditions are judge unsafe, the PIC will immediately command: "EVACUATE". In this case, the Crewmembers will immediately execute their own procedures.

***NOTE**: If no PAS available, use megaphone.*

8.3.20.14.5 EVACUATION COMMANDS FLOWCHART



Safety Directive cards are also available onboard for use by crew. Refer to OM Part A, Appendix 8.J.

8.3.20.14.6 POST EVACUATION

Evacuation is completed after all passengers and crews have evacuated the aircraft. Some post evacuation actions should be carried out as standard procedure. Such as:

- *Lead passenger away (up wind) from the aircraft because of risk of explosion and fire;*
- *Bring passenger and crew together (after accident, people often start running away in a shock condition);*
- *Care for the injured;*
- *Coordinate actions to overcome the first few hours (let other people help or take care each other).*

OM PART C CHAPTER 2 – PERFORMANCE STUDIES

2.2 RUNWAY ANALYSES

For each airport from/to which it operates with a specific aircraft type, BATIK AIR conducts specific take-off and landing performance studies (runway analysis), accounting for each individual runway characteristics, obstacles, and whose purpose is to provide flight crew with a simplified means to obtain maximum take-off weight, V-speeds, or landing weights allowing to comply with all limitations as described in OM Part A, Chapter 8.1.4.3 "Take-off limitations" and Chapter 8.1.4.5 "Landing limitations".

For Boeing fleets, these analyses are conducted using up-to-date runway and obstacle data, the approved Airplane Flight Manual, the type-specific Flight Planning and Performance Manual (FPPM), and the Boeing performance software (BPS).

Outcomes of these analyses are published on dedicated charts:

- *Take-off performance charts provide a means to quickly determine maximum allowable takeoff weight, takeoff speeds, and assumed temperature for maximum and derate thrusts, and different aircraft configurations, as well as engine-out procedures;*
- *Landing performance charts provide a means to quickly determine required landing distances and threshold speeds using selected braking in different aircraft configurations.*

All charts relative to regular BATIK AIR destinations are made available in a type-specific Runway Analysis Manual (RAM). For non-scheduled / supplemental operations to an airport which is not included in the Runway Analysis Manual, the Flight Operations engineering section will publish ad'hoc charts that will be included in a customized trip kit.

1.17.1.2 Company Airport Briefing

Company Airport Briefing (CAB) is a new version of Special Airport Information that contains detailed information about several airports in Indonesia. The special limitation of Adisutjipto airport that described on CAB was as follows:

B. SPECIAL LIMITATIONS

MAX Tailwind and Crosswind limits: As per SOP Limitation.

1.17.1.3 Safety Emergency Procedure

1.1. Company regulations

1.1.1. Crew Briefing

The Crew Member pre-flight safety briefing consists of a join briefing involving all Flight Crews and Flight Attendants. It must be accomplished prior to the first flight of each day and include a coordinated Flight Crew or procedural review of one area of safety. This briefing is mandatory for all operations with Flight Attendant.

Flight Attendant briefings are given by the Captain or Purser/FA-1 prior to or just after boarding the aircraft. The Captain has opportunity to discuss procedures, preferably emergency procedures that must be performed without delay.

The Purser/FA-1 checks FA knowledge of emergency items. In cases of aircraft change or change of part of the crew on trip, the Purser/FA-1 is responsible for type specific briefing of new or all Flight Attendants.

If however, the Captain considers a complete briefing necessary, the Purser/FA-1 must be informed.

Briefings may include, but is not limited to:

a. *Crew introductions*
b. *Ensuring that each Flight Attendant has up-to-date Flight Attendant Manual, ID card, certificate and passport. A periodic check of the F.A.M. of each Flight Attendant should be conducted to ensure the F.A.M is kept up to date by individual Flight Attendant.*
c. *Flight information from the trip advisory such as destination, estimated passenger loads, passengers counting method, lengths of flights, approved service and work assignments, rules of destination country and any other specific passenger requirements*
d. *Recent company information*
e. *A discussion initiated by the PIC, of at lease one area of safety such as Evacuation, rapid depressurization and emergency descent, fire, etc*
f. *An emergency procedure review, such as commands from the Flight crew and actions to be taken by Flight Attendants, operation of the doors, location and operation of the emergency equipment, bomb threat and hijack.*
g. *Stowage of crew and passengers baggage consistent with company policy h. Standards issues such as appearance, attitude and behavior.*

2.2. Procedures to check and to operate

Each required crewmember shall before beginning a flight, familiarize his/her self with the emergency equipment installed on each aircraft to which he/she is assigned and with the procedures to be followed for the use of that equipment in an emergency situation.

3. EMERGENCY PROCEDURES

3.1. Evacuation Procedures

3.1.1. Warning Signal

During evacuation, it must be expected that only emergency exit lights are available. If an emergency requires an immediate evacuation it shall be performed according to the "Warning Signal" irrelevant if it is a prepared or unprepared evacuation.

The order to evacuate is principally given by the Pilot in Command. All emergency commands from Flight crew including possible limitations shall be given twice.

a. *The Primary signal is: "FLIGHT ATTENDANT INTO COCKPIT" and the Secondary signal is: "At least 6(six) chimes" Only Purser/FA-1 in-charge may come to the Flight deck*

b. "EMERGENCY STATION"

This signal will be given Approximately 2(two) minutes or equal with 1000 feet before impact. (If the Public address unserviceable, command will be given when the Purser/FA-1 report "CABIN READY").

c. "BRACE"

This command will be given:

i. Approximately 1(one) minute or equal with 500 feet before impact.

ii. During Takeoff and Landing when the Pilot in Command decided an emergency situation (If time permit)

(If PA unserviceable, command will be given by flashing the Fasten seat belt sign)

d. "ATTENTION CREW ON STATION"

Except ditching, this command should be given:

i. In all emergencies situations

ii. When the aircraft stop under abnormal conditions (During Takeoff and Landing)

It shall alert the Flight Attendant to await further commands from the Flight crew. Because of the Flight crew activities, there may be a relative long time between stand still of the aircraft and further commands. This shall not lead to hasty actions by the Flight Attendants. During this alert phase, Flight Attendants should unfasten seatbelt (if fasten), get up, check door mode, reflect on emergency door operation, take the most suitable position for evacuation at the assigned exit.

The situation (inside) and outside the cabin shall be observed very carefully.

e. "FLIGHT ATTENDANT AND PASSENGERS KEEP YOUR SEAT"

This command should be given incase an evacuation is not required.

A further announcement by the Flight crew will follow (e.g. we return to the ramp).

f. "EVACUATE"

This command should be given for an immediate evacuation.

Incase of unusable exits, Flight Attendants should divert passengers to usable exits:

i. Face the passengers

ii. Block exit, explain with emphasis that exit is unusable: "EXIT BLOCKED" or "FIRE OUT SIDE" or "NO SLIDE HERE"

GO TO THAT EXIT (while pointing to the usable exits and keeps guarding the unusable exit until evacuation is completed.

g. "EVACUATE - KEEP CLOSE….." (e.g. 1R/1L)

This restrict command should be given when the Pilot in Command cannot declare all exits free for the evacuation.

Note: If one or more exits on one side are mentioned, they shall principally remain close. However, each Flight Attendant eventually has to decide after careful check of actual conditions (inside) and outside the cabin whether an

exit is usable.

h. *"CONTROLLED DISEMBARKATION"*

There are cases, where passengers should leave the aircraft as a precautionary measure (e.g.: bomb scares, smoke in the cabin) without the urgency of an emergency evacuation. In those cases the Captain may decide on a "CONTROLLED DISEMBARKATION"

The passengers shall be informed if hand luggage may be taken from board. If stairs cannot be provided in an acceptable period of time, one or more slides shall be used.

Since there is no time critical urgency in a "CONTROLLED DISEMBARKATION", it is not considered necessary to have a pre formulated announcement. The Captain gives an appropriate explanation to passengers and mentions the doors that shall be used.

In a "CONTROLLED DISEMBARKATION" via slides, the passengers should be ordered to:

i) Leave hand luggage on board

ii) Take-off high heel shoes

iii) Sit down and slide

3.1.5. Criteria for initiating evacuation

The Captain has the prime responsibility for initiating a passenger evacuation.

If a Flight Attendant consider an evacuation is necessary he/she must advise the

Captain of the situation and await the Captain's decision.

The Flight Attendants may take full responsibility for initiating the evacuation in cases:

a. *WHERE IT IS OBVIOUS AN EVACUATION IS IMPERATIVE*
b. *NO CONTACT WITH THE FLIGHT CREW/CAPTAIN HAS BEEN POSSSIBLE*
c. *THE SAFETY OF PEOPLE IS IN JEOPARDY such as:*
    i. *Heavy smoke inside or outside the aircraft*
    ii. *Fire*
    iii. *Severe structural damage*
d. *Another Flight Attendant has started evacuating passengers. (if an evacuating is initiated by a Flight Attendant, refer to point c inform the Flight crew that an evacuation is in progress)*

Note: Never evacuate a moving aircraft, or while the engines are still running.

As doing so can result in serious injury to passengers and damage to the evacuation devices.

1.17.1.4 Flight Attendant Manual

4.3.3. Warning signals

4.3.3.1 Flight crew to Flight Attendants

Flight Attendants must be aware of all signals that warn of an emergency or potential emergency.

"All (emergency) commands from the Flight crew will be given twice"

a. *The Primary signal is: "FLIGHT ATTENDANT INTO COCKPIT" and the Secondary signal is: "At least 6(six) chimes"*

   Only Purser/FA-1 in-charge may come to the Flight deck

b. *"EMERGENCY STATION"*

   This signal will be given Approximately 2(two) minutes or equal with 1000 feet before impact. (If the Public address unserviceable, command will be given when the Purser/FA-1 report "CABIN READY").

c. *"BRACE"*

   This command will be given:

   ii. *Approximately 1(one) minute or equal with 500 feet before impact.*

   iii. *During Takeoff and Landing when the Pilot in Command decided an emergency situation (If time permit)*

   (If PA unserviceable, command will be given by flashing the Fasten seatbelt sign)

d. *"ATTENTION CREW ON STATION"*

   Except ditching, this command should be given:

   i. *In all emergencies situations*

   ii. *When the aircraft stop under abnormal conditions (During Takeoff and Landing)*

   It shall alert the Flight Attendant to await further commands from the Flight crew. Because of the Flight crew activities, there may be a relative long time between stand still of the aircraft and further commands. This shall not lead to hasty actions by the Flight Attendants. During this alert phase, Flight Attendants should unfasten seatbelt (if fasten), get up, check door mode, reflect on emergency door operation, take the most suitable position for evacuation at the assigned exit.

   The situation inside and outside the cabin shall be observed very carefully.

e. *"FLIGHT ATTENDANT AND PASSENGERS KEEP YOUR SEAT"*

   This command should be given incase an evacuation is not required.

   A further announcement by the Flight crew will follow (e.g. we return to the ramp).

f. *"EVACUATE"*

   This command should be given for an immediate evacuation.

   Incase of unusable exits, Flight Attendants should divert passengers to usable exits:

   i. *Face the passengers*

   ii. *Block exit, explain with emphasis that exit is unusable:*

"EXIT BLOCKED" or "FIRE OUT SIDE" or "NO SLIDE HERE"

GO TO THAT EXIT (while pointing to the usable exits and keeps guarding the unusable exit until evacuation is completed.

g. *"EVACUATE - KEEP CLOSE……" (e.g. R/1L)*

This restrict command should be given when the Pilot in Command cannot declare all exits free for the evacuation.

Note: If one or more exits on one side are mentioned, they shall principally remain close. However, each Flight Attendant eventually has to decide after careful check of actual conditions (inside) and outside the cabin whether an exit is usable.

h. *"CONTROLLED DISEMBARKATION"*

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In a "CONTROLLED DISEMBARKATION" via slides, the passengers should be ordered to:

i) *Leave hand luggage on board*

ii) *Take-off high heel shoes*

iii) *Sit down and slide*

4.3.14. Principles of Evacuation

a. *Each evacuation should be initiated as quickly as possible after the aircraft has completely stopped, using all possibility at hand to get passengers without hand luggage in a safe distance from the aircraft.*

b. *Passengers and crew shall evacuate an aircraft if they are endangered due to the condition of the aircraft.*

c. *Skidding off the runway during landing, without visual damage to the aircraft does not require an immediate evacuation.*

d. *Every evacuation is a risky procedure and should therefore be performed only when absolutely necessary.*

e. *Always be alert to the possibility of passengers initiating an unpremeditated or undirected emergency evacuation.*

f. *A passenger initiated emergency evacuation could, if not quickly controlled, lead to widespread panic and the possibility of serious to fatal injury to those drawn into such unpremeditated evacuation.*

g. *Immediately upon becoming aware that an unpremeditated emergency evacuation is beginning, shout loudly and clearly, "KEEP CALM, REMAIN*

SEATED" or "STOP, RETURN TO YOUR SEATS, REMAIN CALM". Wait for Captain command and then take any steps necessary (including physical restraint) to prevent passengers from opening doors or removing exits. Enlist the help of other passengers if possible. If no command from the cockpit refer to 4.3.19 (secondary action point IV).

1.17.1.5 Special Airport Information

Special Airport Information (SAI) is a manual that published 25 October 2013 and contains detailed information about several airports in Indonesia in order to enhance pilots familiarity with the region and to address specific requirements like transition altitude, altimetry changes, very high en-route altitudes, political unrest or other non-operational informal that would provide additional guidance to crew operating within or to that area.

This manual was replaced with Company Airport Briefing (CAB) since April 2015. However, the pilots were still using the SAI at the day of accident as a guideline for landing in Yogyakarta.

According Batik Air Special Information book, Adisutjipto International Airport (Yogyakarta) was classified as Category B airport, which was required a written Airport Brief disseminated to crew for proper study and understanding to ensure safe level of operations.

Category B airports require extra consideration such as:

a) Non-standard approach aids and/or approach patterns; or
b) Unusual local weather conditions; or
c) Unusual characteristics or performance limitations; or
d) Any other relevant considerations including obstructions, physical layout, lighting, etc.

Yogyakarta was associated with peculiarities of traffic congested, military training area and special corridor for departure and arrival.

The special limitation of Adisutjipto airport that described on SAI was as follows:

3.18. YOGYAKARTA – WARJ (JOG)

b) SPECIAL LIMITATIONS

1. *No take off or landing in heavy rain, when the RWY is contaminated.*
2. *Dry RWY : MAX Tailwind 10 knots MAX Crosswind 20 knots*
3. *Wet RWY : MAX Tailwind 5 knots. (PIC as PF) MAX Crosswind 15 knots Use MAX auto brakes during wet runway operations.*
4. *MTOW : 70,300 KGS for dry or wet RWY*
5. *MLW : 70,300 KGS for dry or wet RWY*

1.17.1.6 Boeing 737-800/900ER Flight Crew Operations Manual

Normal Configuration Landing Distance

The following is the information of normal configuration landing distance on page PI.22.2 for good and medium braking action on flaps 30.

Good braking action means the value is comparative and intended to mean that aircraft should not experience braking or directional control difficulties when landing.

The landing distance is calculated from a reference distance of 50 feet above the threshold to stop for the particular landing weight and normal approach speed for the selected landing flap at sea level, zero wind, zero slope, and two engine detent reverse thrust.

ADVISORY INFORMATION

Normal Configuration Landing Distance

Flaps 30

	LANDING DISTANCE AND ADJUSTMENTS (M)								
	REF DIST	WT ADJ	ALT ADJ	WIND ADJ	SLOPE ADJ	TEMP ADJ	APP SPD ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	70000 KG LANDING WEIGHT	PER 5000 KG ABV/BLW 70000 KG	PER 1000 FT STD/HIGH*	PER 10 KTS HEAD/ TAIL WIND	PER 1% DOWN/ UP HILL	PER 10°C ABV/ BLW ISA	PER 5 KTS ABOVE VREF30	ONE REV	NO REV

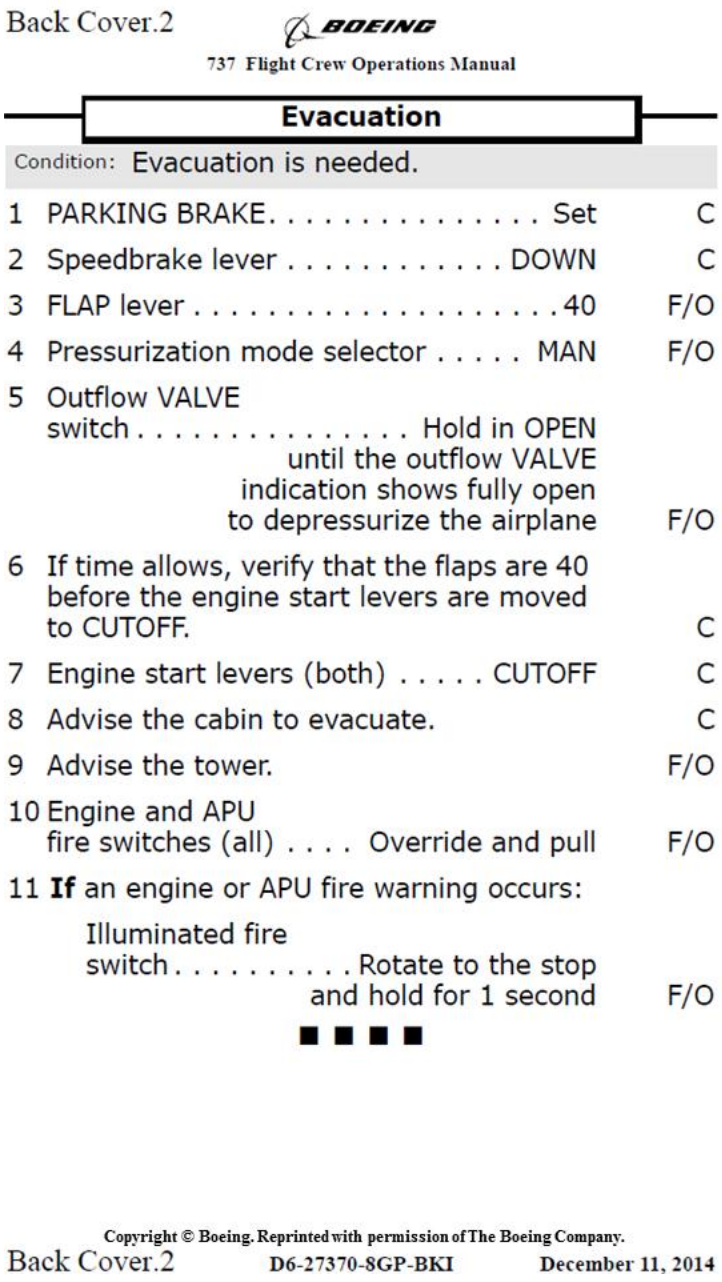
Good Reported Braking Action

MAX MANUAL	1305	65/-70	35/45	-60/200	30/-30	35/-35	45	60	130
AUTOBRAKE MAX	1405	70/-75	35/50	-60/210	30/-25	35/-35	55	65	145
AUTOBRAKE 3	1720	90/-95	45/60	-75/250	5/-5	45/-50	90	5	10
AUTOBRAKE 2	2175	130/-135	65/85	-100/340	30/-40	65/-65	90	55	55
AUTOBRAKE 1	2405	150/-155	80/105	-120/400	65/-70	70/-70	85	170	270

Medium Reported Braking Action

MAX MANUAL	1800	105/-105	55/75	-95/335	85/-65	50/-50	60	165	385
AUTOBRAKE MAX	1840	110/-110	55/75	-95/340	80/-60	50/-50	70	165	395
AUTOBRAKE 3	1925	110/-115	60/75	-95/345	60/-50	55/-55	90	125	340
AUTOBRAKE 2	2235	130/-140	70/90	-110/385	65/-60	65/-65	90	95	195
AUTOBRAKE 1	2420	155/-160	80/105	-120/420	90/-80	70/-70	85	185	320

1.17.1.7 Boeing 737 Quick Reference Handbook



Back Cover.2

737 Flight Crew Operations Manual

Evacuation

Condition: Evacuation is needed.

