Taiwan Transportation Safety Board

Aviation Occurrence Investigation Final Report

13 August 2025

UPS Airlines Flight 5X61

Boeing 747-8F, N613UP

Engine Nacelle Strike during Landing

at Taiwan Taoyuan International Airport

TTSB-AOR-26-08-001

August, 2026

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According to the Transportation Occurrences Investigation Act of the Republic of China and the International Civil Aviation Organization (ICAO) Annex 13 to the Convention on International Civil Aviation, this report is only for the improvements of flight safety.

Transportation Occurrences Investigation Act of the Republic of China, Article 5：

The objective of the TTSB's investigation of major transportation occurrence is to prevent the recurrence of similar occurrences. It is not the purpose of such investigation to apportion blame or liability.

ICAO Annex 13, Chapter 3, Section 3.1：

The sole objective of the investigation of an accident or incident shall be the prevention of accidents and incidents. It is not the purpose of this activity to apportion blame or liability.

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Executive Summary

On August 13, 2025, UPS Airlines flight 5X61, a Boeing 747-8 freighter (B747-8F) registered in the United States as N613UP, was operating a cargo flight under the provisions of 14 Code of Federal Regulations Part 121 from Hong Kong International Airport (VHHH) to Taiwan Taoyuan International Airport (RCTP) with three flight crew members onboard. At 2008 Taipei local time, during landing on Runway 05L at RCTP, the aircraft sustained a No. 4 engine nacelle strike, which resulted in damage to the No. 4 engine and nacelle, the No. 3 engine nacelle, as well as multiple areas of the right wing and fuselage. No injury to any person involved in the flight or to any third party.

According to the Transportation Occurrence Investigation Act of the Republic of China and the content of Annex 13 to the Convention on International Civil Aviation Organization (ICAO), the Taiwan Transportation Safety Board (TTSB), an independent transportation occurrence investigation agency, was responsible for conducting the investigation. The investigation team also included representatives from the U.S. National Transportation Safety Board (NTSB), UPS Airlines, and Taiwan's Civil Aviation Administration (CAA). The investigation report was sent to relevant organizations and authorities for comments and was subsequently reviewed and approved at the TTSB's 89th Board Meeting on 14 August 2026.

The investigation identified 15 findings based on a comprehensive review of factual data and analyses and issued 2 safety recommendations to the relevant organizations.

Findings from the Investigation

Findings Related to Probable Causes

1. At the time of the occurrence, meteorological conditions at Taiwan Taoyuan International Airport were influenced by Typhoon Podul, resulting in strong and gusty winds with a significant right crosswind component on Runway 05L used by the occurrence aircraft for landing.

2. One second after touchdown, the No. 1 forward thrust lever was inadvertently advanced beyond the idle position, triggering automatic speedbrake retraction and causing the aircraft to retain high residual lift after touchdown.

3. The combination of high residual lift and the gusty right crosswind resulted in three transitions of the aircraft’s air/ground sensing system back to AIR mode, delaying the deployment and activation of the aircraft's deceleration devices. The resulting unstable aircraft state, together with the development of asymmetric thrust and the adverse wind conditions, further increased the complexity of aircraft control during the landing roll.

4. During the landing roll, the occurrence aircraft experienced multiple left roll tendencies associated with gusty right crosswind conditions. To counter these tendencies, large right control wheel inputs were applied by the Pilot Flying. The aircraft subsequently developed an excessive 9.2-degree right-wing-down attitude, exceeding the B747-8 ground contact angle limits, resulting in the No. 4 engine nacelle strike.

Findings Related to Risk

1. The delayed deployment of the speedbrakes and the No. 1 thrust

reverser, together with the delayed application of wheel braking, reduced the stopping margin during the landing roll.

2. During the landing roll, the abnormal aircraft attitude directed the flight crew's attention outside the cockpit, reducing the effectiveness of instrument monitoring. This contributed to both premature and delayed callouts related to deceleration devices and reduced the crew's shared situational awareness of the abnormal aircraft configuration.

3. The occurrence aircraft's engine nacelle strike during landing resulted in debris and detached components being scattered along the runway surface. Consequently, a subsequently landing B777F cargo aircraft sustained damage to three main landing gear tires, as well as multiple scratches and punctures to its belly composite panels.

4. Timely communication between the tower Local Controller and the occurrence flight crew could have facilitated earlier recognition of a possible engine nacelle strike and enhanced shared situational awareness of foreign object debris on the runway and its associated risks at an early stage, thereby preventing damage to subsequent landing or departing aircraft.

5. Both the tower Local Controller and the Local Monitor observed sparks emanating from the occurrence aircraft; however, this abnormality was not communicated to the occurrence flight crew, indicating ineffective application of Team Resource Management in addressing the potential operational risk.

Other Findings

1. The flight crew was properly certificated and qualified in accordance with applicable U.S. federal regulations. There was no evidence to

indicate that medical conditions, fatigue, medication use, alcohol, or other drugs impaired the crew's performance during the occurrence flight.

2. The occurrence aircraft was properly certificated, with no reported anomalies in the flight control systems.

3. The aircraft's weight and balance remained within approved operational limits throughout the occurrence flight. Upon landing, the remaining fuel was sufficient for the aircraft to attempt additional approaches or to divert to its alternate airport.

4. During the first and second approaches, the flight crew determined that the crosswind conditions exceeded the operator's limitations and executed go-arounds in accordance with standard operating procedures.

5. During the third approach, the reported wind conditions were within the operator's approach limitations, and the crew established and maintained a stabilized approach in accordance with the operator's stabilized approach criteria.

6. During the flare and initial touchdown of the third approach, the aircraft was handled in a manner consistent with the operator's recommended crosswind landing techniques, and the flare and touchdown were within normal limits.

Transportation Safety Recommendations

To UPS Airlines

UPS Airlines advised that a number of proactive safety actions had been completed or were underway following the occurrence, as detailed in Section 4.2.1. As these actions addressed the safety issues identified by the investigation, no safety recommendations have been issued in this report.

To Taiwan Civil Aviation Administration

1. Enhance training programs for tower controllers on Air Traffic Management Procedures, emphasizing that visual indications such as sparks require immediate advisory to the aircraft concerned and an assessment of runway integrity.

2. Strengthen Team Resource Management practices among Air Traffic Controllers to ensure that, when abnormalities are observed by any team member, timely and appropriate safety actions are initiated.

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Abbreviations

ACM	Additional Crew Member
AIP	Aeronautical Information Publication
AMM	Aircraft Maintenance Manual
AOM	Aircraft Operating Manual
APU	Auxiliary Power Unit
AQP	Advanced Qualification Program
ATIS	Automatic Terminal Information Service
ATMP	Air Traffic Management Procedures
ATP	Airline Transport Pilot
AWOS	Automated Weather Observation System
BCF	Boeing Converted Freighter
CAM	Cockpit Area Microphone
CAS	Calibrated Airspeed
CG	Center of Gravity
CMC	Central Maintenance Computer
CMC-L	Left Central Maintenance Computer
CQ	Continuing Qualification
CQP	Continuing Qualification Proficiency
CVR	Cockpit Voice Recorder
DDM	Difference in Depth Modulation
DME	Distance Measuring Equipment
EEC	Electronic Engine Control
EICAS	Engine Indicating and Crew Alerting System
FAA	Federal Aviation Administration
FCTM	Flight Crew Training Manual
FDR	Flight Data Recorder
FIR	Flight Information Region
FOM	Flight Operations Manual
FPM	Feet Per Minute
G/S	Glideslope
HAT	Height Above Touchdown
hPa	Hectopascal
ILES	Inboard Leading-Edge Station
ILS	Instrument Landing System
LLWAS	Low-Level Wind Shear Alert System
LOC	Localizer
LOE	Line Operational Evaluation
MAC	Mean Aerodynamic Chord
METAR	Meteorological Aerodrome Report
MLW	Maximum Landing Weight
MSL	Mean Sea Level
MTOW	Maximum Takeoff Weight

NM	Nautical Mile
NOSIG	No Significant Change
PF	Pilot Flying
PM	Pilot Monitoring
QAR	Quick Access Recorder
QNH	Altimeter Sub-Scale Setting to Obtain Elevation when on the Ground
RA	Radio Altitude
RCTP	Taiwan Taoyuan International Airport
RESA	Runway End Safety Area
RSA	Runway Safety Area
RTO	Rejected Takeoff
SIGMET	Significant Meteorological Information
SPECI	Aerodrome Special Meteorological Report
STA	Station
TAF	The Aerodrome Forecasts
TAMC	Taipei Aeronautical Meteorological Center
TDZ	Touchdown Zone
TLA	Thrust Lever Angle
TLPR	Thrust Lever Position Resolver
TRA	Throttle Resolver Angle
TRM	Team Resource Management
U-18R	Upper No.18 Right (Wing)
UPS	United Parcel Service
UTC	Coordinated Universal Time
VCF	Variable Camber Flap
VHHH	Hong Kong International Airport
VMC	Visual Meteorological Conditions
WS	Wing Station

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Chapter 1 Factual Information

1.1 History of the Flight

On August 13, 2025, UPS Airlines[1] flight 5X61, a Boeing 747-8 freighter (B747-8F[2]) registered in the United States as N613UP, was operating a cargo flight under the provisions of 14 Code of Federal Regulations Part 121 from Hong Kong International Airport (VHHH) to Taiwan Taoyuan International Airport (RCTP) with three flight crew members onboard. At 2008 Taipei local time[3], during landing on Runway 05L at RCTP, the aircraft sustained a No. 4 engine nacelle strike, which resulted in damage to the No. 4 engine and nacelle, the No. 3 engine nacelle, as well as multiple areas of the right wing and fuselage. No injury to any person involved in the flight or to any third party.

The captain occupied the left seat in the cockpit and was the Pilot Flying (PF) for the occurrence flight, while the first officer occupied the right seat and was the Pilot Monitoring (PM), and an Additional Crew Member (ACM), who was positioning as a non-operating crew member, was seated in the observer's seat. The flight was originally scheduled to depart from VHHH at 1605, but due to weather conditions at RCTP and air traffic flow control, the actual takeoff time was delayed until 1750. In the hours around the estimated arrival time, weather conditions at RCTP were influenced by the passage of Typhoon Podul. Night Visual Meteorological Conditions (VMC) prevailed. According to the Meteorological Aerodrome

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1 It is an American cargo airline owned by United Parcel Service Co. ("UPS")

2 Hereafter, references to Boeing aircraft will be abbreviated with the prefix "B" for simplicity.

3 Unless otherwise noted, the 24-hour clock is used in this report to describe the local time of day, Taipei Local Time, as particular events occurred. Taipei Local Time is Coordinated Universal Time (UTC) + 8 hours.

Report (METAR) for RCTP valid at 1730, the wind was from 090 degrees at 27 knots, gusting to 44 knots, with visibility greater than 10 kilometers. The cloud coverage[4] was few at 800 feet and broken at 18,000 feet. The temperature was 30 degrees Celsius, dew point 22 degrees Celsius, and the altimeter setting (QNH) was 999 hectopascal (hPa). Windshear was reported on all runways, and No Significant Change (NOSIG) was forecast.

According to the crew interviews, while en route to RCTP, the crew maneuvered around the Typhoon Podul and entered a brief holding prior to vectoring for the approach. The approach in use at RCTP was the ILS[5] (Instrument Landing System) Runway 05L.

First Approach

According to the Flight Data Recorder (FDR) and Cockpit Voice Recorder (CVR) data, at 1916:23, Taipei tower cleared the occurrence flight to land on Runway 05L with the wind from 100 degrees at 21 knots gusting to 45 knots. After discussion, the crew agreed to check the wind before reaching 500 feet and execute a go-around if the crosswind limitation[6] was exceeded. At 1919:41, at 682 feet radio altitude (RA)[7], the crew obtained the reported wind from 090 degrees at 29 knots gusting to 45 knots. At 1920:03 while the aircraft was at 370 feet RA, the crew noted an increase in wind speed and initiated a go-around. The flight was then

[4] Cloud amounts are reported in oktas. An okta is a unit of sky equal to one-eighth of total sky visible to the celestial horizon. Few = 1 to 2 oktas, scattered = 3 to 4 oktas, broken = 5 to 7 oktas and overcast = 8 oktas. The METAR reports the height of the cloud base in hundreds of feet above aerodrome elevation.

[5] An ILS is a standard ground aid to landing, comprising two directional radio transmitters: the localizer, which provides horizontal or lateral flightpath tracking guidance; and the glideslope for vertical flightpath tracking guidance, usually at an inclination of 3°; additionally, Distance Measuring Equipment (DME) or marker beacons along the approach provide distance information.

[6] According to the UPS B747 Aircraft Operating Manual (AOM), the crosswind component limit for landing on a dry runway, including gusts, is 30 knots.

[7] Radio altitude is the height of an aircraft above terrain immediately below the aircraft as measured by a radio altimeter.

vectored for a second approach for ILS Runway 05L.

Second Approach

At 1932:15, the flight was cleared to land on Runway 05L with the wind from 090 degrees at 30 knots gusting to 39 knots. At 1934:44, at 527 feet RA, the crew obtained the wind report of 100 degrees at 29 knots gusting to 43 knots, and subsequently commenced a second go-around at 1934:52.

After the second go-around, while in holding, the crew consulted the company for a suitable alternate airport, discussed the situation, and decided to attempt another approach.

Third Approach

At 2000, the RCTP Automatic Terminal Information Service (ATIS) information “Tango” was current, with winds reported from 100 degrees at 23 knots gusting to 36 knots. At 2003:55, the flight was cleared to land on Runway 05L with the wind 090 degrees at 26 knots gusting to 38 knots. The crew discussed the option of conducting an autoland during the approach and decided to check the winds at a lower altitude. At 2005:50, at 2,010 feet RA, the reported wind for Runway 05L was 090 degrees at 28 knots gusting to 38 knots, which exceeded the autoland headwind limitation[8] but remained within the landing crosswind limit. The crew subsequently decided to conduct a manual landing.

Data from the FDR, CVR, and crew interviews indicated that the approach was normal and stabilized below 1,000 feet RA. At 2007:43, the PF disconnected the autopilot at 430 feet RA, and at 2008:05, the

[8] According to the UPS B747 Aircraft Operating Manual (AOM), the autoland headwind and crosswind limitations are both 25 knots.

autothrottle was disconnected at 185 feet RA. From 1,000 feet RA to 50 feet RA, the aircraft maintained a right crab angle that gradually decreased from approximately 12 degrees to 8 degrees. The PF initiated the flare at around 40 feet RA and decrabbed the aircraft before touchdown. All four forward thrust levers were retarded to the idle position at approximately 15 feet RA prior to touchdown.

At 2008:21, the aircraft touched down on Runway 05L at an airspeed[9] of 174 knots, with a pitch angle of 1.1 degrees nose-up, a heading of 058.4 degrees, and a roll angle of 2.5 degrees left-wing-down. The left wing landing gear contacted the ground first, followed shortly by the remaining three main landing gears, as indicated by the Quick Access Recorder (QAR) data.

<u>After Touchdown</u>

The speedbrakes began to extend on touchdown at 2008:21. At 2008:22, approximately one second after touchdown, the No. 1 forward thrust lever was advanced out of idle position and reached a Throttle Resolver Angle (TRA)[10] of approximately 57 degrees[11] at 2008:23, while the No. 2, No. 3, and No. 4 reverse thrust levers were raised to the idle reverse position. At the same time, the speedbrake lever moved backed toward "DOWN" position and the speedbrakes were retracted.

According to the FDR and CVR data, the aircraft experienced a left roll tendency during the landing roll, accompanied by multiple "right wing down" callouts from the PM. During this period, the aircraft experienced

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9 Unless otherwise noted, all airspeeds presented in this report are calibrated airspeeds (CAS).

10 Throttle Resolver Angle (TRA) is the analog electrical signal generated by thrust lever resolvers, which convert the pilot's forward and reverse thrust lever position into an input that is sent to the Electronic Engine Control (EEC) to determine commanded thrust.

11 A TRA value of 57 degrees corresponds to a forward Thrust Lever Angle (TLA) of approximately 22 degrees according to the B747-8 Aircraft Maintenance Manual (AMM).

three momentary transitions back to AIR mode before it finally settled on the runway at 2008:31. At 2008:24, the aircraft reached a maximum left roll angle of 9.2 degrees, with a nose-up pitch attitude of 0.7 degrees while in AIR mode. Although this tendency was briefly corrected, the aircraft began rolling to the left again after 2008:26. At the same time, the aircraft started to yaw to the right with the developing asymmetric thrust condition. At 2008:28, the No.1 Engine N1 reached a maximum value of 70.2%, while the N1 values of the No. 2, No. 3, and No. 4 engines were 37.1%, 36.9% and 37.1%, respectively.

At 2008:29, the aircraft reverted to AIR mode again and the control wheel position was at a maximum of 67.8 degrees to the right. One second later, at 2008:30, the aircraft reached an attitude of 1.4 degrees pitch up and a roll angle of 9.2 degrees to the right, while unidentified impact sounds possibly associated with the engine nacelle strike were recorded on the CVR. At the same time, the No.1 forward thrust lever was retarded to idle position while the No. 2, No. 3, and No. 4 reverse thrust levers to maximum reverse thrust.

The aircraft settled on the runway and transitioned to GROUND mode at 2008:31, the speedbrakes were fully extended at 2008:32, and the autobrake system was activated at 2008:34. At 2008:40, the ACM called "no reverse number one" and the No. 1 reverse thrust lever was then raised at 2008:41. At 2008:47, the brake pedal input was applied, transitioning the autobrake system to manual braking.

