KOMITE NASIONAL KESELAMATAN TRANSPORTASI
REPUBLIC OF INDONESIA

FINAL

KNKT.10.11.17.04

Aircraft Accident Investigation Report

PT. Lion Mentari Airlines (Lion Air)

Boeing B737-400 ; PK-LIQ

Supadio Airport, Pontianak, West Kalimantan

Republic of Indonesia

2 November 2010

2016

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

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

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GLOSSARY OF ABBREVIATIONS

ADC	:	Aerodrome Control Services
AMM	:	Aircraft Maintenance Manual
AOC	:	Air Operator Certificate
APP	:	Approach Control Office
ATA	:	Air Transport Association
ATC	:	Air Traffic Control
ATPL	:	Air Transport Pilot License
BKN	:	Broken
°C	:	Degrees Celsius
CB	:	Cumulonimbus
CPL	:	Commercial Pilot License
CRM	:	Crew Resources Management
CSN	:	Cycles Since New
CVR	:	Cockpit Voice Recorder
DGCA	:	Directorate General of Civil Aviation
DME	:	Distance Measuring Equipment
FDR	:	Flight Data Recorder
FCOM	:	Flight Crew Operations Manual
FCTM	:	Flight Crew Training Manual
IFR	:	Instrument Flight Rules
ILS	:	Instrument Landing System
Kts	:	Knots (nm/hours)
LT	:	Local Time
MAC LDW	:	Mean Aerodynamic Chord Landing Weight
MAC TOW	:	Mean Aerodynamic Chord Takeoff Weight
MTOW	:	Maximum Take-off Weight
KNKT / NTSC	:	Komite Nasional Keselamatan Transportasi / National Transportation Safety Committee
PATS	:	Playback and Test System
PF	:	Pilot Flying
PIC	:	Pilot in Command
PIREPS	:	Pilot Reports
PM	:	Pilot Monitoring
QFE	:	Height above airport elevation (or runway threshold elevation) based on local station pressure
QNH	:	Height above mean sea level based on local station pressure
SIC	:	Second in Command
S/N	:	Serial Number

SSCVR	:	Solid State Cockpit Voice Recorder
SSFDR	:	Solid State Flight Data Recorder
TSN	:	Time Since New
USA	:	United States of America
UTC	:	Universal Time Coordinate
VFR	:	Visual Flight Rules
VOR	:	Very High Frequency Omni Directional Range

INTRODUCTION

SYNOPSIS

On 2 November 2010, a Boeing Company B737-400 aircraft, registered PK-LIQ, was being operated by Lion Mentari Airlines as a passenger schedule flight with flight number JT 712 from Soekarno Hatta Airport, Jakarta at 10.12 LT (03.12 UTC) to Supadio Airport, Pontianak. The Pilot in Command (PIC) was the pilot flying (PF) and the Second in Command (SIC) was the pilot monitoring (PM).

The crew aware that the aircraft has problem on the difficulty of selection the thrust reversers and automatic speed brake deployment. This problem has been reported 13 times.

The flight to Pontianak was normal and the pilot performed ILS approach to runway 15 in slight rain and wet runway.

The FDR recorded that the approach was un-stabilized according to the Boeing B737 FCTM and require for go around.

After the aircraft touched down, the pilot reported that the thrust reverser was hard to operate and the speed brake did not auto-deploy. There was no deceleration felt by the crew. The FDR data revealed that the speed brake deployed 42 seconds after touchdown or 32 seconds after N1 increase.

The aircraft run out of runway and stopped at approximately 70 meters from the runway or 10 meters from the stop-way pavement. The PIC commanded to the flight attendants for passenger evacuation. No one injured and all passengers were evacuated through all available exits.

The investigation concluded that the contributing factors were;

- Inconsistency to the Aircraft Maintenance Manual (AMM) for the rectifications performed during the period of the reversers and auto speed brake deployment problem was might probably result of the unsolved symptom problems.
- The decision to land during the un-stabilized approach which occurred from 1000 feet to 50 feet above threshold influenced by lack of crew ability in assessing to accurately perceive what was going on in the flight deck and outside the airplane.
- The effect of delayed of the speed brake and thrust reverser deployment effected to the aircraft deceleration which required landing distance greater than the available landing distance.

At the time of issuing this Final Report, the Komite Nasional Keselamatan Transportasi has not been informed of safety actions resulting from this accident.

Includes in this final report, the KNKT issued several safety recommendations relates to operator maintenance program and flight operation procedures, wet runway safety and passenger survival aspects to the PT. Lion Air, PT. Angkasa Pura II Supadio Airport, Pontianak and Directorate General of Civil Aviation to address the safety issues identified in this final report.

1 FACTUAL INFORMATION

1.1 History of the Flight

On 2 November 2010, a Boeing Company B737-400 aircraft, registered PK-LIQ, was being operated by Lion Mentari Airlines on a passenger schedule flight with flight number JT 712. This flight was the first flight for the crew and was scheduled for departure at 09.30 LT (02.30 UTC).

On board the flight was 175 person included 2 pilots and 4 flight attendants and 169 passengers consisted 2 infants and one engineer.

The pilots stated that the aircraft had history problem on the difficulty of selection the thrust reversers and automatic of the speed brake deployment. This problem was repetitive since the past three months.

The aircraft pushed back at 0950 LT (0250 UTC). During taxi out, the yaw damper light illuminated for two times. The pilot referred to the Quick Reference Handbook (QRH) which guided the pilot to turn off the yaw dumper switch then back to turn on. Considered to these problems, the pilot asked the engineer to come to cockpit and asked to witness the problem.

The aircraft departed Soekarno Hatta International Airport, Jakarta at 1012 LT (0312 UTC) with destination of Supadio Airport, Pontianak. The Pilot in Command acted as pilot flying (PF) and the Second in Command acted as pilot monitoring (PM). The flight to Pontianak until commenced for descent was uneventful.

Prior to descend, the PF performed approach crew briefing with additional briefing included review of the past experiences on the repetitive problems of thrust reversers which sometimes hard to operate and the speed brake failed to auto deploy. Considering these problems, the PF asked to the PM to check and to remind him to the auto deployment of the speed brake after the aircraft touch down.

During descend, the pilot was instructed by Pontianak Approach controller to conduct Instrument Landing System (ILS) approach for runway 15 and was informed that the weather was slight rain. On the initial approach, the auto pilot engaged, flaps 5° and aircraft speed 180 knots. After the aircraft captured the localizer at 1300 feet, the PF asked to the PM to select the landing gear down, flaps 15° and the speed decreased to 160 knots. The PF aimed to set the flaps landing configuration when the glide slope captured.

When the glide slope captured, the auto pilot did not automatically follow the glide path and the aircraft altitude maintained at 1300 feet, resulted in the aircraft slightly above the normal glide path. The PF realized the condition then disengaged the auto pilot and the auto throttle simultaneously, and fly manually to correct the glide path by pushing the aircraft pitch down. While trying to regain the correct the glide path, the PF commanded for flaps 40° and to complete the landing checklist. The flap lever has been selected to 40°, but the indicator indicated at 30°. Realized to the flaps indication, the PF asked the landing speed for flaps 30° configuration in case the flaps could not move further to 40°.

