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**NATIONAL
TRANSPORTATION
SAFETY
COMMITTEE**

Aircraft Serious Incident Investigation Report

Yayasan Jasa Aviasi Indonesia (YAJASI)

Pilatus Porter PC-6 ; PK-UCJ

Wamena Airport, Wamena, Papua

Republic of Indonesia

17 January 2013



**NATIONAL TRANSPORTATION SAFETY COMMITTEE
MINISTRY OF TRANSPORTATION
REPUBLIC OF INDONESIA
2014**

This Final Report was produced by the National Transportation Safety Committee (NTSC), 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 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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ABBREVIATIONS AND DEFINITIONS

AD	:	Airworthiness Directive
AFM	:	Airplane Flight Manual
AGL	:	Above Ground Level
ALAR	:	Approach-and-Landing Accident Reduction
AMSL	:	Above Mean Sea Level
AOC	:	Air Operator Certificate
ATC	:	Air Traffic Control
BMKG	:	<i>Badan Meteorologi Klimatologi dan Geofisika</i> / Indonesia Agency Meteorology Climatology & Geophysics
BOM	:	Basic Operation Manual
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
DGCA	:	Directorate General Civil Aviation
EFIS	:	Electronic Flight Instrument System
ICAO	:	International Civil Aviation Organization
IFR	:	Instrument Flight Rules
ILS	:	Instrument Landing System
MTOW	:	Maximum Take-off Weight
Nm	:	Nautical mile(s)
KNKT / NTSC	:	<i>Komite Nasional Keselamatan Transportasi</i> / National Transportation Safety Committee
QFE	:	Height above airport elevation (or runway threshold elevation) based on local station pressure
QNH	:	Altitude above mean sea level based on local station pressure
TT/TD	:	Ambient Temperature/Dew Point
UTC	:	Universal Time Coordinate
VFR	:	Visual Flight Rules
VMC	:	Visual Meteorological Conditions

INTRODUCTION

SYNOPSIS

On 17 January 2013, a Pilatus Porter PC-6/B2-H4 aircraft, registered PK-UCJ, was being operated by Yayasan Jasa Aviiasi Indonesia (YAJASI) has experience landing excursion. The aircraft operation was as a non-schedule cargo flight.

The aircraft departed from Sentani Airport, Jayapura, Papua to Wamena Airport, Wamena, Papua at 06:54 LT (21:54 UTC on 16 January 2013).

The person onboard were two pilots; on the left side pilot under training as a pilot flying act as second in command (SIC) and on the right side as an instructor and pilot monitoring act as Pilot in Command (PIC).

During flight from Sentani to Wamena, the aircraft was normal, no indication of any malfunction.

The Wamena weather on was VMC, wind calm, runway slippery due to water and rubber deposit contaminated; the raining was stopped 20 minutes before the occurrence.

The aircraft was touchdown on runway 15 at 0801 LT (23:01 on the center line, and then the pilot flying applied reverse. During reverse, the aircraft veer off to the right and the pilot flying tried to recover by pushing left rudder followed by the application left brake, but no response and the aircraft continues veer to the right.

Just before out of the runway the SIC apply full reverse, the PIC instructed to add the power aimed to make the rudder effectiveness and then took over the controls. The PIC adds the power control lever forward try to straight the aircraft.

At approximately 157 meters from first touchdown the aircraft was out of right runway and continue rolling over the runway shoulder, approximate 15 meters parallel to the runway.

The aircraft hit taxiway marking Alpha, caused the horizontal stabilizer, left wing tip and left aileron detached from the wing. The aircraft become airborne again at a distance of 315 meters from touchdown and continues rolling until approximately 408 meters from the first touchdown the aircraft entered the runway again, and then the aircraft taxied to the Yajasi apron and parked.

No person on board injured and the aircraft had major damaged.

The analysis part of this report discussed all the relevant issues related to aircraft veer off to the right of runway. Because of the aircraft was not equipped with a Flight Data Recorder or Cockpit Voice Recorder hence, the method of investigation used the combination of related assumptions and associate aerodynamic theories.