1	PARKING BRAKE. . . . . Set	C
2	Speedbrake lever . . . . . DOWN	C
3	FLAP lever 40	F/O
4	Pressurization mode selector . . . . . MAN	F/O
5	Outflow VALVE switch . . . . . Hold in OPEN until the outflow VALVE indication shows fully open to depressurize the airplane	F/O
6	If time allows, verify that the flaps are 40 before the engine start levers are moved to CUTOFF.	C
7	Engine start levers (both) . . . . . CUTOFF	C
8	Advise the cabin to evacuate.	C
9	Advise the tower.	F/O
10	Engine and APU fire switches (all) . . . . Override and pull	F/O
11	**If** an engine or APU fire warning occurs:	
	Illuminated fire switch . . . . . Rotate to the stop and hold for 1 second	F/O

■ ■ ■ ■

1.17.1.8 Boeing 737 NG Flight Crew Training Manual

Approach Briefing

The FCTM chapter 5 on page 5.2 stated that the PF should brief the PM of his intentions in conducting the approach before the start of an instrument approach. Both pilots should review the approach procedure and also all pertinent approach information including minimums and missed approach procedures. The approach briefing items should also include landing distance required for current conditions compared to landing distance available.

Recommended Elements of a Stabilized Approach (5.5)

The following recommendations are consistent with criteria developed by the Flight Safety Foundation.

All approaches should be stabilized by 1,000 feet AFE in instrument meteorological conditions (IMC) and by 500 feet AFE in visual meteorological conditions (VMC). An approach is considered stabilized when all of the following criteria are met:

- *the airplane is on the correct flight path*
- *only small changes in heading and pitch are required to maintain the correct flight path*
- *the airplane should be at approach speed. Deviations of +10 knots to – 5 knots are acceptable if the airspeed is trending toward approach speed*
- *the airplane is in the correct landing configuration*
- *sink rate is no greater than 1,000 fpm; if an approach requires a sink rate greater than 1,000 fpm, a special briefing should be conducted*
- *thrust setting is appropriate for the airplane configuration*
- *all briefings and checklists have been conducted.*

Specific types of approaches are stabilized if they also fulfill the following:

- *ILS and GLS approaches should be flown within one dot of the glide slope and localizer, or within the expanded localizer scale*
- *approaches using IAN should be flown within one dot of the glide path and FAC*
- *during a circling approach, wings should be level on final when the airplane reaches 300 feet AFE.*

Unique approach procedures or abnormal conditions requiring a deviation from the above elements of a stabilized approach require a special briefing.

***Note**: An approach that becomes unstabilized below 1,000 feet AFE in IMC or below 500 feet AFE in VMC requires an immediate go-around.*

These conditions should be maintained throughout the rest of the approach for it to be considered a stabilized approach. If the above criteria cannot be established and maintained until approaching the flare, initiate a go-around.

At 100 feet HAT for all visual approaches, the airplane should be positioned so the flight deck is within, and tracking to remain within, the lateral confines of the runway edges extended.

Chapter 6 – Landing

Factors Affecting Landing Distance (6.32)

Factors that affect stopping distance include: height and speed over the threshold, glide slope angle, landing flare, lowering the nose to the runway, use of reverse thrust, speedbrakes, wheel brakes and surface conditions of the runway.

***Note**: Reverse thrust and speedbrake drag are most effective during the high speed portion of the landing. Deploy the speedbrake lever and activate reverse thrust with as little time delay as possible.*

***Note**: Speedbrakes fully deployed, in conjunction with maximum reverse thrust and maximum manual antiskid braking provides the minimum stopping distance.*

Floating above the runway before touchdown must be avoided because it uses a large portion of the available runway. The airplane should be landed as near the normal touchdown point as possible. Deceleration rate on the runway is approximately three times greater than in the air.

Transition to Manual Braking (6.37)

The speed at which the transition from autobrakes to manual braking is made depends on airplane deceleration rate, runway conditions and stopping requirements. Normally the speedbrakes remain deployed until taxi speed, but may be stowed earlier if stopping distance within the remaining runway is assured.

When transitioning to manual braking, use reverse thrust as required until taxi speed. The use of speedbrakes and reverse thrust is especially important when nearing the end of the runway where rubber deposits affect stopping ability.

Manual Braking (6.37)

For short or slippery runways, use full brake pedal pressure.

- *do not attempt to modulate, pump or improve the braking by any other special techniques*
- *do not release the brake pedal pressure until the airplane speed has been reduced to a safe taxi speed*

If the pilot modulates the brake pedals, the antiskid system is forced to readjust the brake pressure to establish optimum braking. During this readjustment time, braking efficiency is lost.

Reverse Thrust Operation

The FCTM chapter 6 on page 6.40, pilot shall maintain the reverse thrust as required, up to maximum until the airspeed approached 60 knots.

Runway Condition Assessment – TALPA ARC (6.40)

The following table is an abbreviated version of the Matrix for runway condition assessment in terms of Takeoff and Landing Performance Assessment Aviation Rules Committee (TALPA ARC) categories. The runway condition descriptions and codes are aligned with control/braking action reports.

Runway Condition Assessment		
Runway Condition Description	**Runway Condition Code**	**Control / Braking Action**
• Dry	6	---
• Frost • Wet (includes damp and less than 1/8" (3mm) depth of water) **Less than 1/8" (3mm) depth:** • Slush • Dry Snow • Wet Snow	5	Good
-15°C and colder OAT: • Compacted Snow	4	Good to Medium
• Slippery when wet (wet runway) • Dry or Wet Snow (any depth) over Compacted Snow **1/8" (3mm) depth or greater:** • Dry Snow • Wet Snow **Warmer than -15°C OAT:** • Compacted snow	3	Medium
1/8" (3mm) depth or greater: • Water • Slush	2	Medium to Poor
• Ice	1	Poor
• Wet Ice • Water on top of Compacted Snow • Dry Snow or Wet Snow over Ice	0	Nil

Chapter 8 – Non-Normal Operations

Evacuation (8.10)

For unplanned evacuations, the captain needs to analyze the situation carefully before initiating an evacuation order. Quick actions in a calm and methodical manner improve the chances of a successful evacuation.

1.17.1.9 Boeing 737-600/700/800/900 Aircraft Maintenance Manual

Landing Application Logic

The AMM on chapter 32-42-00 on page 39 described the deceleration rates and brake pressures for each position of the auto brake selector switch.

AUTO BRAKE Select Switch	Deceleration Rate (ft/sec/ sec)	Pressure (psi)
1	4	1285
2	5	1500

AUTO BRAKE Select Switch	Deceleration Rate (ft/sec/ sec)	Pressure (psi)
3	7.2	2000
MAX	14 (> 80 knots) 12 (< 80 knots)	3000

Based on the table above the deceleration feet/second/second converted into longitudinal deceleration in G as follows:

Autobrake	Deceleration Rate (feet/second/second)	Brake Pressure (psi)	Calculation of Longitudinal Acceleration (G)
1	4	1,285	-0.12
2	5	1,500	-0.16
3	7.2	2,000	-0.22
Max (Speed < 80)	12	3,000	-0.37
Max (Speed > 80)	14	3,000	-0.44

1.17.2 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 Airport, a state owned enterprise that operated 13 airports in Indonesia.

The PT. Angkasa Pura Airport branch Adisutjipto International Airport has a Safety Management System (SMS) unit led by manager with outsourcing staffs that responsible to the implementation of SMS. The observation found that there were no activities related to the hazard identification, risk assessment and mitigation concerning to the runway surface condition and the friction.

The PT. Angkasa Pura Airport 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.

The relevant issue taken from the airport operator AM and SOPs related to the runway operation and maintenance issues, particularly on topics of runway inspection, standing water, runway friction and rubber deposit.

1.17.2.1 Aerodrome Manual

Bab 4 Prosedur Pengoperasian Bandar Udara	**Chapter 4 Airport Operational Procedure**
4.5 Pemeriksaan/Inspeksi Daerah Pergerakan dan Obstacle Limitation Surface *<u>Catatan:</u> Pelaksanaan kegiatan ini berkoordinasi dengan Perum LPPNPI (Airnav Indonesia) Kantor District Yogyakarta*	**4.5 Inspection of Movement Area and Obstacle Limitation Surface** <u>Note:</u> This activities shall be coordinated with Airnav Indonesia of Yogyakarta District Office
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 resources, which are provided to, conducted airport inspection according to Directorate General of Civil Aviation standard.
4.5.2.4 Section Head dari unit Teknik dan Operasi bertanggung jawab untuk melakukan kegiatan inspeksi sehari-hari di daerah pergerakan.	4.5.2.4 Section Head of Maintenance and Operation unit is responsible for the daily inspection of the movement area.

4.5.5 Pemeriksaan kelayakan keselamatan operasi Bandar udara dilaksanakan sebagai berikut :	**4.5.5 Inspection of Airport safety worthiness is performed as follows:**
4.5.5.1 Setelah hujan deras, angin kencang atau fenomena lainnya yang berpengaruh terhadap operasi penerbangan;	4.5.5.1 After heavy rain, strong wind or other phenomena that may affect the flight operation;
4.5.5.2 Ketika diminta oleh ATC (setelah ada pendaratan yang tidak normal); atau	4.5.5.2 If requested by ATC (after an abnormal landing event); or
4.5.5.3 Jika diminta oleh sebuah sumber terpercaya seperti staf darat, pilot pesawat, atau perwakilan perusahaan penerbangan, bahwa ada kemungkinan masalah di wilayah pergerakan.	4.5.5.3 If requested by other trusted sources such as ground staff, pilot or airline representative about the possibility of abnormal event in movement area.
4.5.8 Frekuensi dan Prosedur Inspeksi	**4.5.8 Frequency and Inspection Procedure**
4.5.8.1 Inspeksi harian dilakukan pada pukul 05.00 – 06.00 WIB; 10.00 – 11.00 WIB dan pukul 20.00 – 21.00 WIB.	4.5.8.1 Daily inspection is performed on 05.00 – 06.00 LT; 10.00 – 11.00 LT and 20.00 – 21.00 LT
4.7 Pemeliharaan Daerah Pergerakan	**4.7 Maintenance of Movement Area**
4.7.2 Tanggung Jawab	**4.7.2 Responsibility**
4.7.2.1. General Manager bertanggung jawab sepenuhnya terhadap ketentuan tentang prosedur pemeliharaan di daerah pergerakan di bandar udara.	4.7.2.1. General Manager is fully responsible to the provision of maintenance procedure of the movement area in airport.
4.7.2.2. 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.	4.7.2.2. 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.
4.7.2.3. 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.	4.7.2.3. 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 bagian 7 – 16, berisi antara lain :

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

a. Dua kali sehari dibersihkan dengan runway sweeper dan secara manual serta dengan mengawasi movement area meliputi drainase;

b. Setiap saat apabila terdapat 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 6 bulan.

b. Mengecat kembali marking line pada runway, taxiway dan apron per 3 bulan atau sesuai kebutuhan.

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

4.7.4 The Detail Maintenance Procedure can be found on compiled SOP of Maintenance Implementation Guidelines part 7 – 16, that consist of:

1) Level I : Periodic preventive maintenance that performed three times a day including cleaning, inspection of marking and structure by technician, such as:

a. Clean the runway twice a day by using runway sweeper and manually means as well as monitoring the movement area including drainage;

b. Every time if there is FOD;

2) Level II : A 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. Clean the rubber deposit in runway and taxiway, once every six months.

b. Repainting the marking line on runway, taxiway and apron every 3 months or if required.

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

a. Friction test that performed annually by special examiner.

b. If the test result showed maintenance is required, then the overlay will be performed.

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

4.7.5 Fasilitas/Peralatan	4.7.5 Facility/Equipment
5) Pengukuran kedalaman air tidak dilakukan dengan alat khusus tetapi diukur secara manual dengan penglihatan.	5) Measurement of water depth is conducted manually by visual observation.

1.17.2.2 SOP – Runway, Taxiway and Apron Inspection

5.0 URAIAN PROSEDUR	**5.0 PROCEDURE DESCRIPTION**
5.1 Prosedur Inspeksi Runway, Taxiway dan Apron	5.1 Runway, Taxiway and Apron Inspection Procedure
5.1.1 Pelaksanaan Inspeksi Runway, Taxiway dan Apron dilakukan oleh team terdiri dari:	5.1.1 Runway, Taxiway and Apron Inspection is performed by team that consisted of:
5.1.1.1 Airport Facilities & Readiness Section;	5.1.1.1 Airport Facilities & Readiness Section;
5.1.1.2 Airport Equipment Section.	5.1.1.2 Airport Equipment Section.
5.1.2 Pelaksanaan Inspeksi Runway, Taxiway dan Apron dilakukan pada saat:	5.1.2 The Runway, Taxiway and Apron Inspection is performed on:
5.1.2.1 Dilaksanakan inspeksi pada saat bandara akan dioperasikan (satu jam sebelum operasi);	5.1.2.1 One hour before airport operation;
5.1.2.2 Dilaksanakan inspeksi pada siang hari;	5.1.2.2 Midday;
5.1.2.3 Dilaksanakan inspeksi pada saat Bandar udara selesai operasi;	5.1.2.3 After the termination of airport operation;
5.1.2.4 Dilaksanakan inspeksi khusus pada saat penomena alam seperti angin kencang, hujan badai, gempa bumi atau ketika diminta oleh Air Traffic Control (ATC);	5.1.2.4 Special inspection performs if there are significant phenomena such as strong wind condition, heavy 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 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 called;

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

According to the SOP of Runway, Taxiway and Apron Inspection shows the checklist of runway inspection report as follows:

Jenis Fasilitas	Kondisi			Lokasi	Keterangan
	Baik	Cukup	Rusak/tebal		
Runway 09-27					
A. Pavement					
B. Rubber Deposit					
C. Marka					
– Runway center line marking					
– Threshold marking 09					
– Threshold marking 27					
– Runway side stripe marking					
– Touchdown zone marking					
– Aiming point marking					
D. Lighting					
– Runway edge light					
– Threshold light					

The translation is as follows:

Facilities	Conditions			Location	Remarks
	Good	Fair	Broken/thick		
Runway 09-27					
A. Pavement					
B. Rubber Deposit					
C. Marking					
– Runway center line marking					
– Threshold marking 09					
– Threshold marking 27					
– Runway side stripe marking					
– Touchdown zone marking					
– Aiming point marking					
D. Lighting					
– Runway edge light					
– Threshold light					

The investigation could not find the documentation of daily runway inspection conducted on the midday and after the termination of airport operation as on procedure for the last one-month prior the accident including the observation of standing water. The results of daily runway inspection before the airport open at the day of accident were as follows: the pavement, rubber deposit, markings were on fair condition and the lightings were on good condition.

1.17.2.3 SOP – Runway Friction Test

I. PENDAHULUAN

1.1 Pengertian

1.1.4 Kondisi fasilitas landasan kurang baik dan laik dipergunakan bila permukaan landasan sudah licin (tidak kesat) sehingga dapat menyebabkan kecelakaan bagi pesawat udara.

1.1.5 Untuk mengetahui kondisi permukaan landasan sesungguhnya, perlu dilakukan pengetesan kekesatan permukaan secara berkala.

II. PENGAMATAN KONDISI PERMUKAAN PERKERASAN

Pengamatan terhadap kondisi permukaan perkerasan dilaksanakan secara periodik. Minimal frekuensi pengamatan dilaksanakan sesuai dengan frekuensi pesawat/hari yang mendarat di tiap-tiap ujung Runway.

Jumlah pesawat/hari yang mendarat di tiap-tiap ujung Runway	*Frekuensi Pengamatan Kekesatan*
< 15	*1 tahun*
16 – 30	*6 bulan*
31 – 90	*3 bulan*
91 – 150	*1 bulan*
151 – 210	*2 minggu*
>210	*1 minggu*

I. PREFACE

1.1 Definition

1.1.4 The runway facilities defined as unworthy is when the runway surface becomes slippery (less friction), therefore it can cause aircraft accident.