When aircraft altitude was 600 feet and the pilots completing the landing checklist, the PM reselected the flap from 30° to 40° and was successful.

The pilots realized that the aircraft touched down was beyond the touchdown zone and during the landing roll the PF tried to select the thrust reverser but the levers were hard to select and followed by the speed brake failed to automatic-deploy. The pilots did not feel the deceleration, and then the PF applied maximum manual braking and selected the speed brake handle manually. Afterward, the thrust reversers successfully operated and a loud sound was heard prior to the aircraft stop.

The Supadio tower controller on duty noticed that the aircraft was about to overrun the runway and immediately pressed the crash bell.

The aircraft stopped at approximately 70 meters from the runway or 10 meters from the end of stop-way. The PIC then commanded to the flight attendants to evacuate the passengers through the exits. No one injured in this accident.

1.2 Injuries to Persons

Injuries	Flight crew	Passengers	Total in Aircraft	Others
Fatal	-	-	-	-
Serious	-	-	-	-
Minor/None	6	169	175	-
TOTAL	6	169	175	-

1.3 Damage to Aircraft

Field observation found that the aircraft severely damage, the damages were on the following sections: nose landing gear, right engine, nose section lower fuselage (aft of the nose wheel bay) and right engine.

Figure 1: The damage of the left engine

Figure 2: The damage on the nose landing gear

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	:	42
Nationality	:	Indonesia
License	:	ATPL
Date of issue	:	21 July 2005
Valid to	:	21 January 2011
Aircraft type rating	:	B737-300/400/500
Medical certificate	:	Class 1

Date of medical	:	21 July 2010
Valid to	:	21 January 2011
Last proficiency check	:	13 October 2010
Flying Experience		
Total hours	:	8,190 hours
Last 90 days	:	149 hours 49 minutes
Last 30 days	:	65 hours 28 minutes
Last 24 hours	:	4 hours 25 minutes

1.5.2 Second in Command

Gender	:	Male
Age	:	26
Nationality	:	Indonesia
License	:	CPL
Date of issue	:	28 May 2009
Valid to	:	7 December 2010
Aircraft type rating	:	B737-300/400/500
Medical certificate	:	Class 1
Date of medical	:	7 June 2010
Valid to	:	7 December 2010
Last proficiency check	:	10 December 2009
Flying Experience		
Total hours		656 hours
Last 90 days		212 hours 28 minutes
Last 30 days		89 hours 1 minutes
Last 24 hours		5 hours 7 minutes

1.6 Aircraft Information

1.6.1 General

Aircraft manufacturer	:	Boeing Company, USA
Aircraft model/type	:	Boeing 737-400
Serial number	:	24911
Date of manufacture	:	22 April 1991
Aircraft registration	:	PK-LIQ
Certificate of Registration	:	2236

Valid to	:	25 July 2011
Certificate of Airworthiness	:	2236
Valid to	:	12 October 2011
Time Since New (TSN)	:	49107 hours (data on 30 October 2010)
Cycles Since New (CSN)	:	28889 cycles (data on 30 October 2010)
Maximum Take-off Weight	:	150.50 lbs
Actual Take-off Weight	:	129.61 lbs
Actual Landing Weight	:	122.55 lbs

1.6.2 Engines

Engine type	:	Turbofan
Manufacturer	:	SNECMA
Model	:	CFM56-3C1
Serial Number-1 engine	:	725337
• Time Since New	:	49,829.54 hours
• Cycles Since New	:	29,857 cycles
Serial Number-2 engine	:	724959
• Time Since New	:	44,648.6 hours
• Cycles Since New	:	26,005 cycles

1.6.3 Weight and Balance

The aircraft departed from Soekarno-Hatta International Airport (WIII) Jakarta within the proper weight and balance envelope, as shown in the following table:

Maximum take-off weight	:	64,636 kg
Actual take-off weight	:	58,789 kg
MAC TOW	:	15.13 %
Maximum landing weight	:	56,245 kg
Estimated landing weight	:	55,300 kg
MAC LDW	:	13.42 %
Vref[1] – flap 40	:	138 knots

1.6.4 Fleet Reliability Report of Aircraft

The fleet reliability report of the Boeing 737-400 registered PK-LIQ issued on October 2010, contains information of aircraft reliability, dispatch reliability PIREPS (pilot reports) Delay reports, American Transport Association (ATA) chapter, and the rate of pilot report.

Since 03 September to 27 October 2010, 13 PIREP recorded related to the speed brake failure to auto deployment (ATA 27). The rectifications carried out were;

- Clean the electrical plug of speed brake actuator motor,
- Repositioned control module,
- Clean and reposition relay R280 and R283, and
- Repositioned and clean control plug actuator control speed.

1 Vref (reference speed) is the speed required to be achieved while crossing the runway threshold based on the aircraft configuration and weight. The approach speed after full landing configuration is Vref+5.

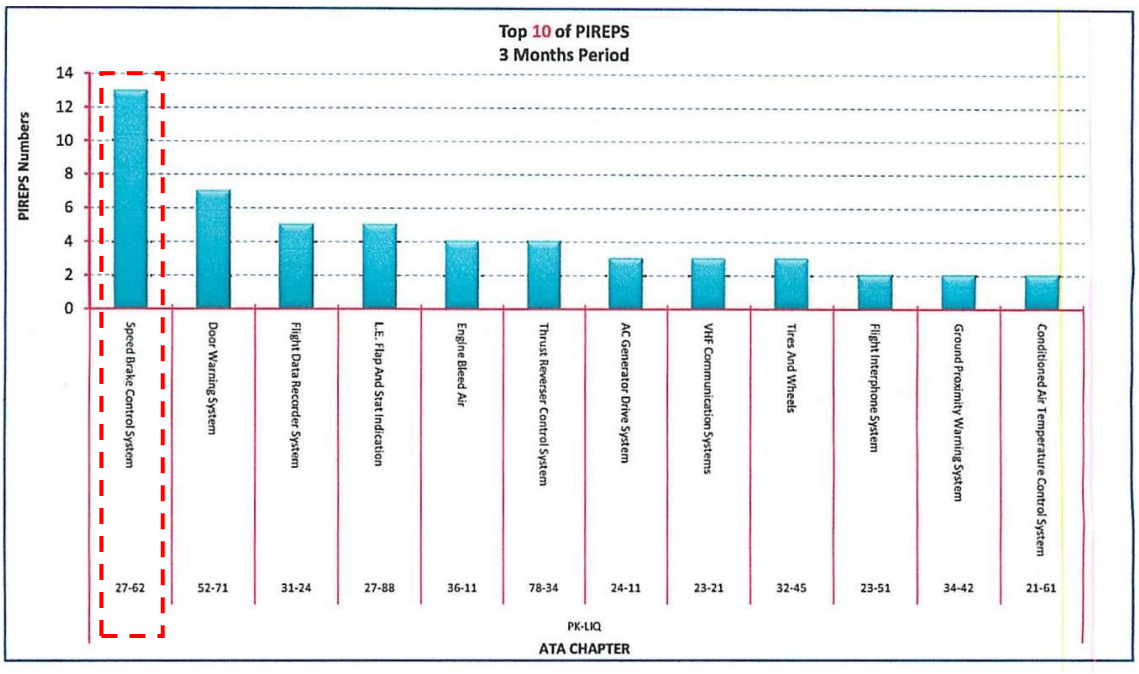


Figure 3: Top 10 PIREPS indicated that there were 13 PIREP related to speed brake control system (red dash box).

