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NATIONAL TRANSPORTATION SAFETY COMMITTEE

Aircraft Accident Investigation Report

PT. Sriwijaya Air

PK–CKM

Boeing 737-300

Adisutjipto International Airport,Yogyakarta

Republic of Indonesia

20 December 2011

NATIONAL TRANSPORTATION SAFETY COMMITTEE
MINISTRY OF TRANSPORTATION
REPUBLIC OF INDONESIA
2013

This Final Report was produced by the National Transportation Safety Committee (NTSC), Transportation Building 3rd Floor, Jalan Medan MerdekaTimur No. 5, Jakarta 10110, Indonesia.

The report is based upon the investigation carried out by the NTSC 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. 3/2001).

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TABLE OF CONTENTS

TABLE OF FIGURES

GLOSSARY OF ABBREVIATIONS

ADF	Automatic Direction Finding
AFM	Airplane Flight Manual
AGL	Above Ground Level
ALAR	Approach-and-landing Accident Reduction
AMSL	Above Mean Sea Level
AP I	PT Angkasa Pura I
AOC	Air Operator Certificate
ATC	Air Traffic Control
ATPL	Air Transport Pilot License
ATS	Air Traffic Service
BMG	Badan Meterologi dan Geofisika
°C	Degrees Celsius
CAMP	Continuous Airworthiness Maintenance Program
CASO	Civil Aviation Safety Officer
CASR	Civil Aviation Safety Regulation
CPL	Commercial Pilot License
COM	Company Operation Manual
CRM	Cockpit Recourses Management
CSN	Cycles Since New
CVR	Cockpit Voice Recorder
DGCA	Directorate General of Civil Aviation
DME	Distance Measuring Equipment
ILS	Instrument Landing System
FDR	Flight Data Recorder
GPWS	Ground Proximity Warning System
ICAO	International Civil Aviation Organization
IFR	Instrument Flight Rules
IIC	Investigator in Charge
ILS	Instrument Landing System
IMC	Instrument Meteorological Conditions
Kg	Kilogram(s)
Km	Kilometer(s)
Kt	Knots (NM/hour)
Mb	Millibar (s)
MAC	Mean Aerodynamic Chord
NDB	Non Directional Beacon

NM	Nautical mile(s)
NOTAM	Notification to Airmen
KNKT / NTSC	Komite Nasional Keselamatan Transportasi / National Transportation Safety Committee
PIC	Pilot in Command
PA	Passenger Announcement
QFE	Height above aerodrome elevation (or runway threshold elevation) based on local station pressure
QNH	Altitude above mean sea level based on local station pressure
RMI	Radio Magnetic Indicator
RPM	Revolution Per Minute
SCT	Scattered
S/N	Serial Number
SIC	Second in Command
SSCVR	Solid State Cockpit Voice Recorder
SSFDR	Solid State Flight Data Recorder
STAR	Standard Arrival
TS/RA	Thunderstorm and rain
TSN	Time Since New
TT/TD	Ambient Temperature/Dew Point
UTC	Coordinated Universal Time
VFR	Visual Flight Rules
VMC	Visual Meteorological Conditions

INTRODUCTION

SYNOPSIS

On 20 December 2011, a Boeing 737-300 aircraft, registered PK-CKM, was being operated by PT. Sriwijaya Air on a schedule passenger flight SJ230 from Soekarno Hatta International Airport (WIII) Jakarta to Adisutjipto International Airport (WARJ), Yogyakarta.

There were 141 persons on board; two pilots, four cabin crews and 135 passengers consisted124 adult, 7 children and 4 infant.

The aircraft departed from Jakarta at 14.00 LT (07.00 UTC), the pilot in command was the pilot flying and the co-pilot was the pilot monitoring. At 08.10 UTC the aircraft made holding at 8 NM from JOG VOR due to bad weather. After the second holding and the weather was deteriorated, the airport authority closed the airport for takeoff and landing. The pilot requested divert to Juanda Airport (WARR), Surabaya and landed at 08.40 UTC.

After refuelling and received the information about weather improvement in Yogyakarta then the aircraft departed, at 09.20 UTC, in this sequence of flight the PIC acted as PF, with 137 persons on board consisted of two pilots, four cabin crews and 131 passengers consisted 120 adult, 7 children and 4 infant.

The aircraft was on the fifth sequence from seven aircraft approaching Adisucipto airport Yogyakarta.

Passing JOG VOR it was seen on radar screen that the aircraft speed was read 203 Kts at 2700 ft. Approach Controller instructed to reduce the speed.

At about 1200 ft, the pilot had the runway insight and disengaged the autopilot and auto-throttle. The pilot made correction to the approach profile by roll up to 25 degrees and rate of descend up to 2040 ft per minute. The GPWS warning of ‘pull up’ and sink ‘rate were’ activated. Aircraft touched down at speed 156 Kts of 138 Kts target landing speed.

During landing roll, the auto-brake and spoiler activated automatically. The thrust reverse were deployed and the N1 were recorded on the FDR increase and decrease to idle before increased to 80% prior to aircraft stop.

The PIC noticed that the aircraft would not be able to stop in the runway and decided to turn the aircraft to the left. The aircraft stopped at 75 meter from the end of runway 09 and 54 meter on the left side of the centre line.

Most of the passenger evacuated through left and right forward escape slides. All passengers were evacuated safely. The passenger on the stretcher case was evacuated by the airport rescue.

6 passengers reported minor injured while all crew and the remaining passengers were not injured. The aircraft suffered major damage on the right main and nose wheel.

The operator had issued several safety actions following this accident. The NTSC issued several safety recommendations to address safety issues identified in this investigation.