The investigation concluded the contributing factors are as follows:

- There was no approach and landing briefing which was considering to the effect of reverse power on wet runway condition.
- The pilot flying applied full left rudder followed by left brake had reduced the capability of the tires to corner, in combination with the slippery generated much more cornering (lateral) force and the aircraft might more skid accelerating right.

- The decision to take over the control by the PIC at a slippery runway was not at the right time, speed and space to absorb the side force occurred at that critical phase.

At the time of issuing this Final Investigation Report, the National Transportation Safety Committee had been informed of any safety actions resulting from this occurrence.

Considering to the findings and the contributing factors as result from the investigation, The NTSC issued several safety recommendations addressed to: PT Yayasan Jasa Aviasi Indonesia (YAJASI) and Director General of Civil Aviation.

1 FACTUAL INFORMATION

1.1 History of the Flight

On 17 January 2013, a Pilatus Porter PC-6/B2-H4 aircraft, registered PK-UCJ, was being operated by Yayasan Jasa Aviiasi Indonesia (YAJASI)¹ as a non-schedule cargo flight under Visual Flight Rule (VFR).

The aircraft departed from Sentani Airport, Jayapura, Papua² to Wamena Airport, Papua³ at 06:54 LT (21:54 UTC⁴).

The persons on board were two pilots. The Second in Command (SIC) was under training occupied the left pilot seat and acted as a Pilot Flying. And the Pilot in Command (PIC) was the instructor occupied the right pilot seat acted as Pilot Monitoring.

During flight from Sentani to Wamena until commenced to approach was normal and no indication of any system malfunctions.

The weather on Wamena was Visual Meteorological Condition (VMC), and the wind was calm. The rain stopped 20 minutes prior to the occurrence and the runway was slippery due to water and rubber deposit contamination.

The aircraft touched down on runway 15 at 0801 LT (2301 UTC) on the centerline, and then the pilot applied reverse. During application of the reverse, the aircraft veered off to the right and the pilot tried to recover by pushing the left rudder followed by the application of the left brake, and the aircraft continued veered to the right.

Before out of the runway the SIC applied full reverse and the PIC instructed to advance the power in order to increase the rudder effectiveness. The PIC took over the controls and tried to recover by advancing the power lever forward.

At approximately 157 meters from first touchdown the aircraft veered off to the right of the runway and continued rolling over the runway shoulder, approximate 15 meters align to the runway.

The aircraft hit taxiway Alpha marking board, and airborne again at a distance of 315 meters from touchdown and continues rolling until approximately 408 meters from the first touchdown. The aircraft re-entered the runway and taxied. The damage found were the horizontal stabilizer, left wing tip and left aileron detached from the wing. The aircraft has been taxied with those damage conditions and parked at the Yajasi apron.

No person on board injured.

¹ Yayasan Jasa Aviiasi Indonesia is referred to as Yajasi on this report.

² Sentani Airport (WAJJ/DJJ), Sentani, Papua is referred to as 'Jayapura' in this report

³ Wamena Airport (WAJW/WMX), Wamena, Papua is referred to as 'Wamena' in this report

⁴ The 24-hour clock in Universal Time Coordinate (UTC) is used in this report to describe the local time as specific events occurred. Indonesia Eastern Standard Time (*Waktu Indonesia Timur* / WIT) is UTC +9 hours

Diagram Landing Accident PK-UCJ 17 January 2013 Wamena (WAJW)

Photo From Google Maps Jan 18 2013
Imagery date 12/20/2010
(digital globe, geo eyes, tele atlas)