1.7 Meteorological Information

Weather report for Supadio, issued 2 November 2010:

	0430 UTC	0500 UTC
Surface wind	220/05 Kts	Calm
Visibility	7 Kilometres	7 Kilometres
Present weather	Rain	Rain
Cloud	BKN 900 feet	FEW CB 1100 feet
Temperature	24°C	25°C
Dew Point	23° C	24° C
QNH	1008 Mbs	1007 Mbs
QFE	1007 Mbs	1006 Mbs

1.8 Aids to Navigation

Supadio Airport equipped with Very High Frequency Omni Directional Range (VOR) / Distance Measure Equipment (DME). The last calibration was performed at 20 March 2010 and the result was good condition.

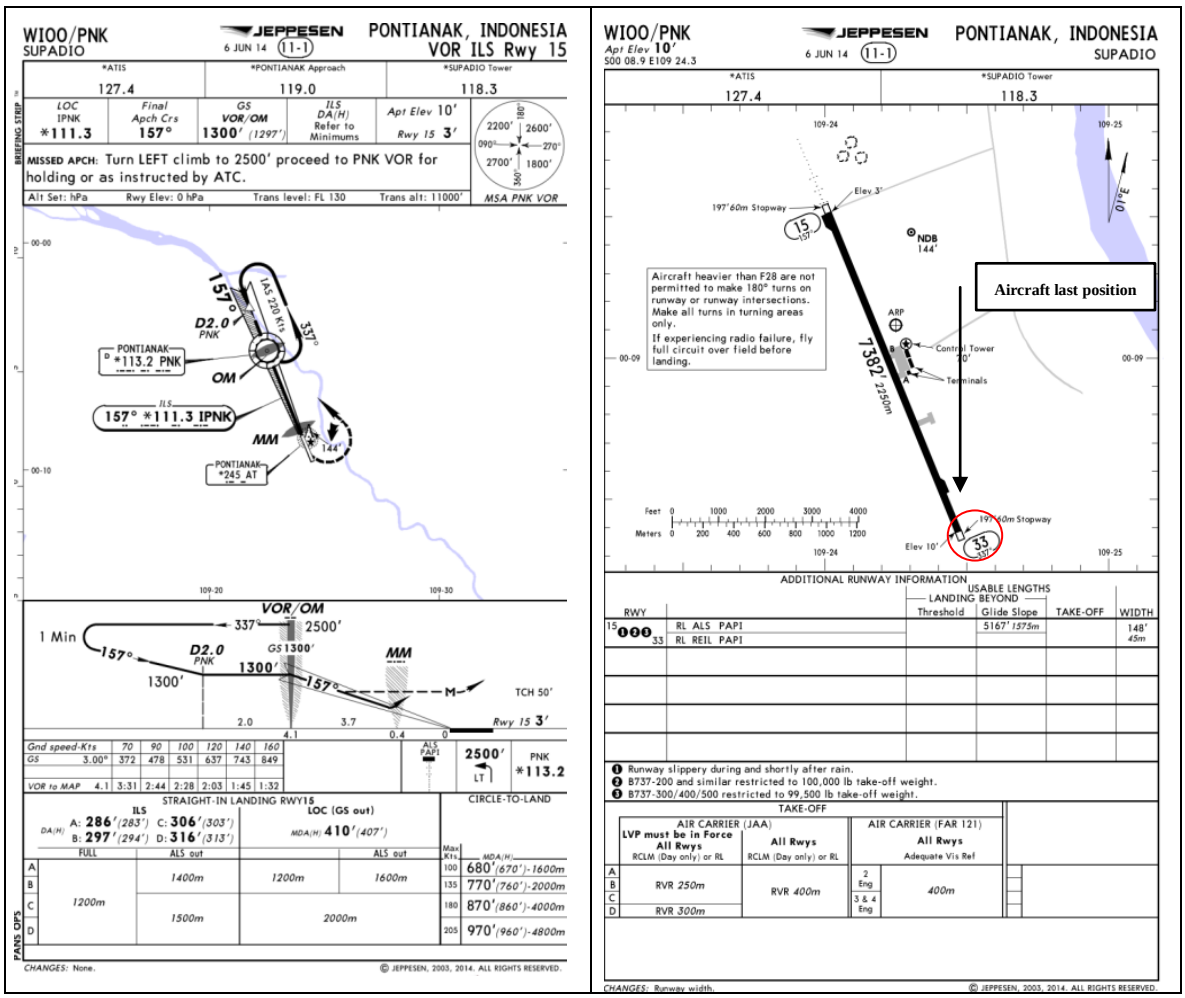


Figure 4: The ILS and Airport Chart (Figure Courtesy of Jeppesen)

1.9 Communications

At the time of the occurrence all the communication between the pilot and Supadio Tower controller was normal flight communication between pilots and there was no significant communication related to this occurrence.

1.10 Aerodrome Information

Aerodrome Code	:	WIOO / PNK
Airport Certificate	:	014/SBU-DBU/VII/2010
Airport Name	:	Supadio Airport
Airport Address	:	Jl. Adi Sucipto KM. 17 Pontianak
Airport Authority	:	PT. Angkasa Pura II (Persero)
Airport Service	:	Aerodrome Control Services (ADC) and Approach Control Office (APP)
Type of Traffic Permitted	:	VFR and IFR
Coordinates	:	00° 08′ 53″ S, 109° 24′ 15″ E

Elevation	:	10 feet
Runway Length	:	2,250 meters
Runway Width	:	30 meters
Stopway	:	60 meters
Azimuth	:	15 / 33
Category for Fire Fighting	:	Category VII

1.11 Flight Recorders

The aircraft was equipped with a Solid State Flight Data Recorder (SSFDR) and a Solid State Cockpit Voice Recorder (SSCVR). The recorders are being downloaded at KNKT facility for further analysis.

1.11.1 Solid State Flight Data Recorder (SSFDR)

Manufacturer	:	Fairchild
Model	:	F1000
Serial Number	:	01598
Part Number	:	S800-2000-00

Selected and related data down loaded from the FDR, the detail data is shown in the table on the figure below.