1.1.5 To be able know the existing runway surface condition requires a periodic runway friction test.

II. OBSERVATION OF SURFACE PAVEMENT CONDITION

Observation of surface pavement condition is conducted periodically. The minimum observation frequency depends on frequency of aircraft landing per day on each runway.

Landing aircraft/day on each runway	Friction observation frequency
< 15	1 year
16 – 30	6 months
31 – 90	3 months
91 – 150	1 month
151 – 210	2 weeks
>210	1 week

Apabila dari hasil pengamatan ditemukan bahwa kondisi permukaan sudah licin yang diakibatkan kumulasi karet yang diakibatkan oleh roda pesawat pada saat pendaratan maka dapat dilakukan pembersihan Rubber Deposit. Frekuensi pembersihan Rubber Deposit dapat dilihat pada tabel berikut:

Jumlah pesawat/hari yang mendarat di tiap-tiap ujung Runway	*Usulan frekuensi pembersihan Rubber Deposit*
< 15	*2 tahun*
16 – 30	*1 tahun*
31 – 90	*6 bulan*
91 – 150	*4 bulan*
151 – 210	*3 bulan*
>210	*2 bulan*

If the observation result found that the surface pavement is slippery as result of rubber deposit accumulation from the aircraft wheel on landing, then the rubber deposit should be cleaned. The frequency of rubber deposit cleaning can be seen on the following table:

Landing aircraft/day on each runway	Suggested rubber deposit cleaning frequency
< 15	2 years
16 – 30	1 year
31 – 90	6 moths
91 – 150	4 moths
151 – 210	3 moths
>210	2 moths

The last runway friction test was performed on 8 October 2009 used MU-meter conducted by Ministry of Public Work after completion of runway levelling and overlay program. During the test, the runway was divided into three segments – segment 1 (KM 2+200 – 2+000), segment 2 (KM 1+500 – 0+800) and segment 3 (KM 0+300 – 0+000) –, and the test was performed into two different tracks – track A (from centreline to north) and track B (from centreline to south).

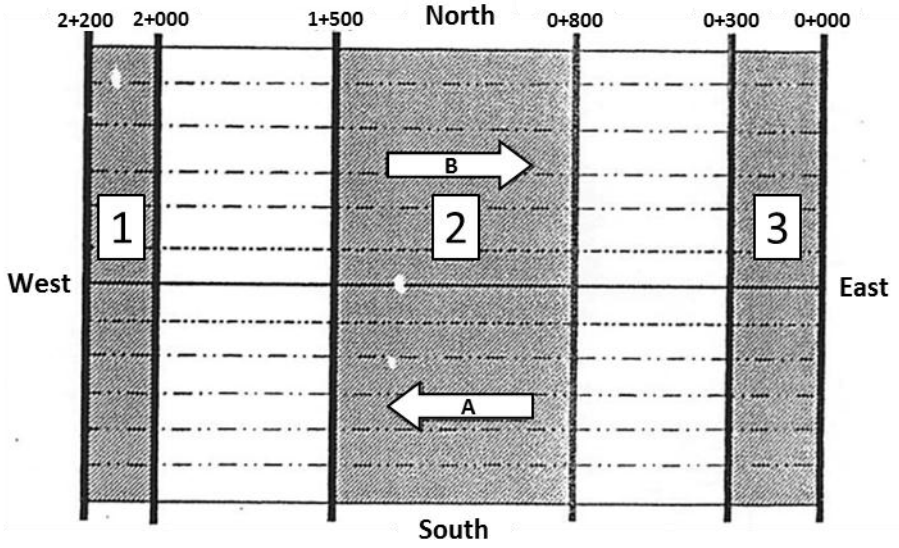


Figure 15: The friction test scheme

The results of the runway friction test were as follows:

Track	Segment		
	1	2	3
A	0,58 – 0,89	0,62 – 0,92	0,79 – 0,92
B	0,60 – 0,85	0,66 – 0,91	0,59 – 090

1.17.3 Air Traffic Services Provider

The air traffic services within Indonesian airspace are provided by *Perum* LPPNPI – *Lembaga Penyelenggara Pelayanan Navigasi Penerbangan Indonesia* (AirNav Indonesia).

The Indonesian airspace divided into two Flight Information Regions (FIRs) of Jakarta and Makassar. Air traffic services in Yogyakarta are included in the Makassar FIR and consist of two units – Yogya Director (Approach Control/APP) and Adi Tower (Aerodrome Control/ADC).

According to Indonesia Aviation Act no 1 of 2009 article 275 and Indonesia Civil Aviation Safety Regulation part 172 stated that the unit providing air navigation services should be certified by the Directorate General of Civil Aviation. The investigation could not find approval certificate of Yogyakarta Air Traffic Services from the Directorate General of Civil Aviation.

1.17.4 Directorate General of Civil Aviation

The Directorate General of Civil Aviation has several directorates including the Directorate of Airport that responsible in formulating policy and standard including supervision of aerodrome operation and issuance of aerodrome certificate.

The Directorate of Airport issued several regulations and standards related to the runway operation and maintenance 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 following are the relevant regulations and standards.

1.17.4.1 Civil Aviation Safety Regulation Part 139 – Volume I Aerodrome

139.041 Pemberitahuan tentang Penyimpangan	**139.041 Notification of Deviation**
1. Penyimpangan terhadap prosedur dan fasilitas, termasuk Runway End Safety Area (RESA) maupun runway strip, dalam Pedoman Pengoperasian Bandar Udara dapat dilakukan oleh penyelenggara bandar udara bersertifikat setelah melakukan risk assessment dan upaya mengurangi dampak (risk mitigation) yang telah mendapat persetujuan Direktur Jenderal.	1. Deviation from procedure and facility, including Runway End Safety Area (RESA) and runway strip in the Aerodrome Manual is possible after the airport operator conducts risk assessment and risk mitigation that was approved by Director General.

2. *Penyelenggara bandar udara wajib melaporkan secara tertulis kepada Direktur Jenderal apabila terdapat penyimpangan Pedoman Pengoperasian Bandar Udara dalam jangka waktu 30 (tiga puluh) hari setelah penyimpangan dilakukan.*	2. Airport operator shall make written report to Director General if there is deviation of Aerodrome Manual within 30 days after the deviation.
APPENDIX 1 ITEM-ITEM YANG DIMASUKKAN DALAM BUKU PEDOMAN PENGOPERASIAN BANDAR UDARA (AERODROME MANUAL)	**APPENDIX 1 ITEMS THAT SHALL INCLUDES ON AERODROME MANUAL**
4.5 Inspeksi atau Pemeriksaan di Daerah Pergerakan dan Obstacle Limitation Surface	**4.5 Inspection in Movement Area and Obstacle Limitation Surface**
Prosedur untuk inspeksi atau pemeriksaan di daerah pergerakan dan Obstacle Limitation Surface, meliputi sedikitnya:	Inspection procedure in movement area and Obstacle Limitation Surface shall include at least:
b. Pengaturan pelaksanaan pengujian friksi runway dan pengukuran water depth di runway dan taxiway;	b. Implementation guideline of runway friction test and measurement of water depth in runway and taxiway;
Bab IV Prosedur Pengoperasian Bandar Udara (Aerodrome Operating Procedures)	**Chapter IV Aerodrome Operating Procedures**

1.17.4.2 Manual of Standard (MOS) CASR Part 139 – Volume I Aerodrome

Definisi	**Definition**
Runway end safety area (RESA)	**Runway end safety area**
Suatu daerah simetris di sekitar perpanjangan garis tengah landas pacu (runway centreline) dan berbatasan dengan ujung strip landas pacu, yang utamanya ditujukan untuk mengurangi risiko kerusakan pada pesawat udara akibat undershooting atau overrunning; dan juga memungkinkan pesawat udara yang mengalami overrunning dapat mengurangi kecepatan dan pesawat udara yang mengalami undershooting dapat meneruskan pendekatannya (approach) atau pendaratannya.	A symmetrical area about the extended runway centre line and adjacent to the end of the strip primarily intended to reduce the risk of damage to an aeroplane undershooting or overrunning the runway, and also possible to reduce speed of aircraft overrunning and for undershooting aircraft could continue approach or land.
6.4. Runway End Safety Area (RESA)	**6.4. Runway End Safety Areas (RESA)**
6.4.1. Umum	**6.4.1. General**

6.4.1.1. RESA harus disediakan di bagian akhir sebuah runway strip dengan Code Number 3 atau 4, dan Code Number 1 atau 2 runway instrument.

6.4.1.1. RESA shall be provided at each end of runway strip where the Code Number 3 or 4, and Code Number 1 or 2 runway instrument.

6.4.1.2. RESA digunakan untuk melindungi pesawat udara pada saat terjadi pesawat undershooting atau over running runway.

Catatan: Standar RESA didalam bagian ini adalah sesuai dengan standar ICAO terkini, termasuk pengukuran RESA dari bagian akhir strip runway.

6.4.1.2. RESA is used to protect aircraft undershooting or overrunning runway.

Note: The standard or RESA in this chapter is consistent with the current ICAO standard, including RESA measurement on the last part of runway strip.

10.2. Inspeksi dan Pelaporan Aerodrome Serviceability

10.2.3. Kondisi permukaan pada area pergerakan (Movement Area), termasuk keberadaan air

Inspeksi harus dilakukan untuk memeriksa keberadaan:

10.2. Inspection and reporting of Aerodrome Serviceability

10.2.3. Surface Movement Area, including presence of water

Inspection shall be carried out to check the presence of:

a. Air di permukaan; informasi kondisi air yang ada di permukaan runway agar mengikuti terminologi sebagai berikut:

- *DAMP – perubahan warna permukaan yang karena kelembaban*
- *WET — permukaan basah tetapi tidak ada STANDING WATER.*
- *STANDING WATER — untuk operasional pesawat udara, lebih dari 25 persen dari luas permukaan (baik di area yang terisolasi atau tidak) runway dengan panjang dan lebar yang ditutupi oleh air dengan kedalaman lebih dari 3 mm.*

a. Water in surface; information of water condition over runway should use the following terminology:

- DAMP – the surface shows a change of colour due to moisture
- WET — the surface is soaked but there is no STANDING WATER.
- STANDING WATER — for aircraft performance purposes, a runway where more than 25 percent of runway surface area (whether in isolated areas or not) runway within the length and width is covered by water more than 3 mm.

b. lapisan karet (rubber deposit);

...

b. rubber deposit;

...

k. inspeksi juga harus memeriksa bagian runway yang mungkin licin saat basah. Terutama pada daerah perkerasan runway yang tidak memenuhi ketentuan kekesatan

k. the inspection shall include runway area that may become slippery when wet. Especially on runway pavement area that known not meet the friction requirement of Directorate General of

/gesekan runway yang ditetapkan oleh Ditjen Hubud.

Civil Aviation.

10.3.2. Perubahan yang dilaporkan ke NOTAM office

10.3.2.2. Informasi berikut harus dilaporkan ke NOTAM office:

...

i. Adanya atau hilangnya atau perubahan signifikan, kondisi bahaya yang disebabkan oleh lumpur atau air di area pergerakan (wet atau standing water);

10.3.2. The change to be reported to the NOTAM office

10.3.2.2. The following information shall be reported to the NOTAM office:

…

i. The existing or reduce or significant change, of hazard that resulted by mud or water in movement area (wet or standing water);

10.17. Penentuan Karakterisik Gesekan Permukaan untuk Keperluan Pembangunan

10.17.5. Karakterisik gesekan permukaan sebuah runway harus:

a. Diukur untuk memastikan karakteristik gesekan permukaan perkerasan runway yang baru atau yang baru dilapisi;

b. Diukur secara berkala guna menentukan kelicinan perkerasan runway.

10.17. Determining the Friction Characteristic for the Purpose of Construction

10.17.5. Surface friction characteristic of runway shall be:

a. measured to ensure the friction characteristic of a new runway pavement or an overlay runway.
b. periodically measured to determine runway friction.

10.17.6. Kondisi perkerasan runway pada umumnya diukur dalam kondisi kering menggunakan alat pengukur self wetting continuous friction. Tes evaluasi karakteristik gesekan permukaan runway diukur pada permukaan runway yang bersih setelah dikonstruksi atau dilapisi.

10.17.6. The condition of runway friction pavement normally measured in dry condition with self wetting continuous friction device. The evaluation test of runway friction characteristic is measured on clean surface after constructed or overlayed.

10.17.7. Tes gesekan kondisi permukaan eksisting dilakukan secara berkala untuk menghindari penurunan di bawah tingkat minimum gesekan yang ditentukan oleh Direktorat Jenderal Perhubungan Udara. Tingkat gesekan minimum akan ditentukan dalam Peraturan Dirjen Hubud.

10.17.7. The friction test of existing condition is conducted periodically to prevent the reduction of friction below the minimum level as required by Directorate General of Civil Aviation. The friction level will be determined in the Director General of Civil Aviation regulation.

10.17.8. Apabila gesekan dari bagian manapun di runway ditemukan berada di bawah nilai tersebut, maka hal tersebut diumumkan melalui NOTAM yang menjelaskan pada bagian mana

10.17.8. If the friction of any part of the runway found to be less than the required level, therefore, it should be notified in NOTAM and explain the location of runway portion that has friction below

dari runway yang berada di bawah tingkat gesekan minimum, dan lokasinya. Selanjutnya tindakan pemeliharaan korektif harus segera dimulai. Pengukuran gesekan diambil pada interval waktu yang akan dapat memastikan identifikasi runway yang membutuhkan pemeliharaan atau perlakuan permukaan khusus sebelum kondisinya menjadi serius. Interval waktu dan rata-rata frekuensi pengukuran tergantung pada factor-faktor seperti : jenis pesawat dan frekuensi penggunaan, kondisi iklim, jenis perkerasan dan perbaikan perkerasan dan kebutuhan pemeliharaan.

the minimum friction level. Furthermore, a corrective maintenance shall be conducted as soon as possible. The friction measurement taken on time interval to ensure an identification of runway which required maintenance or special treatment before it becomes serious. The time interval and average or measurement frequency depends on the following factors: aircraft type and frequency of use, climate condition, pavement type and pavement repair and maintenance requirement.

10.17.9. Pengukuran gesekan untuk runway eksisting, baru atau yang baru dilapisi permukaannya diukur dengan alat pengukur continuous friction dilengkapi dengan sebuah telapak ban halus. Peralatan tersebut sebaiknya menggunakan fitur self-wetting untuk memungkinkan pengukuran dari karakteristik gesekan permukaan yang akan dibuat pada kedalaman air 1 mm.

10.17.9. The friction measurement of existing runway, new or overlayed runway is measured with continuous friction device that equipped with soft tire surface. The device should have self-wetting feature to enable the measurement of surface friction characteristic which will be simulated on water depth of 1 mm.

10.17.12. Direktorat Jenderal Perhubungan Udara menetapkan tingkat gesekan minimum dimana tindakan pemeliharaan korektif harus diambil dilakukan ketika nilai gesekan di bawah tingkat minimum, dalam advisory circular. Dengan tingkat gesekan permukaan runway yang sudah ditetapkan tersebut, operator bandar udara dapat membuat tingkatan perencanaan pemeliharaan, disaat nilai gesekan di bawah tingkat yang dipersyaratkan, maka tindakan pemeliharaan korektif yang tepat harus dilakukan untuk meningkatkan gesekan. The Airport Services Manual (Doc 9137), Part 2, memberikan panduan tentang pembuatan perencanaan pemeliharaan dan tingkat minimum gesekan untuk permukaan runway yang digunakan.

10.17.12. Directorate General of Civil Aviation has determined minimum friction level and corrective maintenance shall be conducted if the friction level downgraded below the minimum requirement as stated in the advisory circular. With this requirement of runway friction, airport operator should develop level of maintenance plan, and when the friction level is below the requirement level, an appropriate maintenance corrective action shall be performed. The Airport Service Manual (Doc 9137), Part 2, provides guideline for the maintenance plan and minimum friction level of the runway surface.

1.17.4.3 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 asrunway

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 make a periodic schedule for maintenance of the pavement friction.

In regards to the result 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 of runway measurement track

e) The speed of measurement

f) The condition of 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 month
31 – 90	3 month
91 – 150	1 month
151 – 210	2 week
>210	1 week

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*
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

Measurement Device	65 km/h (40 mph)			95 km/h (40 mph)		
	Minimal	Maintenance	New Construction	Minimal	Maintenance	New Construction
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

1.17.4.4 Staff Instruction 139-01

Staff Instruction (SI) 139-01 is a guideline to conduct safety oversight of airport operation in order to meet the aviation safety standard. The SI consisted several checklists that divided into five systems (A. Airport Management; B. Airside Control; C. Airport Environment; D. Inspection and Reporting; and E. Safety Management). Each system divided into elements that consisted of several questions referring to the standard requirement on CASR and MOS.

The excerpt of questions on element "B. Airside Control" in performing runway operation oversight that was used during the certification process was as follows:

B. Kontrol Sisi Udara

B.4 PEMELIHARAAN DAERAH PERGERAKAN

Prosedur

1. *Apakah kegiatan pemeliharaan di atau dekat area pergerakan dikontrol sesuai dengan buku pedoman (manual)?*
2. *Apakah pemeliharaan area pergerakan dilakukan sesuai dengan jadwal atau rutinitas yang tercantum dalam buku pedoman (manual)?*
3. *Dapatkah hasil uji kekesatan landas pacu (runway) dikaitkan dengan serviceability dan batas-batas keselamatan?*
4. *Apakah petugas memahami akan persyaratan keselamatan berkaitan dengan area pergerakan?*

B. Airside Control

B.4 Maintenance of Movement Area

Procedure

1. Is the maintenance activity in or near movement area controlled according to aerodrome manual?
2. Is the maintenance of movement area performed according to schedule or period as stated on aerodrome manual?
3. Could the result of runway friction test associated to the serviceability and safety requirements?
4. Is the personnel understand the safety requirement related to movement area?