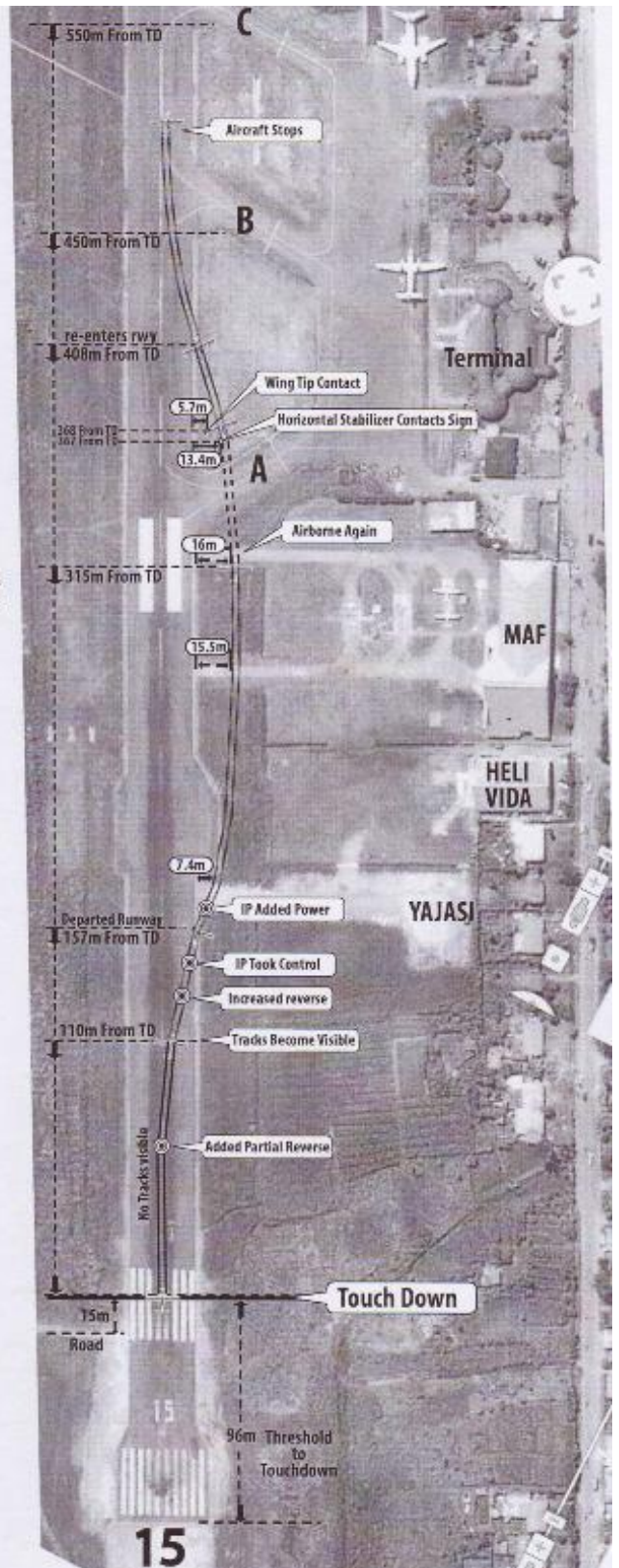


Figure 1: Schematic diagram landing accident PK-UCJ on 17 January 2013

Base on the Chief pilot report there was no approach and landing crew briefing to consider to the effect of reverse power on wet runway condition.

1.2 Injuries to persons

Injuries	Flight crew	Passengers	Total in Aircraft	Others
Fatal	0	0	0	0
Serious	0	0	0	0
Minor	0	0	0	0
None	2	0	2	0
TOTAL	2	0	2	0

1.3 Damage to aircraft

The aircraft was minor damaged.

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

The PIC was American and held valid Commercial Pilot License (CPL) and medical certificate class 1 valid until 13 March 2013. The pilot has total flight hour of 4,230 hours, and has performed 74 hours 18 minutes in the last 60 days. The last proficiency check was performed on 27 July 2012 and the last line check was 8 October 2012.

1.5.2 Second in Command

The SIC was Indonesian and held valid Commercial Pilot License (CPL) and medical certificate class 1 valid until 13 March 2013. The pilot has total flight hour 1,780 hours, and has performed 3 hours 42 minutes in the last 60 days. The last proficiency check was performed on 24 October 2012 and the last line check 15 January 2013.