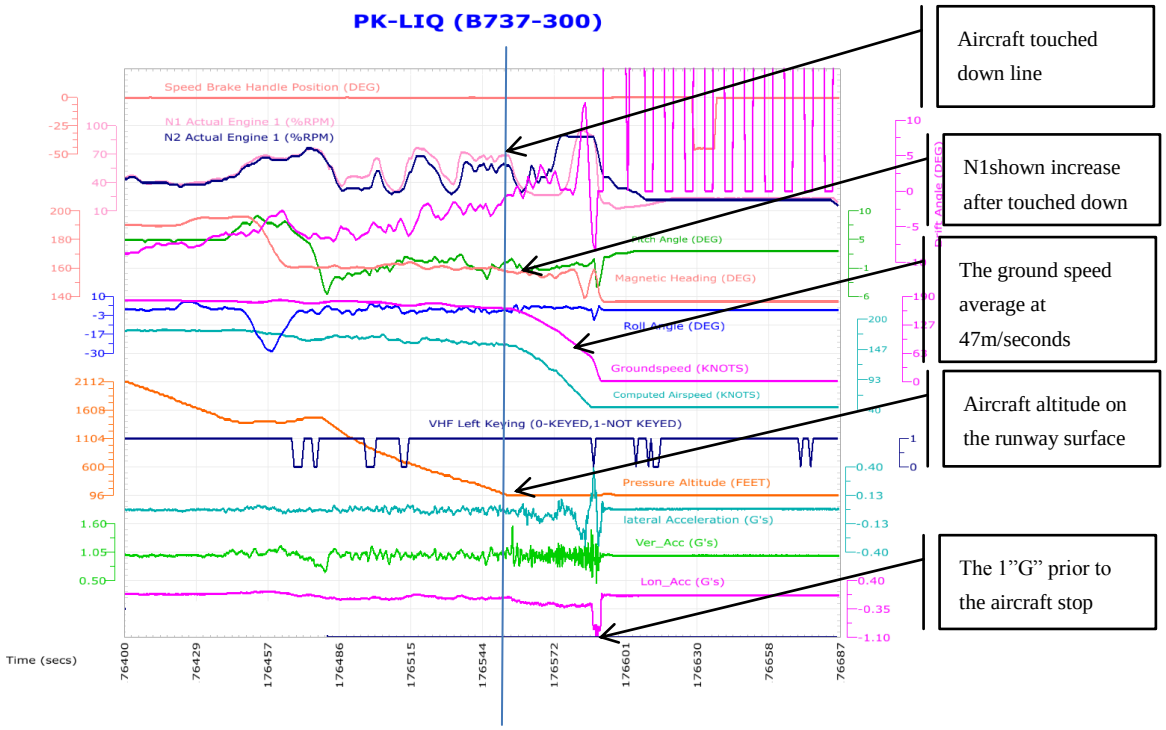


Figure 5: Parameters selected from the FDR

Time	IAS	V_G's)	Pres Alt	Long acc	AIR GND	Speed Brake Handle Position	N1 Act Eng 1 (%RPM)	N2 Act Eng 1 (%RPM)	late Acceleration (G's)	Groundspeed
176495	167	1.02	1024	-0.1	AIR	-0.4	45.1	31.8	-0.01	178
176496	166	1.04	992	-0.1	AIR	-0.4	45.8	33.8	0.01	177
176525	164	0.9	512	-0.1	AIR	-0.4	64.5	51.9	-0.01	
6526	164	0.97	480	-0.1	AIR	-0.4	59.7	47.9	0.01	
176527	161	1	480	-0.1	AIR	-0.4	51	39.9	-0.02	
176528	162	0.93	448	-0.1	AIR	-0.4	47.2	35.8	-0.03	172
176529	164	0.94	448	-0.1	AIR	-0.4	45.9	31.8	0.01	171
176557	152	0.97	96	-0.1	GND	-0.4	43.6	37.8	-0.07	157
176579	82	1.01	96	-0.2	GND	-0.4	58.3	88.2	-0.06	86
176580	76	1	96	-0.2	GND	-0.4	73.2	88.2	-0.04	82
176581	72	1.02	96	-0.3	GND	-0.4	84.6	88.2	-0.18	78
176582	68	0.79	96	-0.3	GND	-0.4	93.3	88.2	-0.24	72
176583	63	0.91	96	-0.2	GND	-0.4	94.3	88.2	-0.18	68
176584	58	1.02	96	-0.3	GND	-0.4	95.5	88.2	-0.35	64
176585	53	1.1	96	-0.2	GND	-0.4	93.3	88.2	-0.08	60
176586	50	1.04	96	-0.2	GND	-0.4	90.9	88.2	0.04	56
176587	45	1.49	96	-0.5	GND	-0.4	89.7	88.2	0.22	48
176588	45	1	96	-0.8	GND	-0.4	89.2	88.2	0.1	33
176589	45	1.22	96	-1.1	GND	-0.4	70.9	80.1	-0.27	15
176590	45	0.72	96	-0.9	GND	-0.4	31	68.1	-0.17	2
176628	45	0.99	96	0.01	GND	-46	23.6	21.7	0.01	1
176629	45	0.98	96	0.01	GND	-45	23.3	21.7	0.01	1
176630	45	0.98	96	0.01	GND	-45	23.4	21.7	0.01	1

Flight data at approx. 1000feet

Flight data's at approx. 500 feet

Flight data at touchdown

Flight data on landing roll

Flight data when aircraft stopped

The significant events recorded by the FDR from 1000 feet until the aircraft stopped as follows:

- The average sink rate of the aircraft between 1000 feet to 850 feet was 2500 ft/minutes.
- The average sink rate of the aircraft between 550 feet to 450 feet was 1200 ft/minutes and the speed was 163 kts.
- At 50 feet the aircraft speed 153 kts and the ground speed was 162 kts, or there was 9 kts of tail wind component.
- The average ground speed during landing roll until aircraft stopped was 47 meter/second.
- The aircraft deceleration started 13 seconds after touch down simultaneous to the increment of the N1's, or equal to 611 meters from the touch down point.

- Prior to aircraft stop the longitudinal acceleration decreased to -1.0 G's for three seconds.
- The speed brake deployed 42 seconds after touched down or 32 seconds after N1 increased at ground speed 1 which assumed that the aircraft has been stopped.

1.11.2 Solid State Cockpit Voice Recorder (SSCVR)

Manufacturer	:	Fairchild
Model	:	A100A
Serial Number	:	51133
Part Number	:	93-A100-80

The CVR was downloaded in the KNKT recorder facility used Honeywell Playback and Test System (PATS). The CVR contained about 30 minutes 30 seconds of audio. The voice data begin sometime after the aircraft stopped until the electrical power removed. The information during the flight and landing has been overwritten and could not be correlated with the FDR data.

1.12 Wreckage and Impact Information

The aircraft run out of runway and stopped at approximately 70 meters from the runway end or 10 meters from the end of stop-way on heading 135°.

The front left escape slide flatted and the tire no 3 ripped and also there were scratches as an indication of hydroplaning of the four wheel tires which shown along the stop way area of runway 15.

Figure 6: Aircraft track and hydroplaning marks

Figure 7: The font left escape slide flatted

Figure 8: The number 3 tire ripped and scratched

1.13 Medical and Pathological Information

No medical or pathological investigations were conducted as a result of this occurrence.