The aircraft vacated the runway via N9 taxiway. According to crew interviews, an Engine Indicating and Crew Alerting System (EICAS) message "ENG 4 REVERSER[12]" was momentarily displayed while

[12] Indicating a fault or abnormal condition related to the No. 4 engine thrust reverser system.

vacating the runway. The aircraft then taxied to the parking bay without further incident.

During the post-landing walk-around, the crew discovered damage on the No. 4 engine and notified RCTP tower of the occurrence. Figure 1.1-1 shows the external appearance of the damage to No. 4 engine, while Figure 1.1-2 illustrates the FDR flight path of the occurrence flight.

Figure 1.1-1 External appearance of the damage to No. 4 engine

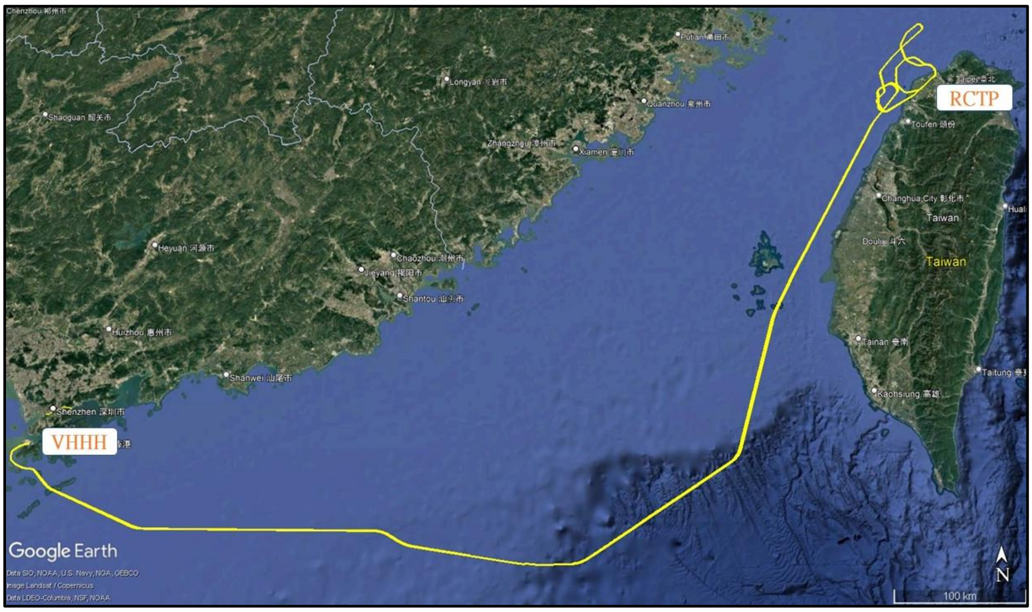

Figure 1.1-2 FDR recorded flight path of occurrence flight

1.2 Injuries to Persons

There was no injury to any person involved in the flight or to any third party.

1.3 Damage to Aircraft

The aircraft sustained damage to the lower portions of the No. 4 engine, the No. 4 engine nacelle, and the No. 3 engine nacelle as a result of ground impact. Subsequently, separated components caused minor damage to the right wing and fuselage. Detailed information is provided in Section 1.12.1.

1.4 Other Damage

Debris and components detached from the occurrence aircraft were scattered along the runway surface. Consequently, a B777F cargo aircraft (flight BR6032, registration B-16790) that landed subsequently at 2011 sustained damage to three main landing gear tires and multiple scratches and punctures to its belly composite panels.

1.5 Personnel Information

1.5.1 The Flight Crew

The flight crew basic information is shown in Table 1.5-1.

Table 1.5-1 Flight crew basic information

Item	Captain	First Officer
Gender	Male	Male
Age as of the occurrence	63	51
Commenced employment with UPS Airlines	July 31, 2017	March 2, 2021
License date of issue	FAA ATP Certificate November 5, 2017	FAA ATP Certificate November 7, 2018
Type ratings	B747-400, B757, B767, B777	B737, B747-400, B777
Medical certificate date of examination	FAA first class March 28, 2025	FAA first class April 8, 2025
Total flight time	14,767 hrs	7,779 hrs
Total flight time on B747	2,685 hrs	2,105 hrs
Total flight time last 12 months	250 hrs	598 hrs
Total flight time last 90 days	61 hrs	93 hrs
Total flight time last 30 days	61 hrs	62 hrs
Total flight time last 7 days	14 hrs	11 hrs
Total flight time last 24 hours	2 hrs 41 mins	2 hrs 41 mins
Rest period before the occurrence	20 hrs 30 mins	20 hrs 30 mins

1.5.1.1 The Captain

The captain had a military background and entered civil aviation in 1997. He initially flew corporate aircraft, Hawker 125, for approximately 1.5 years. He later achieved his first command on the B757 and subsequently flew the B767, B777, and B747. He joined UPS Airlines in 2017 and has flown the B747 for the past eight years, including the -8F, -400F, and -BCF[13] variants. He had accumulated 14,767 total flight hours,

[13] Boeing Converted Freighter (BCF) denotes a B747 aircraft that has been converted from a passenger configuration to a freighter configuration.

of which 2,685 hours were on the B747.

The captain held an Airline Transport Pilot (ATP) Certificate issued by the Federal Aviation Administration (FAA) with ratings for airplane multiengine land and type ratings for B747-400[14], B757, B767 and B777. He also held valid FAA Flight Instructor and Ground Instructor Certificates.

UPS Airlines operates under an FAA-approved Advanced Qualification Program (AQP), utilizing a Continuing Qualification (CQ) system that functions on a 24-month cycle divided into two 12-month evaluation periods. A midpoint CQ Proficiency (CQP) session is conducted within each 12-month evaluation period to sustain operational proficiency. The captain completed his most recent 3-day CQ recurrent session, which included recurrent ground and flight training and a Line Operational Evaluation (LOE), on September 30, 2024. His most recent recurrent line check was completed on May 4, 2024[15], confirming satisfactory operational performance during line operations. In addition, he completed the CQP session on March 14, 2025 to maintain operational proficiency between CQ evaluations.

The captain held a first class medical certificate issued by the FAA on March 28, 2025, with no limitations.

The result of the captain's alcohol test, conducted by the RCTP operations officer after the occurrence, indicated a reading of 0.00 mg/L.

1.5.1.2 The First Officer

The first officer had a military background and entered civil aviation in 2017. He joined UPS Airlines in 2021. His commercial experience

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[14] The B747-400 pilot type rating is valid for both B747-400 series and B747-8 series.

[15] UPS is approved to conduct CQ line checks under the no-notice provision of the approved AQP per 14 CFR 121.915. Line checks for the pilot in command occur at least once every 24 months.

included three aircraft types, the B737, B777, and B747, and he had been operating the B747 for approximately four and a half years. He had accumulated 7,779 total flight hours, of which 2,105 hours on the B747.

The first officer held an ATP Certificate issued by the FAA with ratings for airplane multiengine land and type ratings for B737, B747-400 and B777.

The first officer completed his most recent 3-day CQ recurrent session, which included recurrent ground and flight training and a LOE, on March 26, 2025. His most recent recurrent line check was completed on August 25, 2024, confirming satisfactory operational performance during line operations. In addition, he completed the CQP session on July 21, 2025 to maintain operational proficiency between CQ evaluations.

The first officer held a first class medical certificate issued by the FAA on April 8, 2025, with the limitation: “Must use corrective lens(es) to meet vision standards at all required distances.”

The result of the first officer’s alcohol test, conducted by the RCTP operations officer after the occurrence, indicated a reading of 0.00 mg/L.

1.5.2 Flight Crew Activities within 72 hours Before the Occurrence

1.5.2.1 The Captain

<u>August 11, 2025 – Anchorage time (UTC-8)</u>

0900L Trip pairing began.
1140L Flight departed Anchorage.

<u>August 12, 2025 – Shenzhen time (UTC+8)</u>

1430L Arrived in Shenzhen and was transported to the hotel. Had a meal and went to sleep until after midnight.

August 13, 2025 – Shenzhen time (UTC+8)

0630L Worked out in the hotel gym, followed by breakfast. Rested afterwards in the hotel room for about 2.5 hours of light sleep.

1205L Checked out. Ground transportation was arranged from Shenzhen to Hong Kong Airport for the onward flight to Taipei. Upon arrival at Hong Kong Airport, had lunch with the first officer in the terminal.

1500L Proceeded to the aircraft. Departure was delayed until 1730L due to flow control.

1750L The aircraft was airborne.

1.5.2.2 The First Officer

August 10, 2025 – Anchorage time (UTC-8)

2100L Arrived in Anchorage and proceeded to the apartment. Went to sleep shortly after arrival.

August 11, 2025 – Anchorage time (UTC-8)

0700L Awoke, completed some errands, and picked up breakfast before reporting for pre-flight briefing. Operated UPS flight 76 as first officer from Anchorage to Shenzhen.

August 12, 2025 – Shenzhen time (UTC+8)

1430L Arrived in Shenzhen. Had dinner and went to sleep by 2200L.

August 13, 2025 – Shenzhen time (UTC+8)

0800L Awoke and had breakfast.

1200L Departed the Shenzhen hotel by ground transport to Hong

Kong Airport. Had lunch at an airport restaurant with the captain. Proceeded to the aircraft and received an official delay of about 1.5 hours due to flow control.

1750L The aircraft was airborne.

1.6 Aircraft Information

1.6.1 Aircraft and Engine Basic Information

The aircraft basic information is shown in Table 1.6-1.

Table 1.6-1 Aircraft basic information

Aircraft basic information (till August 13 2025, through the end of the occurrence flight)	
Nationality	USA
Aircraft Registration Marks	N613UP
Manufacturer	Boeing
Aircraft model	B747-8F
Manufacturer's Serial Number	64259
Manufactured Date	11/2018
Received Date	11/08/2018
Owner	CCE
Operator	UPS
Certificate of Airworthiness Date	11/05/2018
Total Airframe Hours/Cycles	26,098.83 hours / 3,852 cycles
Maximum Takeoff Weight (MTOW)	987,000 lbs.
Maximum Landing Weight (MLW)	763,000 lbs.

The engine basic information is shown in Table 1.6-2.

Table 1.6-2 Engine basic information

Engine basic information (till August 13 2025, through the end of the occurrence flight)				
Number/Position	1	2	3	4
Manufacturer	GE Aviation			
Model	GENX-2B67/P			
Serial number	959770	959484	959763	959748
Manufacture date	1/31/2020	8/18/2014	9/28/2019	4/16/2019
Time since last maintenance	19.5	419.6	19.5	403.3
Cycle since last maintenance	3	63	3	59
Time since new	17,545	27,980	19,113	22,513
Cycle since new	2,633	4,119	2,855	3,344

1.6.2 Aircraft Maintenance Records

A review of the aircraft's Central Maintenance Computer (CMC) fault history and aircraft logbook records for the three flight legs preceding the occurrence revealed no anomalies related to the event.

The Present Legs Fault Summary Report from the Left CMC (CMC-L) recorded two faults during the occurrence flight:

- During the initial climb, an intermittent "CARGO SMOKE DETECTION MAIN DECK MID DETECTOR 32 FAIL" fault was recorded at 1752.
- During the taxi-in, an "ENG 4 REVERSER" fault was recorded at 2009, after landing.

The Existing Faults Summary Report from the CMC-L indicated six active faults remaining after landing. Four faults, recorded at 2009, were associated with the stow locking mechanisms of the left and right thrust reversers on the No. 4 Engine. The remaining two faults, recorded at 2008, involved the No. 4 Engine's starter pressure sensor and fuel filter pressure sensor. All six existing faults were logged following the engine nacelle strike.

1.6.3 Weight and Balance Information

According to the loading documentation and computer flight plan provided by UPS Airlines, as well as FDR data, the aircraft had a zero fuel weight of 605,300 lbs., with the zero fuel weight Center of Gravity (CG) located at 20.0% Mean Aerodynamic Chord (MAC). It's takeoff weight was 748,343 lbs., with the takeoff CG located at 21.7% MAC. The zero fuel weight CG envelope and the takeoff CG envelope for the B747-8F are depicted in Figures 1.6-1 and 1.6-2. Table 1.6-1 shows the aircraft's weight and balance data. The aircraft took off with approximately 142,835 lbs. of fuel on board and landed with approximately 86,421 lbs. remaining.

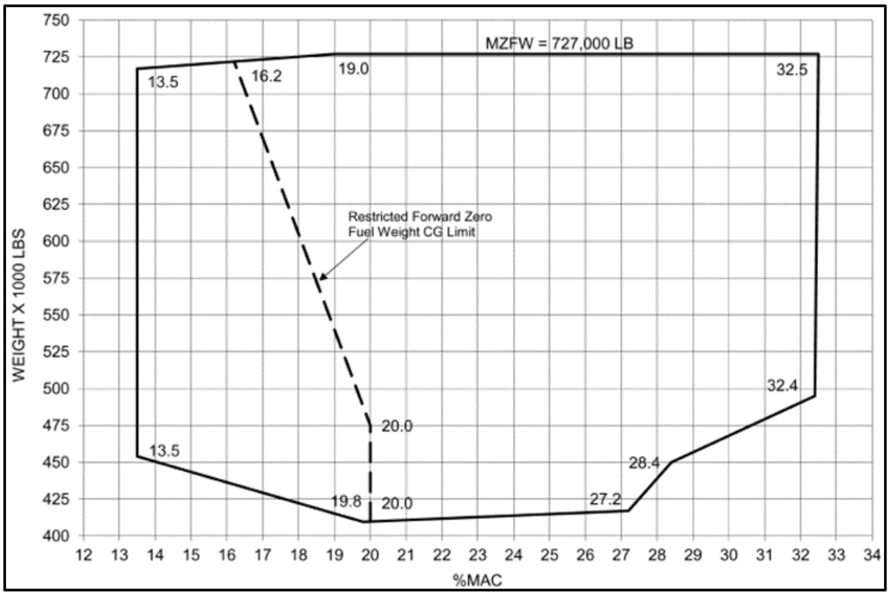


Figure 1.6-1 B747-8F zero fuel weight CG envelope[16]

[16] For takeoff weight ≤ 753,000 lbs.

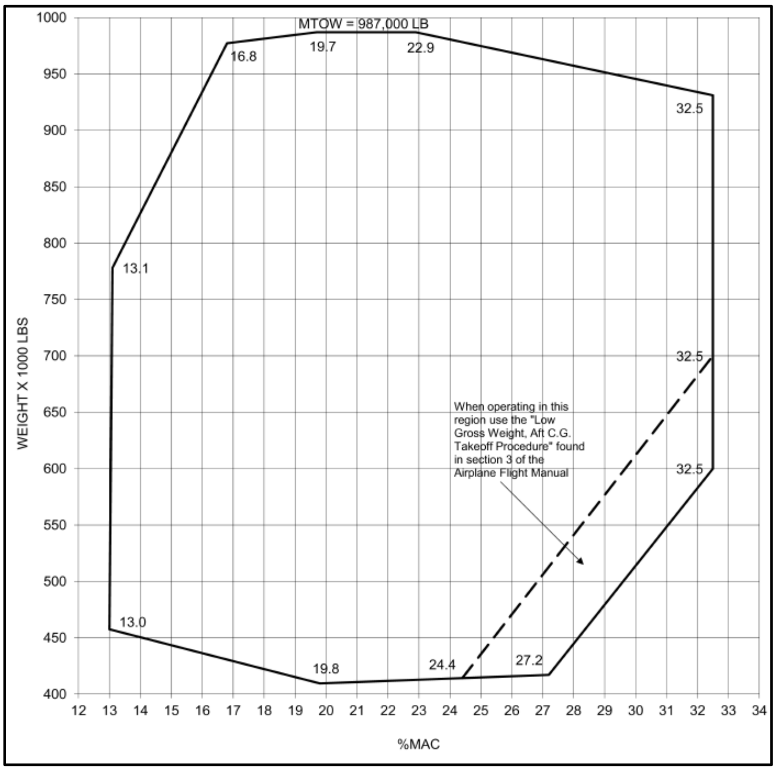


Figure 1.6-2 B747-8F takeoff CG envelope

Table 1.6-3 Weight and balance data

Max. zero fuel weight	727,000 lbs.
Zero fuel weight	605,300 lbs.
Max. takeoff weight	987,000 lbs.
Takeoff weight	748,343 lbs.
Takeoff fuel	142,835 lbs.
Estimated trip fuel	30,800 lbs.
Max. landing weight	763,000 lbs.
Landing weight	691,689 lbs.
Zero fuel weight CG	20.0% MAC
Takeoff CG	21.7% MAC
CG: Center of Gravity MAC: Mean Aerodynamic Chord	

1.6.4 Aircraft System

Figure 1.6-3 shows the layout of the B747-8 P9 control stand, including the speedbrake handle, forward thrust levers, and reverse thrust levers.