1.6 Aircraft information

1.6.1 General

The aircraft PC6 B2 / H4 was manufactured in Switzerland and had total of 788 hours 54 minutes flight hours since manufactured. The aircraft has valid C of A & C of R and there was no system malfunction recorded or reported.

1.6.2 Engine data

The engine Model PT6A-27 was manufactured by Pratt & Whitney Canada Serial number PCE-PG0339, with the total time since new of 788 hours 54 minutes and total cycles since new of 1,853 cycles.

1.6.3 Propeller data

The propeller model HC-B3TN-3D manufactured by Hartzell USA, serial number BUA 29775, total time since new 3,552 hours 18 minutes. The propeller rotation is clockwise as viewed from the cockpit.

1.6.4 Weight & Balance

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

1.7 Meteorological information

Not relevant to this serious incident.

1.8 Aids to Navigation

Not relevant to this serious incident.

1.9 Communications

Not relevant to this serious incident.

1.10 Aerodrome information

The Wamena Airport operates by Directorate General of Civil Aviation with elevation of 5084 feet and surrounded by mountainous area. The Runway was 1,650 meters length and 30 meters width.

The rubber deposit about half of the runway from the beginning of the threshold runway 15 was observed.

Most of the landing aircrafts were from runway 15 and take-off from runway 33, it was due to the mountainous area surrounding the final area of runway 33.



Figure 2: Surface condition on runway 33

1.11 Flight recorders

The aircraft was not equipped with a Flight Data Recorder or Cockpit Voice Recorder. Neither recorder was required by current Indonesian civil aviation regulations.

1.12 Wreckage and impact information

The aircraft damage assessment after the accident identified also substantial damage to the left wing as a result of the wing touching the ground and fuselage was also damaged in several areas.

Damaged to the aircraft were as follows:

- a. Left horizontal and left elevator broken;
- b. Left wing damage and Aileron detached;
- c. Right rear fuselage deformed;
- d. Right windshield cracked and the fairing deformed.



Figure 3: Left horizontal stabilizer



Figure 4: Left wing aileron



Figure 5: Windshield crack (red circle)

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 pre or post impact fire.

1.15 Survival Aspects

Not relevant to this serious incident.

1.16 Tests and Research

Apart from fuel testing, no other tests or research were required to be conducted as a result of this occurrence.

1.17 Organizational and Management Information

1.17.1 General

Aircraft Owner : Yayasan Jasa Aviasi Indonesia (YAJASI)
Address : Jl. PLN Airport Sentani, Jayapura
P.O BOX. 1800, Jayapura
AOC Number : AOC 91/500

1.17.2 Operator Manuals

YAJASI Operation Manual chapter 2.3.7 and 9.3.10

2.3.7 Duties and Responsibilities of Crew Members Other Than the PIC

2.3.7.1 Second-in-Command (SIC)

- a. When a Second-in-Command (SIC) is assigned to a flight*
- i. The SIC shall assist the PIC in the management of the flight and flying the aircraft in accordance with the directions of the PIC Duties Accountabilities and Qualifications For the Positions of Operations Management and Flight Department Personnel*
- ii. The SIC may carry out take-offs and landings under the authority of the PIC and shall take over control in the event of PIC incapacitation*

9.3.10 Landing In Precipitation

9.3.10.1 Landing with precipitation on the windshield shall not be commenced unless specifically approved for landing in precipitation in the Hazards and Remarks section of the YAJASI Runway Charts

1.18 Additional Information

Newton's First Law:

Every object persists in its state of rest or uniform motion in a straight line unless it is compelled to change that by forces impressed on it.

1.19 Useful or Effective Investigation Techniques

The investigation was 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

The analysis part of this Final Report will discuss the relevant issues resulting in the runway excursion involving a Pilatus Porter PC-6 aircraft, PK-UCJ during the landing at Wamena airport on 17 January 2013.