1.14 Fire

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

1.15 Survival Aspects

The passengers evacuated the aircraft through the emergency exits with all escape slides inflated.

Refer to the picture taken during the evacuation process (see figure 9), some passengers were standing on the wing carried their luggage and there was no person who assisted or guided the passengers. The flaps were full down and speed brakes were on retracted position.

Figure 9: Passengers evacuation process (picture courtesy of local newspaper)

1.16 Tests and Research

Not relevant for this accident.

1.17 Organisational and Management Information

Aircraft Owner		Airplanes Finance LTD
Address	:	Aercap House, Shannon. Co., Clare, Ireland
Aircraft Operator	:	PT. Lion Mentari Airlines
Address	:	Lion Air Tower Jl. Gajah Mada No. 7, Jakarta 10130
Air Operator Certificate (AOC) Number	:	AOC/121-010

1.17.1 Crew Resource Management (FCTM Page 1.2)

Crew resource management is the application of team management concepts and the effective use of all available resources to operate a flight safely. In addition to the aircrew, it includes all other groups routinely working with the aircrew who are involved in decisions required to operate a flight.

These groups include, but are not limited to, airplane dispatchers, flight attendants, maintenance personnel, and air traffic controllers.

Throughout this manual, techniques that help build good CRM habit patterns on the flight deck are discussed. For example, situational awareness and communications are stressed. Situational awareness or the ability to accurately perceive what is going on in the flight deck and outside the airplane, requires ongoing monitoring, questioning, crosschecking, communication, and refinement of perception.

It is important that all flight deck crewmembers identify and communicate any situation that appears unsafe or out of the ordinary. Experience has proven that the most effective way to maintain safety of flight and resolve these situations is to combine the skills and experience of all crewmembers in the decision making process to determine the safest course of action.

1.17.2 The Ground Operation of the Speed Brake

Ground Operation

During landing, the auto speed brake system operates when these conditions occur:

- SPEED BRAKE lever is in the ARMED position
- SPEED BRAKE ARMED light is illuminated
- radio altitude is less than 10 feet
- landing gear strut compresses on touchdown

  Note: Compression of any landing gear strut enables the flight spoilers to deploy. Compression of the right main landing gear strut enables the ground spoilers to deploy.
- both thrust levers are retarded to IDLE
- main landing gear wheels spin up (more than 60 kts).

The SPEED BRAKE lever automatically moves to the UP position and the spoilers deploy.

If a wheel spin-up signal is not detected, when the air/ground system senses ground mode (any gear strut compresses) the SPEED BRAKE lever moves to the UP position and flight spoiler panels deploy automatically. When the right main landing gear strut compresses, a mechanical linkage opens the ground spoiler bypass valve and the ground spoilers deploy.

If the SPEED BRAKE lever is in the DOWN position during landing or rejected takeoff, the auto speed brake system operates when these conditions occur:

- main landing gear wheels spin up (more than 60 kts)
- both thrust levers are retarded to IDLE
- reverse thrust levers are positioned for reverse thrust.

The SPEED BRAKE lever automatically moves to the UP position and spoilers deploy.

After an RTO or landing, if either thrust lever is advanced, the SPEED BRAKE lever automatically moves to the DOWN detent and all spoiler panels retract. The spoiler panels may also be retracted by manually moving the SPEED BRAKE lever to the DOWN detent.

1.18 Additional Information

1.18.1 Factors Affecting Landing Distance (FCTM Page 6.20)

Actual stopping distances for a maximum effort stop are approximately 60% of the dry runway field length requirement. 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, speed brakes, wheel brakes and surface conditions of the runway.

Note: 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.

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

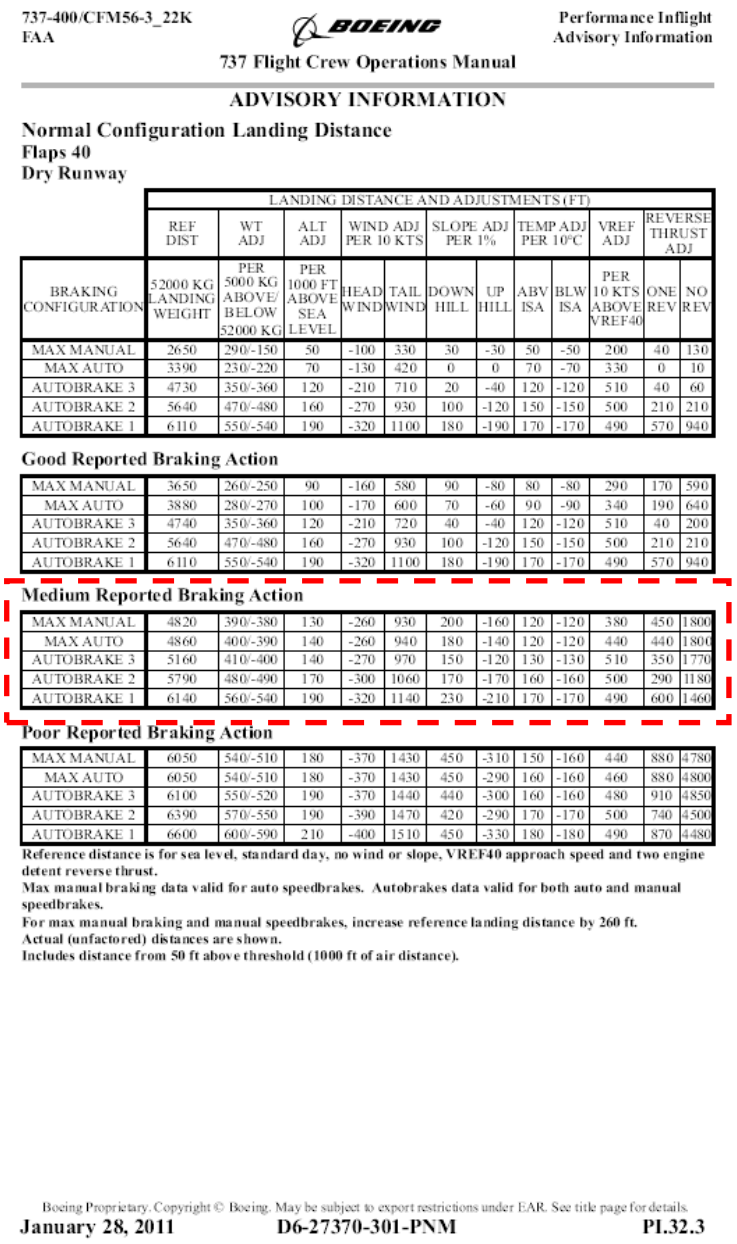
Floating above the runway before touchdown must be avoided because it uses a large portion of the available runway. The airplane should be landed as near the normal touchdown point as possible. Deceleration rate on the runway is approximately three times greater than in the air.