1 FACTUAL INFORMATION

1.1 History of the flight

On 20 December 2011, a Boeing 737-300 aircraft, registered PK-CKM, was being operated by PT. Sriwijaya Air on a schedule passenger flight from Soekarno Hatta International Airport (WIII) Jakarta to Adisutjipto International Airport (WARJ) Yogyakarta[1],with flight number SJ230.

On board in this flight were 141 persons consist of two pilots, four flight attendants and 135 passengers' consist of 124 adult, 7 children and 4 infants. One sick passenger was used stretcher on the left aft side of the cabin and was accompanied by two other passengers. One elderly passenger required wheel chair during boarding was accompanied her next of kin and were seated on the right side of second row.

At 14.00 LT (07.00 UTC[2]), the aircraft departed from Jakarta. The flight was scheduled at 05.45 and was delayed due to the aircraft was late from the previous flight. In this flight, the Pilot in Command (PIC) acted as pilot flying (PF) and the Second in Command (SIC) acted as Pilot Monitoring (PM). This flight was the first flight for the crew of two sectors scheduled for the day.

At that day the Instrument Landing System (ILS) for runway 09 at Yogyakarta was unusable as stated in the notification to airmen (NOTAM) due to installation of new ILS.

At 08.10 UTC the aircraft arrived at Yogyakarta and made holding at 8 NM from JOG VOR due to weather was below minima for landing. After the second holding, the weather deteriorated, the airport authority decided to close the airport for takeoff and landing.

Following this situation, the pilot decided to divert to Juanda Airport (WARR). The flight to Surabaya was uneventful and the flight arrived at Surabaya at 08.40 UTC.

The aircraft refuelled at Surabaya while the pilot waiting for the weather improvement at Yogyakarta and there were four passengers decided not continuing their flight to Yogyakarta.

During transit in Surabaya one passenger came to the front of the cabin and expressed his disappointment of the pilot decision to divert to Surabaya. He stated that his trip Yogyakarta was to attend his father funeral and because of the delay arrival to Yogyakarta, he might have missed the funeral. The passenger then returned to his seat then afterward, the crewmember noticed that there was changing in the captain behaviour.

1 AdisutjiptoInternational Airport (WARJ) Yogyakarta, will be called as Yogyakarta for the purpose in this report.

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

The aircraft departed to Yogyakarta with 137 persons on board at 09.20 UTC the PIC acted as PF after receiving the improved weather in Yogyakarta, which informing the visibility was 2 km.

During en-route to Yogyakarta, the weather was partially cloudy especially around point LASEM. After passing point PURWO, the aircraft started to descend and known that the pilots did not perform approach crew briefing.

The aircraft was on the fifth sequence of seven aircrafts approaching to Yogyakarta. After passing SO NDB while descend passing 14000 ft, the aircraft was under radar controlled and instructed to descend to 8000 ft. The aircraft then instructed to continue descend to 7000 ft and flew on heading 270 to GEPAK point, then instructed to descend to 5000 ft heading 040 to intercept inbound course for VOR/DME approach runway 09.

While passing JOG VOR, the Approach controller detected on the radar screen that the aircraft speed was 203 Kt at altitude of 2700 ft then speed increased to 210 Kt, and then the Approach controller instructed to reduce aircraft speed.

During this approach, the Second in Command made radio communication to another company crew who had landed at Yogyakarta previously that informed during the final approach they could see the runway at approximately over the VOR.

At about 1200 ft of aircraft altitude, the pilot reported that the runway was insight. Approach controller instructed to contact to Adisutjipto Tower controller. The controller gave clearance to land and informed that the weather was slight rain, runway was wet and the wind was calm.

The pilot realized that the aircraft was not aligned with the runway and above the glide, with the Visual Approach Slope Indicator (VASI) were all four lights in white. The pilot disconnected the autopilot and auto throttle and flew manually to correct the approach. During the approach, the PF course indicator was set at 091 and the PM was at 084.

The pilot noticed several warnings of the Ground Proximity Warning System (GPWS) of ‘pull up’. The PF also commanded to select the auto brake to position four.

On short final the flight path was managed to return to the normal glide path and the PF noticed that the aircraft speed indicated approximately 158 Kt. The controller detected on the radar screen that the aircraft speed indicated around 169 Kts during touched down. The FDR recorded the touchdown speed was 156 Kt.

During approach the PM did not perform standard call out nor reminded the PF of the condition of approach.

After touchdown, the PF activated the thrust reverser. The crew did not feel any deceleration. Prior to the end of the runway, the PF noticed that the aircraft would not be able to stop in the runway and decided to turn the aircraft to the left.

The aircraft stopped at 75 meter from the end of runway 09 and 54 meter on the left side of the centre line.

After the aircraft stopped, the PIC commanded “brace, brace” to the flight attendants and passenger via passenger announcement (PA) system, however there was no PA announcement heard. Both pilots then executed the Emergency on Ground Procedure.

The flight attendants noticed that after aircraft stopped, the cabin ceiling light changed to evacuation light. They also noticed black smoke came out from the left engine.

The flight attendants immediately initiated passenger evacuation by opening all exits. Some passengers immediately opened the over wing emergency exit windows.

During the evacuation, the elderly passenger on the second row was pushed by other passengers. The flight attendant noticed this situation and held the other passenger while another flight attendant assisted the elderly passenger to evacuate. The passenger on the stretcher evacuated from the aircraft assisted by ground rescue.

Six passengers were reported suffer minor injury. All crew were no injury.

Figure 1: PK-CKM stopped at 75 meters from end of runway 09

1.2 Injuries to Persons

Injuries	Flight crew	Passengers	Total in Aircraft
Fatal	-	-	-
Serious	-	-	-
Minor/None	6	131	137
TOTAL	6	131	137

1.3 Damage to Aircraft

The aircraft hit the ground with nose landing gear and right main landing gear collapsed, damaged the aircraft bottom structure.

Figure 2: Nose wheel

Figure 3: Right main gear.