The investigation determined that there were no issues with the aircraft and all systems were operating normally. The analysis will therefore focus on the following issues:

- Flight technique
- Decision Making at a Critical Phase

The analysis part of this report will discuss the relevant issues to aircraft veer off to the right of runway 15 on 17 January 2013.

The aircraft was not equipped with a Flight Data Recorder or Cockpit Voice Recorder hence, the method of investigation used the combination of related assumptions and associate aerodynamic theories. The analysis will therefore focus on:

- Flight technique.
- Decision Making at a Critical Phase.

2.1 Flight Technique

The aircraft was touchdown on the centerline and rolled for few meters, and then the pilot flying applied the reverse power. Thereafter the aircraft veered off to the right and traveled parallel with the runway.

When the aircraft landed at Wamena Airport, the weather was VMC, wind calm and the runway slippery due to water and rubber deposit contamination on the touch down area runway 15.

Examinations of the side force energy and several sequence of events until the aircraft traveled parallel with the runway found that:

- When reverse being applied the aircraft start veer off to the right. It most likely that, this was due to the yawing moments produced by the propeller are mainly caused by the spiralling slipstream striking the fuselage aft of the Centre of Gravity (CG), and the other half is from the slipstream striking the vertical stabilizer.

The reaction to these moments yawed the lateral axis of the aircraft to the left (propellers rotates anti-clockwise as viewed from the rear) because of the asymmetry reverses thrust being produced, the left side of the aircraft (down going blade) is about twice as much as the up going blade on the left side (Figure 2-30). In fact, the aircraft move to the right of the runway.

- The pilot then applied full left rudder followed by left brake. As the aircraft starts to skid, the reverse thrust side force component adds to the skid inertia and will drift the aircraft to the side of the runway. High braking force reduces the capability of the tires to corner. In combination with the slippery runway the

cornering (lateral) force on the tire to resist the sideways sliding motion would be greater. The combination of reverse thrust, brake and slippery runway, and the aircraft might more skids accelerating right.

- The PIC instructed to advance the power in order to increase the rudder effectiveness. The PIC took over the controls recovered by advancing the power lever forward. Advancing the power has changed the reverse thrust of the propeller to forward thrust. The right yaw moment has reduced. This action was correct action according to the cornering technique (see Appendices 6.2) and this was consistent with the aforesaid cornering technique and it indicated that the aircraft had travelled parallel with the runway before pilot re-entered the aircraft to runway.

Collecting of this aforesaid sequence of particular events and conditions, the investigation conclude several most probability energy that caused the aircraft move left after touch down are as follow;

1. It might possible that there was a possibility of an asymmetry wheel skid friction coefficient between right (greater) and left wheels when traveling over the rubber deposit and slippery area.
2. It might possible that the aircraft was coming in unaligned direction with the runway e.g. the track tended to the right of runway prior to touch down resulted (refers to Newton's First law) the aircraft veer off to the right of runway. Applying reverse power, brakes either asymmetry or both by the pilots had generated more a dynamic side force effect to the right, combining with a slippery runway condition there might be much more cornering (lateral) force on the tire to resist the sideways sliding motion, and the aircraft might more skid accelerating right.

As such, an anticipation of applying left rudder in the correct speed and time in countering such side force is required. In this serious incident, it most likely that the recovery actions by the SIC in applying the one or both brakes in combination with reverse power while the aircraft veering off the runway was inconsistent with the cornering technique as in appendix.