Height of the airplane over the runway threshold also has a significant effect on total landing distance. For example, on a 3° glide path, passing over the runway threshold at 100 feet altitude rather than 50 feet could increase the total landing distance by approximately 950 feet. This is due to the length of runway used up before the airplane actually touches down.

Glide path angle also affects total landing distance. As the approach path becomes flatter, even while maintaining proper height over the end of the runway, total landing distance is increased.

1.18.2 Landing Distance

The landing distance calculation in this final report used the B737-400 FCOM Inflight Performance PI.32.3 assumed on Medium Reported Braking Action as shown in the red dash line box.



737-400/CFM56-3_22K
FAA

BOEING

Performance Inflight
Advisory Information

737 Flight Crew Operations Manual

ADVISORY INFORMATION

Normal Configuration Landing Distance
Flaps 40
Dry Runway

	LANDING DISTANCE AND ADJUSTMENTS (FT)											
	REF DIST	WT ADJ	ALT ADJ	WIND ADJ PER 10 KTS		SLOPE ADJ PER 1%		TEMP ADJ PER 10°C		VREF ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	52000 KG LANDING WEIGHT	PER 5000 KG ABOVE/ BELOW 52000 KG	PER 1000 FT ABOVE SEA LEVEL	HEAD WIND	TAIL WIND	DOWN HILL	UP HILL	ABV ISA	BLW ISA	PER 10 KTS ABOVE VREF40	ONE REV	NO REV
MAX MANUAL	2650	290/-150	50	-100	330	30	-30	50	-50	200	40	130
MAX AUTO	3390	230/-220	70	-130	420	0	0	70	-70	330	0	10
AUTOBRAKE 3	4730	350/-360	120	-210	710	20	-40	120	-120	510	40	60
AUTOBRAKE 2	5640	470/-480	160	-270	930	100	-120	150	-150	500	210	210
AUTOBRAKE 1	6110	550/-540	190	-320	1100	180	-190	170	-170	490	570	940

Good Reported Braking Action

MAX MANUAL	3650	260/-250	90	-160	580	90	-80	80	-80	290	170	590
MAX AUTO	3880	280/-270	100	-170	600	70	-60	90	-90	340	190	640
AUTOBRAKE 3	4740	350/-360	120	-210	720	40	-40	120	-120	510	40	200
AUTOBRAKE 2	5640	470/-480	160	-270	930	100	-120	150	-150	500	210	210
AUTOBRAKE 1	6110	550/-540	190	-320	1100	180	-190	170	-170	490	570	940

Medium Reported Braking Action

MAX MANUAL	4820	390/-380	130	-260	930	200	-160	120	-120	380	450	1800
MAX AUTO	4860	400/-390	140	-260	940	180	-140	120	-120	440	440	1800
AUTOBRAKE 3	5160	410/-400	140	-270	970	150	-120	130	-130	510	350	1770
AUTOBRAKE 2	5790	480/-490	170	-300	1060	170	-170	160	-160	500	290	1180
AUTOBRAKE 1	6140	560/-540	190	-320	1140	230	-210	170	-170	490	600	1460

Poor Reported Braking Action

MAX MANUAL	6050	540/-510	180	-370	1430	450	-310	150	-160	440	880	4780
MAX AUTO	6050	540/-510	180	-370	1430	450	-290	160	-160	460	880	4800
AUTOBRAKE 3	6100	550/-520	190	-370	1440	440	-300	160	-160	480	910	4850
AUTOBRAKE 2	6390	570/-550	190	-390	1470	420	-290	170	-170	500	740	4500
AUTOBRAKE 1	6600	600/-590	210	-400	1510	450	-330	180	-180	490	870	4480

Reference distance is for sea level, standard day, no wind or slope, VREF40 approach speed and two engine detent reverse thrust.
Max manual braking data valid for auto speedbrakes. Autobrakes data valid for both auto and manual speedbrakes.
For max manual braking and manual speedbrakes, increase reference landing distance by 260 ft.
Actual (unfactored) distances are shown.
Includes distance from 50 ft above threshold (1000 ft of air distance).

Figure 10: Performance In-flight table (red line dash)

1.18.3 Skills and Decision Making

The skills are abilities that are learned, usually through training, to achieve a desired outcome.

Two basic classifications of skills are;

The perceptual-motor skill; which involve an interaction between perception and voluntary movement.

Perceptual motor skills are;

- Taught during initial and recurrent training
- Required to fly aircraft in normal and emergency situation.

The cognitive skill; which involve mental processes such as comprehension, judgment, memory and reasoning.

Cognitive skills are;

- More complex than perceptual-motor skills.
- Related to learning and recall
- Involved in gaining and maintaining situational awareness and in decision making
- Used when speaking, listening and understanding.

Decision making in safety critical and time constrained situations largely relies on flight crews following a predetermined course of action, typically encapsulated in Standard Operating Procedures. If a crew is uncertain about an aspect of flight operations, with the potential to compromise safety, then where possible the most prudent course of action is to operate in a way that allows time to adequately assess the situation and act accordingly. This aspect of decision making can be incorporated into Crew Resource Management (CRM) training. Conducting a go-around would have enabled them to ensure the immediate safety of the aircraft and then, with more time on hand, to resolve the uncertainty concerning the suitability of the runway.

1.18.4 AMM 27-62-00 May 2008

Auto speed brake trouble shooting

On the red dash box lines is the trouble shooting associates with the pilot reports on the previous flight PIREPS. In summary the AMM requires the adjustment or replacement of mechanism, arming switch and or to replacement of the actuator.

Trouble	Probable Cause	Isolation Procedure	Remedy
Ground spoilers do not operate.	Ground spoiler interlock valve cable is bad.	Check operation of interlock valve cable (PAGEBLOCK 27-6251/501).	Adjust or replace cable (PAGEBLOCK 27-62-51/401).
	Ground spoiler interlock valve is bad.	Check operation of interlock valve (PAGEBLOCK 27-6261/501).	Replace interlock valve and valve linkage (PAGEBLOCK 27-62-61/401).
	Ground spoiler control valve is bad.	Check for damaged or leaking control valve	Replace valve (PAGEBLOCK 27-6241/401).
For automatic actuation, speedbrake control lever and system do not actuate or do not actuate fully UP or DOWN (force required to rotate control lever not excessive).	Speedbrake lever brake mechanism is defective, or out of adjustment.	Operate automatic speedbrake system (PAGEBLOCK 27-6200/501). Check if electric actuator operates but lever brake slips.	Adjust or replace mechanism (Page block 27-62-21/501).
	Speedbrake arming switch is bad, or out of adjustment.	Electric actuator does not operate.	Adjust or replace arming switch Page block 27-62-34/401.
	Speedbrake lever electric actuator is defective		Replace actuator (page block27-6231/401).

1.19 Useful or Effective Investigation Techniques

The investigation is being 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 analysis part of this Final Report will discuss the relevant issues resulting in the landing on taxiway involving a Boeing 737-400 aircraft registered PK-LIQ at Supadio Airport of Pontianak on 2 November 2010.