The certification assessment process for Adisutjipto Airport was conducted by the Directorate of Airport personnel on 10 until 13 March 2015. The assessment process referred to Staff Instruction 139-01. The findings related to runway operation and maintenance was as follows:

- *Belum tersedia program manajemen perkerasan / Pavement Management System (PMS), tidak adanya suatu sistem pemeliharaan konstruksi yang terencana, tepat dan terdokumentasi untuk mempertahankan konstruksi perkerasan yang mempunyai kinerja tinggi, handal serta berkelanjutan.*

  There was no Pavement Management System (PMS), which is maintenance systems that appropriately planned, executed, and documented to ensure sustainability of pavement construction.

- *Belum tersedia standar dan prosedur pelaksanaan pekerjaan pemeliharaan / perbaikan pada kondisi khusus / mendadak.*

  There was no standard and procedure to conduct maintenance/repair on special/urgent condition.

The investigation did not find the DGCA finding related to the inspection of runway including the runway friction check.

1.17.4.5 Advisory Circular 170-02

The DGCA has Directorate of Navigation responsible for regulating the air traffic services. The Directorate of Navigation issued several regulations and standards. The relevant regulations and standards are as follows:

7.4 ESSENTIAL INFORMATION ON AERODROME CONDITIONS

7.4.1 Essential information on aerodrome conditions is information necessary to safety in the operation of aircraft, which pertains to the movement area or any facilities usually associated therewith. For example, construction work on a taxi strip not connected to the runway-in-use would not be essential information to any aircraft except one that might be taxied in the vicinity of the construction work. As another example, if all traffic must be confined to runways, that fact should be considered as essential aerodrome information to any aircraft not familiar with the aerodrome.

7.4.2 Essential information on aerodrome conditions shall include information relating to the following:

a) construction or maintenance work on, or immediately adjacent to the movement area;

b) rough or broken surfaces on a runway, a taxiway or an apron, whether marked or not;

c) snow, slush or ice on a runway, a taxiway or an apron;

d) water on a runway, a taxiway or an apron;

e) snow banks or drifts adjacent to a runway, a taxiway or an apron;

f) other temporary hazards, including parked aircraft and birds on the ground or in the air;

g) failure or irregular operation of part or all of the aerodrome lighting system;

h) any other pertinent information.

Note.— Up-to-date information on the conditions on aprons may not always be available to the aerodrome control tower. The responsibility of the aerodrome control tower in relation to aprons is, with respect to the provisions of 7.4.1 and 7.4.2, limited to the transmission to aircraft of the information which is provided to it by the authority responsible for the aprons.

7.4.3 Essential information on aerodrome conditions shall be given to every aircraft, except when it is known that the aircraft already has received all or part of the information from other sources. The information shall be given in sufficient time for the aircraft to make proper use of it, and the hazards shall be identified as distinctly as possible.

Note.— "Other sources" include NOTAM, ATIS broadcasts, and the display of suitable signals.

12.3 ATC PHRASEOLOGIES

12.3.1 General

12.3.1.10 AERODROME INFORMATION

g) RUNWAY REPORT AT (observation time) RUNWAY (number) (type of precipitant) UP TO (depth of deposit) MILLIMETRES. BRAKING ACTION GOOD (or MEDIUM TO GOOD, or MEDIUM, or MEDIUM TO POOR, or POOR or UNRELIABLE) [and/or BRAKING COEFFICIENT (equipment and number)];

h) BRAKING ACTION REPORTED BY (aircraft type) AT (time) GOOD (or MEDIUM, or POOR);

i) BRAKING ACTION [(location)] (measuring equipment used), RUNWAY (number), TEMPERATURE [MINUS] (number), WAS (reading) AT (time);

j) RUNWAY (or TAXIWAY) (number) WET [or DAMP, WATER PATCHES, FLOODED (depth), or SNOW REMOVED (length and width as applicable), or TREATED, or COVERED WITH PATCHES OF DRY SNOW (or WET SNOW, or COMPACTED SNOW, or SLUSH, or FROZEN SLUSH, or ICE, or ICE UNDERNEATH, or ICE AND SNOW, or SNOWDRIFTS, or FROZEN RUTS AND RIDGES)];

1.18 Additional Information

1.18.1 Reporting of Runway Surface Condition

ICAO Annex 14 – Aerodromes, Volume I – Aerodrome Design and Operations

2.9 Condition of the movement area and related facilities

2.9.1 Information on the condition of the movement area and the operational status of related facilities shall be provided to the appropriate aeronautical information service units, and similar information of operational significance to the air traffic services units, to enable those units to provide the necessary information to arriving and departing aircraft. The information shall be kept up to date and changes in conditions reported without delay.

2.9.2 The condition of the movement area and the operational status of related facilities shall be monitored and reports on matters of operational significance affecting aircraft and aerodrome operations shall be provided in order to take appropriate action, particularly in respect of the following:

a) construction or maintenance work;

b) rough or broken surfaces on a runway, a taxiway or an apron;

c) snow, slush or ice on a runway, a taxiway or an apron;

d) water on a runway, a taxiway or an apron;

e) snow banks or drifts adjacent to a runway, a taxiway or an apron;

f) anti-icing or de-icing liquid chemicals or other contaminants on a runway, taxiway or apron;

g) other temporary hazards, including parked aircraft;

h) failure or irregular operation of part or all of the aerodrome visual aids; and

i) failure of the normal or secondary power supply.

2.9.3 To facilitate compliance with 2.9.1 and 2.9.2, inspections of the movement area shall be carried out each day at least once where the code number is 1 or 2 and at least twice where the code number is 3 or 4.

2.9.6 Information that a runway or portion thereof may be slippery when wet shall be made available.

Note.— The determination that a runway or portion thereof may be slippery when wet is not based solely on the friction measurement obtained using a continuous friction measuring device. Supplementary tools to undertake this assessment are described in the Airport Services Manual (Doc 9137), Part 2.

2.9.7 Notification shall be given to aerodrome users when the friction level of a paved runway or portion thereof is less than that specified by the State in accordance with 10.2.3.

10.2 Pavements

10.2.3 A paved runway shall be maintained in a condition so as to provide surface friction characteristics at or above the minimum friction level specified by the State.

10.2.4 Runway surface friction characteristics for maintenance purposes shall be periodically measured with a continuous friction measuring device using self-wetting features and documented. The frequency of these measurements shall be sufficient to determine the trend of the surface friction characteristics of the runway.

ICAO Annex 15 – Aeronautical Information Services

8.1 Pre-flight information

8.1.1 At any aerodrome/heliport normally used for international air operations, aeronautical information essential for the safety, regularity and efficiency of air navigation and relative to the route stages originating at the aerodrome/heliport shall be made available to flight operations personnel, including flight crews and services responsible for pre-flight information.

8.1.2 Aeronautical information provided for pre-flight planning purposes at the aerodromes/heliports referred to in 8.1.1 shall include relevant:

a) elements of the Integrated Aeronautical Information Package;

b) maps and charts.

Note.— The documentation listed in a) and b) may be limited to national publications and when practicable, those of immediately adjacent States, provided a complete library of aeronautical information is available at a central location and means of direct communications are available between the aerodrome AIS unit and that library.

8.1.2.1 Additional current information relating to the aerodrome of departure shall be provided concerning the following:

- *a) construction or maintenance work on or immediately adjacent to the manoeuvring area;*
- *b) rough portions of any part of the manoeuvring area, whether marked or not, e.g. broken parts of the surface of runways and taxiways;*
- *c) presence and depth of snow, ice or water on runways and taxiways, including their effect on surface friction;*
- *d) snow drifted or piled on or adjacent to runways or taxiways;*
- *e) parked aircraft or other objects on or immediately adjacent to taxiways;*
- *f) presence of other temporary hazards;*
- *g) presence of birds constituting a potential hazard to aircraft operations;*
- *h) failure or irregular operation of part or all of the aerodrome lighting system including approach, threshold, runway, taxiway, obstruction and manoeuvring area unserviceability lights and aerodrome power supply;*
- *i) failure, irregular operation and changes in the operational status of SSR, ADS-B, ADS-C, CPDLC, D-ATIS, D-VOLMET, radio navigation services, VHF aeromobile channels, RVR observing system, and secondary power supply; and*
- *j) presence and operation of humanitarian relief missions, such as those undertaken under the auspices of the United Nations, together with any associated procedures and/or limitations applied thereof.*

ICAO Document 9137 – Airport Services Manual, Part 2 – Pavement Surface Conditions

3.1.6 The criteria used by a State for evaluating runway surfaces should be published in the State's aeronautical information publication (AIP). When a runway surface that does not meet the criteria is found, a NOTAM should be issued until such time as corrective action has been taken.

3.2.11 States should specify three friction levels as follows:

- *a) a design level which establishes the minimum friction level for a newly constructed or resurfaced runway surface;*

b) a maintenance friction level below which corrective maintenance action should be considered; and

c) a minimum friction level below which the information that a runway may be slippery when wet should be made available and corrective action initiated.

ICAO Circular 319 – Assessment, Measurement and Reporting of Runway Surface Conditions

Figure 7-2: Key participants in the gathering and provision of runway friction data

<table>
<tr><td colspan="3">Maintenance (Functional)</td></tr>
<tr><td colspan="2">Aerodrome (1)</td><td>ATC (2)</td><td>Flight Crew (3)</td></tr>
<tr><td>Operatives</td><td>Management</td><td rowspan="2"></td><td rowspan="2"></td></tr>
<tr><td>Gathers Information →</td><td>Interprets Information and Takes Action</td></tr>
<tr><td colspan="3">Operational (Contaminated)</td></tr>
<tr><td colspan="2">Aerodrome (1)</td><td>ATC (2)</td><td>Flight Crew (3)</td></tr>
<tr><td colspan="2">Gathers Information →</td><td>Transmit Information →</td><td>Interpret Information and Makes Decision ←</td></tr>
</table>

1.19 Useful or Effective Investigation Techniques

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

2 ANALYSIS

The investigation based on the factual data gathered from flight recorders, interview, and other related data. The investigation also utilized several related and current manuals uses by the operators, CASR, MOS and ICAO. The investigation is focused on the factors contributed to the runway excursion and other significant issues. Therefore, the analysis will focus on the following topics:

- Decision to land;
- Factors affecting landing distance;
- Landing distance calculation;
- Braking Action Assessment;
- Passenger Evacuation.

2.1 Decision to land

After received weather information from the Automatic Terminal Information Services (ATIS) the PF decided to land with flaps 40 and auto-brake max. When the aircraft approaching altitude 2,000 feet, the pilots noticed cumulonimbus cloud over Yogyakarta as indicated by magenta figure on the weather radar and the PF decided to follow wind shear precaution recommendation as described on the Flight Crew Operations Manual (FCOM) to use flaps 30 for landing. This change of landing flap configuration would increase the landing speed and the landing distance. The landing speed for the estimated landing weight of 63,900 kg and flaps 30 was 141 knots. There was no recalculation of the required landing distance following the landing configuration changing.

The recommended elements of a stabilized approach stated in the FCOM, described that the approach in VMC below 500 feet, the aircraft should be in the correct flight path, approach speed deviation of +10 knots to -5 knots are acceptable if the airspeed is trending toward approach speed and all briefings and checklists have been conducted.

The sequence of events below 500 feet when the PF flown the aircraft manually were as follows:

- At 07:59:43 UTC, at altitude 381 feet, the N1s were at approximately 60% and the speed was at 157 knots. At altitude 87 feet, the N1s were increased to approximately 70% followed by the speed increased from 153 knots to 159 knots at 10 feet. At this time the tailwind recorded 6 knots. The aircraft passed altitude 50 feet with speed of 153 knots then at altitude 10 feet the speed increased to 159 knots.
- At 07:59:52 UTC, at 229 feet, the PM advised the PF to fly right and was acknowledged by the PF.
- The time interval between the aircraft passed altitude of 10 feet to touchdown was 6 seconds and the speed was 154 knots.

The decision to land or go around basically rests to the PIC assessment to the possibility of critical condition on landing. The CRM principle requires the PM to callout for any deviation and to take any action if there is no acknowledgement from the PF. In this particular approach, there was no discussion between the pilots concerning to the landing distance following the change of the landing configuration to use flaps 30 for the existing condition, and there was no callout from the PM when the speed was 13 knots above the approach speed. The speed was an indication that one of the stabilize approach element was not achieved and required go around.

A combination of the absence of landing distance calculation for landing configuration with flap 30 and callout of speed above the approach speed might cause the pilots did not aware of the required landing distance for the existing condition and decided to continue landing.

2.2 Factors Affecting Landing Distance

According to FCTM 6.32 Factor Affecting Landing Distance, several factors that affecting the landing distance include the height and speed over the threshold, glide slope angle, landing flare, lowering the nose to the runway, use of reverse thrust, speed brakes, wheel brakes and surface conditions of the runway. The reverse thrust and speed brake drag are most effective during the high-speed portion of the landing. Deploy the speed brake lever and activate reverse thrust with as little time delay as possible. Moreover, floating above the runway before touchdown must be avoided because it uses a large portion of the available runway.

As of FCTM 6.33 Factors Affecting Landing Distance (Typical) describes that floating above the runway, wheel brakes and reverser are three significant factors affecting the landing distance.

Significant events from altitude of 200 feet to touchdown

- From approximately 200 feet to 10 feet, the average tail wind was 6 knots.
- 08:00:16 UTC, the FDR data recorded that the aircraft touched down 6 seconds after passed 10 feet with speed of 154 knots or 13 knots above Vref. The 6 seconds floating resulted in the aircraft touch down at approximately 730 meters from the beginning runway 09 threshold or 427 meters beyond the touchdown zone aim point. The prolonged touchdown for 6 seconds was the factor that affecting additional landing distance.
- Two seconds after the aircraft touched down, the thrust reversers and the spoilers deployed and auto-brake active with the brake pressure up to 2,900 psi at 7 seconds after touchdown.
- 08:00:28 UTC, the manual brake was applied with intention to increase the brake pressure. The FDR recorded average brake pressure dropped to approximately 785 psi for 3 seconds and the longitudinal acceleration increased (less deceleration). The less deceleration was consistent with lower brake pressure application.

The FCTM 6.37 Transition to Manual Braking described that the transition from auto brake to manual brake depends on airplane deceleration rate, runway conditions and stopping requirements. When transitioning to manual braking, use reverse thrust as required until taxi speed. Immediately after main gear touchdown, smoothly apply a constant brake pedal pressure for the desired braking. For short or slippery runways, use full brake pedal pressure and do not attempt to modulate, pump or improve the braking by any other special techniques and modulating the brake pedals could affecting the braking efficiency is lost.

- 08:00:33 UTC, the reverser stowed for seven seconds at approximately 76 knots, while the recommended speed to stow the reversers was below 60 knots. The FDR data showed that the longitudinal acceleration was at -0.03 G, even though the brake pressure was increased to more than 2,000 psi. It can be concluded that stowing the thrust reversers resulted in less deceleration.

The FDR recorded, the thrust reversers were deployed, followed by all spoiler deployment and auto-brake activation with the average brake pressure of approximately 2,494 psi and N1 84.8%. The average of longitudinal acceleration was -0.27 G for 8 seconds. The deceleration rate with maximum auto-brake selection of 0.44 G as calculated on chapter 1.17.1.9 did not achieve with brake pressure and thrust reversers close to maximum. The investigation considered external factors reducing the deceleration rate such as the runway friction.

It can be concluded that there were four conditions affecting the landing distance, specifically the aircraft floated for about 6 seconds and touched down at the end of the touchdown zone, 427 meter beyond the aim point, after bouncing once; the airspeed at touchdown was 13 knots above Vref plus there was average tailwind of 6 knots; the thrust reversers were stowed at a higher than recommended speed and there was little braking for about 305 meter after the autobrakes were disconnected; and the wet runway conditions resulted in less deceleration.

2.3 Landing Distances

The Boeing FCOM provides the normal configuration distance tables as advisory information to help determine the actual landing distance performance of the airplane for different runway surface conditions and brake configurations.

The Indonesia MOS 139-23 stated that the definition for wet runway when the surface is soaked but there is no standing water. According to the Boeing FCTM, the braking action on wet runway condition is classified as good.

Since the airport operator did not issue the runway friction level therefore, the analysis applies several landing distance calculations with assumption of Good and Medium Braking Action for the existing aircraft landing weight, landing configuration and environmental condition.

The calculation of landing distance based on normal configuration landing distance table for the actual or assumed condition and the available runway length stated in the AIP, which was 2,200 meters.

Assumption of aircraft landed at touch down area with touchdown speed 13 knots above Vref on the existing environment condition with good braking action were as follows:

Component	Adjustment (m)
Landing Weight reference (70,000 kg)	1,405
Landing Weight (63,900 kg)	-80
Elevation (350 feet)	+ 12
Wind (tailwind 6 knots)	+ 120
Slope (0)	0
Temperature (32°C)	+ 55
Approach speed (Vref + 13)	+ 144
Thrust reverser (reversers deployed)	0
Total	**1,656**

Assumption of aircraft landed at 730 meters from beginning runway and touchdown speed of 13 knots above Vref on the existing environment condition with good braking action were as follows:

Component	Adjustment (m)
Landing Weight reference (70,000 kg)	1,405
Landing Weight (63,900 kg)	-80
Elevation (350 feet)	+ 12
Wind (tailwind 6 knots)	+ 120
Slope (0)	0
Temperature (32°C)	+ 55
Approach speed (Vref + 13)	+ 144
Thrust reverser (reversers deployed)	0
Prolong touchdown (730 m - 305 m)	+425
Total	**2,081**

Based on these calculations, assuming that the runway braking action was good, the runway was sufficient for the aircraft to stop with existing conditions.

Assuming that the runway braking action was medium, and aircraft landed at touchdown area with correct touchdown speed on the existing environment condition the calculation are as follows:

Component	Adjustment (m)
Landing weight reference 70,000 kg	1,840
Landing weight (63,900 kg)	-132
Elevation (350 feet)	+ 25
Wind (tailwind 6 knots)	+ 204
Slope (0)	0
Temperature (32°C)	+ 85
Approach speed (Vref)	0
Thrust reverser (reversers deployed)	0
Total	**2,022**

This calculation indicated that, the runway length available was sufficient for the aircraft to land on the existing environment with correct speed and touchdown point.