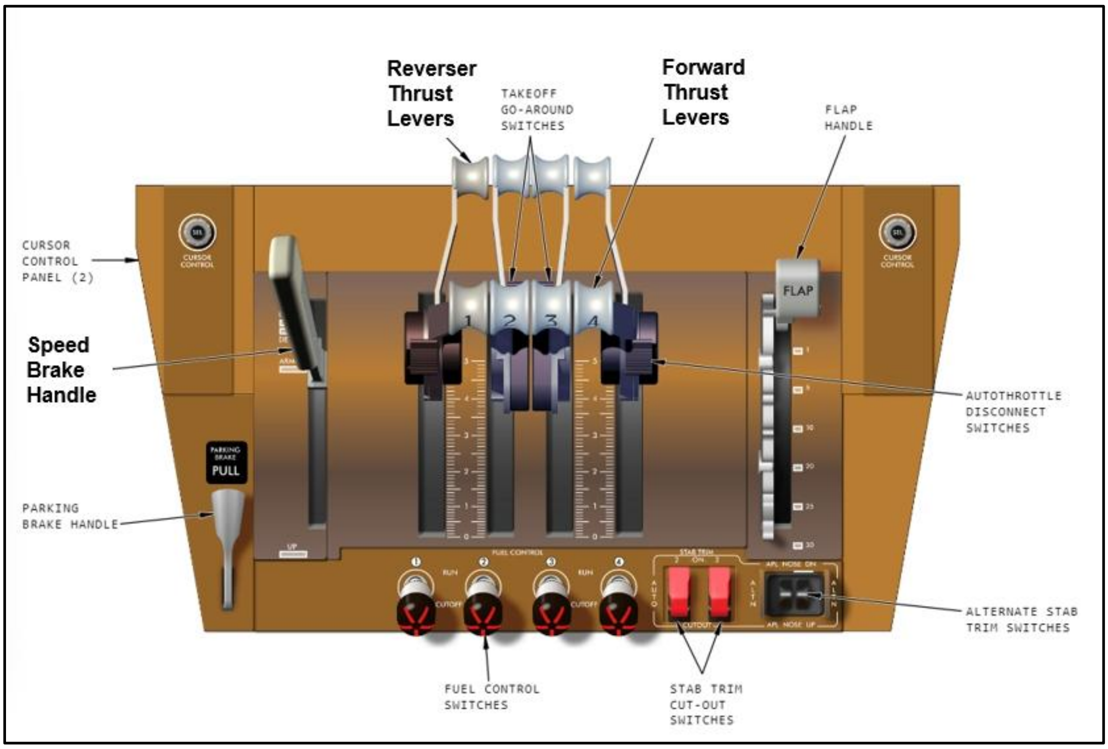


Figure 1.6-3 B747-8 P9 control stand diagram

1.6.4.1 Engine Thrust Control

Each engine is equipped with an independent thrust control system, utilizing an architecture with no mechanical connections between the thrust levers and the engines. All thrust commands are transmitted electrically. Each thrust lever is mechanically connected to a Thrust Lever Position Resolver (TLPR). Whether the lever is moved manually by the crew or automatically by the autothrottle via a servo motor, the thrust lever and TLPR move in unison.

The TLPR converts the Thrust Lever Angle (TLA) into an electrical signal sent to the Electronic Engine Control (EEC), which regulates fuel flow to produce the commanded thrust. The thrust lever assembly provides manual control of both forward and reverse thrust and includes switches for autothrottle disengagement and go-around engagement. Continuous feedback from the TLPR ensures engine output accurately matches the commanded input.

The operational ranges for the levers are defined as follows:

- Forward Thrust: Travel is 50 degrees from idle to full forward thrust.
- Reverse Thrust: Travel is 89 degrees from idle to full reverse thrust.

1.6.4.2 Thrust Reverser Operation and Interlocks

Each engine is equipped with a hydraulic fan air thrust reverser system, restricted to ground operations while the engines are running. To ensure safety, a mechanical interlock prevents simultaneous forward and reverse thrust; the thrust levers must be at idle before reverse levers can be raised, and thrust levers remain locked until reverse levers are fully stowed.

When reverse levers are raised to the idle detent, hydraulic pressure deploys the reversers, and an amber "REV" indication appears above the N1 gauge during transit. Once fully deployed, the indication turns green, signaling that the interlock is released and higher reverse thrust may be applied. During stowing, the "REV" indication reverts to amber and disappears once the unit is fully locked. An auto-stow feature automatically applies hydraulic pressure to lock the reverser if it unlocks without a command.

1.6.4.3 Speedbrake System Logic

The speedbrake system uses spoiler panels to modulate drag in flight and maximize braking on the ground.

- In-Flight Operation: Moving the lever to the flight detent partially extends inboard and middle spoilers. Beyond the flight detent, further movement is electrically prevented to avoid excessive lift loss.

- Automatic Deployment: Deployment occurs if the lever is ARMED and thrust levers 1 and 3 are at idle upon main gear touchdown.
- Fail-Safe Backup: If unarmed, the lever is automatically driven to UP if thrust levers 1 and 3 are at idle and either reverse lever 2 or 4 is pulled to the idle detent while on the ground.
- Retraction Override: If thrust lever 1 or 3 is advanced from idle, the speedbrake lever is automatically driven to the down position for go-around protection.

1.6.4.4 Autobrake System and Disarm Logic

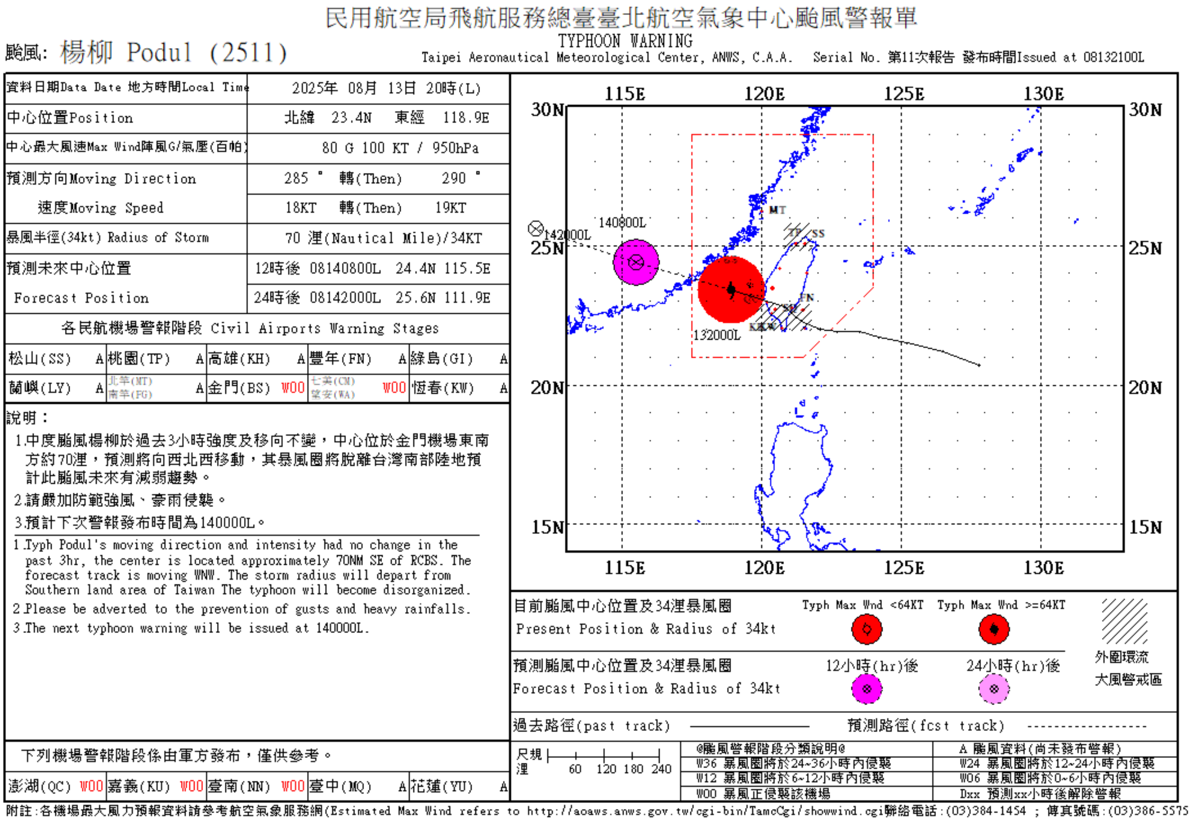
The autobrake system provides automated deceleration through preselected rates.

- Rejected Takeoff (RTO) Mode: Commands maximum braking pressure if groundspeed exceeds 85 knots and all thrust levers are closed. It remains inactive below this threshold.
- Landing Mode: Application begins upon touchdown if all thrust levers are closed, ground mode is sensed, and wheel spin-up is detected. The system reduces brake pressure as thrust reversers and spoilers contribute to deceleration.
- Disarm Logic: The system disarms immediately if manual pedal braking is applied, any thrust lever is advanced, the speedbrake lever is stowed after deployment, or a system failure (e.g., antiskid fault) occurs.

1.7 Meteorological Information

1.7.1 Synopsis

At the time of the occurrence, the center of Typhoon Podul was located approximately 163 nautical miles (NM) southwest of RCTP, with a radius of approximately 70 NM. The relevant typhoon warning[17] is shown in Figure 1.7-1. The northern, southern, and southeastern areas of Taiwan were within the strong wind warning area associated with the outer circulation of the typhoon.



民用航空局飛航服務總臺臺北航空氣象中心颱風警報單
TYPHOON WARNING
颱風: 楊柳 Podul (2511)
Taipei Aeronautical Meteorological Center, ANWS, C.A.A. Serial No. 第11次報告 發布時間Issued at 08132100L

資料日期Data Date 地方時間Local Time	2025年 08月 13日 20時(L)
中心位置Position	北緯 23.4N 東經 118.9E
中心最大風速Max Wind陣風G/氣壓(百帕)	80 G 100 KT / 950hPa
預測方向Moving Direction	285 ° 轉(Then) 290 °
速度Moving Speed	18KT 轉(Then) 19KT
暴風半徑(34kt) Radius of Storm	70 浬(Nautical Mile)/34KT
預測未來中心位置 Forecast Position	12時後 08140800L 24.4N 115.5E
	24時後 08142000L 25.6N 111.9E

各民航機場警報階段 Civil Airports Warning Stages

松山(SS) A	桃園(TP) A	高雄(KH) A	豐年(FN) A	綠島(GI) A
蘭嶼(LY) A	北竿(MT) 南竿(FG) A	金門(BS) W00	七美(CM) 望安(WA) W00	恆春(KW) A

說明：
1.中度颱風楊柳於過去3小時強度及移向不變，中心位於金門機場東南方約70浬，預測將向西北西移動，其暴風圈將脫離台灣南部陸地預計此颱風未來有減弱趨勢。
2.請嚴加防範強風、豪雨侵襲。
3.預計下次警報發布時間為140000L。

1.Typh Podul's moving direction and intensity had no change in the past 3hr, the center is located approximately 70NM SE of RCBS. The forecast track is moving WNW. The storm radius will depart from Southern land area of Taiwan The typhoon will become disorganized.
2.Please be adverted to the prevention of gusts and heavy rainfalls.
3.The next typhoon warning will be issued at 140000L.

下列機場警報階段係由軍方發布，僅供參考。

澎湖(QC) W00	嘉義(KU) W00	臺南(NN) W00	臺中(MQ) A	花蓮(YU) A

@颱風警報階段分類說明@	A 颱風資料(尚未發布警報)
W36 暴風圈將於24~36小時內侵襲	W24 暴風圈將於12~24小時內侵襲
W12 暴風圈將於6~12小時內侵襲	W06 暴風圈將於0~6小時內侵襲
W00 暴風正侵襲該機場	Dxx 預測xx小時後解除警報

附註:各機場最大風力預報資料請參考航空氣象服務網(Estimated Max Wind refers to http://aoaws.anws.gov.tw/cgi-bin/TamcCgi/showwind.cgi聯絡電話:(03)384-1454 ; 傳真號碼:(03)386-5575

Figure 1.7-1 The typhoon warning

The following warnings, issued by RCTP Weather Station and valid at the time of the occurrence, were in effect:

[17] Issued by the Taipei Aeronautical Meteorological Center at 2100 based on data valid at 2000.

Aerodrome Warning 2: valid from 1430 to 2020, surface wind from 090 degrees at 32 knots gusting to 46 knots observed at 1430.

Wind Shear Warning 4: valid from 1853 to 2253, severe wind shears all runway observed at 1853.

The Taipei Aeronautical Meteorological Center (TAMC) issued multiple Significant Meteorological Information (SIGMET)[18] advisories for the Taipei Flight Information Region (FIR) on the day of the occurrence. Two SIGMETs remained in effect at the time of the occurrence, as detailed below:

SIGMET 7: valid from 1800 to 2100; tropical cyclone Podul at N2312 E11948; cumulonimbus was observed at 1700 within 70 nautical miles of the center of the tropical cyclone with top above flight level 450; no changes in intensity are expected; at 2000 the center of the tropical cyclone is forecast to be located at N2324 E11906, cumulonimbus is within 70 nautical miles of the center.

SIGMET 8: valid from 1800 to 2100; embedded thunderstorms are forecasted to be within N2400 E11730 - N2600 E12100 - N2600 E12400 - N2330 E12400 - N2100 E12130 - N2100 E11730 - N2400 E11730, with cloud tops above flight level 450 and moving westward at

[18] Information concerning the occurrence or expected occurrence of specified en-route weather phenomena which may affect the safety of aircraft operations.

10 knots; no changes in intensity are expected.

1.7.2 Surface Weather Observations

The METAR issued for RCTP before and after the occurrence were as follows:

METAR at 2000: wind from 100 degrees at 23 knots gusting to 36 knots, visibility greater than 10 kilometers, few clouds at 1,500 feet, scattered clouds at 18,000 feet, temperature 31°C; dew point temperature 22°C, altimeter setting 1,000 hPa, wind shear all runway, trend forecast - no significant change. Remarks: altimeter setting 29.55 in-Hg (ATIS T).

METAR at 2030: wind from 100 degrees at 28 knots gusting to 41 knots, visibility greater than 10 kilometers, few clouds at 1,500 feet, scattered clouds at 18,000 feet, temperature 31°C; dew point temperature 22°C, altimeter setting 1,000 hPa, wind shear all runway, trend forecast - no significant change. Remarks: altimeter setting 29.55 in-Hg (ATIS U).

1.7.3 Surface Weather Forecasts

The Aerodrome Forecasts (TAF) issued for RCTP, valid at the time of the occurrence, were as follows:

TAF issued at 1300 valid from 1400 on August 13 to 2000 on August

14; wind from 080 degrees at 25 knots gusting to 40 knots, visibility 6,000 meters, few clouds at 1,200 feet, broken clouds at 3,200 feet;

temporarily between 1400 and 1600 on August 13, wind from 100 degrees at 37 knots gusting to 55 knots, visibility 4,000 meters with shower rain, few clouds at 1,000 feet, few cumulonimbus clouds at 1,200 feet, broken clouds at 1,600 feet, broken clouds at 3,000 feet;

temporarily between 1600 and 2000 on August 13, wind from 090 degrees at 30 knots gusting to 45 knots, visibility 4,000 meters with shower rain, few clouds at 1,000 feet, few cumulonimbus clouds at 1,200 feet, broken clouds at 1,600 feet, broken clouds at 3,000 feet;

becoming between 2200 and 2400 on August 13, wind from 140 degrees at 10 knots;

temporarily between 0200 and 0800 on August 14, wind from 030 degrees at 5 knots;

becoming between 0800 and 1000 on August 14, wind from 330 degrees at 8 knots;

becoming between 1800 and 2000 on August 14, wind from 140 degrees at 8 knots.

1.7.4 Surface Wind Observations

RCTP is equipped with an Automated Weather Observation System (AWOS) and a Low-Level Wind Shear Alert System (LLWAS), both maintained and operated by the RCTP Weather Station, TAMC. The AWOS provides continuous, real-time weather information for airport operations, while the LLWAS is a ground-based system that uses a network of anemometers to detect potential low-level wind shear in the airport vicinity. The locations of the anemometers associated with the AWOS and the LLWAS at RCTP are shown in Figure 1.7-2. The AWOS anemometer height is 10 meters, while the LLWAS anemometer heights range from approximately 20 to 30 meters.

AWOS 05L and 05L/23R wind observations recorded between 2007 and 2009 are presented in Figure 1.7-3. Wind data from LLWAS sensors #3, #4, and #9, covering the period from 2007:05 to 2008:55, are shown in Figure 1.7-4.