The investigation determined that there were three relevant safety issues found which was associated with the approach profile, thrust reverser and automatic speed brake deployment to this occurrence.

The analysis will therefore focus on the following issues;

- Auto speed brake control system
- Stabilized Approach
- Landing Distance Calculation

2.1 The Auto Speed Brake Control System

Investigation on the maintenance and reliability records related to the auto speed brake control system.

There were 13 repetitive pilot reports (PIREP) of the speed brake fail for auto deployment (ATA 27) recorded since 03 September up to 27 October 2010. The maintenance rectifications carried out were:

- Clean the electrical plug of speed brake actuator motor,
- Repositioned control module,
- Clean and reposition relay R280 and R283, and
- Reposition and clean control plug actuator control speed.

The rectification of the fail of automatic actuation of the speed brake control lever and system, refer to Aircraft Maintenance Manual (AMM) Chapter 27-62-00 page 104 were:

- Adjust or replace mechanism (page block 27-62-21/501),
- Adjust or replace arming switch (page block 27-62-34/401), or
- Replace actuator (Page block 27-62-31/401).

Based on the interview with the PIC and SIC, it also noted that prior to descend the crew had aware that the problem related to the reverser and automatic spoiler deployment were still exist sometimes.

In summary the AMM requires the adjustment or replacement of mechanism, arming switch and or the actuator. In fact, the investigation did not find evidence of the consistency of the rectifications and no evaluation and risk assessment program performed during the period in which the problem reported up to the occurrence. The aforesaid particular condition reappeared during the landing was might probably result of the unsolved symptom problems.

2.2 Un-stabilized Approach and Decision to Land

Refers to the Flight Crew Training Manual (FCTM) of the Boeing B 737 (revision July 29, 2011) page 5.4 it was stated that:

- *the aircraft speed is not more than VREF +20 knots indicated airspeed and not less than VREF*
- *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*

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

In fact, that the average sink rate of the aircraft between 1000 feet to 850 feet was 2500 ft/minutes and the average sink rate between 550 feet to 450 feet was 1200 ft/minutes. At 50 feet the aircraft speed was 162 kts or 24 knot above the Vref of 138 knots. There was 9 kts of tail wind component. These particular conditions indicated that the aircraft was un-stabilized since 1000 feet to 50 feet above the threshold, according to the Flight Crew Training Manual (FCTM) of the Boeing B 737 (revision July 29, 2011) page 5.4 which requires an immediate go-around.

Crew Resource Management (FCTM Page 1.2) described that technique that help to build a good CRM habit pattern, such as stressing on Situational Awareness and communication.

Situational awareness or the ability to accurately perceive what is going on in the flight deck and outside the airplane, requires ongoing monitoring, questioning, crosschecking, communication, and refinement of perception.

It is important that all flight deck crewmembers identify and communicate any situation that appears unsafe or out of the ordinary. Experience has proven that the most effective way to maintain safety of flight and resolve these situations is to combine the skills and experience of all crewmembers in the decision making process to determine the safest course of action.

Examination on the interview notes, the investigation did not find any of the crew communication or interaction respecting to their situational awareness while the aircraft was not aligning with the stabilized approach elements criteria. The conditions required the pilot assessment the ability to accurately perceive what was going on in the flight deck and outside the aircraft which required ongoing monitoring, questioning, crosschecking, communication, and refinement of their perception before the decision to land was made.

2.3 Landing Distance Calculation

The calculation of landing distance based on existing condition of weather, the weight and balance and condition recorded on the FDR refers to Flight Crew Operation Manual PI.32.3 Normal Configuration Landing Distance. The existing condition such as: the aircraft estimated landing weight at 55,589 kgs, at 50 feet aircraft speed was 153 kts, tail wind condition of 9 kts, temperature 26°C, braking action medium and maximum manual braking action. The calculations were as follows:

Max manual braking	: 4820 feet
Landing weight adjustment	: + 300 feet
tail wind 10 knots	: + 930 feet
slope adjustment	: -
Temperature 11 above ISA	: + 120 feet
Speed 9 knots above target	: + 380 feet
Total landing distance required	: 6,550 feet (2,041 meters)

Examination on several events recorded by the FDR, it indicated 10 seconds after touched down the N1 gradually increased which it can be assumed as a result of the reverses deployment. The speed brake deployed 42 seconds after touchdown after the aircraft stopped. Further examination on the recorded aircraft speed, it indicated that the average ground speed after touchdown was 47 meter/second and the deceleration occurred 13 second after touchdown or it similar to 611 meters.

Based on aforesaid calculation the required landing distance has penalty of 611 meters as consequences of the delay in deceleration of 13 seconds after touchdown.

The calculations of the existing condition of 2,041 meters and the effect of the delayed of the reversers and deceleration resulted that the aircraft would require distance to stop which might reach to 2,652 meter, while the available landing distance was 2,250 meters.

The FDR data revealed that the speed brake handle extended at 42 seconds after touchdown which the aircraft has stopped. This can be assumed that the speed brakes did not deploy during the landing roll. The landing distance calculation stated on the FCOM is based on the auto-deployment of the speed brake. Absence of the speed brake would prolong the landing distance.

In fact, the aircraft stopped and trapped on the soft surface at 10 meters from the end of the pavement instead of 2,652 meters, it was consistent with the increasing of the deceleration up to 1.0 G’s for three seconds as recorded on the FDR.

3 CONCLUSIONS

3.1 Findings[2]

1. The aircraft was airworthy prior to this occurrence and was operated under a correct weight and balance envelope.
2. All crew have valid licenses and medical certificates.
3. Pilot in Command was the pilot flying (PF) and the Second in Command was the pilot monitoring (PM). The flight to Pontianak was reported normal and no abnormality reported and or recorded during the flight prior to the occurrence.
4. On approach briefing prior to descend, the pilot flying reviewed the past experiences of this particular aircraft that the thrust reverser handles were hard to operate and the speed brake failed to auto deploy. The PF asked the PM to check and to remind the PF in respect to the auto deployment of the speed brake when aircraft touched down.
5. Base on top ten PIREPS three months' period, the speed brake control system trouble were 13 times reported and was the leading chapter.
6. When conducting the ILS approach for runway 15, it was reported that the weather was slight rain.
7. The last calibration of all the navigation aids at Supadio Airport was performed at 20 March 2010 and resulted in good condition.
8. When the glide slope captured, the auto pilot failed to follow the glide path and the aircraft maintained at 1300 feet. The PF then fly manually to correct the flight path.
9. As the flaps lever has been selected to 40, the flaps indicator indicated at 30 positions. Realized to the actual flaps indication, the PF asked to PM of the landing speed for that particular flaps position in case the flaps could not move further to 40.
10. At 600 feet and the pilots completing the landing checklist, PM reselected the flap from 30° to 40° and was successful.
11. Estimated landing weight was 55,300 kg and the Vref – flap 40 was 138 knots
12. During on the interview, the pilots stated that the aircraft touched down beyond the touchdown point, and during the landing rolled, the PF tried to select the thrust reversers but it was difficult to operate and also the speed brake did not deploy automatically.
13. The pilots stated that there was no deceleration felt by the crew the PF then applied maximum manual braking and selected the speed brake handle manually

2 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.

to deploy. Few seconds later the reversers activated normally. During the landing roll a loud bang was heard by the crew.