1.4 Other Damage

There were two of right runway lights and one of taxiway signboard light broken, hit by the aircraft.

1.5 Personnel Information

1.5.1 Pilot in command

Gender	:	Male
Age	:	58 years
Nationality	:	Indonesia
Marital status	:	Married
Date of joining company	:	March 2011
License type	:	ATPL
Validity	:	31 January 2012
Aircraft type rating	:	B 737 -300/400/500
Medical certificate	:	First Class
Limitation	:	Holder shall wear corrective lenses
Date of medical examanination	:	03 October 2011
Validity	:	03 April 2012

Flight Time

Total hours	:	29,801 hours 09 minutes
Last 90 days	:	279 hours 23 minutes
Last 60 days	:	215 hours 25 minutes
Last 24 hours	:	2 hours 53 minutes

The PIC has recorded flight hours of 109 hours 22 minutes in July 2011 and subsequently 100 hours 58 minutes in August, 109 hours 44 minutes in September, 109 hours 36 minutes in October, 105 hours 49 minutes in November and 65 hours 51 minutes in up to 20 December.

1.5.2 Second in Command

Gender	:	Male
Age	:	28 years
Nationality	:	Indonesia
Marital status	:	Single
Date of joining company	:	September 2010
License type	:	CPL
Validity	:	31 October 2012
Aircraft type rating	:	B 737 -300/400/500

Medical certificate	:	First Class
Limitation	:	None
Date of medical examanination	:	16 December 2011
Validity	:	16 June 2012

Flight Time

Total hours	:	562 hours
Last 90 days	:	272 hours 20 minutes
Last 60 days	:	205 hours 47 minutes
Last 24 hours	:	2 hours 53 minutes

The Second in Command has performed 66 hours 33 minutes flight hours during December 2011. Between 6 and 12 December, the SIC has performed 38 flight hours.

1.6 Aircraft Information

1.6.1 General

Aircraft Registration	:	PK-CKM
Aircraft Manufacturer	:	Boeing Company
Year of Manufacture	:	1996
Type/ Model	:	Boeing 737-300
Serial Number	:	28333
Certificate of Airworthiness		
Valid to	:	24August 2012
Certificate of Registration		
Valid to	:	24 August 2012
Total flying hours since new	:	31,281 hours
Total cycle since new	:	21,591 cycles

1.6.2 Engine

Engine type	:	Turbofan
Manufacturer	:	CFM International
Model	:	CFM56-3C1

Left Engine

Serial Number	:	858392
Time Since New	:	30,143 hours
Cycle Since New	:	20,909 cycles

Right Engine

Serial Number	:	858393
Time Since New	:	29,967 hours
Cycle Since New	:	20,854 cycles

1.6.3 Weight and Balance

The aircraft took off with estimated takeoff weight of 54,329 kg, flap 5, takeoff stabilizer trim 4.75, and Mean Aerodynamic Chord (MAC) 20%, estimated landing weight was 52,019 kg. With this landing weight, the landing speed was 138 Kt.

The aircraft was being operated within the approved weight and balance limitations.

1.7 Meteorological Information

Weather report for Yogyakarta, issued 20 December 2011, at 1000 UTC

Wind	:	270/05 Kt
Visibility	:	1000 meters (Runway 27)
		2000 meters (Runway 09)
Temperature/Dew point	:	26 °C /24 °C
Present Weather	:	Thunder storm and rain
Cloud	:	Broken 1400 ft
QNH	:	1005 mb / 29.68 inch Hg
QNE	:	992 mb/ 29.31 inch Hg