Figure 1.7-2 AWOS and LLWAS anemometer locations at RCTP

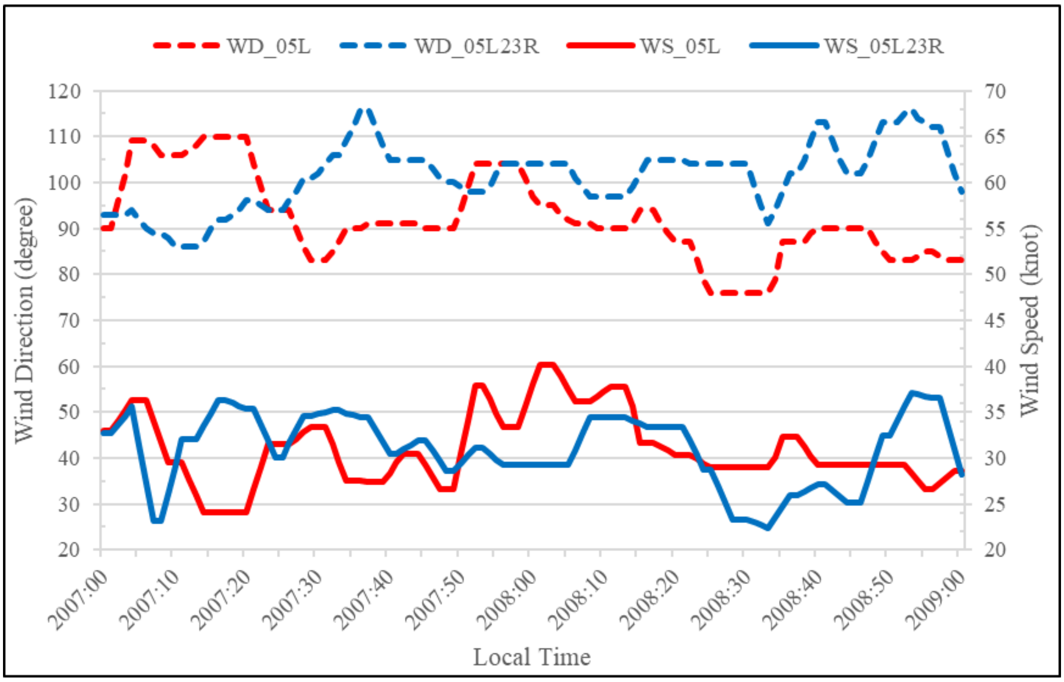


Figure 1.7-3 AWOS wind direction/speed

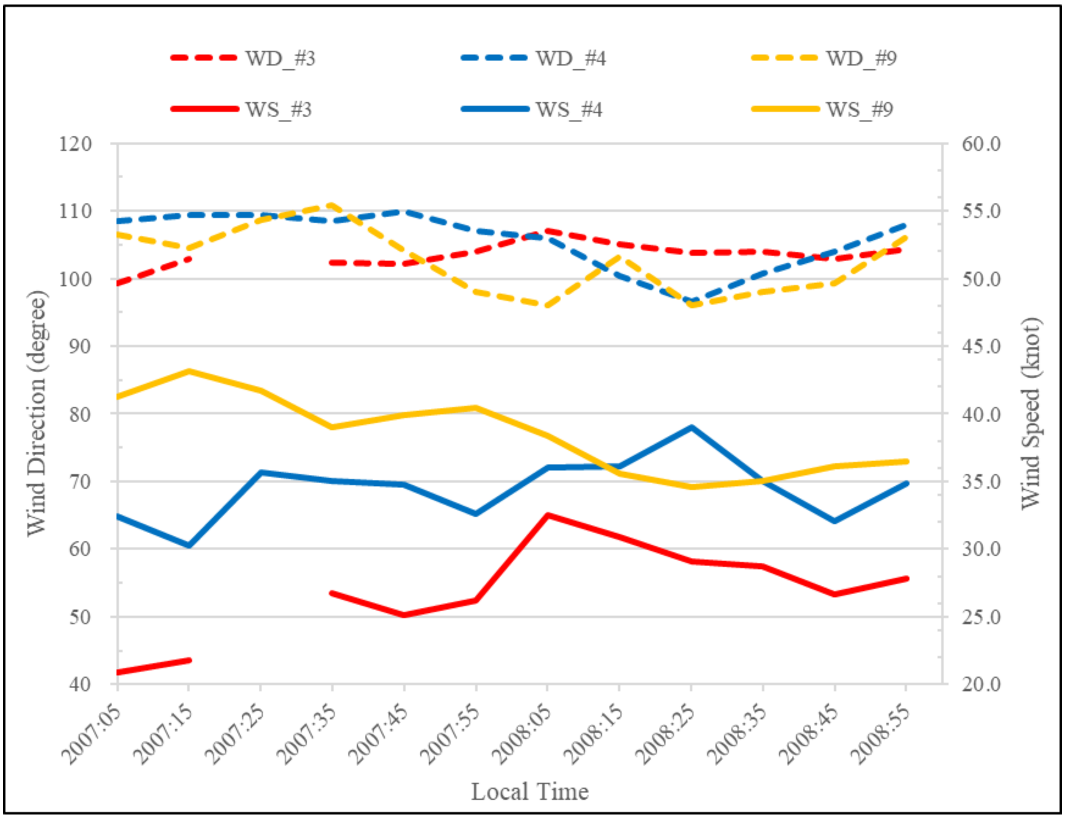


Figure 1.7-4 LLWAS wind direction/speed

1.7.5 Weather Information Summary

The weather information provided by RCTP Weather Station, AWOS, LLWAS, ATIS, and ATC units was summarized in Table 1.7-1.

Table 1.7-1 Summarized weather information

Time	Source	Details
1500	METAR	wind 090 degrees 33 knots gusting 50 knots directional variations 060 to 120 degrees, visibility 9,000 meters, QNH 999, wind shear all runway (ATIS I)
1600	METAR	wind 090 degrees 34 knots gusting 50 knots, visibility greater than 10 kilometers, minimum visibility 4500 meters (to south), QNH 998, wind shear all runway (ATIS K)
1700	METAR	wind 090 degrees 30 knots gusting 42 knots, visibility greater than 10 kilometers, minimum visibility 4500 meters (to south), QNH 998, wind shear all runway (ATIS M)
1730	METAR	wind 090 degrees 27 knots gusting 44 knots, visibility greater than 10 kilometers, QNH 999, wind shear all runway (ATIS N)
1800	METAR	wind 100 degrees 25 knots gusting 40 knots, visibility greater than 10 kilometers, QNH 999, wind shear all runway (ATIS O)
1830	METAR	wind 100 degrees 27 knots gusting 40 knots, visibility greater than 10 kilometers, QNH 1000, wind shear all runway (ATIS P)
1900	METAR	wind 110 degrees 22 knots gusting 35 knots, visibility greater than 10 kilometers, QNH 1000, wind shear all runway (ATIS Q)
1916	Taipei tower	Runway 05L wind 100 degrees 21 knots gusting 45 knots QNH 1000
1917	SPECI[19]	wind 100 degrees 27 knots gusting 45 knots, visibility greater than 10 kilometers, QNH 999, wind shear all runway (ATIS R)
1919	Taipei tower	Runway 05L wind 090 degrees 29 knots gusting 45
1930	METAR	wind 090 degrees 28 knots gusting 39 knots, visibility greater than 10 kilometers, QNH 999, wind shear all runway (ATIS S)
1931	ATIS S	wind 090 degrees 28 knots gusting 39 knots QNH 999, wind shear all runway
1932	Taipei tower	Runway 05L wind 090 degrees 30 knots gusting 39 knots QNH 999
1932	Taipei tower	Runway 05L arrival wind shear alert, 25 knots gain 2

19 Aerodrome special meteorological report.

Time	Source	Details
		miles final
1934	Taipei tower	Runway 05L wind 100 degrees 29 knots gusting 43 knots
1948	Taipei approach	Runway 05L wind 100 degrees 21 knots gusting 36 knots
2000	METAR	wind 100 degrees 23 knots gusting 36 knots, visibility greater than 10 kilometers, QNH 1000, wind shear all runway (ATIS T)
2000	Taipei approach	ATIS T QNH 1000
2001	ATIS T	wind 100 degrees 23 knots gusting 36 knots QNH 1000, wind shear all runway
2003	Taipei tower	Runway 05L wind 090 degrees 26 knots gusting 38 knots QNH 1000
2004	Taipei tower	Runway 05L arrival wind shear alert, 25 knots gain 2 miles final. R05R arrival wind shear alert, 15 knots loss 2 miles final
2005	Taipei tower	Runway 05L wind 090 degrees 28 knots gusting 38 knots
2006:35-2008:25	LLWAS	Runway 05L arrival wind shear alert, 15 knots loss on runway
2006	Taipei tower	Runway 05L arrival wind shear alert, 15 knots loss on runway

1.8 Aids to Navigation

There were no reported difficulties with navigational aids along the occurrence aircraft's flight path.

1.9 Communications

There were no communications issues related to this occurrence.

1.10 Aerodrome Information

According to the Aeronautical Information Publication (AIP)[20] of Taipei FIR, RCTP is located 16.7 nautical miles (30.9 kilometers) west of Taipei City, at an elevation of 108 feet above mean sea level (MSL). The

[20] Effective date: 10 July, 2025.

airport has two parallel runways oriented northeast to southwest, designated Runway 05L/23R and Runway 05R/23L, as shown in Figure 1.10-1.

The runway in use for the occurrence flight was Runway 05L/23R, which has declared dimensions of 3,660 meters in length and 60 meters in width. The threshold elevation of Runway 05L is 74 feet, while that of Runway 23R is 63 feet.

Runway 05L/23R is equipped with CAT II approach and runway lighting, as well as CAT II ILS. At the time of the occurrence, the systems were functioning normally, with no reported difficulties.

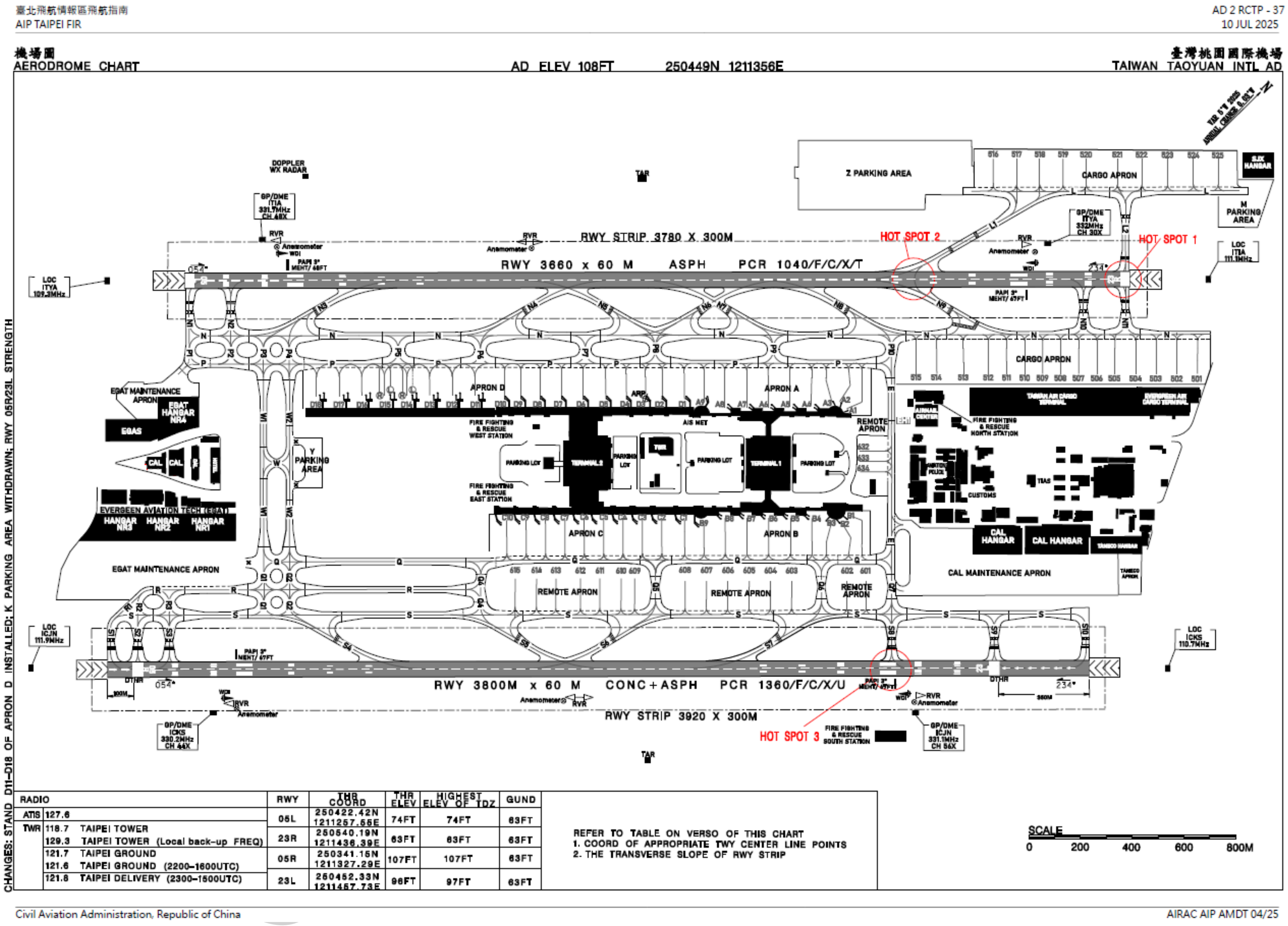


Figure 1.10-1 Aerodrome chart of RCTP

1.11 Flight Recorders

1.11.1 Cockpit Voice Recorder

The aircraft was equipped with an L3Harris FA2100-1025-22 solid-state Cockpit Voice Recorder (CVR), serial number 001209462.

The exterior and interior of the CVR were intact. The CVR was sent to the laboratory for readout, and the audio information was extracted normally and without difficulty. The downloaded CVR recording contained four channels of good-quality audio data, with a total recording duration of 124 minutes and 0.3 seconds. The four channels contained audio information from each flight crew, one channel for a cockpit observer, and one channel for the Cockpit Area Microphone. The investigation team prepared a summary of approximately 30 minutes of CVR recording related to the two missed approaches and a transcript of approximately 13 minutes of CVR recording related to the occurrence.

Timings for the CVR recording were established by correlating the CVR events to common events on the FDR and then synchronizing those events with the FDR recorded time.

1.11.2 Flight Data Recorder

The aircraft was equipped with an L3Harris FA2100-4945-22 solid-state Flight Data Recorder (FDR), serial number 001211412.

The exterior and interior of the FDR were intact. The FDR was sent to the laboratory for readout, which was performed based on the interpretation document[21] provided by the Boeing Company. The FDR

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[21] FDR data interpretation – Digital Flight Data Acquisition Card (DFDAC) interface control document, d243u316, revision:s.

contained approximately 124 hours 58 minutes and 3 seconds of data, recording approximately 1,100 parameters.

Data from QAR, made by Teledyne Controls, which includes the relevant landing gear tilt position of the aircraft, is also available. Those corresponding QAR parameters were readout [22] and then time synchronized with the FDR recorded time.

Additionally, wind information was obtained from AWOS data of the RCTP Runway 05L.

A review of the flight data related to the occurrence is summarized as follows, time shown refers to Taipei local time (UTC+8):

1. Between 2007:05 and 2008:10, the aircraft had its radio altitude descend from 1,000 to 110 feet, airspeed from 181 to 173 knots, groundspeed from 161 to 158 knots, pitch attitude between 1.1 degrees down and 0.7 degrees up, roll attitude between 0.4 and 0.7 degrees left, magnetic heading altering between 65.8 to 63.7 degrees, TRA[23] of all engines between 53.5 and 55.6 degrees, Glideslope (G/S) deviation between 0.00313 Difference in Depth Modulation (DDM[24]) below and 0.00469 DDM above, and Localizer (LOC) deviation between 0 to 0.0078 DDM right. Autopilot was disengaged at 2007:43 at radio altitude of 430 feet. Windspeed varied between 25.6 and 33.3 knots, and wind direction changed between 85 and 93 degrees. At 2008:05

[22] QAR data interpretation – application requirements document for IDMU P/N 2252000-26 (Collins P/N 822-1799-102) acms application for Rockwell Collins, ard-col0053oprtr, revision:c.

[23] Corresponded TRA of all engine indicated throttle position, which is refered to Aircraft Maintenance Manual, Part I, UPS Rev48. 15 Jul 2025. D633U8101-UPS Chapter 76-11-00-212 ENGINE CONTROL SYSTEM-THRUST LEVER POSTION RESOLVER-FUNCTIONAL DESCRIPTION.

[24] Difference in Depth of Modulation (DDM) is an ILS parameter indicating an aircraft's deviation from the localizer course or glide path: zero denotes the centerline or glide path, while a greater absolute value denotes a greater deviation. According to ICAO definitions, the half course sector and half ILS glide path sector are bounded at DDM values of 0.0775 and 0.0875, respectively, each corresponding to one dot of deviation on the applicable aircraft display.

autothrottle was disconnected at radio altitude of 185 feet.

2. Between 2008:11 and 2008:15, the aircraft had its radio altitude descend from 92 to 36 feet, airspeed between 173 and 179 knots, groundspeed between 163 and 164 knots, rate of descent between 1,040 Feet Per Minute (FPM) and 752 FPM down, pitch attitude between 1.7 degrees and 0.7 degrees up, roll attitude between 0.7 degrees left and 3.1 degrees right, magnetic heading altering between 60.5 and 63.6 degrees, G/S deviation between 0.04536 DDM above and 0.15640 DDM above, and LOC deviation between 0.00626 and 0.00782 DDM left. TRA of all engines from 55 degrees to 48 degrees. Windspeed varied between 25.6 and 33.3 knots, and wind direction changed between 85 and 93 degrees.

3. At 2008:16, the aircraft had its radio altitude at 31 feet, airspeed 177 knots, groundspeed 164 knots, rate of descent 672 FPM down, pitch attitude 1.7 degrees up, roll attitude 0.4 degrees left, magnetic heading 60.1 degrees, G/S deviation at 0.17829, and LOC deviation at 0.00704 DDM left. TRAs were 40.3 degrees (ENG 1), 39.2 degrees (ENG 2), 36.2 degrees (ENG 3), and 34.5 degrees (ENG 4). N1 were 65.5% (ENG 1), 64.4% (ENG 2), 63.2% (ENG 3), and 61.5% (ENG 4), as it flew over Runway 05L threshold. Windspeed recorded at 27.4 knots with wind direction at 90 degrees.