14. Based on the interview, the Supadio Tower controller on duty stated that when the aircraft was about to run out of runway then he immediately pressed the crash bell.
15. The aircraft run out of runway and stopped at approximately 70 meters from the runway or 10 meters from the end of stop-way.
16. All passengers were evacuated through all available exits and all the escape slides were inflated. No one injured in this accident.
17. Refer to the picture taken during the evacuation process (see figure 9), some passengers were standing on the wing carried their luggage and there was no person who assisted or guided the passengers.
18. The FDR recorded shown:
    - Sink rate between 1000 feet to 850 feet was 2500 ft/minutes.
    - Sink rate between 550 feet to 450 feet was 1200 ft/minutes and the speed was 163 kts.
    - At 50 feet the aircraft speed 153 kts and the ground speed was 162 kts, or there was 9 kts of tail wind component.
    - The average ground speed during landing roll until aircraft stopped was 47 meter/second.
    - The aircraft deceleration occurred 13 seconds after touch down together with increment of the N1's.
    - Prior to aircraft stopped the longitudinal acceleration decrease to -1.0 G's for three seconds.
    - The speed brake deployed 42 seconds after touchdown or 32 seconds after N1 increase at ground speed 1 which assumed that the aircraft has been stopped
19. The CVR data recorded during the flight and landing has been overwritten.
20. There was no evidence of fire in-flight or after the aircraft impacted.
21. The flaps were full down and speed brakes were on retracted position.
22. Flight Crew Training Manual (FCTM) of the Boeing B 737 (revision July 29, 2011) page 5.4, shown the detail of recommended Elements of a Stabilized Approach. An approach that becomes un-stabilized below 1,000 feet AFE in IMC or below 500 feet AFE in VMC requires an immediate go-around.
23. The aircraft speed was more than VREF +20 knots when approached below 1000 feet.
24. Decision making in safety critical and time constrained situations largely relies on flight crews following a predetermined course of action, typically encapsulated in Standard Operating Procedures.
25. The stabilized approach, thrust reverser and automatic speed brake system deployment were the issues related to this occurrence.

26. Examination on the interview notes, the investigation did not find any of the crew communication or interaction respecting to their situational awareness while the aircraft was not aligning with the stabilized approach elements criteria.
27. Related to auto speed brake deployment rectification the investigation referred to Aircraft Maintenance Manual (AMM) Chapter 27-62-00 page 104. The AMM requires the adjustment or replacement of mechanism, arming switch and or the actuator. In fact, the investigation did not find the consistency of the rectifications according to the AMM.
28. The investigation did not find evidence of the consistency of the rectifications and no evaluation and risk assessment program performed during the period in which the problem reported up to the occurrence.
29. Assuming reversers and auto speed brake deployment operative normally the total landing distance required would be 6,550 feet (2,041 meters).
30. The calculations of the existing condition assuming reversers and auto speed brake deployment operative normally the total landing distance required would be 6,550 feet (2,041 meters) and the effect of the delayed of the reversers and deceleration resulted that the aircraft would require distance to stop which might reach to 2,652 meter, while the available landing distance was 2,250 meters.
31. The aircraft stopped and trapped on the soft surface at 10 meters from the end of the pavement instead of 2,652 meters, it was consistent with the increasing of the deceleration up to 1.0 G's for three seconds as recorded on the FDR.
32. There were indications of hydroplaning on number 3 tire and mark of all tires on the paved surface after the runway end.

3.2 Contributing Factors[3]

- Inconsistency to the Aircraft Maintenance Manual (AMM) for the rectifications performed during the period of the reversers and auto speed brake deployment problem was might probably result of the unsolved symptom problems.
- The decision to land during the un-stabilized approach which occurred from 1000 feet to 50 feet above threshold influenced by lack of crew ability in assessing to accurately perceive what was going on in the flight deck and outside the airplane.
- The effect of delayed of the speed brake and thrust reverser deployment effected to the aircraft deceleration which required landing distance greater than the available landing distance.

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

4 SAFETY ACTIONS

At the time of issuing this Draft Accident Investigation Report, the Komite Nasional Keselamatan Transportasi (KNKT) has not been informed of any safety actions resulting from this accident.

5 SAFETY RECOMMENDATIONS

The investigation identified safety issues contributed to this accident which were: un-stabilized approach, selection of the thrust reverser and automatic system of the speed brake deployment problem.

Consider CRM perspective, the pilots decided to land the aircraft while some of the stabilize approach criteria did not meet to land the aircraft safely.

The recommendations issued are based on the findings and analysis in this investigation, and the finding that classified as a safety hazard which may not be analyzed prior to issue a safety recommendation. However, the operators and the addressee of the recommendation shall consider that the condition possibly extends to other pilots, related operators as well as regulators.

Concerning to the safety issues identified in this investigation, the Komite Nasional Keselamatan Transportasi issued several safety recommendations intended for the safety improvement and addressed to:

5.1 PT. Lion Air

The contributing factors described on 3.2 in this final report shown the queuing factors that highlighted as a back ground of the safety recommendations;

- **04.O-2016-90.1**

  Learn from this accident, it is strongly required that the maintenance department to be consistent with the Aircraft Maintenance Manual (AMM) for any aircraft technical and system rectification guidance.

  Note: The Chapter 2. 2.1 Analyses describe the detail specifically.

- **04.O-2016-1.4**

  The aircraft was un-stabilized approach since 1000 feet to 50 feet above the threshold and the pilot decided to land the aircraft, this condition might be extended to the other crew. As such, the enforcement of the crew disciplines factors shall be improved.

  Note: Chapter 2.2.2 Analysis describes the detail of each single element went wrong of the SOP specifically.

- **04.O-2016-20.3**

  Refer to the finding number 20, the passengers were not guided and assisted during the evacuation process. It considers to be evaluated refer to company policy.

5.2 PT. Angkasa Pura II Branch Office Supadio Airport, Pontianak

- **04.B-2016-91.1**

  There were indications of hydroplaning on No 3 tire and mark of all tires on the paved surface after the runway end. This condition is classified as a hazard that might contribute and endanger the safety of the flight. Therefore, the KNKT recommends to airport authority to be aware and takes necessary safety action to minimize the risk.

- **04.B-2016-92.1**

  Refer to the finding number 20, the passengers were not guided and assisted during the evacuation process. It considers to be evaluated refer to aerodrome operator policy.

5.3 Directorate General of Civil Aviation

- **04.R-2016-93.1**

  Refer to the ICAO Annex 19 sub chapter 7 The DGCA shall implement documented surveillance processes, by defining and planning inspections, audits, and monitoring activities on a continuous basis. Therefore, the KNKT recommends for proactively assure the oversight and ensure that the recommendations issued in this final report were implemented correctly by the addressee and other related operators.

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