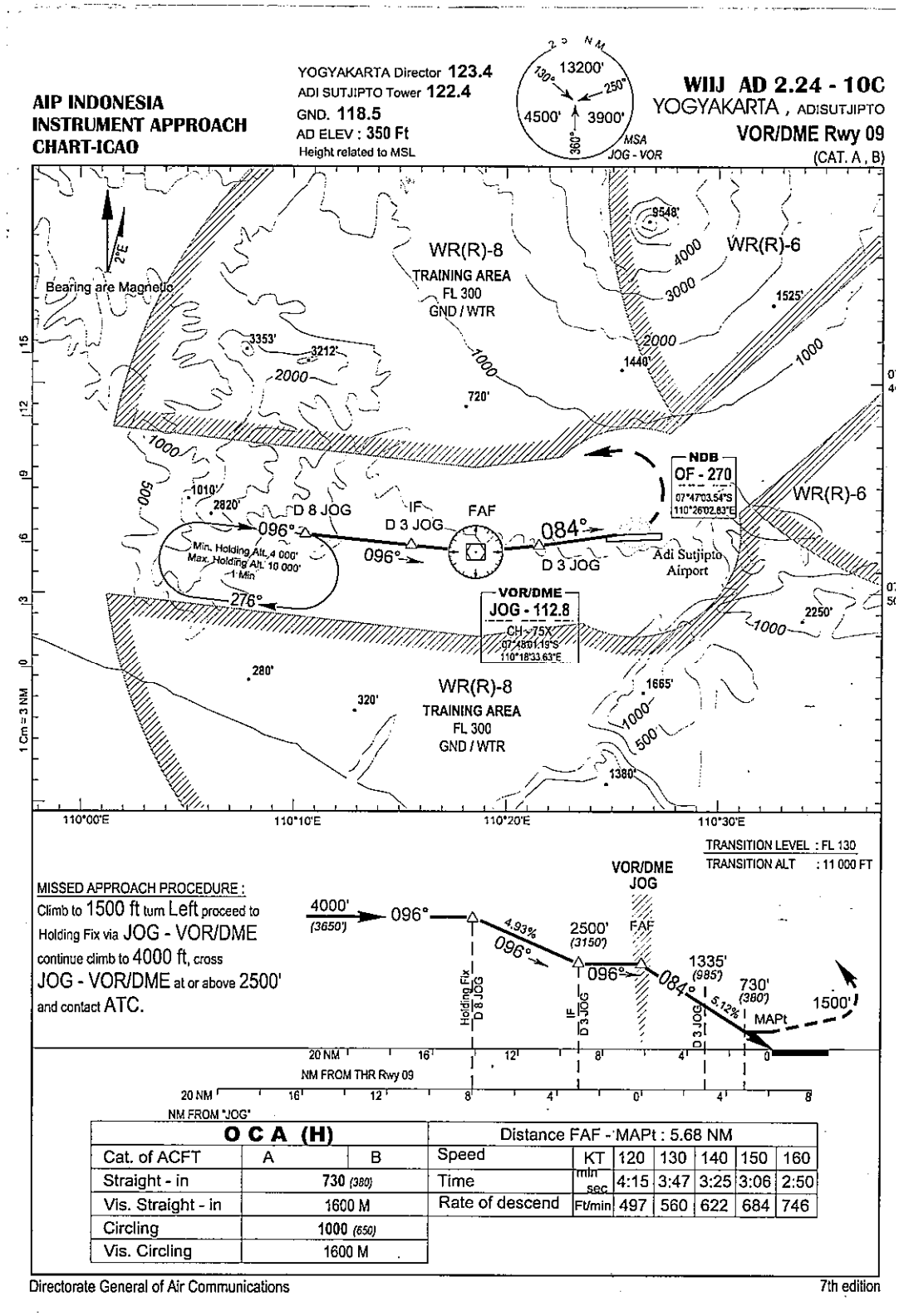
1.8 Aids to Navigation

Runway 09 Yogyakarta equipped with Instrument Landing System (ILS), at the day of the occurrence the ILS was being upgraded and should not be used as stated in the *NOTAM* (Notification to Airmen). The instrument approach procedure used VOR/DME approach runway 09.

The JOG VOR performed in good condition and not relevant to this serious incident.

1.9 Communications

All communication between ATS and the crew were recorded by ground-based automatic voice recording equipment for the duration of the flight. The quality of the ground-base automatic voice recording and the aircraft transmission was good. There was no radio communication considered to be relevant to this accident.



OCA (H)		
Cat. of ACFT	A	B
Straight - in	730 (380)	
Vis. Straight - in	1600 M	
Circling	1000 (650)	
Vis. Circling	1600 M	

Speed	KT	120	130	140	150	160
Time	min sec	4:15	3:47	3:25	3:06	2:50
Rate of descend	Ft/min	497	560	622	684	746

Figure 4: VOR/DME approach runway 09 Yogyakarta

1.10 Aerodrome Information

Airport Name	:	Adisutjipto International Airport
Airport Identification	:	WARJ
Coordinates	:	07° 47’12” S 110°25’55”E
Elevation	:	350 feet
Airport Operator	:	PT. Angkasa Pura I (Persero)
Class	:	1B
Runway Direction	:	09 /27
Runway Length	:	2,200 meters
Runway Width	:	45 meters
Surface	:	Asphalt

1.11 Flight Recorders

The aircraft was equipped with a Solid State Flight Data Recorder (SSFDR) and a Solid State Cockpit Voice Recorder (SSCVR).

Solid State Flight Data Recorder (SSFDR)

Manufacturer	:	Honeywell
Serial Number	:	1545
Part Number	:	980-4700-001

Solid State Cockpit Voice Recorder (SSCVR)

Manufacturer	:	Allied Signal
Serial Number	:	0918
Part Number	:	980-6800-001

Both recorders were recovered from the accident site and delivered to NTSC facility and were successfully downloaded.

The FDR contain of 470 parameters in the last 26 flight hours in good quality, including the accident flight.

1.11.1 The significant data retrieved from the FDR on approach and landing

During the final approach and landing, the FDR recorded as follows:

- The aircraft was at heading greater than 090 after started to descend left 2500 ft;
- At below 1000 ft, the aircraft heading was relatively constant;
- The rate of descend recorded vary and up to 1920 ft per minute and below 500 ft AGL, the rate of descend recorded up to 2040 ft per minute.
- The aircraft touched down at 10.12 UTC at speed 156 Kt before it bounced.
- The left and right engines indications were relatively equal during the approach phase. After landing, the N1 value increased then decreased to idle value and increased until the aircraft about to stop.
- The ground spoilers were extended, immediately after landing.
- The flap extended to 40 after the aircraft touch down.
- The brake pressures were relatively at maximum pressure from few moments after touch down until the aircraft stop.