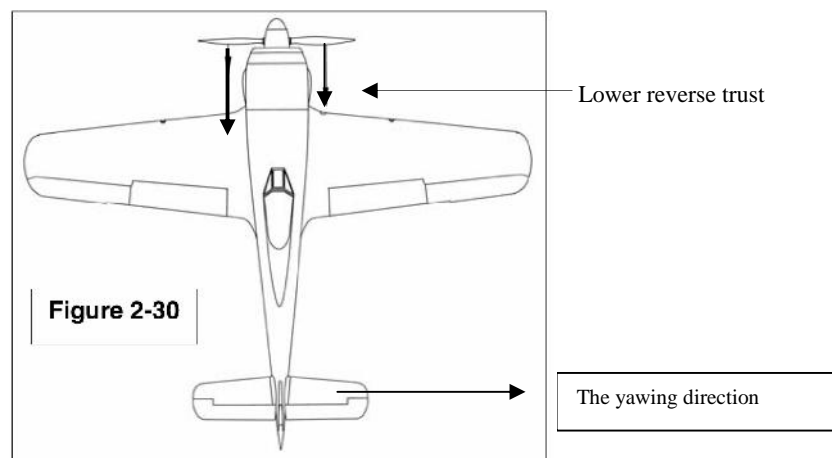


Figure 6: The reaction of the yawing moments

2.2 Decision Making at a Critical Phase

This flight was categorized as a line training since the crew composition consist of pilot under training as pilot flying seat on the left side and an instructor as pilot monitoring seat on the right side the SIC.

Since the SIC was pilot under training, it might be assumed that the knowledge, experience and skill in such of the dynamic effect was still in the minimum level.

In this serious incident, the SIC applying the reverse power that generate a dynamic side force effect to the right which should be anticipated by applying the left rudder, in this serious incident, it most likely that the application of the left rudder was not well anticipated.

The pilot flying applied full left rudder followed by left brake, as basic theory that the braking force would reduce the capability of the tires to corner, in combination with the slippery runway there might be much more cornering (lateral) force on the tire to resist the sideways sliding motion, and the aircraft might more skid accelerating right.

The PIC realized this condition it indicated by the instruction to add the power on the critical phase rather than took over the controls, few moments later the PIC took over the controls meanwhile the aircraft already about out of the runway.

Good CRM pattern is techniques that help build habit pattern on the flight deck are discussed, situational awareness and communication are stressed.

The 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.

The investigation noted that, based on the Chief pilot report there was no approach and landing crew briefing related to the runway condition. As such, it most likely that, the consequences of applying reverse power on slippery runway was not communicated and or discussed properly prior to the landing on that particular runway condition.

It can be concluded that:

- The missing of crew briefing to consider the effect of reverse power on wet runway condition might made the SIC as pilot under training, was not aware to the consequences of the dynamic side force when applying the reverse power.
- To be able to take accurate decision in speed and time the PIC shall realise that flying with a pilot under training requires more effort on ongoing monitoring, questioning, crosschecking, communication, and refinement of perception, in order to maintain a good situational awareness.

3 CONCLUSIONS

3.1 Findings

- a. The aircraft was airworthy prior to the occurrence.
- b. The Second in Command (SIC) was a pilot under training acted as Pilot Flying and Pilot in Command (PIC).occupied on the right pilot seat was an instructor and acted as Pilot Monitoring.
- c. The Wamena weather was VMC, wind calm, runway slippery due to water and rubber deposit contamination.
- d. Both pilots had valid licenses, medical certificates, proficiency check and line check.
- e. It might possible that there was a possibility of an asymmetry wheel skid friction coefficient between right (greater) and left wheels when traveling over the rubber deposit and slippery area.
- f. It might possible that the aircraft was coming in unaligned direction with the runway e.g. the track tended to the right of runway prior to touch down resulted (refers to Newton's First law) the aircraft veer off to the right of runway.
- g. Applying reverse power, brakes either asymmetry or both by the pilots had generated more a dynamic side force effect to the right, combining with a slippery runway condition there might be much more cornering (lateral) force on the tire to resist the sideways sliding motion, and the aircraft might more skid accelerating right.
- h. Base on the Chief Pilot report there was no approach and landing crew briefing which consider to the effect of reverse power on wet runway condition.
- i. During landing after reverse power was applied, the aircraft veered off to the right and the pilot flying tried to recover by pushed left rudder followed by left brake, and the aircraft continued veered to the right.
- j. Just before out of the runway the SIC applied full reverse power, the PIC instructed to advance the power in order to increase the rudder effectiveness and then took over the controls.
- k. The PIC recovered by advancing the power and resulted to aircraft travelled aligning with the runway and re-entered the runway.
- l. The basic aerodynamic theory that the braking force would reduce the capability of the tires to corner, in combination with the slippery runway there might be much more cornering (lateral) force on the tire to resist the sideways sliding motion, and the aircraft might more skid accelerating right.
- m. The decision to take over the controls at a slippery runway was not at the right speed and time, to counter the side force occurred at that critical phase.
- n. The aircraft has been taxied with damage conditions and parked at the Yajasi apron.
- o. No person on board injured and there was no evidence pre or post impact fire.