The FDR data showed that the aircraft speed was 13 knots above Vref and touched down at 730 meters from beginning runway, the calculation for the existing environment condition with medium braking action are as follows:

Component	Adjustment (m)
Landing Weight reference (70,000 kg)	1,840
Landing Weight (63,900 kg)	-132
Elevation (350 feet)	+ 25
Wind (tailwind 6 knots)	+ 204
Slope (0)	0
Temperature (32°C)	+ 85
Approach speed (Vref + 13)	+ 182
Thrust reverser (reversers deployed)	0
Prolong touchdown (730 m - 305 m)	+425
Total	**2,629**

Based on these calculations, assuming that the runway braking action was medium, the available runway was not sufficient for the aircraft to stop with existing environment and conditions.

Summary of the calculation

Factors affecting landing distance as discussed on Chapter 2.2 of this report particularly on the application of brake and thrust reverser were not included in the calculation. However these factors certainly would have affected the aircraft stopping distance.

Based on the landing distance calculations above, it indicated that when the aircraft was on proper landing profile and touchdown, the aircraft would be able to stop on the available runway with runway braking action good or medium.

The existing condition of Vref that was 13 knots above the target speed and the prolong touchdown resulted in the available runway was not sufficient for the aircraft to stop on medium braking action. On good braking action the runway available would be sufficient with relatively narrow margin. This narrow margin might have occupied by the improper application of brake and thrust reversers which have been discussed on Chapter 2.2. However, there was no information about runway friction classified as good or medium braking action from the air traffic controller or the airport operator which can be used as consideration.

2.4 Braking Action Assessment

According to Matrix for runway condition assessment of TALPA ARC as stated on FCTM Chapter 6, the information of runway condition such as wet runway, slippery when wet, standing water, etc. can be used to assess the runway-braking action.

Based on MOS 139 Volume I, the information of runway condition shall be reported to the NOTAM office. The runway friction information was not part of the information that shall be reported to NOTAM office.

According to ICAO Document 9137 chapter 3.1.6 when the runway surface does not meet the standard criteria of runway friction level, a NOTAM should be issued until such time as corrective action has been taken.

Based on ICAO Annex 14 chapter 2.9.1, *information on the condition of the movement area and the operational status of related facilities shall be provided to the appropriate aeronautical information service units, and similar information of operational significance to the air traffic services units, to enable those units to provide the necessary information to arriving and departing aircraft. The information shall be kept up to date and changes in conditions reported without delay.*

The absence of runway friction level information to the aircraft operators might reduce the accuracy of the landing distance calculation, either for dispatch planning or for the pilot during inflight prior to land.

2.5 Passenger Evacuation

After the aircraft stopped, the SIC commanded "ATTENTION CREW ON STATION" and the PIC commanded "BRACE, BRACE, BRACE". The SIC then asked PIC to set the engine power to idle. All commands during the evacuation shall only be provided by the PIC unless the PIC incapacitates and the "BRACE" command should be given before impact.

After the aircraft stopped, the pilot called flight attendant and commanded the Flight Attendant 1 (FA-1) to check the possibility of fire and standby for further instruction through interphone.

According to the Operation Manual Part-A Chapter 8.3.20.14.4 Initiation of The Evacuation stated that when the aircraft comes to a full stop under abnormal conditions the PIC commanded "ATTENTION FLIGHT ATTENDANT ON STATION" twice and evaluate situation will decide whether evacuation is required or not. This command should be followed by the FA-1 check the outside conditions and coordinated with other FA.

The crew started the APU and selected the APU generator to supply the aircraft electrical system and also the APU bleed air to supply the air conditioning system. The QRH for evacuation checklist stated that the engine and APU fire-warning switch shall be overrode and pulled. It means the engines and APU will be shutdown. Starting the APU may increase the hazard that induces fire, as there is possibility of system damage. The APU noise and exhaust gas might also disturbing the evacuation process.

The evacuation checklist was read and executed approximately three and half minutes after the aircraft stopped. FCTM Chapter 8.10 on evacuation stated that "*For unplanned evacuations, the captain needs to analyze the situation carefully before initiating an evacuation order. Quick actions in a calm and methodical manner improve the chances of a successful evacuation*". The PIC required three and half minutes to start evacuation check list while a quick action is required.

The CVR recorded that the evacuation was planned without escape slide and changed with escape slide. The evacuation was initiated approximately nine minutes after the aircraft stopped without utilizing over-wing emergency exit window. The passenger evacuation process completed in approximately eight minutes.

According to the conditions above, the emergency procedures for evacuation was not performed appropriately. This indicated inadequacy of evacuation training.

3 CONCLUSION

3.1 Findings[7]

1. The aircraft was airworthy prior to the accident.
2. The crew held valid licenses and medical certificates.
3. Both pilots had performed recurrent emergency training on 2015.
4. The PIC acted as PF and the SIC acted as PM.
5. During approach, the pilots noticed cumulonimbus cloud over Yogyakarta as indicated by magenta figure on the weather radar and decided to follow wind shear precaution recommendation as described on the Flight Crew Operations Manual (FCOM) to use flaps 30 for landing.
6. The aircraft landed with configuration of flap 30, auto-brake MAX, landing weight of 63,900 kg and Vref of 141 knots.
7. On approach the N1s value increased from 60% to 70%, resulted in the speed increased from 153 knots to 159 knots.
8. On short final, the PM advised the PF to fly right and acknowledged by PF.
9. The conditions during landing were runway wet and tail wind of 6 knots.
10. The interval from altitude of 10 feet to touchdown was 6 seconds and according to the FDR data, the aircraft touched down at 730 meters from the beginning runway 09.
11. The aircraft touched down with the speed of 154 knots followed by RAAS aural "Four Thousand Remaining".
12. A combination of the absence landing distance calculation for landing configuration with flap 30 and callout of speed above the Vref might cause the pilots did not aware of the required landing distance for the existing condition and decided to continue landing.
13. Based on the landing distance calculations indicated that when the aircraft was on proper landing profile and touchdown, the aircraft would be able to stop on the available runway with runway braking action good or medium.
14. The existing condition of Vref that was 13 knots above the target speed and the prolong touchdown, resulted in the available runway was not sufficient for the aircraft to stop on medium braking action. On good braking action the runway available would be sufficient with relatively narrow margin. This narrow margin might have occupied by the improper application of brake and thrust reversers.

7 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.

15. Four conditions which affecting the landing distance were the aircraft floated for about 6 seconds, and touched down at the end of the touchdown zone, 427 meter beyond the aim point, after bouncing once; the airspeed at touchdown was 13 knots above Vref plus there was average tailwind of 6 knots; the thrust reversers were stowed at a higher than recommended speed and there was little braking for about 305 meter after the autobrakes were disconnected; and the wet runway conditions resulted in less deceleration.
16. The deceleration rate with maximum auto-brake selection of 0.44 G did not achieve with brake pressure and thrust reversers close to maximum. The investigation considered the external factors contributed to the reduction of the deceleration rate such as runway condition.
17. The aircraft stopped at about 80 meters on the left of runway 09 centerline extension and about 84 meters from end of runway 09 with the nose landing gear collapsed, and no one injured in this accident.
18. The aircraft operator had amended the Special Airport Information (SAI) into Company Airport Briefing (CAB). The special limitation for Adisutjipto airport which was mentioned in the SAI was not included into CAB. The pilot referred to the SAI instead of the CAB.
19. The Adisutjipto airport was on airport certification renewal process, the investigation did not find the DGCA finding related to the inspection of runway including the runway friction check.
20. Discrepancies on the procedure of friction test between Aerodrome Manual which stated the test performs annually and the SOP – Runway Friction Test which the test frequency depend on number of aircraft landing per day.
21. There were different information related to stopway, clearway and RESA between AIP and the Jeppesen publication.
22. The investigation could not find the documentation of daily runway inspection conducted on the midday and after the termination of airport operation as on procedure for the last one-month prior the accident including the observation of standing water.
23. The last rubber deposit cleaning was performed on 29 October 2015.
24. Runway End Safety Area was not provided in runway 27. The DGCA issued exemption for this issue by referring to the mitigations performed by airport operator.
25. The airport operator shall conduct runway friction check in accordance with the airport operator manual and MOS 139. The last runway friction check was performed on 2009.
26. The investigation found that there was no activity of the airport operator related to the hazard identification, risk assessment and mitigation concerning to the runway surface condition including the friction level.
27. The absence of runway friction level information to the aircraft operators might reduce the accuracy of the landing distance calculation, either for dispatch planning or for the pilot during inflight prior to land.

28. The weather data for Adisutjipto International Airport was provided by the Air Force Meteorological Unit that utilized Automatic Weather Observation System (AWOS).
29. The AWOS monitor display was relayed by a CCTV camera to tower desk controller and when the visual quality of the monitor display became unclear, the tower controller has to call meteorology officer to get the latest information from AWOS.
30. The investigation could not find an approval certificate of Air Traffic Services provider from Directorate General of Civil Aviation.
31. The evacuation procedures did not performed according to the aircraft operator SOP which indicated inadequacy of crew evacuation training.

3.2 Contributing Factors[8]

- The absence of landing distance calculation following landing reconfiguration and the higher speed with no reminder callout might have made the pilots decided to continue landing.
- The conditions of the aircraft floated and eventually touched down at the end of the touchdown zone 13 knots above Vref with average 6 knots tailwind, lower brake pressure for 305 meter after the autobrakes were disconnected, and removal of the thrust reverser application at a higher than recommended speed along with medium braking action had extended the landing distance.

3.3 Other Safety Issue

The external factors such as runway condition might have contributed to the reducing of deceleration rate while the brake pressure and thrust reversers were close to maximum.

8 "Contributing Factors" are those events which alone, or in combination with others, resulted in injury or damage. The contributing factor is an act, omission, condition, or circumstance which if eliminated or avoided would have prevented the occurrence or would have mitigated the resulting injuries or damage.

4 SAFETY ACTION

At the time of issuing this Final report, the Komite Nasional Keselamatan Transportasi had been informed PT. Batik Air Indonesia safety actions resulting from this occurrence.

1. On 6 November 2015, the aircraft operator issued Notice to Pilot (NTP) number 014/XI/2015 contained the following instructions:
    - To review NTP number 13/XI/2015 Subject to Wet Season and SSQ Safety Circular Subject to Safety Precautions on Wet/Rainy Season.
    - PIC must ensure the crew to do proper dispatch briefing to properly analyze the flight;
    - Delay the Take Off and Landing when the windshear is forecast in the takeoff and approach path;
    - Delay the takeoff and landing on marginal runway during heavy rain since all our airports in Indonesia do not have water depth measurement, and some airports the drainage is poor;
    - Delay the approach and landing during heavy rain especially at night since the visibility can be very poor during flare and roll out which increase the risk of bad runway contact;
    - Ensure correct performance calculation for takeoff and landing;
    - Ensure stabilize approach, positive landing, and all stopping device are functioning;
    - Carry sufficient fuel to anticipate for holding;
    - During Enroute keep updating the alternate weather;
    - PIC must create good CRM and enforce cockpit discipline, "There is no Pilot Error it is Crew error", which means the PIC must encourage good communications to remind each other mistakes.
2. On 10 November 2015, the aircraft operator issued notices to pilot number 00l/NTPB/Xl/2015 that strongly recommend to all respected Boeing Pilots to use flap 40 for landing in any airport has landing distance available (LDA) less than 2500 meters. It should apply in any condition wet or dry.
3. On 12 November 2015, the aircraft operator issued notices to pilot number 002/NTPB/XI/2015. The notice contained instruction in landing configuration change to consider increasing of safety, correct calculation and acknowledges by both pilots and changing shall be made no later than leaving Initial Approach Fix.

4. On 13 November 2015, the aircraft operator issued company NOTAM for operation to Yogyakarta that contained instruction to all pilots for taking cautions which the end runway 09 or beginning runway 27 is slippery when wet and do not disengage auto brakes and stowed the reverse thrust until the aircraft on taxi speed.
5. On 1 December 2015, the aircraft operator issued company Safety Alert that contained information as follows:
    - Until the Company Airport Briefing (CAB) is revised and published with complete information, CAB is considered as temporary invalid.
    - Until the CAB revision is complete, the Special Airport Information (SAI) will be the only source of airport information and shall be included in every trip-kit document.
    - The A320 fleet shall seek for equivalence in SAI for type specific information.
6. On 4 December 2015, a Crew member Emergency Training (CET) was performed to the flight crew of the accident flight.
7. On 14 December 2015, a join Crew Resource Management (CRM) was performed to the flight crew of the accident flight.
8. On 17 December 2015, the aircraft operator issued safety notice that contained instruction as follows:
    - Whenever weather information indicates rain over an aerodrome and or the runway condition is declared WET or based on relevant data is assumed WET without BRAKING ACTION; a more conservative Landing Distance Calculation shall be performed with a safety margin. Such a result may be achieved by calculating landing distance performance based on the Medium Reported Braking or (if necessary) Poor Braking Action. If BRAKING ACTION INFORMATION is available either provided by the ATC/BMKG/PIREP or any other valid source, the dispatch and pilot shall use and comply to this information.
    - The Good Reported Braking Action should be considered only when the light precipitation is visible on the windshield, or declared and published by ATC /METAR if provided.
    - When necessary, Pilot shall consider the need of Maximum Autobrake and apply the proper Approach, Landing and Deceleration Technique as listed below, but not limited to:
        a. Touchdown on the touchdown point and not more than first 1000ft of the runway length.
        b. Avoid early disconnection of Autobrake (especially with Autobrake MAX).
        c. Avoid modulating the brake, in case of manual brake.
        d. Get the taxi speed before reaching the last third of the runway.

e. Remind the use of reverse power, maintain reverse thrust as required, up to maximum, until the airspeed approach 60 knots, if necessary maintain max reverse before the end of the runway.

f. Remind if the reversers were stowed (too early).

g. To establish common criteria among all Airline operating Narrow Body Jet Aircraft: for operating on short runway (<2700m), Pilot shall assure the Approach Flaps is 40/FULL and all braking devices operative.

h. Comply with the tailwind and cross wind restriction by Manufacture and Company SOP (Company Airport Briefing)

- If the runway surface condition or the precipitation is worse than expected and leaving an uncertainty, Pilot shall cancel the approach / conduct a missed approach to make time for another approach preparation.

9. On 10 February 2016, the aircraft operator notified the following safety actions:

- Notified Jepessen to check the discrepancies of the information related to stopway, clearway and RESA between AIP and Jeppesen publication of Adisutjipto International Airport.
- Improved the simulator training syllabus including evacuation that highlighted on evacuation sequence.
- Conducted join CRM Training flight crew and flight attendant in order to improve crew coordination during emergency.
- Flight attendant emergency training to practice emergency equipment drill.
- Implementation of improved emergency training as stated on Operation Training Manual revision of 2 October 2015.

5 SAFETY RECOMMENDATIONS

As a result of this investigation, the Komite Nasional Keselamatan Transportasi issued safety recommendations to address safety issues identified in this report.

The Directorate General of Civil Aviation is responsible for the implementation of these recommendations addressed to the relevant parties.

5.1 PT. Batik Air Indonesia

While the KNKT acknowledges the safety actions taken by the aircraft operator, there still remain safety issues that need to be considered. The KNKT issues the following Safety Recommendations:

- **04.O-2016-20.1**

  To improve the crewmember emergency training to ensure all crewmembers performs the evacuation according to the company procedures.

5.2 PT. Angkasa Pura Airport Branch Adisutjipto International Airport

- **04.B-2016-22.1**

  To perform daily inspection of the movement area as specified in the Aerodrome Manual (AM) and airport Standard Operating Procedure (SOP).

- **04.B-2016-23.1**

  To develop procedure for measurement of water depth in runway and taxiway as required by chapter 4.5 of Appendix 1 Civil Aviation Safety Regulation (CASR) Part 139 Volume I.

- **04.B-2016-24.1**

  To update the AM and SOP, and implement the runway friction measurement according to the specified in the Advisory Circular (AC) CASR Part 139-23.

- **04.B-2016-25.1**

  To develop a reporting system to enable disseminate significant information of runway condition to Air Traffic Service (ATS) unit and for those units to provide the necessary information to arriving and departing aircraft without delay as required in ICAO Annex 14 Chapter 2.9.1.

- **04.B-2016-51.1**

  To review the possibility of development an instrument approach for runway 27.

5.3 AirNav Indonesia District Office Yogyakarta

- **04.A-2016-26.1**

  To provide the tower controller with the current weather information by installation of AWOS display monitor in the tower control desk.

- **04.A-2016-51.2**

  To review the possibility of development an instrument approach for runway 27.

5.4 Directorate General of Civil Aviation

- **04.R-2016-1.2**

  To emphasize all aircraft operators comply with stabilize approach criteria.

- **04.R-2016-27.1**

  To ensure all aircraft operators calculate the landing distance available is suitable for the landing distance required on existing condition.

- **04.R-2016-28.1**

  To emphasize all aircraft operators implement standard callout procedure on approach.

- **04.R-2016-29.1**

  To emphasize all aircraft operators conduct emergency training to ensure the crewmember taking appropriate action during emergency.

- **04.R-2016-30.1**

  To ensure that the airport operators manual contain the requirement specified in the CASR Part 139, AC CASR Part 139-23 and Manual of Standard CASR Part 139.

- **04.R-2016-22.2**

  To ensure all airport operators conduct inspection of movement area according to the approved manuals.

- **04.R-2016-24.2**

  To ensure all airport operators implement the runway friction measurement according to the specified in the AC CASR Part 139-23.

- **04.R-2016-25.2**

  To include in the Indonesia regulation, the procedure of reporting system from the airport operator to the ATS unit to enable disseminate significant information of runway condition to arriving and departing aircraft without delay as required in ICAO Annex 14 Chapter 2.9.1.

- **04.R-2016-31.1**

  To issue approval certificates for the Air Traffic Services providers.

- **04.R-2016-51.3**

  To review the possibility of development an instrument approach for runway 27.