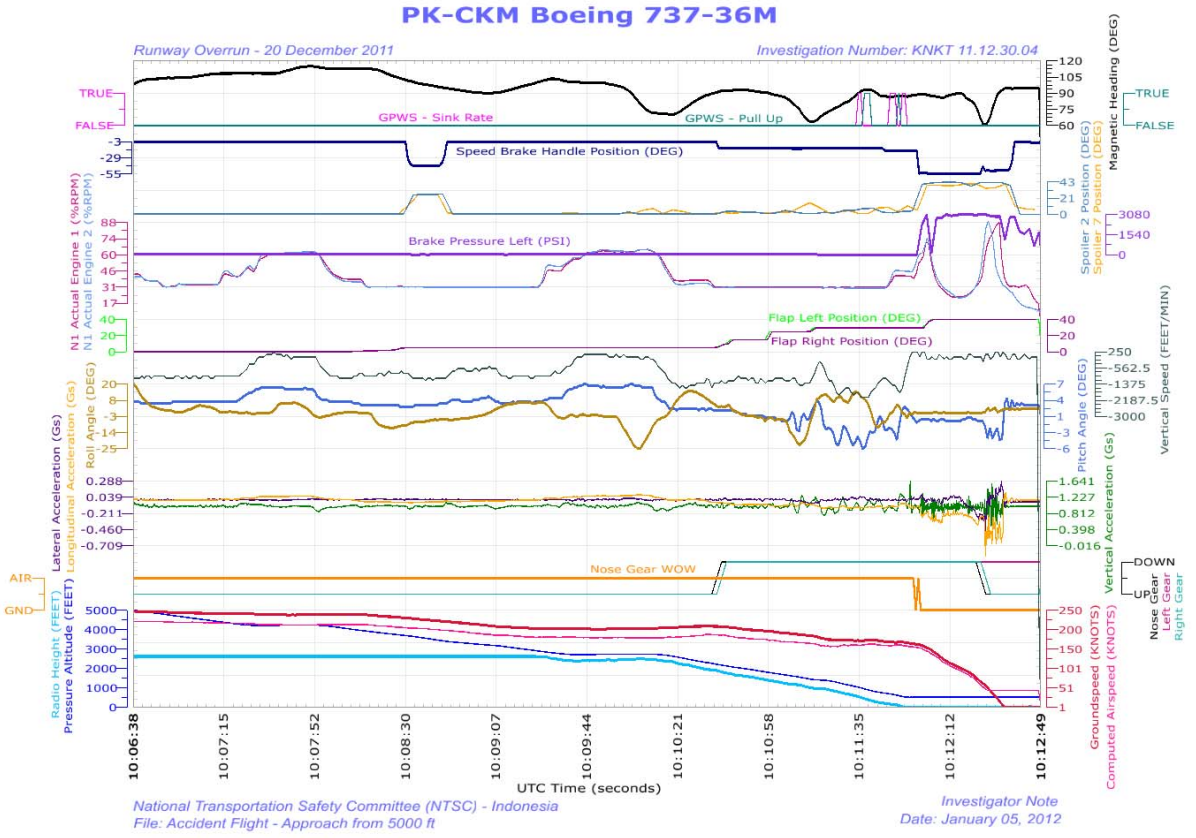


Figure **5**: The FDR data plot on approach started from altitude 5000 ft.

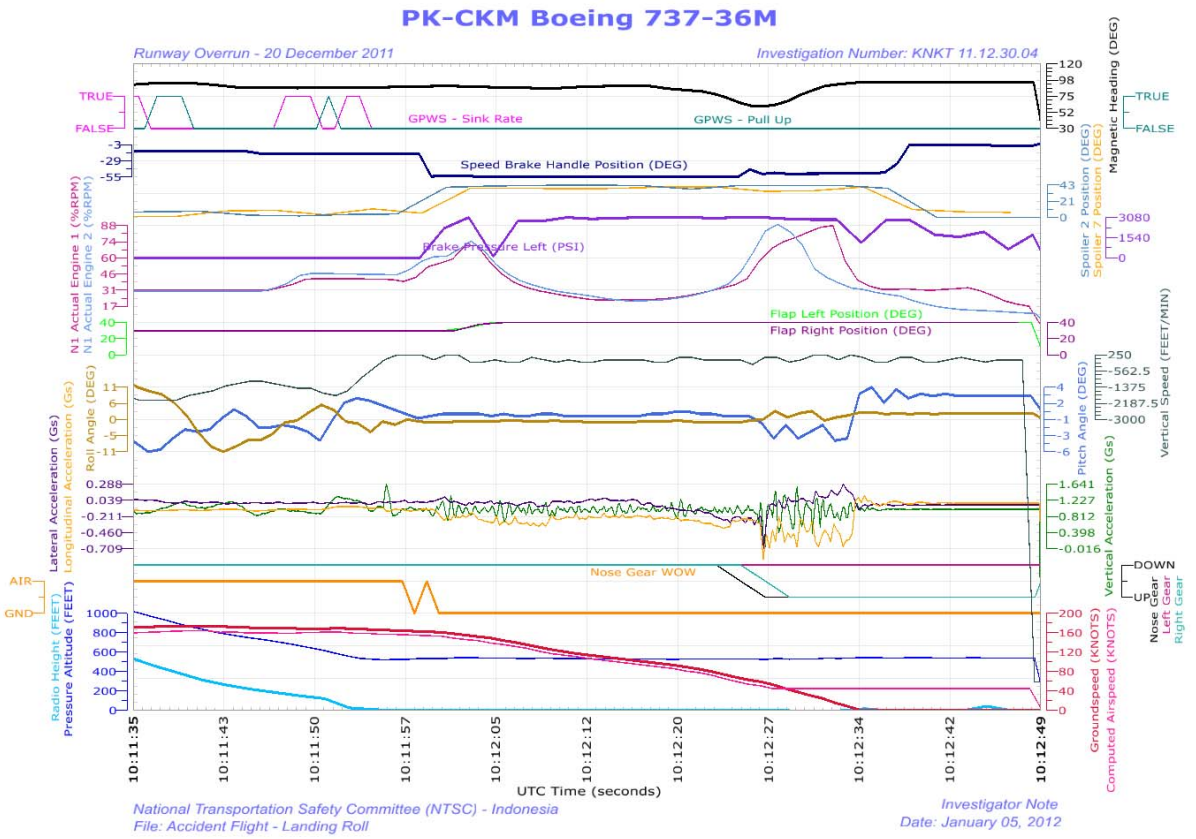


Figure 6: FDR data plot started from altitude 1000 feet.

1.11.2 The significant excerpt from the CVR

The CVR contained 30 minutes high quality recording, started while the aircraft commenced to descend until the end of the flight. Some important data of the CVR are as follows:

- There was no checklist reading and crew briefing recorded;
- There was a discussion between the pilots related to the approach pattern of VOR/DME approach runway 09 especially to the inbound course and altitude to be flown at certain part of the approach;
- The PF asked the position of the aircraft (how many miles are we now?);
- The autopilot and auto-throttle were disengaged immediately after a call runway insight.
- Runway was insight prior to EGPWS called ‘ONE THOUSAND’.
- There was GPWS warning ‘sink rate’ continue with ‘pull up’ (two times) at 500 ft;
- After GPWS call ‘two hundred’, the GPWS warning ‘sink rate’ reappear two times, followed by warning ‘pull up’ and ‘sink rate’ two times. These warning were end prior to GPWS call ‘ten’.