3.2 Contributing Factors⁵

1. There was no approach and landing briefing which was considering to the effect wet and slippery of reverse power on wet runway condition.
2. The pilot flying applied full left rudder followed by left brake had reduced the capability of the tires to corner, in combination with the slippery generated much more cornering (lateral) force and the aircraft might more skid accelerating right.
3. The decision to take over the control by the PIC at a slippery runway was not at the right time, speed and space to absorb the side force occurred at that critical phase.

⁵ “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 ACTION

At the time of issuing this Final Investigation Report, the National Transportation Safety Committee had received of several safety actions from the operator

4.1 Yayasan Jasa Aviasi Indonesia (YAJASI)

The National Transportation Safety Committee had received of several safety actions from Yayasan Jasa Aviasi Indonesia consisting of:

1. Ekspanded our Approach Briefing in the PC-6 type aircraft to include the following specific items that must be briefed by our flightb crews before each landing:
 - a. Surface Condition
 - b. Wind Conditions
 - c. Abort/ Missed Approach Procedures
 - d. Planned Brake Usage (based on surface conditions)
 - e. Reserve usage
 - f. Swerve Recovery Procedures

We have added each of these briefing items to our Before Landing Checklist the PC-6 type aircraft.

2. Implemented *swerve recovery* training in our initial type transition training, proficiency checks, line checks nd runway check out training.
3. Re-emphasized that for reserve usage to accomplished safely in the PC-6, runway conditions should allow for good braking conditions.
4. Reviewed and enchanced our exchange of control procedures (between Pilot Flying and Instructor Pilot).

5 SAFETY RECOMMENDATIONS

Base on the examination of the factual data and the findings that contributed to this serious incident such as;

- a) No approach and landing briefing which considering to the effect of reverse power on wet runway condition
- b) The pilot flying action to recover of skid condition.
- c) The decision to take over the control by the PIC.

As result of this investigation, the National Transportation Safety Committee issued safety recommendations addressed to:

5.1 Yayasan Jasa Aviasi Indonesia (YAJASI)

Refers to the particulars contributing factors, The National Transportation Safety Committee recommends to the Yajasi;

- a) To review and encourage the procedure and the operation department should ensure that the approach briefing should be part of the mandatory briefing items prior to land.
- b) It might extend to the other pilots that the missed conduct of cornering technique of this serious incident as such, the operation department should ensure that the correct cornering technique should be reviewed and encouraged during the flight check or in all means of training.
- c) Considering to the PIC that taxi with damage aircraft conditions without proper evaluation might endanger to the pilots, other person or properties. As such, the NTSC recommends the operation department to review the Standard Operating Procedures regarding the operation of such condition.
- d) The instructor should able to take accurate decision to recover any mistake that possibly makes by the pilot under training. As such, the NTSC recommends the operation department to review the instructor training syllabus and the teaching method.

5.2 Directorate General of Civil Aviation

- a) The rubber deposit in about half of the runway 15 at Wamena Airport might have a part of the contributing factors in this runway excursion. as such, it is strongly required that the authority has to consider a regular runway decontamination schedule, not only in Wamena Airport but it could be extended to the other airports in a regular basis.
- b) Consider to the recommendations address to PT. Yayasan Jasa Aviasi Indonesia, the National Transportation Safety Committee recommends to the DGCA has to ensure that the aforesaid recommendations are well implemented.