4. Between 2008:17 and 2008:20, the aircraft continued to descend at airspeed 169 knots, then increased to 184 knots, it had its groundspeed between 164 and 160 knots, with a rate of descent reducing from 448 FPM to 240 FPM down, pitch attitude between 0 and 1.7 degrees up, and roll attitude between 1.8 degrees right to 2.5 degrees left. Magnetic heading altered between 60.2 and 59.5 degrees, G/S deviation between

0.23148 DDM below and 0.19081 DDM above, and LOC deviation between 0.00547 and 0.00704 DDM left. TRA remained at the same position. Wind conditions approximately remained.

5. Following 2008:21, the aircraft's left wing gear touched down as the recorded gear status changed from "air" to "ground" and QAR "landing gear tilt" changed from "tilt" to "notilt." LOC deviation was at 0.04 DDM right. Vertical acceleration recorded a maximum value of 1.2g's. The aircraft had its airspeed 174 knots, groundspeed 160 knots, pitch attitude 1.1 degrees up, roll attitude 2.5 degrees left, and magnetic heading 58.4 degrees.

6. Between 2008:21 and 2008:34, selected recorded parameters related to aircraft control inputs and attitude are listed in Table 1.11-1. At 2008:30 the aircraft had its largest roll angle during landing roll at 9.2 degrees right.

7. Engine TRAs and N1 variation between 2008:21 and 2008:40 are as follows:

   - Upon aircraft touchdown, ENG 1 TRA gradually increased from 36.4 degrees to 57.2 degrees while those of others remained approximately at the same positions between 34.3 degrees and 37.30 degrees.

   - Between 2008:23 and 2008:28, TRA of engines 2, 3, and 4 were reduced to between 23.9 degrees and 25.2 degrees while ENG 1 TRA remained between 57.9 degrees and 55.6 degrees. During the period, ENG 1 N1 increased from 39.9% to 70.2% while those of other engines remained between 36.9% and 39.6%.

   - At 2008:29, ENG 1 TRA was reduced from 55.6 degrees to 35.4

degrees in 2 seconds, while ENG 2 TRA was reduced from 24.5 degrees to 5.1 degrees, ENG 3 TRA was reduced from 23.8 degrees to 4.8 degrees, and ENG 4 TRA was reduced from 23.9 degrees to 5.1 degrees. ENG 1 N1 was recorded between 70.2% and 60.7% in the same period of time.

- Between 2008:38 and 2008:40, ENG 1 TRA began to reduce from 35.0 degrees to 4.9 degrees.

8. At 2009:58, the aircraft vacated Runway 05L.
9. The FDR stopped recording at 2011:51.
10. The following figures outline the phases of the flight occurrence:

- Figure 1.11-1 shows selected parameters of the occurrence flight;
- Figure 1.11-2 shows selected parameters related to the stabilized approach criteria when the aircraft was between 1,000 and 50 feet radio altitude;
- Figure 1.11-3 shows selected parameters of the occurrence flight when the aircraft was below radio altitude of 500 feet; and
- Figure 1.11-4 shows selected parameters for the duration from the aircraft's left wing gear touching down at 2008:21 until all ENG T/R stowed at 2008:39.

Table 1.11-1 Selected parameters related to aircraft control inputs and attitude during landing

Time	CAS/GND speed (kts)	Magnetic heading (deg.)	Rudder pedal Pos. (deg.)	Roll attitude (deg.)	Control wheel pos. (deg.)	Landing gear	Nose Gear Wow	Left wing gear	Left body gear	Right body gear	Right wing gear
						FDR	QAR				
								0= "notilt" / 1= "tilt"			
2008:21	174/160	58.4	2.4 left	2.5 left	12.7 right	GND	AIR	1→0	1→0	1→0	1→0
2008:22	174/159	58.4	2.1 left	0.4 left	32.7 left	GND	AIR	0	0	0	0
2008:23	167/157	58.1	2.7 left	3.9 left	1.2 left	GND	AIR	0	0	0	0
2008:24	158/156	57.4	3.7 left	9.2 left	0.6 right	AIR	AIR	0	0	0→1	0→1
2008:25	164/155	57.0	2.2 left	7.1 left	47.1 right	AIR	AIR	0	0	1→0	1→0
2008:26	166/154	57.4	2.0 left	2.1 left	12.5 left	GND	AIR	0	0	0→1	0→1
2008:27	169/153	57.7	1.5 left	4.2 left	7.0 right	AIR	AIR	0	1	1	1
2008:28	162/152	58.8	2.5 left	3.9 left	28.9 right	GND	AIR	0	0	1→0	1→0
2008:29	158/151	60.5	12.4 left	1.1 right	67.8 right	AIR	AIR	0→1	0	0	0
2008:30*	158/149	61.9	15.8 left	9.2 right	24.1 left	AIR	AIR	1	1	0	0
2008:31*	162/145	59.8	13.1 left	2.8 right	28.2 right	GND	AIR	1→0	1→0	0	0
2008:32*	149/142	57.4	21.2 left	6.3 left	35.4 right	GND	GND	0	0	0→1→0	0
2008:33*	144/139	55.6	21.3 left	2.1 left	25.2 right	GND	AIR	0	0	0	0
2008:34*	141/136	53.1	18.0 left	2.8 right	49.5 right	GND	GND	0	0	0	0

*ENG2, ENG3, and ENG4 thrust reversers deployed.

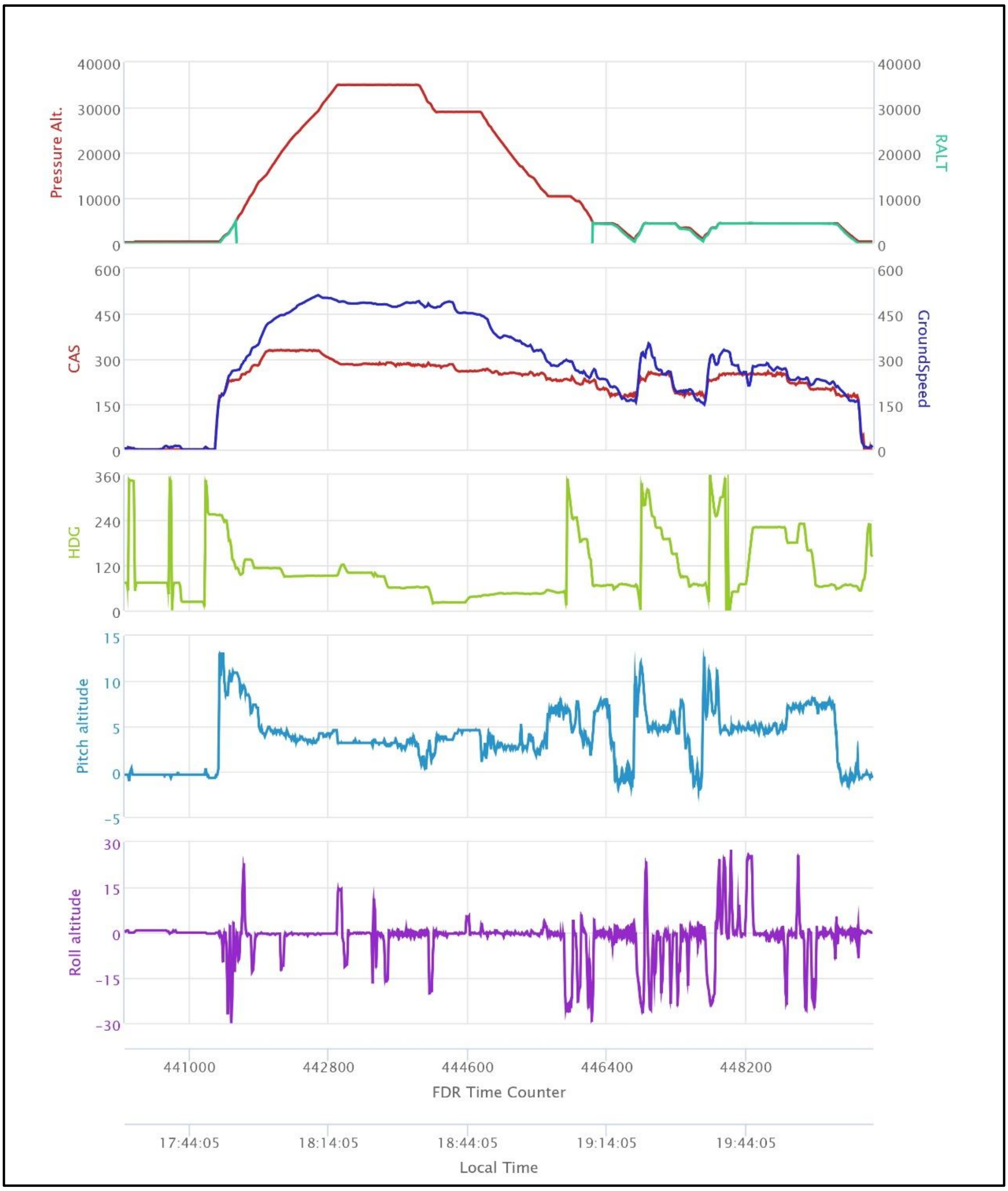

Figure 1.11-1 Selected parameters of the occurrence flight (1/3)

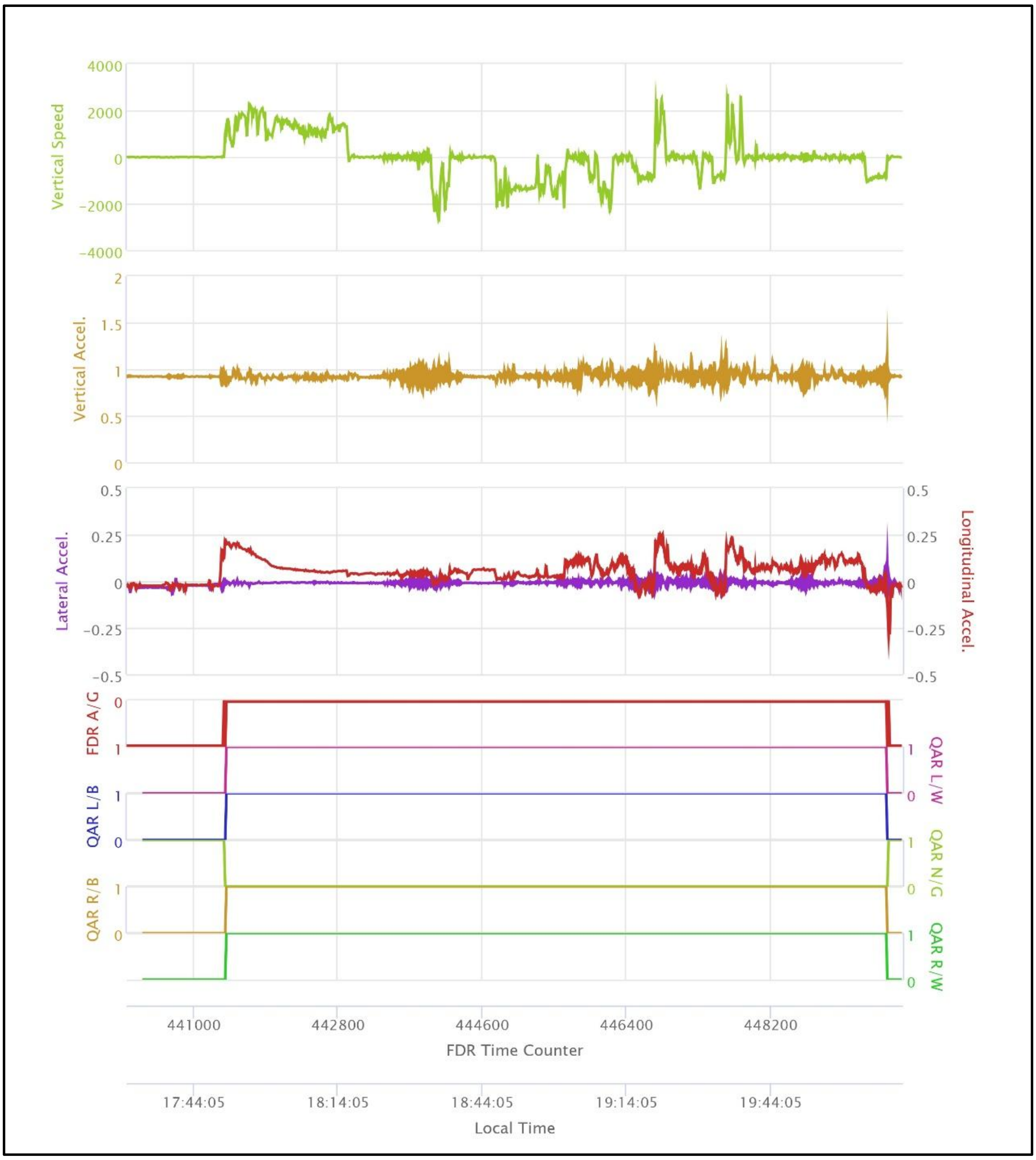

Figure 1.11-1 Selected parameters of the occurrence flight (2/3)

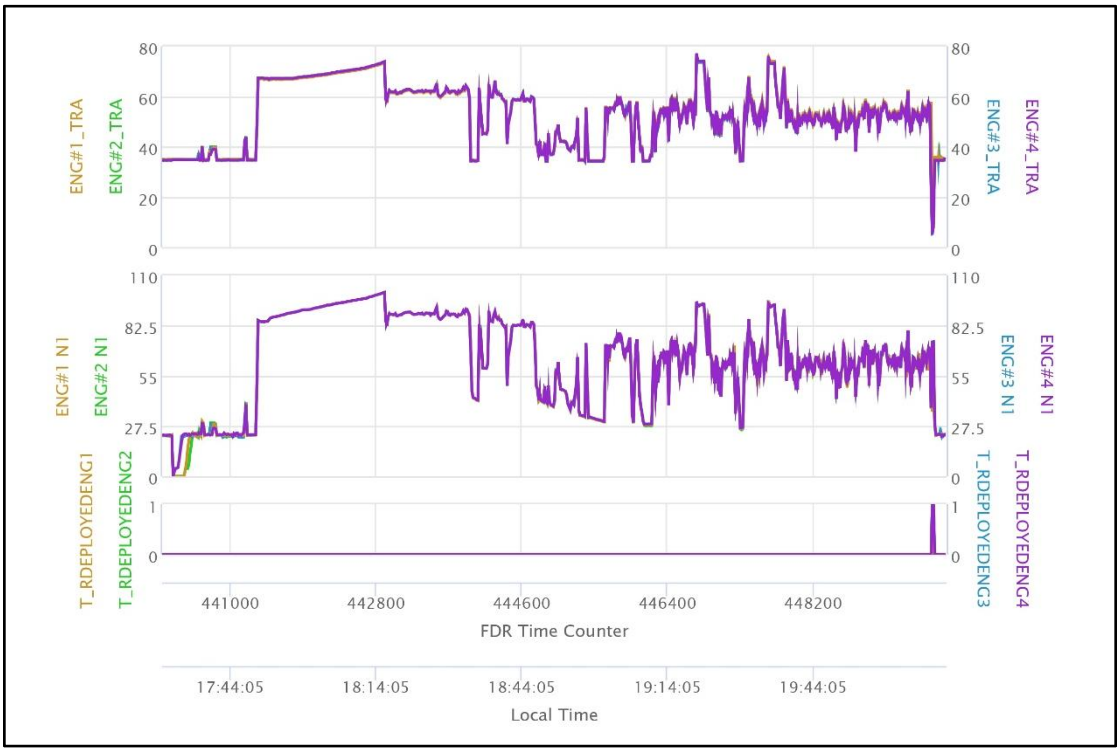

Figure 1.11-1 Selected parameters of the occurrence flight (3/3)