1.12 Wreckage and Impact Information

The aircraft stopped at left side of runway.

Aircraft tail position was 75 meters from the end of runway and 54 meters left side of runway centreline.

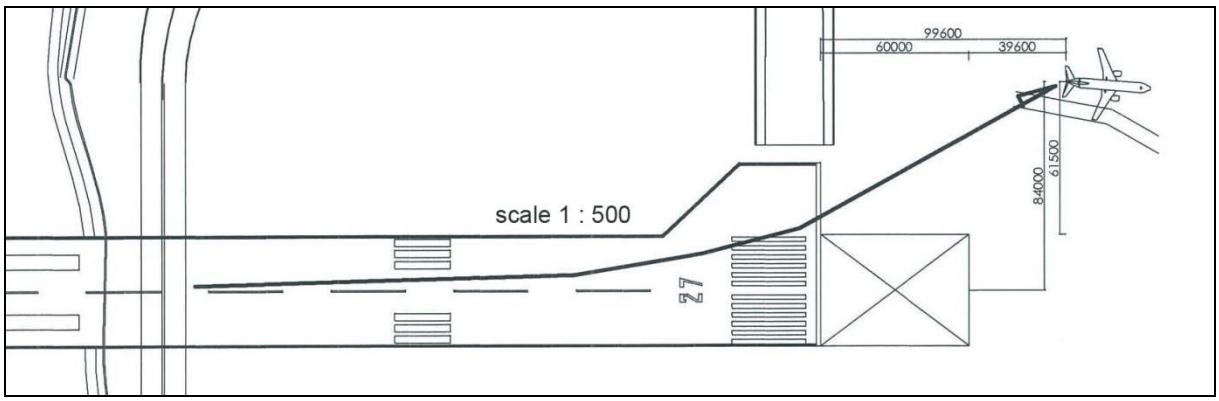


Figure 7: Location (source from AP I)

Figure 8: Aircraft final position

During the investigation it was found on the left writing pad holder found 3 pages of approach chart. The top page was ILS Approach runway 10 Surabaya, second page was ILS approach runway 09 Yogyakarta and the VOR/DME runway 09 on the other side of the page (face down) and the bottom page was Standard Arrival (STAR) runway 09 Yogyakarta.

Figure 9: Approach charts on the PIC pad folder.

The Radio Magnetic Indicator (RMI) of the left pilot found that both pointers were set to Automatic Direction Finding (ADF).

The left course indicator was set at 091 and the right course indicator was at 084.

The battery switch was on OFF position with guard open.

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 indication of pre or post impact fire.

1.15 Survival Aspects

All forward door escape slide (2 escapes slides) were inflated normally. The 2 aft escape slides were not inflated by the flight attendant due to too close to the ground. Most of the passenger evacuated through forward escape slides. The passenger on the stretcher evacuated from the aircraft assisted by ground rescue.

Six passengers were reported suffer minor injury.

1.16 Tests and Research

There was no test or research conducting as result of this accident.

1.17 Organisational and Management Information

Aircraft Owner	:	AFT Trust – SUB I
Address	:	Wilmington Trust Company, 1100 North Market Street, Rodney Square, N. Wilmington, Delaware 19890 USA
Aircraft Operator	:	PT. Sriwijaya Air
Address	:	Jalan Pangeran Jayakarta No. 68 C 15-16, Mangga Dua Selatan, Jakarta Republic of Indonesia
Operator Certificate Number	:	AOC 121/035

1.18 Additional Information

1.18.1 Stabilized Approach Criteria

Flight Crew Training Manual (FCTM) of the Boeing B 737 (revision July 29, 2011) page 5.4.

Recommended Elements of a Stabilized Approach

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

- *the aircraft is on the correct flight path*
- *only small changes in heading and pitch are required to maintain the correct flight path*
- *the aircraft speed is not more than VREF +20 knots indicated airspeed and not less than VREF*
- *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*
- *power setting is appropriate for the aircraft configuration*
- *all briefing and checklist have been conducted.*

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

- *ILS approach should be flown within one dot of the glide slope and localizer, or within the expanded localizer scale (as installed)*
- *During a circling approach, wings should be level on final when the aircraft 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 un-stabilized below 1,000 feet AFE in IMC or below 500 feet AFE in VMC requires an immediate go-around.

1.18.2 FCOM on subject: flight control

Flap Load Relief

A flap load limiter provides a TE flap load relief which protect the flaps from excessive air loads. This function is operative at the flaps 40 position only. The FLAP lever does not move, but the flap position indicator displays flap retraction and re-extension and some airplanes a FLAP LOAD RELIEF light illuminates.

When the flaps are set at 40 the TE flaps:

- *Retract to 30 if airspeed exceeds 162 knots for the 737-400, 158 knots for the 737-300*
- *Re-extend when airspeed is reduced to 157 knots for the 737-400, 153 knots for the 737-300.*

1.18.3 Company Operation Manual (COM)

3.47 ENHANCED GROUND PROXIMITY WARNING SYSTEM (EGPWS)

If EGPWS instructions are received, the pilot flying will react appropriately to those instructions without delay (i.e. "Whoop Pull Up" at night or under IMC will require an immediate maximum rate climb to safe altitude).

1.18.4 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.

1.19 Useful or Effective Investigation Techniques

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

2 ANALYSIS

2.1 Situations at the final segment of the flight

During the final approach, the aircraft was on heading around 090° until approaching 1000 ft. After a call runway insight, there was a roll up to 25 degree to the left and the aircraft maintained heading approximately 070° for few moments. While below 1000 ft, the aircraft heading was relative constant on 090°.