6 APPENDICES

6.1 Notice to Pilot

NOTICE TO PILOT
No: 014/XI/2015
PK-LBO Accident

Applicabilty : A320 and B737NG Pilot
Effective Date : November, 6th 2015

Dear All Pilots,

Referring to the accident PK-LBO at Jogjakarta by today, we would like to remind again to review all our NTP No 13/XI/2015 Subject to Wet Season and SSQ Safety Circular Subject to Safety Precautions on Wet/Rainy Season.

SAFETY IS OUR NO 1 PRIORITY

- PIC must ensure the crew to do proper dispatch briefing to properly analyze the flight;
- Delay the Take Off and Landing when the windshear is forecast in the takeoff and and approach path;
- Delay the takeoff and landing on marginal runway during heavy rain since all our airports in Indonesia do not have water depth measurement, and some airports the drainage is poor;
- Delay the approach and landing during heavy rain especially at night since the visibility can be very poor during flare and roll out which increase the risk of bad runway contact;
- Ensure correct performance calculation for takeoff and landing;
- Ensure stabilize approach, positive landing, and all stopping device are functioning;
- Carry sufficient fuel to anticipate for holding;
- During Enroute keep updating the alternate weather;
- PIC must create good CRM and enforce cockpit discipline, "There is no Pilot Error it is Crew error, which means the PIC must encourage good communications to remind each other mistakes.

Our directives are strongly recommend to implemented in each your flight duty.

Thank you for your attention.

Batik air

NOTICE TO PILOT BOEING

No: 001/NTPB/XI/2015

FLAPS SETTING RECOMMENDATION

Applicabilty : B737NG Pilot
Effective Date : November, 10th 2015

Dear All Pilots,

Herewith we strongly recommend to all respected Boeing Pilots to use flap 40° for landing in any airport has landing distance available (LDA) less than 2500 meters. It should apply in any condition wet or dry.

Thank you for your attention.

NOTICE TO PILOT BOEING

No: 002/NTPB/XI/2015

SUDDEN CHANGES LANDING CONFIGURATION

Applicabilty : B737NG Pilot
Effective Date : November, 12nd 2015

Dear All Respective Pilots,

Please take in account this notice for daily operations in **Sudden Changes** landing configuration, autobrakes selection and disarm technique.

This changes solely apply with this conditions:

1. The execution value must be **Increase Safety Aspect**, instead of follow initial or early plan
2. It has **calculated correctly** with all **considerations and possibilities**, also briefed and acknowledge by both pilot
3. Any changes on plan landing configuration/autobrake selection no later than leaving **Initial Approach Fix**. If this situation did not meet, the approach should be cancel and start proper preparation from beginning.

Thank you and Salam Stabilized Approach.