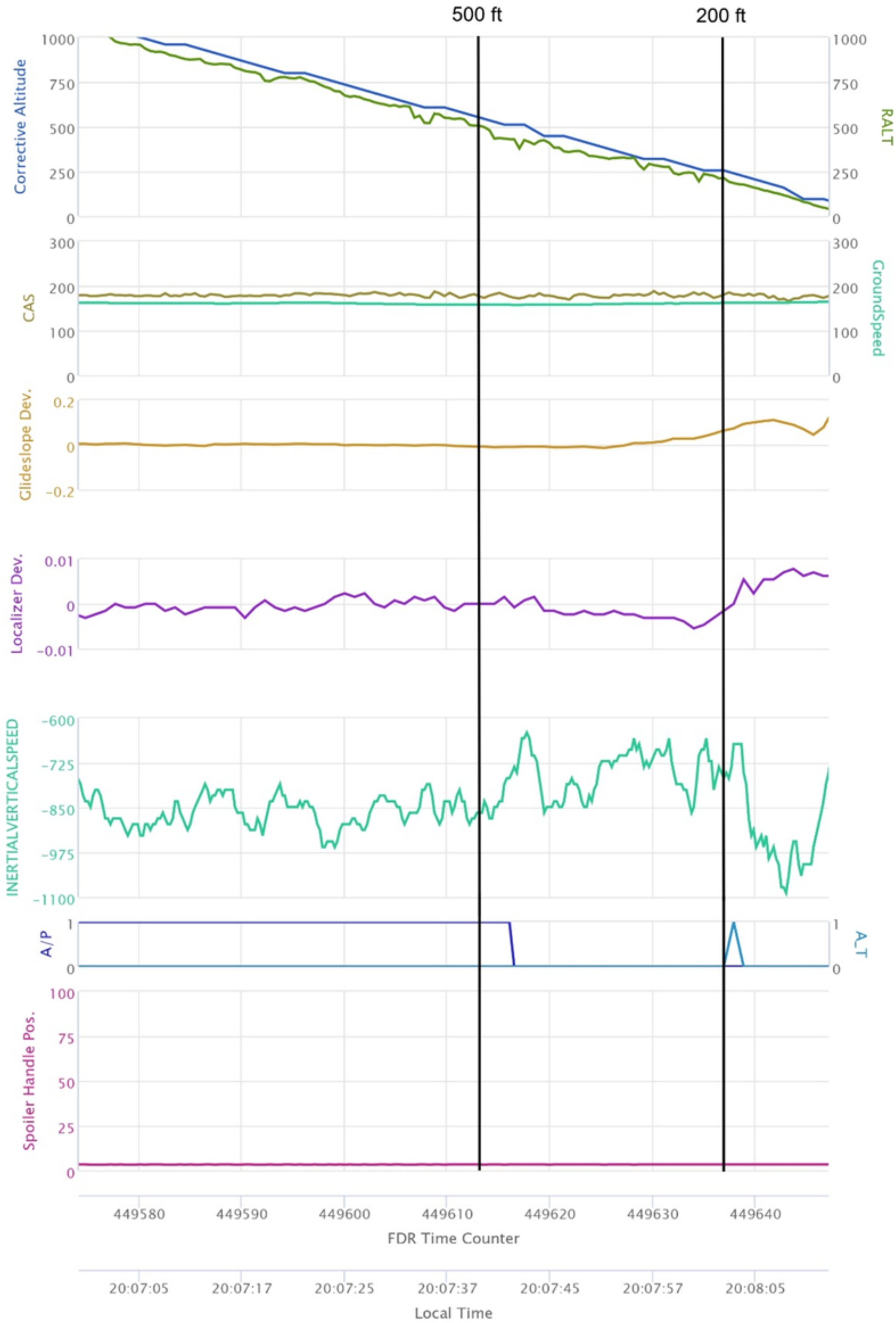

Figure 1.11-2 Selected parameters related to the stabilized approach criteria

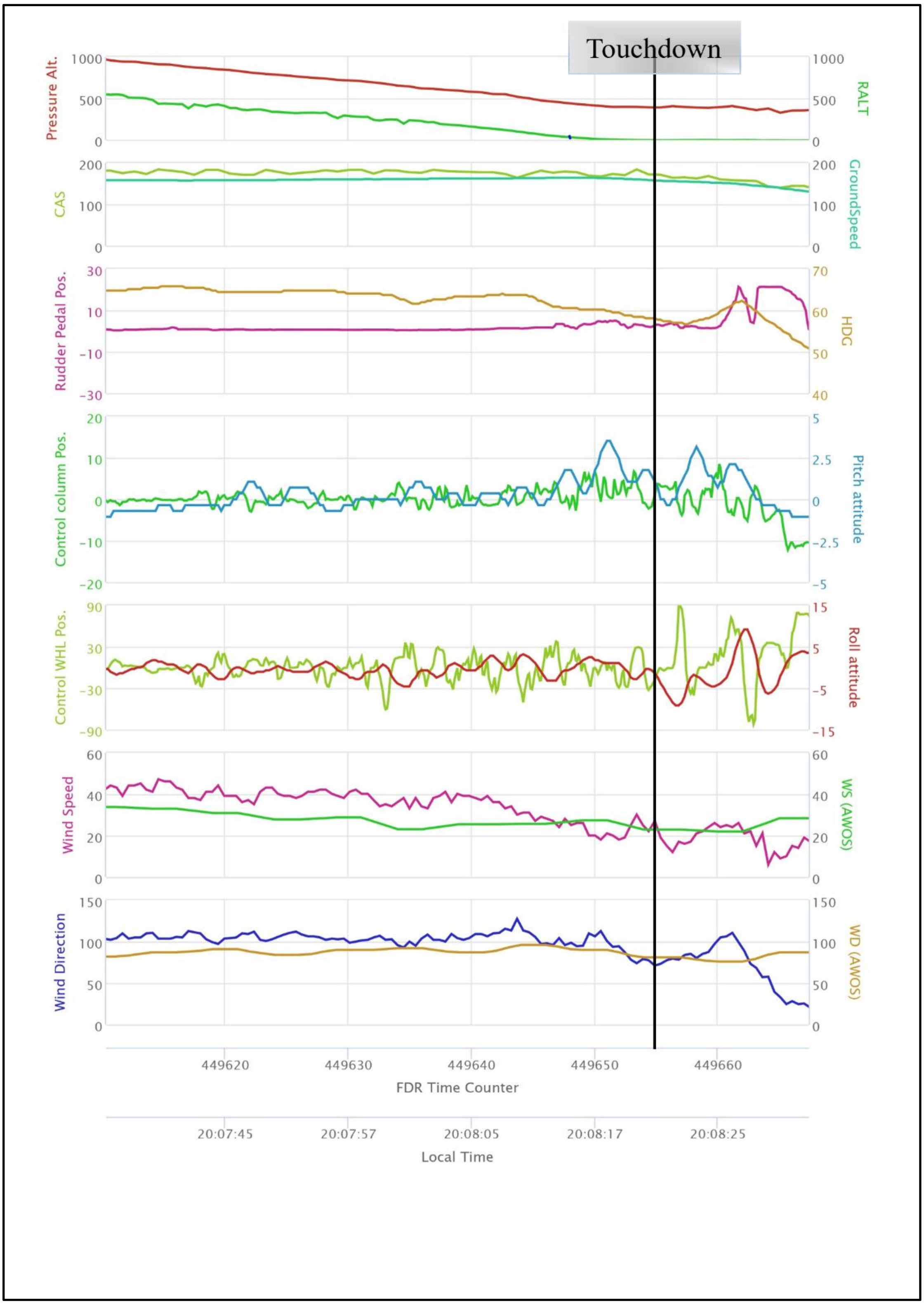

Figure 1.11-3 Selected parameters during landing phase (below RA 500 ft, 1/2)

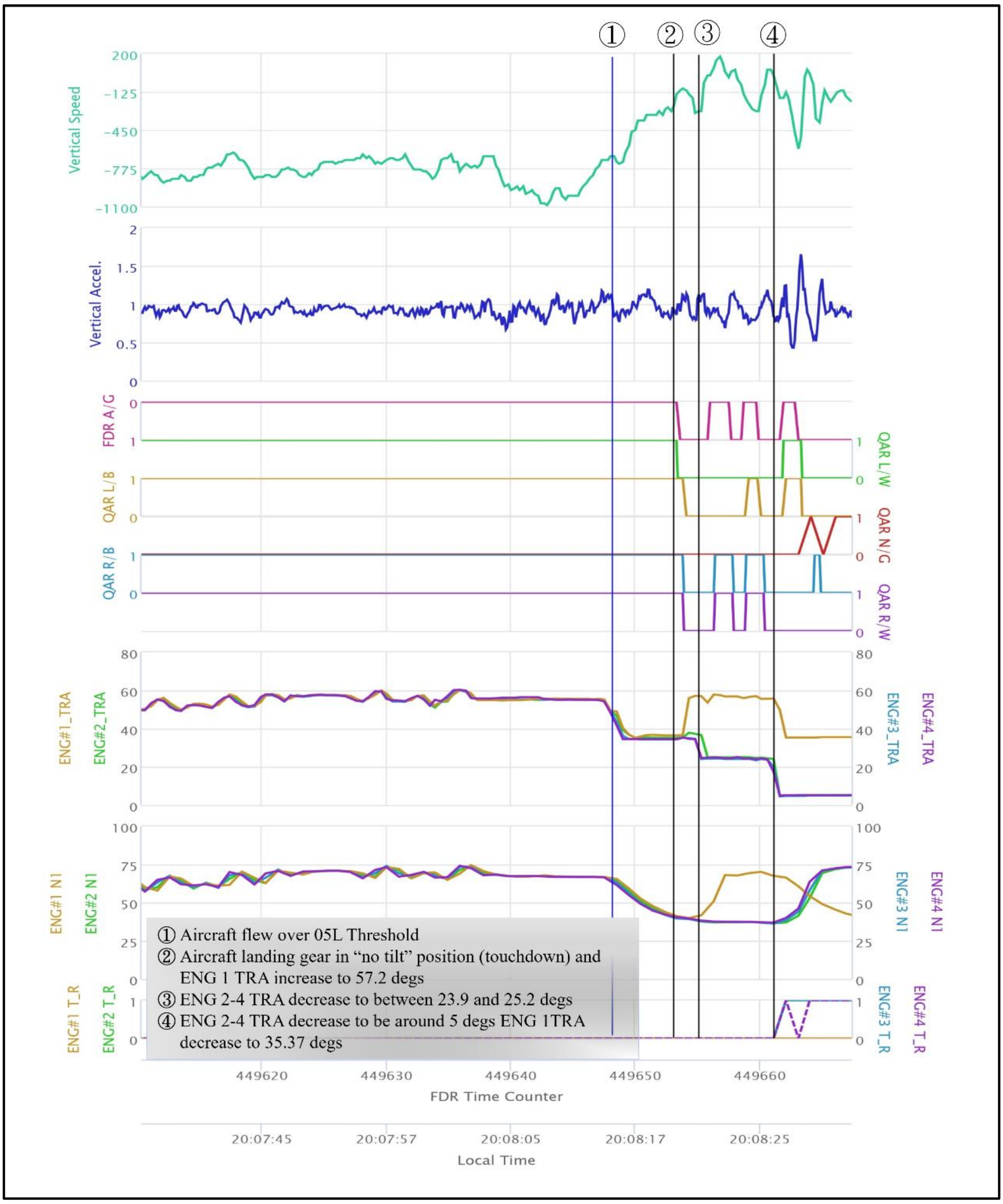

Figure 1.11-3 Selected parameters during landing phase (below RA 500 ft, 2/2)

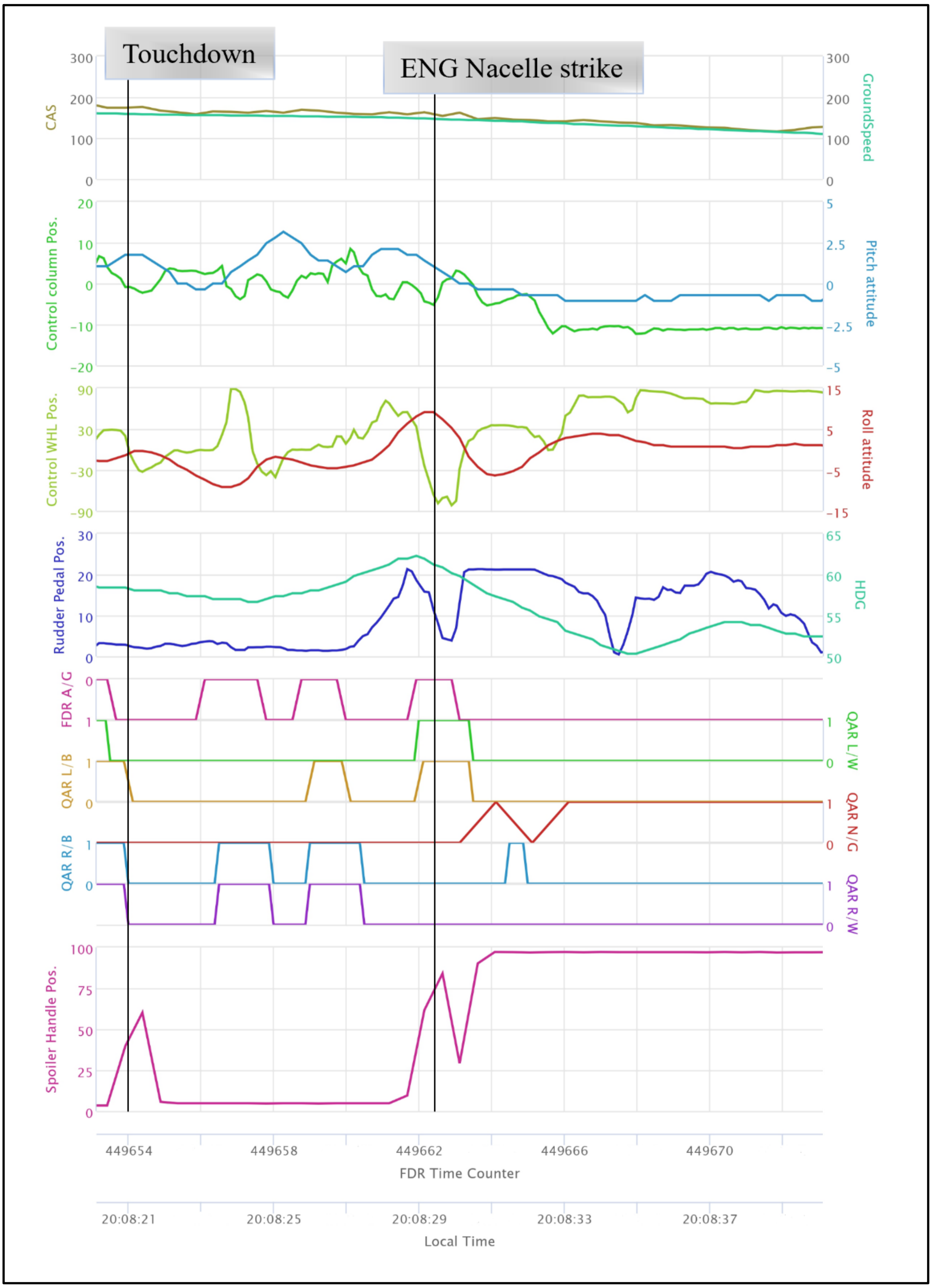

Figure 1.11-4 Selected parameters for the duration from the left wing gear touched down until all ENG T/R stowed (1/2)

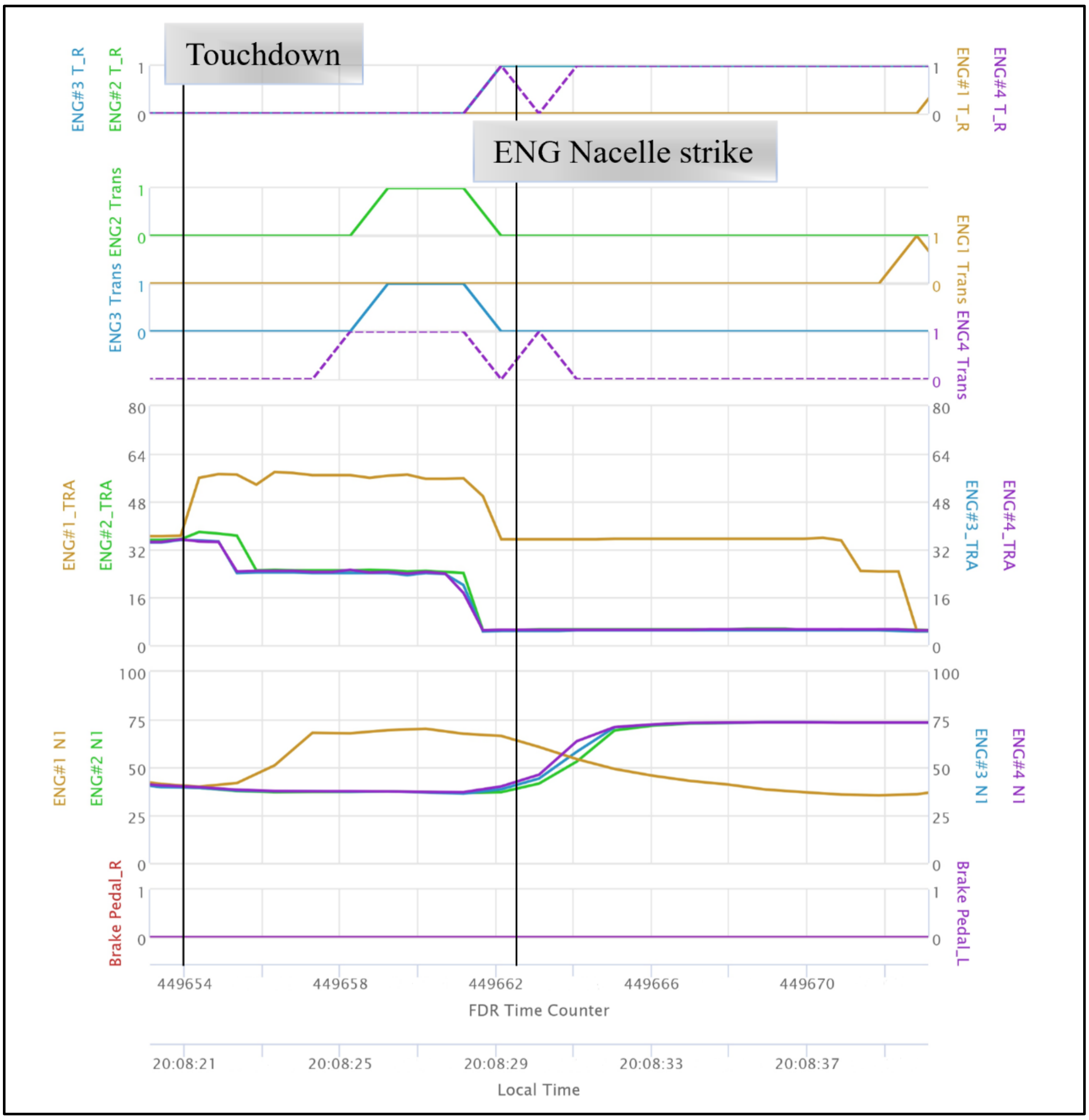

Figure 1.11-4 Selected parameters for the duration from the left wing gear touched down until all ENG T/R stowed (2/2)

1.12 Wreckage and Impact Information

1.12.1 Aircraft Damage

The damage sustained by the occurrence aircraft can be categorized into four major areas: the No. 4 engine and nacelle, the No. 3 engine nacelle, the wing, and the fuselage. These are described in detail below.