6 APPENDICES

6.1 Cornering Technique

The aircraft experienced skid on the slippery runway. The technique to counter this condition is states as follows:

As the aircraft starts to skid, the reverse thrust side force component adds to the skid inertia and will drift the aircraft to the side of the runway. High braking force reduces the capability of the tires to corner.

To correct back to centre line, release the brakes and reduce the reverse thrust. Release the brake increases the tire cornering capability and contributes to maintaining or regaining the directional control. Reducing the reverse thrust will reduces the reverse side force component. Use rudder pedal and/or differential braking as required to regain the centre line. Avoid over correction not to pass the runway centre line. When the directional control is regained and the aircraft is correcting toward the runway centerline, apply maximum braking and symmetrical reverse thrust to stop the aircraft. This technique will increase the required landing distance.

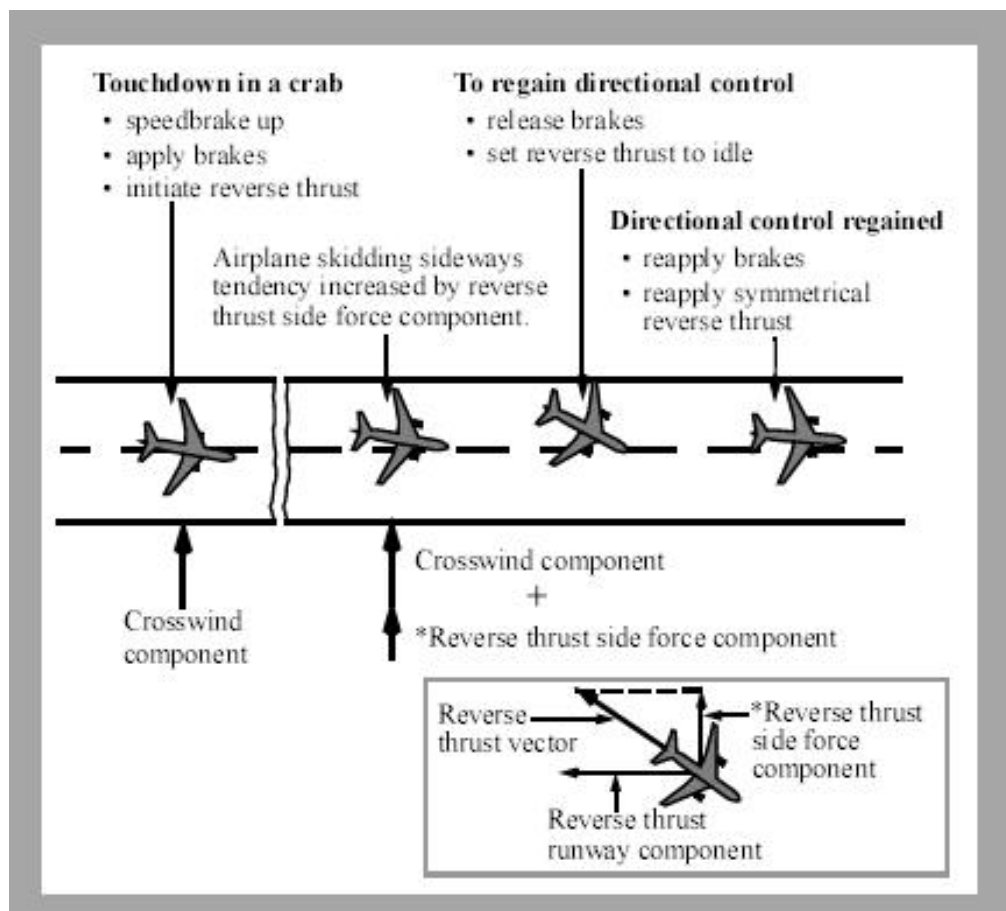


Figure 7: Recovery technique for landing on slippery runway