6.2 Company NOTAM

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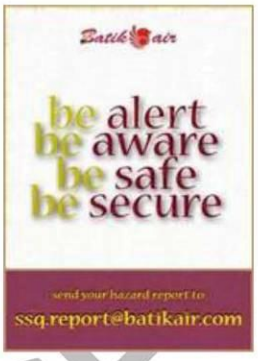
COMPANY NOTAM FOR BATIK AIR AREA OF OPERATIONS
------------------------------------------------------------------------
COTAM LEGEND :
1. OPS - OPERATIONS
2. SEC - SECURITY
3. GEN - GENERAL
4. TECH - TECHNICAL
5. FOS - FLIGHT OPS SAFETY
6. FS - FLIGHT SECURITY
7. FSS - FLIGHT SERVICES
8. FCB - FUEL CONTROL BULETIN
9. AC - AIRPORT CATEGORY
10.SB - SAFETY BULETIN
------------------------------------------------------------------------
ADI SUCIPTO AIRPORT / WAHH
1.OPS ALL FLEETS
- ALL PILOTS SHOULD TAKE CAUTIONS END OF RUNWAY 09 OR BEGINNING
  RUNWAY 27 IS SLIPPERY WHEN WET.
- DO NOT DISENGAGE AUTO BRAKES AND STOWED THE REVERSE THRUST UNTIL
  THE AIRCRAFT ON TAXI SPEED.
2.GEN
- APRON CAPACITY DURING PEAK HOURS OVERLOADED.
3.FOS
- MANY TCAS EVENT REPORTED DUE TRAFFIC CONGESTED.
------------------------------------------------------------------------
SOEKARNO-HATTA INTERNATIONAL AIRPORT / WIII
1.GEN
- SEASONAL BIRD WILD LIFE ARE EXPECTING NEARBY THE R/W. PILOTS IS
  EXPECTING TO USE ALL AVAILABLE LIGHTS FOR PRECAUTION
2.FOS
- INFORM ATC BEFORE LANDING IF UNABLE COMPLY ROT REQUIREMENT
  DESIGNATED EXIT RAPID TAXIWAY.
- SHORTCUT RADAR VECTOR CAN BE EXPECTED. BE AWARE WITH HIGH ENERGY
  APPROACH.
```

6.3 Safety Notice

Batik air Safety, Security, and Quality	SAFETY, SECURITY AND QUALITY DIRECTORATE	006/SSQ/SN/XI/2015
		17 11 2015
	SAFETY NOTICE	Page 1 / 2

Date of effectiveness:	November 17th, 2015
Distribution list:	DZ, DO, OF, OC, OT
Applicability:	Pilots, Cabin Crew
Approved by:	DS
Subject:	*Safety Recommendation Following BTK6380 Runway Overrun in Yogyakarta, 6 November 2015*



Dear all related Departments/Units,

Following the serious incident of runway excursion in Adisutjipto International Airport, involving B 737-900 which occurred on 6 November 2015, based on the finding during initial investigation stage, Safety Office issues following recommendation to prevent similar occurrence from happening in near future:

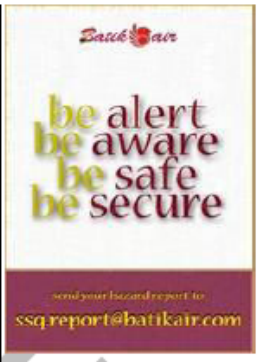
1. Flight Operation Department to update its Company Airport Briefing documentation with some additional information that might be useful for pilot on their decision making process. WAHH information in Special Airport Information (SAI) has more detailed information e.g. max landing weight, max tailwind, guidance when wet runway detected, etc.
2. Flight Operation to standardise Take Off and Landing Card across the fleet with additional column for landing distance required for different runway condition, autobrake setting, flaps setting, reverser condition, etc.
3. Flight Operation to provide the pilot with guidance or policy regarding the use of flaps 30 in various runway and environmental condition.
4. Training Department to provide pilot and cabin crew a joint training concerning:
   a. Coordination between pilot – cabin crew or cabin crew – cabin crew, especially during electrical blackout and no normal communication device available.
   b. Decision making concept during emergency / abnormal situation to determine the need of evacuation or controlled-disembarkation.
5. Training Department to provide pilot training with highlight on decision making process during final and landing phase with the sudden change of environmental and runway condition.
6. Training Department to provide pilot training with highlight on go around or cancelling the landing in case of floating or any other unsafe condition.
7. Training Department to provide Cabin Crew Training concerning the actual force required to open the emergency doors in armed position.

This Safety Recommendation is based on the initial stage of investigation. SSQ Office will publish additional recommendation as the final investigation progresses.

Each department shall submit their implementation evidence as agreed on the Safety Action Group Meeting on 12 November 2015.

Batik Air Safety, Security, and Quality	SAFETY, SECURITY AND QUALITY DIRECTORATE	008/SSQ/SN/XII/2015
		16 12 2015
	SAFETY NOTICE	Page 1 / 2

Date of effectiveness:	December 17th, 2015
Distribution list:	DZ, DO, OF, OT
Applicability:	Flight Operation – Pilots, Flight Operation Dispatch, Training – Pilot, Training – Dispatcher
Checked by:	SS
Approved by:	DS
Subject:	***Safety Recommendation: Runway Excursion Risk Reduction***



Dear related Departments/Units,

Following the serious incident of runway excursion in Adisutjipto International Airport, involving B 737-900, which occurred on 6 November 2015, and in the relation to the rainy season in most of South East Asia territory, Safety Office would like to recommend a course of actions to be considered by all pilots in order to mitigate and to prevent similar incident in near future.

FAA SAFO (Safety Alert For Operations) 15009, dated 8/11/15, warns airplane operators and pilots that the advisory data for wet runway landings may not provide a safe stopping margin under all conditions.

The FAA SAFO highlights on the additional requirement of 30 to 40 percent landing distance required where the condition of the runway is very wet, but not flooded. It also discussed the need of consideration regarding the mitigation at airports where aircraft operators have reason to suspect the runway's capability of creating good friction while very wet during active precipitation.

To address these safety issues and increase the safety margin; during the approach preparation, if the METAR forecasts an active precipitation over the field (or surrounding the airport) or if ATC reports that the runway is wet or contaminated; SSQ recommends:

1. Whenever a weather information indicates rain over an aerodrome and or the runway condition is declared WET or based on relevant data is assumed WET without BRAKING ACTION; a more conservative Landing Distance Calculation shall be performed with a safety margin. Such a result may be achieved by calculating landing distance performance based on the Medium Reported Braking or (if necessary) Poor Braking Action. If BRAKING ACTION INFORMATION is available either provided by the ATC/BMKG/PIREP or any other valid source, the dispatch and pilot shall use and comply to this information.
2. The Good Reported Braking Action should be considered only when the light precipitation is visible on the windshield, or declared and published by ATC /METAR if provided.

3. When necessary, Pilot shall consider the need of Maximum Autobrake and **apply** the proper **Approach, Landing and Deceleration Technique** as listed below, but not limited to:
   a. Touchdown on the touchdown point and not more than first 1000ft of the runway length.
   b. Avoid early disconnection of Autobrake (specially with Autobrake MAX).
   c. Avoid modulating the brake, in case of manual brake.
   d. Get the taxi speed before reaching the last third of the runway
   e. Remind the use of reverse power, maintain reverse thrust as required, up to maximum, until the airspeed approach 60 knots, if necessary maintain max reverse before the end of the runway.
   f. Remind if the reversers were stowed (too early).
   g. To establish common criteria among all Airline operating Narrow Body Jet Aircraft: for operating on short runway (<2700m), Pilot shall assure the Approach Flaps is 40/FULL and all braking devices operative.
   h. Comply with the tailwind and cross wind restriction by Manufacture and Company SOP (Company Airport Briefing)
4. If the runway surface condition or the precipitation is worse than expected and leaving an uncertainty, Pilot shall cancel the approach / conduct a missed approach to make time for another approach preparation.
5. Flight Operation Directorate may issue a copy of this notice to Pilot, but on point 1, 2, and 3h Flight Operation Directorate shall document the policy so those proposed actions can be considered as a permanent policy.
6. Training Department shall highlight above recommendations during pilot and dispatcher training.

6.4 Safety Plan of Runway End Safety Area Runway 27

RENCANA PENGELOLAAN KESELAMATAN (SAFETY PLAN)
RUNWAY END SAFETY AREA (RESA) RUNWAY 27
PADA BANDAR UDARA ADISUTJIPTO - YOGYAKARTA

I. PENDAHULUAN.

A. DASAR PERATURAN DAN KETENTUAN

1. Peraturan dan Ketentuan Nasional:

a. Undang – Undang No.1 Tahun 2009 Tentang Penerbangan;
b. Keputusan Menteri Perhubungan Nomor: 24 tahun 2009 Tentang Peraturan Keselamatan Penerbangan Sipil Bagian 139 (Civil Aviation Safety Regulation 139) Tentang Bandar Udara (Aerodrome);
c. Keputusan Menteri Perhubungan Nomor : 20 tahun 2009 Tentang Sistem Manajemen Keselamatan Penerbangan (Safety Management System);
d. Keputusan Direktorat Jenderal perhubungan Udara Nomor : SKEP 223/X/2009 Tentang Petunjuk dan tata Cara Pelaksanaan System Manajemen keselamatan (Safety Management System) Operasi Bandar Udara, Bagian 139-01 (Advisor Circular 139-01, Airport safety Management System);
e. Manual Of Standar point 139 (MOS).

2. Referensi / Acuan Internasional.

a. Annex-14 ICAO Vol I: Aerodrome Design and Operation;
b. Annex-19 ICAO Safety Management System
c. ICAO Manual Doc. 9774 AN/969 Manual On Certification Of Aerodromes;
d. ICAO Manual Doc. 9859 Safety Management Manual.

B. LATAR BELAKANG.

Berdasarkan MOS CASR 139 - 6.2.26 bahwa Runway End Safety Area (RESA) wajib disediakan bagi Bandar Udara yang:

1. Memiliki karakteristik kode nomor 4 yang melayani pesawat udara Jet;
2. Panjang dan lebar minimum RESA harus 90 m x 90 m dimana runway yang terhubung dengannya dapat dipergunakan oleh pesawat terbang nomor kode 3 atau 4 dan dipergunakan oleh pesawat terbang jet transportasi udara.

Berdasarkan CASR 139.099, bagi Bandar Udara yang tidak memenuhi ketentuan dapat diberikan pengecualian dengan terlebih dahulu membuat Safety Plan, yang menunjukkan dan memastikan bahwa resiko keselamatan operasi Bandar Udara masih dalam batas yang dapat diterima walaupun ada ketentuan yang belum dapat dipenuhi.

Oleh karena penyediaan RESA Runway 27 merupakan ketentuan yang harus dipatuhi bagi operasional Bandar Udara Adisutjipto, namun hingga saat ini RESA Runway 27 belum ada sesuai yang dipersyaratkan yaitu 90 m x 90 m karena lahan

1

yang tidak tersedia, maka operator Bandar Udara mempunyai kewajiban untuk menyediakan dan melaksanakan safety plan yang telah dikomunikasikan dengan para pihak terkait dan dapat diterima oleh Direktorat Jenderal Perhubungan Udara.

C. TUJUAN

Tujuan dari pembuatan program pengelolaan keselamatan (safety plan) Bandara Adisutjipto adalah :

1. Untuk memastikan keselamatan operasi pesawat udara kode 4C (B737-all series, Airbus 320);
2. Mengidentifikasi target keselamatan yang harus dipenuhi yaitu tersedianya minimal dimensi RESA Runway 27;
3. Menyediakan dokumen tertulis sebagai pedoman dalam pelaksanaan meminimalkan resiko keselamatan operasi pesawat pada Bandar Udara Adisutjitpto pada tingkat yang dapat diterima akibat belum adanya RESA runway 27;

D. APLIKASI

Safety Plan ini wajib dilaksanakan oleh seluruh unit kerja dan personel Bandar Udara Adisutjipto yang bertugas dalam operasi Bandar Udara Adisutjipto serta wajib ditaati oleh para pihak dan personel di luar Operator Bandar Udara Adisutjipto namun terkait dengan pengoperasian Bandar Udara Adisutjipto, terutama semua perusahaan penerbangan dan personelnya yang beroperasi di lingkungan Bandar Udara Adisutjipto.

E. DISTRIBUSI DOKUMEN DAN PENGAWASAN

1. Distribusi dokumen

Copy dokumen Safety Plan ini disampaikan kepada:
a. Direktorat Bandar Udara;
b. Direktorat Navigasi Udara;
c. Direktorat Kelaikan Udara dan Pengoperasian Pesawat Udara;
d. Direksi PT Angkasa Pura I (Persero);
e. Airport Service Group Head PT AP I;
f. Station Manager Garuda Indonesia;
g. Station Manager Citilink;
h. Station Manager Lion Air;
i. Station Manager Batik Air;
j. Station Manager Wings Air;
k. Station Manager Sriwijaya Air;
l. Station Manager Nam Air;
m. Station Manager Aviastar;
n. Station Manager Express Air;
o. Station Manager Air Asia Indonesia;
p. Station Manager Silk Air;

2. Pengawasan Dokumen.

Penyimpanan, pengawasan dan perubahan perbaikan serta distribusi dari dokumen safety plan ini menjadi tanggung jawab unit Airport Operation & Readiness Dept dan SMS, QM & CS Dept Bandar Udara Adisutjipto.
Setiap perubahan dokumen akan dilaksanakan setelah dikoordinasikan dengan unit terkait operasional Bandar Udara Adisutjipto dan dapat diterima (accepted) oleh Direktorat Jenderal Perhubungan Udara.

General Manager Bandar Udara Adisutjipto dalam melaksanakan pengawasan, wajib secara berkala melaporkan perubahan kondisi eksisting kepada Direktorat Jenderal perhubungan Udara.

Setiap perubahan terhadap dokumen safety plan akan disampaikan juga kepada pihak-pihak tersebut diatas pada point E.1 oleh petugas operasi Bandar Udara Adisutjipto.

II. KONDISI FASILITAS DAN OPERASI BANDAR UDARA ADISUTJIPTO YANG TERSEDIA

A. KONDISI FASILITAS

1. Arah / Nomor Landasan :
   Arah landasan adalah 87 ° dan 267 °
   Nomor Landasan adalah 09 dan 27

2. Dimensi Landasan
   Demensi landasan adalah 2.200 m x 45 m

3. Daya dukung / Kekuatan Landasan
   Landasan saat ini mempunyai PCN 55 /F/C/X/T/ aspal concrete

4. Runway Strip
   Runway Strip yang tersedia adalah 2285 m X 150 m (Belum memenuhi ketentuan Standar Teknis / MOS CASR 139)

5. Stopway
   Tidak tersedia untuk runway 27 dan 09

6. RESA
   RESA Runway 27 : tidak tersedia (NIL)
   RESA Runway 09 : lahan tersedia namun kondisinya perlu disesuaikan.

7. Clearway
   Clearway Runway 27 Nil
   Clearway Runway 09 tersedia dengan dimensi : 150 m x 150 m

8. Obstacle
   Ref. surat GM Bandara Adisutjipto no. AP.I 919/OP.01.03/2010/GMI-B tanggal 27 Juli 2010 perihal Penerbitan Data Airac AIP Supplement, Bandara Adisutjipto tidak memiliki obstacle.

9. Lain-lain
   a. Kondisi Runway dan sekitarnya
      - Pada daerah Runway End 09 terdapat jalan milik Akademi Angkatan Udara dengan elevasi lebih rendah +/- 2 meter;
      - Runway Friction test dilakukan setelah overlay;
      - Pembersihan Rubber Deposit dilakukan 2 (dua) kali dalam setahun.
   b. Keadaan Cuaca
      - Curah hujan rata – rata per bulan dalam setahun antara 300 – 500 ml;
      - Rata-rata arah angin calm – head wind antara 3 – 15 knot;
      - Visibility kurang dari minima dimana tercantum dalam lokal prosedur untuk runway 09 minimal 1.200 m dan runway 27 adalah 4.000 m;
   c. Pemakaian Runway
      - Arah dominan pendaratan dan lepas landas untuk pesawat udara yang beroperasi adalah menggunakan Runway 09;
      - Perbandingan penggunaan runway untuk pendaratan adalah :
        a. Runway 09 = 70 %
        b. Runway 27 = 30 %, hal ini dapat terjadi dikarenakan pada saat pendaratan arah dan kecepatan angin tidak memungkinkan untuk menggunakan runway 09.

B. OPERASIONAL BANDAR UDARA.

1. Pesawat terbesar beroperasi
   Pesawat terbesar yang beroperasi saat ini adalah B-737-900ER atau B737-800/NG dan Airbus 320; dan rute penerbangan terjauh adalah ke Kuala Lumpur Malaysia;

2. Prosedur pendaratan.
   a. Pendaratan dan lepas landas pada dasarnya adalah into the wind, namun jika memungkinkan (wind calm), pendaratan dan lepas landas diarahkan untuk menggunakan runway 09 khususnya di saat malam hari;
   b. Pendaratan di Bandar Udara Adisutjipto dilengkapi dengan ILS dan pendaratan Instrument Precision ada pada Runway 09.

III. PENILAIAN RESIKO (RISK ASSESSMENT)

A. IDENTIFIKASI GANGGUAN (HAZARD IDENTIFICATION)
Berdasarkan kondisi eksisting, ditemukan hazard yang utama dalam operasi Bandar Udara Adisutjipto, yaitu:

- RESA untuk Runway 27 belum ada.

B. PENILAIAN RESIKO

1. RESA Runway 27.
   Tujuan dari RESA adalah:
   - Keberadaan RESA untuk melindungi pesawat udara pada saat Undershooting atau Overruning.

Dengan mempergunakan metode brainstroming di antara para pihak terkait, yaitu airline yang beroperasi di Bandar Udara Adisutjipto, ATC, dan personel yang menangani operasi Bandar Udara Adisutjipto, serta dengan mempertimbangkan data kondisi cuaca sepanjang tahun dan kondisi topografi di sekitar Bandar Udara Adisutjipto, maka kejadian over-running di Bandar Udara Adisutjipto probalitasnya adalah sangat jarang, namun mempunyai konsekuensi yang Catastropic.

Dengan mempergunakan matrik toleransi resiko, maka tidak adanya RESA pada Runway 27 perlu adanya Review, atau tindakan mitigasi untuk mengurangi resiko sehingga berada pada tingkat yang dapat diterima.

Mengingat bahwa RESA merupakan ketentuan wajib, maka penyediaan RESA untuk Runway 27 harus dilaksanakan sesuai dengan persyaratkan ketentuan standar teknis yang berlaku.

Matrik penilaian resiko dapat dilihat pada lampiran 1

Berdasarkan brainstroming yang telah dilakukan untuk menilai resiko, bahwa kejadian over-running di Bandar Udara Adisutjipto dapat saja terjadi akan tetapi kemungkinan kecil/remote (3) dan mempunyai konsekuen catastrophic (A), sehingga perlu dilakukan upaya mitigasi resiko.

Matrik toleransi resiko dapat dilihat pada lampiran 2

C. MITIGASI RESIKO.

Tidak adanya RESA untuk Runway 27.

Mengingat panjang landasan yang ada adalah 2.200 meter untuk operasi B-737-900ER dan Airbus 320 di Bandar Udara Adisutjipto, dengan tidak adanya RESA untuk Runway 27, maka untuk mitigasi resiko :

a. Untuk jangka pendek / short term :

- Penerbitan NOTAM terkait dengan tidak adanya RESA untuk Runway 27;
- Publikasi tentang local procedure kepada penerbang, dimana pendaratan di Bandara Adisutjipto diarahkan untuk menggunakan runway 09; terutama di malam hari, hal ini disebabkan terrain bukit Boko hanya berjarak 4,2 NM dari touch down runway 27;
- Jika pendaratan terpaksa dilakukan menggunakan runway 27 maka petugas ATC harus menginformasikan tentang Tail Wind dan tidak ada RESA di Runway 27 kepada penerbang pada waktu pendaratan akan dilakukan;
- Removal rubber deposit, dilakukan penambahan frekwensi kegiatan pembersihan rubber deposit, dari 2 (dua) kali dalam 1 (satu) tahun menjadi 4 (empat) kali dalam 1 (satu) tahun;
- Petugas inspeksi melaksanakan pengawasan pada area Runway yang berpotensi terjadinya water pounding, apabila diperlukan dilaksanakan pembersihan terutama sehabis turun hujan.

- Pemberian training yang memadai kepada para petugas inspeksi manouvering area, sehingga dapat dengan cepat memahami situasi pada saat inspeksi dilakukan.
- Menjaga kinerja peralatan khususnya Lighting System dan ILS dengan cara melakukan Ground Check.

b. Untuk jangka panjang / Long term

Berdasarkan dokumen :

1. Keputusan Menteri Perhubungan nomor : KP 836 tahun 2014 tentang Perubahan atas Keputusan Menteri Perhubungan nomor KP 1164 tahun 2013 tentang Penetapan Lokasi Bandar udara Baru di Kabupaten Kulon Progo Provinsi Daerah Istimewa Yogyakarta, tanggal 20 Oktober 2014;
2. Pengumuman Pemda DIY tentang Penetapan Lokasi Pembangunan untuk Pengembangan Bandara Baru di Daerah Istimewa Yogyakarta;

PT Angkasa Pura I akan membangun Bandara baru yang berlokasi di Kabupaten Kulon Progo sebagai pengganti Bandara Adisutjipto, sehingga hal-hal teknis terkait belum terpenuhinya persyaratan di Bandara Adisutjipto, dapat dipenuhi dengan berdirinya Bandara baru tersebut.

Selanjutnya, untuk mengurangi konsekuen yang catastrophic akibat tidak adanya RESA untuk Runway 27, dilakukan dengan mengacu butir a dan b tersebut diatas, sehingga hasil dari mitigasi tersebut dapat menurunkan indeks 3D yaitu dengan kriteria nilai toleransi resiko "Pengendalian resiko / mitigasi memerlukan keputusan manajemen dapat diterima setelah mengkaji pelaksanaan operasi".

IV. RENCANA PENGELOLAAN RESIKO.

A. RENCANA PELAKSANAAN PENGELOLAAN RESIKO

Pengelolaan resiko keselamatan operasi Bandar Udara Adisutjipto dilakukan secara bertahap, yaitu jangka pendek dan jangka panjang.

1. Untuk jangka pendek, akan dilaksanakan:

a. Prosedur :

- Diterbitkan NOTAM terkait dengan tidak adanya RESA untuk Runway 27;
- Publikasi tentang local procedure, dimana pendaratan di Bandara Adisutjipto diarahkan untuk menggunakan runway 09; terutama di malam hari, hal ini disebabkan terrain bukit Boko hanya berjarak 4,2 NM dari touch down runway 27;
- Petugas unit Teknik melakukan pengecekan runway sebanyak 2 (dua) kali setiap hari dan dibantu petugas PKPPK setelah penerbangan selesai, kemudian hasil inspeksi tersebut akan langsung dilaporkan kepada unit Teknik terutama jika menemukan suatu hal yang perlu tindak lanjut perbaikan;

b. Teknologi

- Runway friction test dilakukan setelah overlay, apabila dari hasil inspeksi di daerah pergerakan ditemukan catatan maka harus dilakukan tambahan pengujian kekesatan;
- Petugas inspeksi melaksanakan pengawasan pada area Runway yang berpotensi terjadinya water pounding, apabila diperlukan dilaksanakan pembersihan terutama sehabis turun hujan.

c. Training untuk para petugas inspeksi manouvering area akan dilaksanakan secara berkala;

2. Untuk Jangka Panjang

Berdasarkan dokumen :

1. Keputusan Menteri Perhubungan nomor : KP 836 tahun 2014 tentang Perubahan atas Keputusan Menteri Perhubungan nomor KP 1164 tahun 2013 tentang Penetapan Lokasi Bandar udara Baru di Kabupaten Kulon Progo Provinsi Daerah Istimewa Yogyakarta, tanggal 20 Oktober 2014;
2. Pengumuman Pemda DIY tentang Penetapan Lokasi Pembangunan untuk Pengembangan Bandara Baru di Daerah Istimewa Yogyakarta;

PT Angkasa Pura I akan membangun Bandara baru yang berlokasi di Kabupaten Kulon Progo sebagai pengganti Bandara Adisutjipto, sehingga hal-hal teknis terkait belum terpenuhinya persyaratan di Bandara Adisutjipto, dapat dipenuhi dengan berdirinya Bandara baru tersebut.

B. MONITORING PELAKSANAAN RENCANA PENGELOLAAN RESIKO

Untuk memastikan bahwa rencana pengelolaan resiko keselamatan dapat memenuhi tujuannya, maka akan dilakukan monitoring terhadap pelaksanaan dari rencana pengelolaan resiko tersebut.

Monitoring pelaksanaan pengelolaan resiko dilaksanakan dan menjadi tanggung jawab SMS, QM & CS Departement termasuk melakukan evaluasi dan pemberian rekomendasi kepada General Manager Bandar Udara akan perlunya perubahan perbaikan dari rencana pengelolaan resiko yang ada.

General Manager Bandar Udara wajib mempertimbangkan setiap saran masukan hasil evaluasi dari petugas monitoring guna perbaikan perencana pengelolaan keselamatan, dan wajib mengkomunikasikan dengan para stake holder.

Perubahan pengelolaan keselamatan operasi Bandar Udara (safety plan) wajib mendapat acceptance dari Direktorat Bandar Udara.

B. HAZARD LOG

Lihat lampiran 3

V. PENUTUP

Demikian rencana pengelolaan keselamatan operasi Bandar Udara ini disusun untuk menjadi pedoman dalam pelaksanaan pengoperasian yang belum sepenuhnya memenuhi ketentuan standar teknis operasi Bandar Udara sebagaimana ditetapkan dalam MOS CASR 139-6.2.25 Runway End Safety Area (RESA).

Yogyakarta, 22 Oktober 2015

LAMPIRAN 1

PENILAIAN RISIKO
(RISK ASSESSMENT)

Penilaian risiko merupakan proses identifikasi, analisa, dan eliminasi dan/atau mitigasi pada tingkat yang dapat diterima terhadap risiko yang mengancam operasional bandar udara. Penilaian risiko bertujuan untuk mencari keseimbangan alokasi sumber daya terhadap segala risiko dan pengendalian serta mitigasinya. Dalam manajemen risiko ditentukan terlebih dahulu probabilitas risiko dan keparahan/konsekuensi risiko.

Probabilitas Kejadian		
Definisi kualitatif	**Arti**	**Nilai**
Frequent	Mungkin terjadi berkali-kali (telah berulang kali terjadi)	5
Occasional	Mungkin terjadi beberapa kali (telah beberapa kali terjadi)	4
Remote	Kemungkinan kecil, tetapi bisa terjadi (telah terjadi tapi jarang)	3
Improbable	Sangat kecil kemungkinannya terjadi (belum pernah diketahui terjadi)	2
Extremely improbable	Hampir tidak mungkin terjadi	1

KEPARAHAN/KONSEKUENSI RESIKO

Yang dimaksud dengan keparahan adalah kemungkinan konsekuensi dari situasi bahaya, dimana sebagai patokan adalah situasi terburuk yang mungkin terjadi. Keparahan risiko ditentukan berhubungan dengan konteks : properti, kesehatan, keuangan, tanggung jawab hukum, penduduk, lingkungan, citra, dan/atau kepercayaan masyarakat.