1.12.1.1 No. 4 Engine and Nacelle

The nacelle consists of the inlet cowl, fan cowl, and thrust reverser cowl. Following the occurrence, the inlet cowl remained attached to the engine, and the thrust reverser cowl remained attached to the pylon; however, both exhibited impact and abrasion damage on their lower surfaces due to ground contact.

The four latch assemblies on the lower side of the fan cowl separated from the cowl structure, causing the fan cowl to become unsecured. Consequently, both the inboard and outboard halves detached from the pylon and were scattered across the runway surface and adjacent grass areas.

The No. 4 engine itself was compressed by the displaced inlet and thrust reverser cowls. The thrust reverser channel, attached to the aft portion of the fan case, was found fractured and separated. Several tubes and support brackets located in the lower section of the engine were deformed due to compression. Notably, the air starter was forced upward, causing a crack in the aft face of the accessory gearbox casing.

Although the lower portion of the engine sustained damage, data recorded in the FDR indicates that the No. 4 engine continued to operate normally until it was shut down after taxi-in. The data also indicated that, following the ground impact, the engine oil quantity was approximately five quarts lower than that of the other engines.

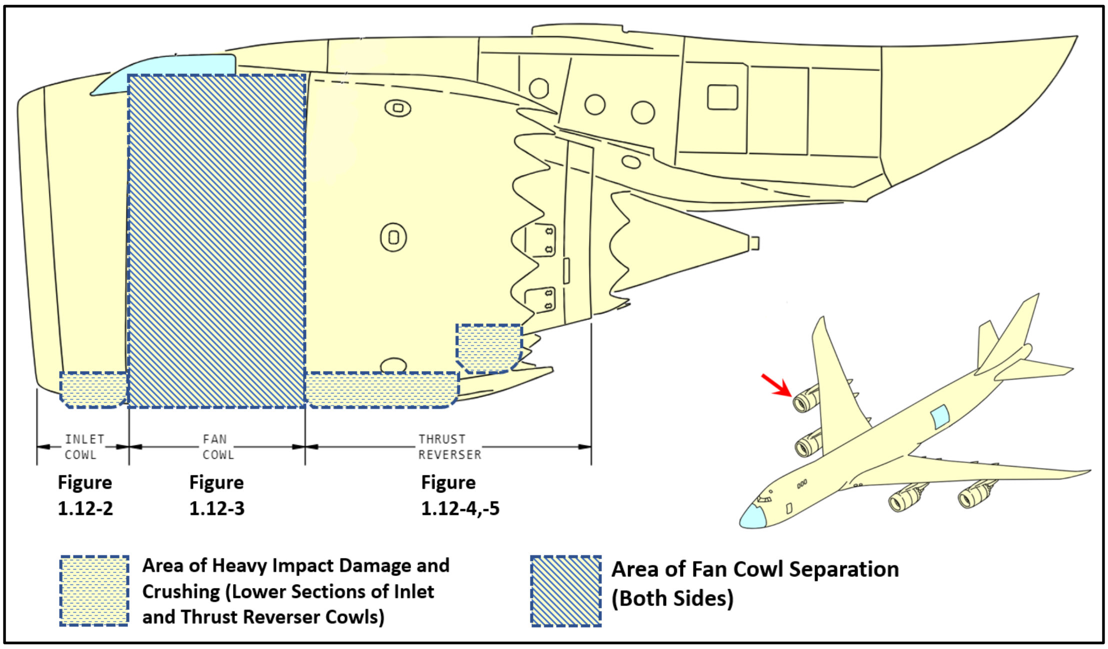

Figure 1.12-1 No. 4 engine nacelle damage areas

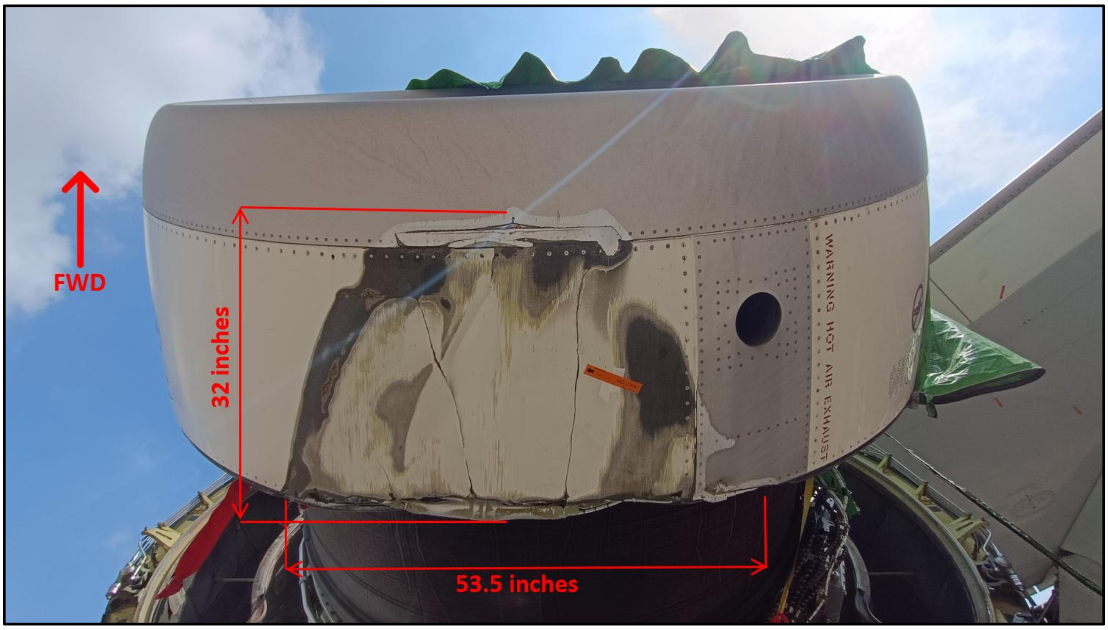

Figure 1.12-2 No. 4 engine inlet cowl damage areas (bottom view)

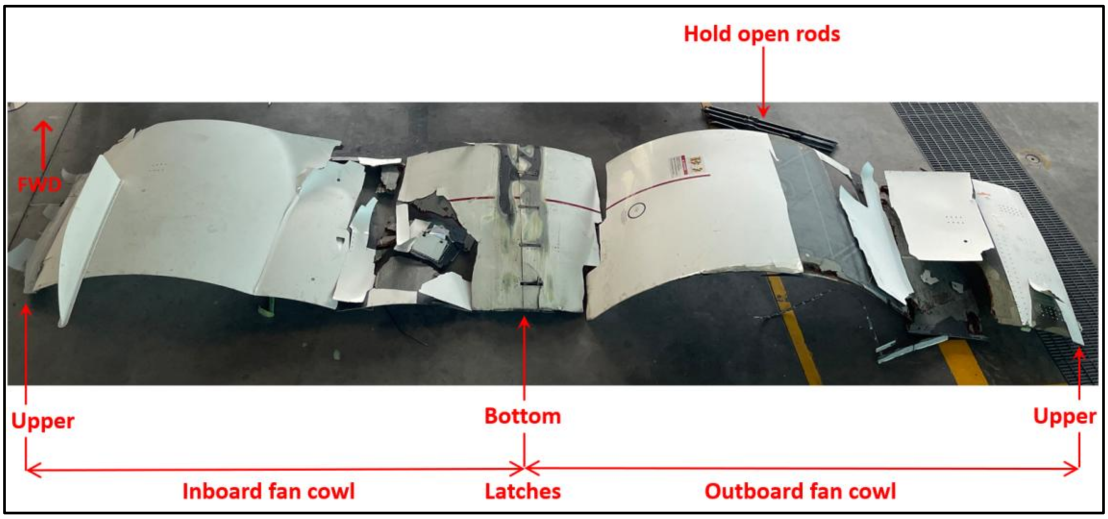

Figure 1.12-3 Reassembled fragments of the No. 4 engine fan cowl

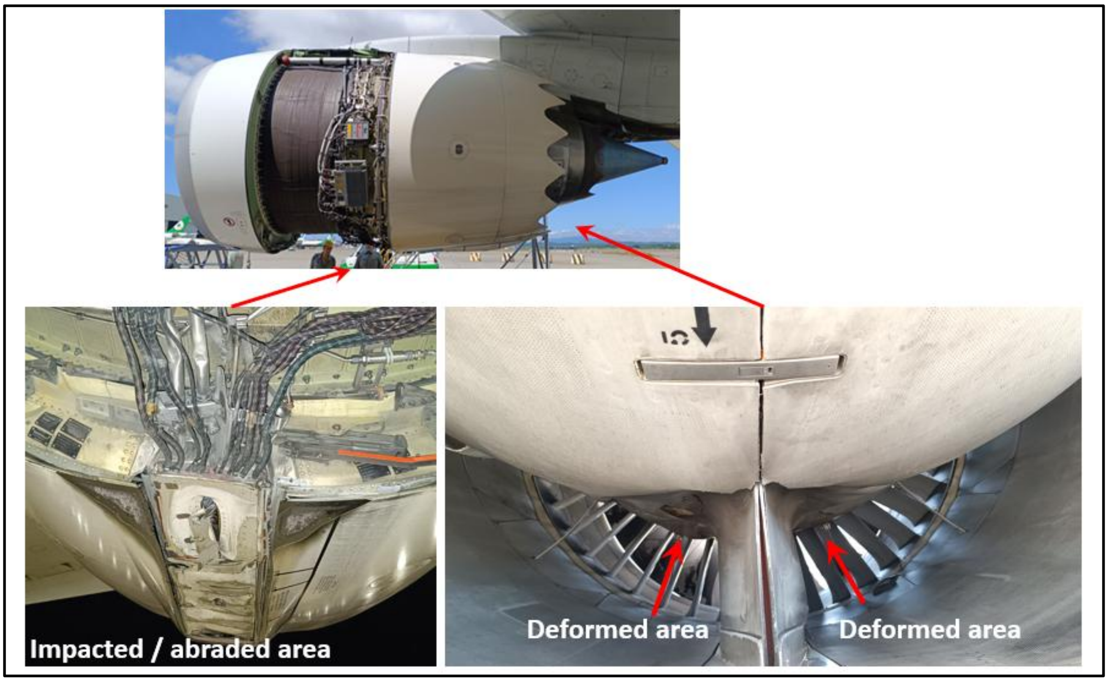

Figure 1.12-4 No. 4 engine thrust reverser cowl damage areas

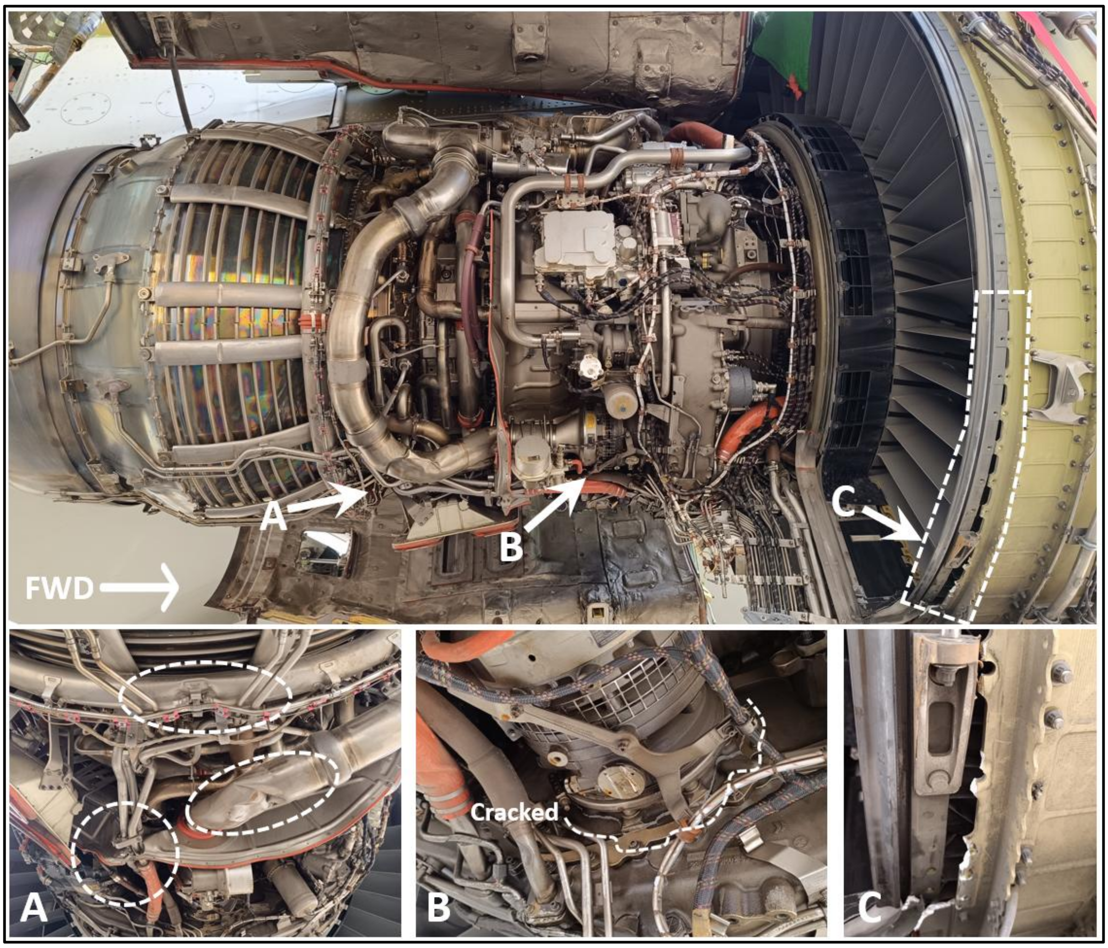

Figure 1.12-5 No. 4 engine damage areas (right side view)

1.12.1.2 No. 3 Engine Nacelle

The No. 3 engine nacelle sustained contact damage to the lower surface of the reverser cowl at the 6 o'clock position, specifically beneath the drain mast, due to ground abrasion.

1.12.1.3 Wing

The right wing sustained minor damage. Components detaching from the No. 4 engine nacelle struck the right wing, causing minor dents and scratches to the leading edge at Inboard Leading-Edge Station (ILES) 975, the panel of Variable Camber Flap (VCF) 21, and the wing surface at Wing Station (WS) 947 (Panel U-18R).

1.12.1.4 Fuselage

The fuselage sustained minor damage concentrated in three specific areas:

- Dents and scratches on the forward upper side of the right-hand Auxiliary Power Unit (APU) door skin external surface near Station (STA) 2658.
- Damage on the fuselage bonded skin assembly external surface between STA 2638 and 2658 at Stringer 25 Right (S-25R).
- Two dents on the right-hand fuselage skin near STA 1760, located between Stringer 20 Right (S-20R) and 22 Right (S-22R).

1.12.2 Site Survey

Examination of Runway 05L at RCTP revealed two scrape marks, one indicative of contact with the No. 4 engine nacelle, and the other with the No. 3 engine nacelle drain mast.

The scrape mark from the No. 4 engine nacelle (labeled as R1) started at approximately 3,880 feet from the runway threshold and 50 feet to the right of the centerline, and terminated at approximately 4,090 feet from the runway threshold and 60 feet to the right of the centerline, with a total length of 210 feet. The mark veered 3 degrees to the right of the runway centerline direction.

The scrape mark from the No. 3 engine nacelle drain mast (labeled as R2) started at approximately 3,965 feet from the runway threshold and 27 feet to the right of the centerline, and terminated at approximately 3,985 feet from the runway threshold and 28 feet to the right of the centerline, with a total length of 20 feet. The mark veered 3 degrees to the right of the runway centerline direction.

In addition to the two scrape marks, approximately 40 pieces of aircraft debris[25], marked by the airport operations officers, were identified as debris from the No. 4 engine and were distributed along the runway surface between 4,080 and 5,300 feet from the runway threshold.

The site survey item list and its distribution on Runway 05L are shown in Table 1.12-1 and Figure 1.12-6, respectively. Figure 1.12-7 shows photographs of the two scrape marks.

Table 1.12-1 Site survey item list

No.	Site survey item	Distance from Runway 05L threshold (ft)	Length (ft)
1	Scrape mark of No. 4 engine nacelle (R1)	3,880~4,090	210
2	Scrape mark of No. 3 engine nacelle drain mast (R2)	3,965~3,985	20
3	About 40 pieces of debris from No. 4 engine	4,080~5,300	n/a

[25] After 2 weeks from occurrence, there are about 40 more smaller pieces of debris found at nearby grass field (Runway Safety Area, RSA) northern from the paved runway.