The VOR/DME approach runway 09 procedure stated that after passed over head the VOR at 2500 ft, the inbound course was 084°.

The FDR indicated that after passed the VOR the flight profile was maintain on around 090° heading. This has made the aircraft flew on the right side of the approach profile. After the runway insight at slightly above 1000 ft, the pilot tried to correct the flight path by manual flight with roll angle up to 25°.

After passed 1000 ft, the CVR recorded GPWS warning ‘sink rate’. Furthermore, while below 500 ft the GPWS warning ‘sink rate’ was activated twice followed by ‘pull up’. At below 200 ft GPWS warning ‘sink rate’ reappeared twice and immediately followed by GPWS announced ‘ten’. At this phase of flight, the FDR recorded the rate of descend up to 2040 ft per minute.

This profile indicated that the aircraft was higher than the required profile. The pilot tried to correct the profile by increasing the rate of descend. This manoeuvre has a consequence of increase in aircraft speed.

These situations indicated that the aircraft was not on profile for approach related to the path (direction) and profile (altitude) compare to the VOR DME approach procedure for runway 09 Yogyakarta. This might due to that the PF did not perform approach briefing and was not ready with the approach page on the writing pad for review.

The aircraft touched down and bounced at speed 156 Kt, instead of 138 Kt target landing speed.

On the final phase up to short final, the engine power was on idle. Prior to touch down the small amount of engine power increment were recorded. After touchdown, the FDR recorded the N1 of left and right engines increased up to 70% and 74% and then decreasing to 23% and 22% respectively. Just prior to aircraft stop, the N1 increased up to 87% and 88%.

The increasing of N1 indicated that the engine power increased for reverser. The value of 23% and 22% were indication of idle power. The investigation could not reveal the decreasing of engine power. There was no engines problem reported. This could be the reason of the crew did not feel aircraft deceleration. The value of N1 increased prior to aircraft stop. This was the pilot action to stop the aircraft.

The ground spoilers were extended immediately after touchdown and the brake pressures were relatively constant at maximum pressure. The spoiler and auto brake were automatically operated by aircraft system after the aircraft touchdown.

The flap extended to 40 after touchdown.

Boeing 737-300 flap systems are equipped with load relieve system. This system is design to prevent the flap become detaches due to high load as the effect of air flow. The system will prevent the flap to extend to position 40 while the aircraft speed is greater than 158Kts.

The extend flap to 40 after touchdown indicated that the flap lever has been selected to 40 position however, the aircraft speed was greater than 158 KIAS. This activated the load relieve system. After touch down while the aircraft decreased lower than 158 Kt, the system has released and the flap could extend to 40.

These situation indicated that the approach was not meet the 9 criteria of stabilize approach according to the Flight Safety Foundation as stated in the Boeing Flight Crew Training Manual (FCTM). The aircraft speed was 20 Kt above the target. The aircraft path was deviate and higher from the published approach path. The pilot corrected the final track and approach path by lower the aircraft nose down and rate of descend up to 2040 ft per minute. However, this action has resulted in high aircraft speed.

2.2 Cockpit Discipline

The CVR revealed that there was conversation between the pilots related to the approach path and altitude at certain point of the flight. The CVR also recorded that the PIC asked the aircraft position.

The CVR did not record any crew briefing and checklist reading.

The investigation found that the VOR/DME runway 09 was not ready to use on the PIC writing pad holder. The available approach chart was the ILS Approach runway 10 Surabaya. It also found that both pointers of the Radio Magnetic Indicator (RMI) on the left pilot were set to Automatic Direction Finding (ADF).

Missing the crew briefing and no approach chart available might have made the PF not familiar with the VOR/DME runway 09 approach path.

The autopilot and auto-throttle were disengaged immediately after a call runway insight. The PF made correction of the final track and glide. The FDR also recorded that the aircraft maintained heading approximately 070 for few moments and the rate of descend was up to 2040 ft per minute. This indicated that aircraft position was away from the final track and altitude.

After passed 1000 ft, the CVR recorded GPWS warning ‘sink rate’. Furthermore, while below 500 ft the GPWS warning ‘sink rate’ was activated twice followed by ‘pull up’. At below 200 ft GPWS warning ‘sink rate’ reappeared twice and immediately followed by GPWS announced ‘ten’. At this phase of flight, the FDR recorded the rate of descend up to 2040 ft per minute.

The operator company operation manual (COM) stated that:

> *If EGPWS instructions are received, the pilot flying will react appropriately to those instructions without delay (i.e. "Whoop Pull Up" at night or under IMC will require an immediate maximum rate climb to safe altitude).*

According to the COM, the pilot should react to the initial GPWS warning while below 1000 ft and furthermore below 500 ft. In fact the pilot ignored the GPWS warning and the warning continued until below 200 ft.

According to the descriptions above, the procedures were not well implemented.

2.3 Human Factors

The VOR/DME runway 09 approach procedure stated that after holding pattern to the VOR, the course was 096 and after passing the VOR, the course changed to 084. The target altitude over the VOR is 2500 ft.

The FDR recorded that the aircraft was at heading greater than 090 after started to descend from 2500 ft. It can be concluded that after passed the VOR, the aircraft was maintain heading instead of altered to 084.

The left course indicator was set at 091 and the right course indicator was at 084.

This could be as the result of the pilot did not familiar with the VOR DME runway 09 approach procedure due to no approach briefing and positioning of the approach chart which was not easily accessible.

These situations are the symptoms of fixation which is one of the critical elements of the situational awareness.

After the call "runway insight" at approximately 1200 ft, the pilot saw the VASI light indicated all four white.