Keparahan Resiko Suatu Peristiwa		
Definisi Penerbangan	**Arti**	**Nilai**
Catastrophic	• Peralatan hancur • Banyak kematian	A
Hazardous	• Penurunan besar dari batas keselamatan,tekanan fisik atau beban kerja • sedemikian rupa sehingga penyelenggara tidak dapat diandalkan untuk dapat melaksanakan tugas dengan akurat atau paripurna.	B

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	• Cedera serius atau kematian bagi sejumlah orang. • Kerusakan besar pada peralatan	
Major	• Penurunan signifikan dari batas keselamatan, berkurangnya kemampuan penyelenggara dalam menghadapi kondisi operasi yang sulit sebagai akibat dari peningkatan beban kerja, atau sebagai akibat dari kondisi yang mempengaruhi efisiensi penyelenggara tersebut. • Insiden serius.	C
Minor	• Gangguan. • Keterbatasan operasi. • Penggunaan prosedur darurat. • Insiden kecil.	D
Negligible	Konsekuensi kecil	E

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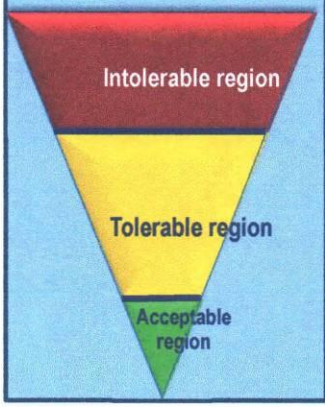
LAMPIRAN 2

TOLERABILITAS RISIKO

Setelah dilakukan penilaian terhadap probabilitas dan keparahan suatu risiko, maka penilaian tersebut dimasukkan ke dalam matrik penilaian risiko. Masing-masing warna menyatakan toleransi keberadaan suatu risiko.

Risk probability	Risk severity				
	Catastrophic A	Hazardous B	Major C	Minor D	Negligible E
Frequent 5	5A	5B	5C	5D	5E
Occasional 4	4A	4B	4C	4D	4E
Remote 3	3A	3B	3C	3D	3E
Improbable 2	2A	2B	2C	2D	2E
Extremely improbable 1	1A	1B	1C	1D	1E

Risk management	INDEKS PENILAIAN RISIKO	USULAN KRITERIA
	5A, 5B, 5C, 4A, 4B, 3A	Tidak dapat diterima pada kondisi yang ada
	5D, 5E, 4C, 4D, 4E, 3B, 3C, 3D, 2A, 2B, 2C	Pengendalian risiko/mitigasi memerlukan keputusan manajemen. Dapat diterima setelah mengkaji pelaksanaan operasi
	3E, 2D, 2E, 1A, 1B ,1C, 1D, 1E	Dapat diterima

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LAMPIRAN 3

No	Tipe operasi atau kegiatan	Deskripsi Hazard	Risiko	Indeks Risiko	Tolerabilitas Risiko	Mitigasi	Indeks Risiko Setelah Mitigasi	Tolerabilitas Risiko setelah Mitigasi	Tindakan, jika ada untuk mengurangi risiko serta indeks risiko dan tolerabilitasnya
1.	Pengoperasian Pesawat Udara	Pengoperasian pesawat udara kode 4C pada Bandar Udara Adisutjipto.	• Kerusakan yang lebih parah pada struktur pesawat • Menyebabkan korban jiwa	3A	Tidak dapat diterima pada kondisi yang ada	a. Untuk jangka pendek / short term : • Penerbitan NOTAM terkait dengan tidak adanya RESA untuk Runway 27; • Publikasi tentang local procedure kepada penerbang, dimana pendaratan di Bandara Adisutjipto diarahkan untuk menggunakan runway 09; terutama di malam hari, hal ini disebabkan terrain bukit Boko hanya berjarak 4,2 NM dari touch down runway 27; • Jika pendaratan terpaksa dilakukan menggunakan runway 27 maka petugas ATC harus menginformasikan tentang Tail Wind dan tidak ada RESA di Runway 27 kepada penerbang pada waktu pendaratan akan dilakukan; • Removal rubber deposit, dilakukan penambahan frekwensi kegiatan pembersihan rubber deposit, dari 2 (dua) kali dalam 1 (satu) tahun	3D	Pengendalian risiko/mitigasi memerlukan keputusan manajemen.Dapat diterima setelah mengkaji pelaksanaan operasi	• Memonitor efektifitas prosedur mitigasi resiko • Indeks Resiko : 3E • Tolerabilitas :Dapat Diterima

						menjadi 4 (empat) kali dalam 1 (satu) tahun; • Petugas inspeksi melaksanakan pengawasan pada area Runway yang berpotensi terjadinya water pounding, apabila diperlukan dilaksanakan pembersihan terutama sehabis turun hujan. • Pemberian training yang memadai kepada para petugas inspeksi manouvering area, sehingga dapat dengan cepat memahami situasi pada saat inspeksi dilakukan. • Menjaga kinerja peralatan khususnya Lighting System dan ILS dengan cara melakukan Ground Check. b. Untuk jangka panjang Pembangunan Bandara Baru pengganti Adisutjipto di Kabupaten Kulon Progo - DIY			

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6.5 Direct Involve Parties Comments

The comments show the text from the draft report in *italic blue text* with proposed deletions shown as ~~*strikethrough*~~ and proposed additions as *underline*.

6.5.1 National Transportation Safety Board

<table>
<tr><th>NO</th><th>PAGE</th><th>COMMENTS</th><th>KNKT RESPONSE</th></tr>
<tr><td>1.</td><td>6</td><td>According to the Boeing 737-800/900ER Flight Crew Operations Manual (FCOM) Chapter PI.20.5, the Vref landing with configuration flap 30 was 141 knots.
<table>
<tr><th rowspan="2">WEIGHT (1000 KG)</th><th colspan="3">FLAPS</th></tr>
<tr><th>40</th><th>30</th><th>15</th></tr>
<tr><td>85</td><td>158</td><td>161</td><td>171</td></tr>
<tr><td>80</td><td>153</td><td>157</td><td>166</td></tr>
<tr><td>75</td><td>148</td><td>152</td><td>160</td></tr>
<tr><td>70</td><td>143</td><td>147</td><td>155</td></tr>
<tr><td>65</td><td>137</td><td>142</td><td>149</td></tr>
<tr><td>60</td><td>131</td><td>136</td><td>143</td></tr>
<tr><td>55</td><td>125</td><td>130</td><td>137</td></tr>
<tr><td>50</td><td>119</td><td>124</td><td>130</td></tr>
<tr><td>45</td><td>112</td><td>118</td><td>123</td></tr>
<tr><td>40</td><td>105</td><td>111</td><td>116</td></tr>
</table>
Rationale: Please remove the V-Speeds table that is copied from the Boeing Flight Crew Operations Manual. This manual is Boeing Proprietary and Copyright. Boeing may grant permission to reproduce limited information from this manual upon request.</td><td>Accepted</td></tr>
<tr><td>2.</td><td>9</td><td>Figure 5: The ILS approach chart issued by Jeppesen
Comment: The revision date on the Jeppesen chart included in Figure 5 is 26 Nov 15. This event occurred on 6 Nov 15 prior to this revision being published.</td><td>Accepted
The ILS chart has been changed to ILS approach chart provided by Directorate General of Civil Aviation on Aeronautical Information Publication (AIP) Volume II amendment 43 dated 17 September 2015</td></tr>
</table>

NO	PAGE	COMMENTS	KNKT RESPONSE
3.	**14**	1.11.3 Significant Events from Recorders *07:59:23 UTC, Auto pilot and auto throttle disconnected at approximately 700 feet* Rationale: For clarification of the relative sequence of events, Boeing suggests adding the altitude at which the autoflight systems were disconnected.	**Accepted**
4.	**14**	1.11.3 Significant Events from Recorders *08:00:16 UTC, the aircraft touched down with the speed of 154 knots (Vref + 13), bounced briefly and touched down a second time followed by RAAS aural "Four Thousand Remaining".* Rationale: For technical correctness, Boeing suggests changing the sentence to reflect that the aircraft bounced briefly between touchdowns. The bounce is significant because over 200 feet of runway were used for the bounce which delayed the initial application of the autobrakes and further limited the available deceleration for the aircraft.	**Accepted**
5.	**14**	1.11.3 Significant Events from Recorders *08:00:28 UTC, the auto brake disarmed, the average brake pressure dropped to approximately 785 psi for 3 seconds, until manual braking was applied and the pressure increased to 3000 psi again, the longitudinal acceleration increased.* Rationale: This section did not include a statement about the use of manual braking which occurred following the disconnect of the autobrakes and eventually reached 3000 psi.	**Accepted**
6.	**14**	1.11.3 Significant Events from Recorders *08:00:33 UTC, the reverser stowed for approximately seven seconds at approximately 76 knots, although they had been reduced from the maximum setting at 91 knots.* Rationale: Clarification. It is important to identify both the speed at which the thrust reversers started transit from the fully deployed position to the stowed position because less than maximum thrust reverse was provided during the time of transit.	**Accepted**
7.	**32, 35, 35, 46**	1.17.1.6 Boeing 737-800/900ER Flight Crew Operations Manual (page 32) 1.17.1.7 Boeing 737 Quick Reference Handbook (page 35) 1.17.1.8 Flight Crew Training Manual (page 35) 1.17.1.9 Boeing 737-600/700/800/900 Aircraft Maintenance Manual (page 46) Comment: The above sections are all copied materials from Boeing Copyright and Boeing Proprietary manuals that may not be reproduced without permission from Boeing.	**Accepted** KNKT has rephrased some of information from the manuals and the Boeing has granted permission to use some materials of the Boeing Proprietary.

NO	PAGE	COMMENTS	KNKT RESPONSE
		Boeing may grant permission to reproduce limited information from these documents upon request, but does not authorize the KNKT to publish the information contained in these sections of the report.	
8.	**71**	2.1 Decision to Land (1st paragraph) *In this particular approach, there was no discussion between the pilots concerning to the landing distance with flaps 30 for the existing condition, and there was no callout from the PM when the speed was ~~15~~ 13 knots above the Vapp ~~Vref~~.* Rationale: Clarification. The Stabilized Approach speed criteria is related to Vapp, not Vref. Vapp is Vref plus 5 knots which would have been 146 knots. A 10 knot exceedance is allowed. The airplane speed reached 159 knots during the approach, which is 13 knots above Vapp.	**Accepted**
9.	**71**	2.2 Factors Affecting Landing Distance (first bullet) *08:00:16 UTC, the FDR data recorded that the aircraft touched down 6 seconds after passed 10 feet with speed ~~159~~ 154 knots or ~~18~~ 13 knots above Vref.* *The 6 seconds floating resulted in the aircraft touch down at approximately ~~773~~ 730 meters from the beginning runway 09 threshold or ~~468~~ 427 meters beyond the ~~touchdown zone~~ Aim Point. This condition met the factor that affecting additional landing distance.* Rationale: Our review of the QAR data indicated a touchdown speed of 154 knots which is also the speed identified as the touchdown speed in Section 1.11.3 and Section 3.1 of this report. Boeing's analysis computed a touchdown location 730 meters beyond the runway threshold. The touchdown zone is considered to be the first third of the runway and in this case extends 2406 feet (730 meters) passed the runway threshold. Therefore the airplane touched down at the very end of the touchdown zone, but was 1400 feet (427 meters) beyond the Aim Point.	**Accepted**
10.	**71**	2.2 Factors Affecting Landing Distance (second bullet) *Two seconds after the aircraft touched down, the thrust reversers and the spoilers deployed and auto-brake active with the brake pressure up to 2,900 psi at 7 seconds after touchdown.* Rationale: For technical correctness, Boeing suggests changing the sentence to indicate that the brake pressure did not reach 2900 psi until 7 seconds after the aircraft touched	**Accepted**

NO	PAGE	COMMENTS	KNKT RESPONSE
		down.	
11.	**72**	2.2 Factors Affecting Landing Distance *It can be concluded that there were ~~three~~ four conditions affecting the landing distance, ~~which were contrary with the procedures~~ specifically the aircraft floated for about 6 seconds and touched down at the end of the touchdown zone, 1400 feet beyond the aim point, after bouncing once; the airspeed at touchdown was 13 knots above Vref plus there was a 5 knot tailwind; the thrust reversers were stowed at a higher than recommended speed by over 30 knots and there was little braking for about 1000 feet after the autobrakes were disconnected; and the wet runway conditions resulted in Medium braking action ~~lower brake pressure and reverser application.~~* Rationale: The landing distance was affected by the aircraft speed at touchdown, the location of the final touchdown, the under usage of deceleration devices during the rollout, and the wet runway conditions. • The airspeed at the touchdown point was 13 knots above Vref which added approximately 600 feet to the additional runway required to dissipate this excess energy. Additionally, there was a 5 knot tailwind which required approximately an additional 550 feet of stopping distance. • The aircraft touched down at the very end of the landing zone and 1400 feet beyond the aim point, leaving less of the available runway for deceleration. An early flare at 80 feet instead of the recommended 20 feet was likely a contributor to the long touchdown point. • The deceleration devices were not fully utilized. The flight crew stowed the thrust reversers at a 91 knots instead of the recommended 60 knots. There was very little manual braking for about 6 seconds or about 1000 feet after the autobrakes were disengaged. The transition from reverse to forward thrust was made at 75 knots instead of at the recommended taxi speed. • The wet runway conditions resulted in an airplane braking coefficient that is equivalent to Medium braking action.	**Accepted**

NO	PAGE	COMMENTS	KNKT RESPONSE
12.	**73**	2.3 Landing Distances *Assumption of aircraft landed at ~~773~~ 730 meters from beginning runway and touchdown speed of ~~15~~ 13 knots above Vref on the existing environment conditions with good braking action and maximum autobrakes were as follows:* Rationale: For technical correctness, Boeing suggests changing the analysis to assume a touchdown speed of 13 knots above Vref since the QAR data shows this was true during the event landing. Note there are multiple locations in this section that use 15 knots and Boeing recommends revising them all to 13 knots. Boeing analysis also indicates the airplane touched down 730 meters from the runway threshold. It appears the calculations in section 2.3 were performed assuming maximum autobrakes were used. This should be stated as well.	**Accepted**
13.	**74**	2.3 Landing Distances *~~However, there was no information about runway friction classified as good or medium braking action which can be used as consideration~~.* Rationale: Boeing conducted a runway friction analysis and provided this to the NTSB and the operator. Our analysis computer an airplane braking coefficient of 0.1, which is equivalent to a braking action of Medium.	The information of runway braking action discussed in this case was from the air traffic controller or airport operator. Correction has been made on 2.3.
14.	**77**	3.1 Findings *10. The interval from altitude of 10 feet to touchdown was 6 seconds and according to FDR data, the aircraft touched down at ~~773~~ 730 meters from the beginning runway 09.* Rationale: Boeing's calculations show the aircraft touched down 730 meters from the runway 09 threshold.	**Accepted**
15.	**77**	3.1 Findings *14. The existing condition of Vref that was ~~15~~ 13 knots above the target speed and the prolong touchdown…* Rationale: The touchdown speed of 154 knots stated in section 1.11.3 and item 10 in section 3.1 is 13 knots above the target Vref.	**Accepted**
16.	**77**	3.1 Findings (item 15) *Four ~~Three~~ conditions which were the aircraft floated for about 6 seconds and touched down at the very end of the touchdown zone and 1400 feet past the aim point; the*	**Accepted**

NO	PAGE	COMMENTS	KNKT RESPONSE
		airspeed at touchdown was 13 knots above Vref and there was a 5 knot tailwind; lower brake pressure for about 1000 feet after the autobrakes were disconnected and stowing of the thrust reversers at a higher than recommended speed; and wet runway conditions that resulted in an airplane braking coefficient equivalent to Medium braking action ~~application~~ affected the landing distance. Rationale: Similar to the comment made regarding Section 2.2, there were four conditions that affected the landing distance. These were the long touchdown point, the high speed at touchdown along with a tailwind, the under-utilization of the deceleration devices and the medium braking action due to the wet runway conditions.	
17.	**79**	3.2 Contributing Factors (second bullet) *The conditions of the aircraft floated and eventually touched down at the end of the touchdown zone 13 knots above Vref with a 5 knot tailwind, lower brake pressure for 1000 feet after the autobrakes were disconnected, and removal of the thrust reverser application at a higher than recommended speed along with medium braking action had extended the landing distance.* Rationale: Similar to the comment made above, there were four conditions that affected the landing distance. These were the long touchdown point, the high speed at touchdown along with a tailwind, the under-utilization of the deceleration devices and the medium braking action due to the wet runway conditions.	**Accepted** KNKT used the average of tailwind value and converted the distance using meter.
18.	**83**	5 Safety Recommendations (page 83) Comment: There are several areas that Boeing believes are relevant to the event and important to mention in this report that are not currently included: • Boeing understands that there is currently no approach available to runway 27. Adding approaches to this runway would prevent the need for a flight crew to land on runway 09 with a tailwind. We suggest that the KNKT consider a recommendation to develop an approach to runway 27. • Boeing suggests the KNKT consider adding a recommendations to address go-around decision making, such as identifying a go-around point or latest touchdown point during the landing distance assessment. This type of preparation could have resulted in	**Accepted** Batik Air has issued safety action for this particular issue, therefore KNKT did not issue recommendation.

NO	PAGE	COMMENTS	KNKT RESPONSE
		a go around decision when the end of the landing zone was reached at high speed instead of an attempt to continue landing.	

6.5.2 Directorate General of Civil Aviation

NO	PAGE	COMMENTS	KNKT RESPONSE
1.	**viii**	***ABBREVIATIONS AND DEFINITION*** *ATIS: ~~Aerodrome~~ Automatic Terminal Information System*	**Accepted**
2.	**10**	***1.10 Aerodrome Information*** *Airport Certificate: ~~018/SBU-DBU/VII/2010~~ 018/SBU-DBU/XI/2015*	**Accepted**
3.	**11**	***Figure 7: The airport layout published on Aeronautical Information Publication*** The airport layout is using aerodrome chart amendment 38(20 February 2014), meanwhile the current chart is amendment 41 (2 April 2015)	KNKT has not received the amendment 41 of the airport layout.
4.	**84**	***04.R-2016-1.2*** *To emphasize all aircraft operators comply with stabilize approach criteria.* On 23 April 2007 DGCA has issued safety circular number AU/2162/DSKU/04/EK/2007 with subject implementation of Approach And Landing Accident Reduction (ALAR) Tool Kit in order to prevent serious incident and accident during landing. Implementation of the safety circular is monitored by the Directorate of Airworthiness and Aircraft Operation through aircraft operator training program agreement and also through continued surveillance in accordance with the DGCA Staff Instruction 8400 - Flight Operation Inspector Handbook Volume 3 Surveillance of Air Operator. *Terkait dengan penekanan kepada operator penerbangan untuk mengikuti stabilize approach criteria, Direktorat Jenderal Perhubungan Udara telah menerbitkan Edaran Keselamatan No. AU/2162/DSKU/04/EK/2007 tanggal 23 April 2007 tentang Implementasi "Approach And Landing Accident Reduction (ALAR) Tool Kit" Dalam Rangka Tindakan Pencegahan Terjadinya Serius Insiden Dan Kecelakaan Pesawat Udara Saat Phase Pendaratan.* *Implementasi dari edaran keselamatan ini diawasi oleh Ditjen Perhubungan Udara cq*	KNKT recommendation intended to the DGCA to ensure the effectiveness of safety circular.

NO	PAGE	COMMENTS	KNKT RESPONSE
		Direktorat Kelaikudaraan dan Pengoperasian Pesawat Udara melalui proses persetujuan training program operator penerbangan serta melakukan pengawasan berkelanjutan (continued surveillance) dengan mengacu kepada Staff Instruction 8400 Flight Operation Inspector Handbook Volume 3 Surveillance of Air Operator.	
5.	**84**	***04.R-2016-27.1*** *To ensure all aircraft operators calculate the landing distance available is suitable for the landing distance required on existing condition.* DGCA advised to emphasize go-around while the condition requiring recalculation of landing distance as a result of a change condition of the runway. *Terkait dengan penekanan kepada operator penerbangan untuk melakukan kalkulasi landing distance pada kondisi landasan yang berbeda, Direktorat Jenderal Perhubungan Udara menyarankan agar rekomendasi ini lebih diarahkan kepada penekanan untuk operator penerbangan agar mengutamakan go-around saat suatu penerbangan menghadapi kondisi yang membutuhkan penghitungan ulang landing distance karena kondisi landasan yang berbeda.* *Hal ini didasarkan pada 3 Conclusion 3.1 Findings butir 12 dan 13 yang mengindikasikan bahwa perhitungan landing distance menunjukkan runway distance remaining akan memadai untuk kondisi pendaratan tersebut, namun ketiadaan perhitungan landing distance memperlihatkan bahwa flight crew membutuhkan waktu Iebih banyak untuk melakukan perhitungan tersebut yang mana akan dapat dilakukan apabila flight crew melakukan go-around.*	KNKT recommendation intended to the DGCA to ensure that the calculation of landing distance required on the existing condition is conducted to ensure safe landing.
6.	**84**	***04.R-2016-28.1*** *To emphasize all aircraft operators implement standard callout procedure on approach.* DGCA has required every aircraft operator shall have Standard Operating Procedures (SOP) that include standard callout. This SOP is evaluated and approved during certification process of a new aircraft. Implementation of the standard callout is monitored through continued surveillance in	KNKT recommendation intended to the DGCA to ensure the effectiveness of the continued surveillance of the SI 8400 regarding standard callout procedure.

NO	PAGE	COMMENTS	KNKT RESPONSE
		accordance with DGCA Staff Instruction 8400 - Flight Operation Inspector Handbook Volume 3 Surveillance of Air Operator. *Terkait dengan penekanan kepada operator penerbangan untuk mengimplementasikan standard callout during approach, Direktorat Jenderal Perhubungan Udara telah mempersyaratkan dalam CASR 121.143 bahwa setiap operator penerbangan harus memiliki Standard Operating Procedures yang meliputi penerapan standard callout, dimana dokumen ini dievaluasi dan disetujui saat proses sertifikasi suatu operator penerbangan dan pada saat sertifikasi operasi jenis pesawat baru di operator penerbangan.* *Pengawasan terhadap implementasi standard callout tersebut dilakukan melalui sistem pengawasan berkelanjutan (continued surveillance) dengan mengacu kepada Staff Instruction 8400 Flight Operation Inspector Handbook Volume 3 Surveillance of Air Operator.*	
7.	**84**	***04.R-2016-29.1*** *To emphasize all aircraft operators conduct emergency training to ensure the crewmember taking appropriate action during emergency.* DGCA has required every aircraft operator to conduct emergency training for every crewmember before performs a duty as flight crewmember and re-train periodically every 24 months. The implementation of the emergency training is monitored by the DGCA through continued surveillance in accordance with DGCA Staff Instruction 8400 - Flight Operation Inspector Handbook Volume 3 Surveillance of Air Operator. *Terkait dengan penekanan kepada operator penerbangan untuk melakukan emergency training, Direktorat Jenderal Perhubungan Udara telah mempersyaratkan pelaksanaannya dalam CASR 121.417 dimana setiap crewmember harus mendapatkan emergency training sebelum mulai melaksanakan tugas sebagai crewmember serta mendapatkan pelatihan berkala setiap 24 bulan. Pengawasan terhadap hal tersebut di*	KNKT recommendation intended to the DGCA to ensure the effectiveness of the continued surveillance of the SI 8400 regarding to emergency training.

NO	PAGE	COMMENTS	KNKT RESPONSE
		atas dilakukan melalui sistem pengawasan berkelanjutan (continued surveillance) dengan mengacu kepada Staff Instruction 8400 Flight Operation Inspector Handbook Volume 3 Surveillance of Air Operator.	

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