- The pilot immediately disengaged the autopilot and auto throttle, and fly manually to align the final course.
- The FDR recorded 25 degrees roll and rate of descend up to 2000 ft/minute.

Refer to these data can be assumed that the pilot realized that the approach was not meet the VOR DME approach profile.

- The CVR recorded EGPWS warning of "sink rate" and "pull up".
- Aircraft touch down at speed 156 Kt.
- The flap travelled to 40 degrees after touchdown as the function of flap load limiter system.

The pilot kept on landing while the approach was not in the stabilize approach criteria. This symptom is an indication of complacency, which is one of the critical elements of the situational awareness.

There was a passenger expressed his disappointment of the pilot decision to divert to Surabaya. This event was suspected to affect the pilot decision.

Within the preceding six months, the PIC has flight hours more than 100 hours every month. This condition may lead to pilot fatigue.

Fatigue is result of workload induce (number of landing and transit, long duty period), circadian rhythm disruption, and inadequate rest. Fatigue affects degradation on overall performance.

2.4 Crew Resources Management (CRM)

During the approach while passing JOG VOR, the approach controller instructed to reduce aircraft speed. However, the aircraft speed was increasing.

At approximately the 1500 ft the FDR recorded flap selected to 40 however, the flap stopped at 30 as function of flap load limiter, this indicated that the selection was performed at speed greater than 157 Kt. In this case, PM should checked the flap speed limitation and called whenever exceeded.

At about 1200 ft the PM called 'runway insight'. The pilot realized that the aircraft not aligned with the runway and above the glide, with the VASI were all four lights in white. The pilot flew manually to correct the approach. The PM noticed that during the approach, the PF course indicator was set at 091 while the procedure stated the course should be at 084.

The rate of descend recorded vary and up to 1920 ft per minute and below 500 ft AGL, the rate of descend recorded up to 2040 ft per minute. Several warnings of the GPWS of 'pull up' and 'sink rate' activated. However the pilots did not react.

On short final the flight path was managed to return to the normal glide path and the PF noticed that the aircraft speed indicated approximately 158 Kt. The FDR recorded the touchdown speed was 156 Kt.

The flap extended to 40 after the aircraft touchdown.

During approach the PM did not perform standard call out nor reminded the PF of the condition of approach.

> Crew Resource Management (Boeing FCTM page 1.2).
> *……., 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……..*

The progress of the flight in the flight deck and effective communication with the controller has failed to accurately perceive due to missed of the requirements of ongoing monitoring, questioning, crosschecking, communication, and refinement of perception. This indicated by the absence to comply of the controller instruction, react to EGPWS warning, communicating missed selection of course indicator and standard callouts, also exceeding of flap limitation and approach speed.

These conditions could be concluded that the CRM was not well implemented.

3 CONCLUSIONS

3.1 Findings

1. The aircraft was airworthy prior the accident. There was no evidence that the aircraft had malfunction during the flight.
2. The crew had valid license and medical certificate. There was no evidence of crew incapacitation.
3. In this flight Pilot in Command acted as Pilot Flying and Second In command acted as Pilot Monitoring.
4. The flight crew did not conduct approach crew briefing.
5. There was no checklist reading.
6. The PIC as Pilot Flying did not have the instrument approach procedure immediately available to review during approach.
7. During the approach, the PIC course indicator was set at 091 and the SIC was at 084.
8. The rate of descend recorded vary and up to 1920 ft per minute and below 500 ft AGL the rate of descend recorded up to 2040 ft per minute.
9. The approach did not meet the stabilize approach criteria as stated in the FCOM.
10. There were several GPWS warning of ‘sink rate’ and ‘pull up’ activated during approach.
11. The aircraft touched down at speed 156 Kt before bounced, instead of 138 Kt target landing speed.
12. The flap extended to 40 after the aircraft touch down.
13. The FDR recorded reduction in N1 during thrust reverser activation after landing.
14. The CRM was not well implemented.

3.2 Factors[3]

Unsuccessful to recognize the two critical elements, namely fixation and complacency affected pilot decision to land the aircraft while the approach was not meet the criteria of stabilized approach.

3 “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

The operator has conducted the internal investigation to this accident. The investigation report has been sent to National Transport Safety Committee. In the investigation report, the operator proposed several safety actions as follows:

Operations Directorate to:

To review and remind on the following subjects:

1. *Standard Operating Procedures:*
   - ➥ *Crew Resources Management (CRM);*
   - ➥ *New Boeing Procedure;*
   - ➥ *Standard Callout; etc*

2. *Approach and Landing Accident Reduction (ALAR)➡ Stabilized approach and CANPA (Constant Angle Non Precision Approach)*

3. *Line Orientation Flight Training (LOFT) and Proficiency pilot Check (PPC) highlight related to the seasons, factual environments and Safety Recommendation.*

To conduct mandatory training:

- ➥ *Line Check*
- ➥ *Ground Recurrent*

5 RECOMMENDATIONS

The examination on the factual data and the associate findings which might have contributed to this accident, that the procedures and CRM were not well implemented. These conditions maybe exist to the other pilots.

5.1 Directorate General Civil Aviation

The National Transportation Safety Committee issued several safety recommendations to DGCA to review the DGCA's quality system in controlling the operator:

a. In conduct pilot training.

b. In monitor pilots duty to ensure acceptable fatigue level.

5.2 PT. Sriwijaya Air

The National Transportation Safety Committee issued several safety recommendations to Sriwijaya Air to:

a. To ensure pilot compliances to the procedures and CRM as such during Line Operation Safety Audit (LOSA), line check and proficiency check.

b. To monitor the pilots duty to ensure acceptable fatigue level.

c. The investigation had examined the safety actions issued by the operator and considered relevant, however, the NTSC recommends that the safety actions should be systematic and focused to overcome safety issues as describe in chapter 2 of this report and oversight periodically by the Safety Department.