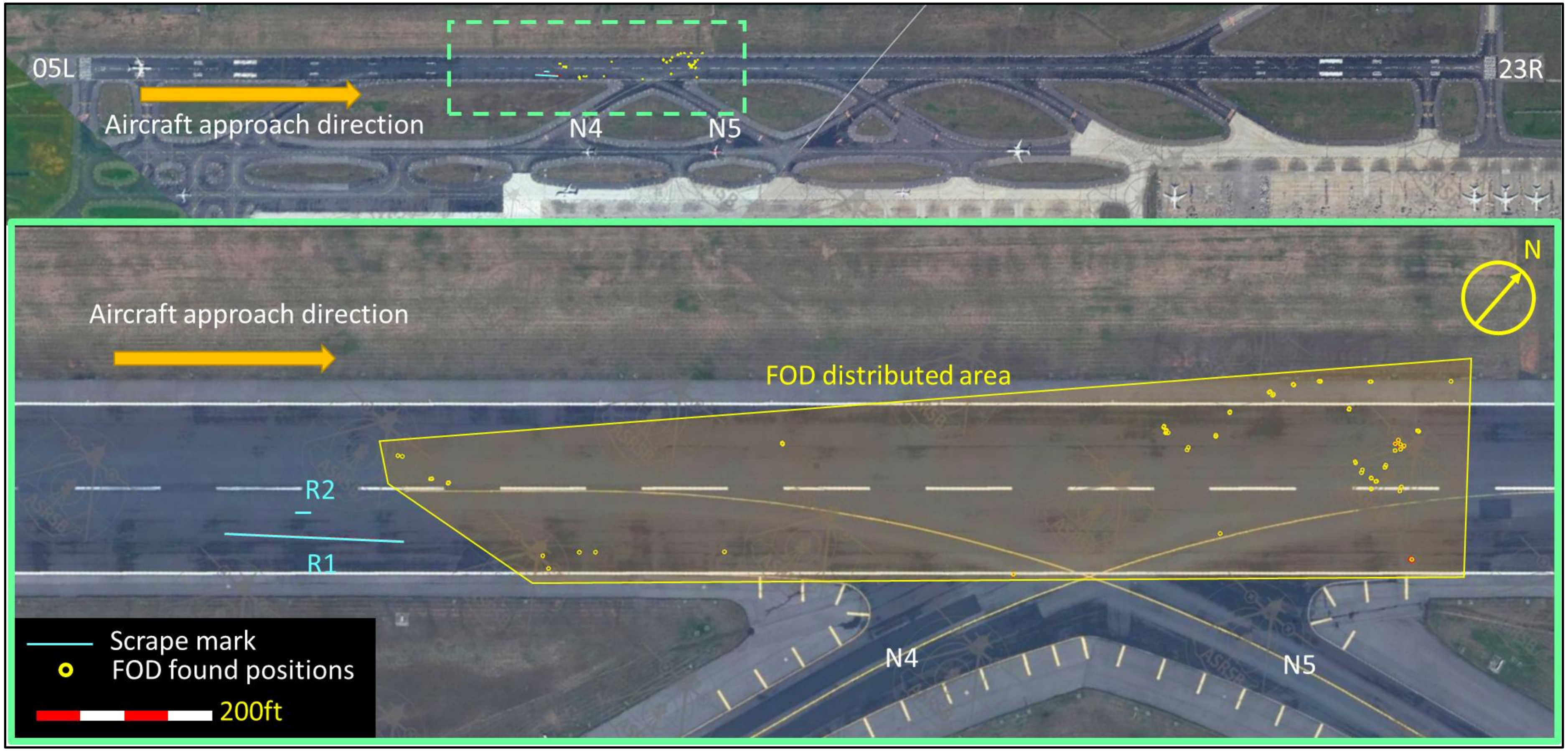

Figure 1.12-6 Distribution of site survey items on Runway 05L

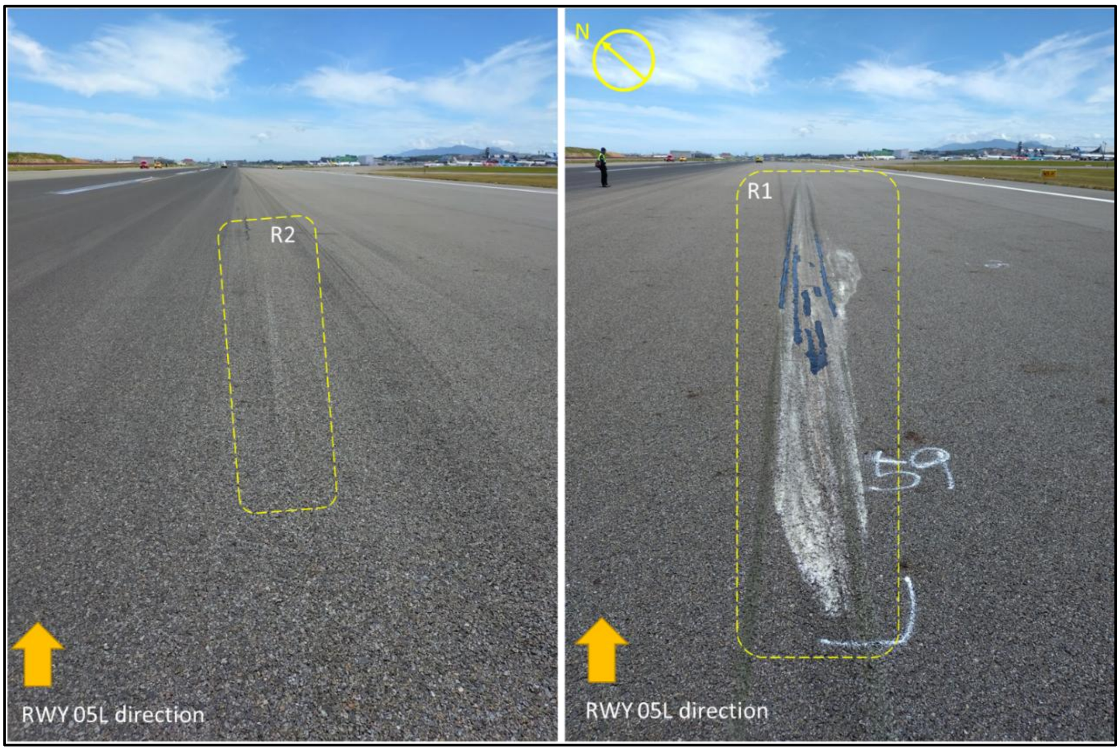

Figure 1.12-7 Scrape marks observed on Runway 05L

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 fire damage on the aircraft.

1.15 Survival Aspects

No search and evacuation were required as a result of this occurrence.

1.16 Tests and Research

There were no specific tests and research done in this investigation.

1.17 Organizational and Management Information

UPS Airlines, established in 1988, is an American cargo airline owned by United Parcel Service, Inc. Headquartered in Louisville, Kentucky, it operates as one of the world's largest air freight carriers, managing a global hub-and-spoke network that connects major regional and international centers. The airline provides scheduled cargo services to more than 220 countries and territories, forming a core component of UPS's international logistics operations. As of 2025, UPS Airlines operates a fleet of 292 owned aircraft and about 210 leased or chartered aircraft, including B747-8F, B747-400F, B767-300F, B757-200F, Airbus A300-600F, and McDonnell Douglas MD-11F.

1.18 Additional Information

1.18.1 Interview Summaries

1.18.1.1 The Captain

The occurrence flight was delayed due to the weather in Taipei. The crew received a flow time of 0930 UTC, at which the aircraft pushed back and was airborne at 0950 UTC. The captain served as PF of the flight. The flight deviated for weather, descended early, and was instructed to hold at JAMMY. After descending into the hold, the crew received vectors for the approach.

The captain stated that the crosswind limit of SOP is 30 knots, including gusts. On the first approach, the wind exceeded the limits, so the crew performed a missed approach and was vectored around for a second approach. The winds were also out of limits for the second approach, so the crew went around again. After the second missed approach, the crew contacted the company to consider options. The alternate was Clark in the Philippines, and the aircraft carried sufficient fuel to continue holding and to attempt further approaches.

Later, the wind became within limits, and the crew discussed and decided to try another approach. The last ATIS was Tango with winds being reported as 100 at 23 gusting to 36. This resulted in a maximum crosswind component of 28 knots and a headwind of 23 knots. The calculated crosswind component was within operational limits, and the crew decided to continue the approach. The third approach was stable, despite gusts, windshear, and turbulence, all within limits and compliant with the stable approach criteria.

The captain stated that the company's stabilized approach policy allows a max target speed of V_{APP}[26]+20 knots on approach. The stabilized approach criteria require V_{APP}+20/−5 knots at 1,000 feet, and within 5 knots below 500 feet. Because the final approach was manually flown with the autothrottle disconnected, the crew carried V_{APP} of V_{REF}[27]+20, requiring additional energy dissipation during flare. The autopilot was disconnected below 1,000 feet, and the autothrottle was disconnected prior to landing, in accordance with company procedures.

The captain stated that, after all four thrust levers were retarded to idle and touchdown was confirmed by the first officer's "speedbrakes up" call, he removed his hand from the thrust levers to immediately raise all thrust reverser levers to the interlock position and applied light pressure until release. A "reversers normal" call was then made by the first officer, followed shortly by a "no reverse engine one" call from the ACM. The captain stated that he was not aware that only three, rather than all four, thrust reversers had been raised, and that he may have inadvertently advanced the No. 1 forward thrust lever while

[26] V_{APP} is the target speed flown during the final approach, derived from V_{REF} and adjusted as necessary for wind or other operational considerations.

[27] V_{REF} is the reference landing speed used as the target speed at the runway threshold, providing an adequate margin above stall speed in the landing configuration. According to the UPS B747 FCTM: If the autothrottle is disconnected, or is planned to be disconnected prior to landing, maintain V_{REF} plus the wind additive until approaching the flare. The steady headwind additive is bled off before touchdown while the gust correction is maintained to touchdown. Plan to touchdown at V_{REF} plus the gust correction. With proper airspeed control and thrust management, touchdown should occur at no less than V_{REF}- 5 knots.

responding to the “no reverse engine one” call. He further stated that his primary focus at that time was maintaining directional control of the aircraft, which most likely became an issue as a result of the retraction of the speedbrakes following the inadvertent advancement of the No. 1 thrust lever.

The captain’s perception at the time was that the aircraft was experiencing a strong gust from the right and had possibly become airborne again. He believed that the No. 4 engine nacelle strike might have occurred while he was applying corrective inputs in response to the lifted right wing. There were no indications of the strike in the aircraft except for a “No. 4 REVERSER” EICAS message that appeared while taxiing clear of the runway. The aircraft exited via N9 and taxied to the parking gate.

It was in the post-flight that the crew discovered that there was damage to the No. 4 engine. Aside from the reverser advisory message, there were no other abnormal indications during taxi.

1.18.1.2 The First Officer

The first officer was the PM of the occurrence flight. The first officer stated that the flight was delayed in Hong Kong while the crew waited for the wind speed to decrease. The actual takeoff time was about one and a half hours later than scheduled. While en route to TPE, the crew maneuvered around the typhoon and then entered a brief holding prior to the first approach.

During the first and second approaches, the winds reported were out of limits, and the crew went around before attempting landings. The crew was then radar vectored for a holding and consulted with the company. The company advised that a diversion to Clark be considered in the event landing could not be accomplished, and the crew reviewed the routing to Clark during the hold. Later, the updated wind report was within limits, and therefore, the crew attempted a third approach.

The first officer stated that the third approach met their company's stable approach criteria and touched down normally. He described the main factor for a stabilized approach is the descent rate of 1,200 FPM or less, and the speed within plus five knots of the approach speed, which was 177 knots for the last approach. The first officer stated that after touchdown, he saw the speedbrake deployed and made the standard call "speedbrakes up". As he observed the reversers begin to indicate normal on the display, the aircraft encountered wind gusts on the runway, and the right wing was lifted. His attention then turned from the display to an outside scan. Since the reversers were already deployed, it is not an option for the crew to perform a go-around. As the pilot monitoring, the first officer recalled he gave a "reversers normal" call followed by a "right wing down" call to provide verbal guidance, and the captain corrected it.

The first officer stated that after the aircraft attitude returned to a normal trend, he shifted his scan back to the display and noticed that the No. 1 reverser was not indicating deployment. Almost simultaneously, the ACM called out "no reverse, engine one" and he observed the captain corrected the throttle position; therefore, he did not make an additional call for the reverser.

Although the crew suspected possible damage from the oscillations during rollout, there were no indications on the instruments except for the "NO. 4 REVERSER" caution, which came up as the aircraft exited the runway. Nevertheless, the damage could not be confirmed until the aircraft vacated the runway and parked.

After parking, the first officer remained in the cockpit while the jump seater conducted a walk-around, during which he saw people gathered around the No. 4 engine and confirmed the damage. As soon as the crew was aware of the damage, the first officer notified Taipei Tower on the tower frequency immediately.

According to the first officer, the company's crosswind limit is 30 knots, and during the approaches, he calculated the crosswind component with real-time wind checks from the tower to decide whether to continue at around 500 feet. The first officer recalled that it was initially 40 knots with the wind from 100 degrees. Later, the wind shifted to 090 degrees, which was more aligned with the runway, and its speed decreased as well to be within the limits for the final approach. The first officer recalled that for the last approach, the steady wind was approximately 23 knots, with gusts in the low 30s.

The first officer recalled that the taxi route was N9, N, then Spot 515, which was a very short taxi.

The first officer stated that he was unsure about the dispatch policy under typhoon, but explained that the general policy is that if the weather is forecast to be within limits, the flight proceeds. He noted that the occurrence flight was delayed due to forecast winds, but subsequent updates indicated that the winds would be within operational limits by the time of arrival.

1.18.1.3 The Additional Crew Member

The ACM was scheduled to operate the flight from Taipei to Anchorage the following day. This sector was therefore a positioning flight for him. Given the weather conditions of the flight, after discussion, the captain agreed that the ACM would sit in the cockpit observer's seat to assist the crew.

Throughout the flight, the crew checked the weather regularly. Upon receiving the ATIS from TPE, the reported wind exceeded the limits with only a small margin. Therefore, the crew decided to shoot an approach and request an update on wind from the tower. After receiving the landing clearance, the crew checked the wind with the tower again and discontinued the approach at approximately 500 or 600 feet due to the wind being over limits. The go-around was uneventful.

The condition was similar for the second approach. When the crew received the landing clearance, the wind was within limits. However, a subsequent wind check on final was again outside limits and resulted in another go-around at approximately the same altitude as the first approach.

According to the ACM, at the beginning of the third approach, the wind reported by approach control did not exceed the limits and stayed within limits for the whole approach. The ACM monitored the descent rate and the airspeed closely from the observer's seat. It was a stabilized approach, and therefore there was no reason to go-around.

The landing was initially uneventful on touchdown, and the first officer made the “speedbrakes up” and “reversers normal” calls. Shortly after touchdown, the right wing started to come up. The first officer called out, and the captain corrected it. There was a bit of lateral roll because of the crosswind. He was surprised that it was the engine that made contact on the right side. The crew was unsure if something would have made contact or not from the cockpit. He also noted that he observed three green “REV” indications on the upper EICAS and noted that the No. 1 thrust reverser was not yet in reverse. He recalled that he called “no reverse, engine one” and the captain then selected reverse on No. 1 engine.

The ACM recalled the winds reported during the approaches were varying from 090 to 100, and maybe 080. For the last approach, the wind reported by the tower was 090 at 28 knots, gusting to 38 knots, with a crosswind component of about 24 knots.

The ACM stated that both he and the first officer did the crosswind component calculations. The company crosswind limit for dry runway is 30 knots, including gusts. Stable approach criteria require the aircraft to be flown on the proper glide path with a descent rate of 1,000 FPM or less at 1,000 feet AGL (up to 1,200 FPM if briefed), and airspeed within +20/-5 knots of the approach speed. At 500 feet AGL, the thrust lever position had to be correct and the airspeed within +5 knots.

The ACM stated that the crew used V_{APP} in accordance with Boeing procedures. V_{APP} is calculated as V_{REF} plus 1/2 the steady headwind component and all of the gust factor, with a maximum addition of 20 knots. For the last approach, the approach speed was 177 knots.

The ACM did not notice any indication of the strike on the instruments. After the door opened, the captain asked him to see if there might have been some damage. It was when he saw people gathered near the right side of the aircraft that he noticed the damage. The ACM immediately advised the first officer to call the tower and report potential FOD.

The ACM explained that company policy does not prohibit attempting an approach if the wind in ATIS exceeds the limits, as the ATIS may be 30 minutes or an hour old. Usually, the crew waits until they receive a landing clearance and then checks with the tower for the most current wind. However, visibility has stricter limits. It is not legal to start an approach if it is below the minimum.

The ACM stated that in the U.S. the PIC shares joint responsibility for flight safety with the dispatcher and can delay or cancel a flight based on the weather forecast. In this case, the flight was initially delayed departing Hong Kong and further delayed due to slot restrictions. While in flight, the ACM also discussed with the dispatcher that Clark was a suitable alternate and the route would avoid the weather if diversion was necessary.

1.18.2 Manual Information

1.18.2.1 Aircraft Operational Procedures and Limitations

Manual information related to the B747-8F—covering crosswind limitations, autoland limitations, stabilized approach criteria, approach speed, landing procedures and techniques, crosswind landing techniques, reverse thrust operation, and pitch and roll limit conditions—was collected by the investigation team, subsequently verified by UPS, and will be used for further analysis.

1.18.2.2 Tower Controllers' Operations

According to the Air Traffic Management Procedures (ATMP)[28] jointly published by the Civil Aviation Administration and the Air Force Command Headquarters of Taiwan, the relevant operating procedures when tower controllers visually observe an abnormal aircraft landing (such as one accompanied by sparks) are described in Chapter 3 Aerodrome Traffic Control-Terminal, as follows:

3-1-5 Runway Incursion or Obstructed Runway

a. In the event the aerodrome controller, after a take-off clearance or a landing clearance has been issued, becomes aware of a runway incursion or the imminent occurrence thereof, or the existence of any obstruction on or in close proximity to the runway likely to impair the safety of an aircraft taking off or landing, appropriate action shall be taken as follows:

1. cancel the take-off clearance for a departing aircraft;

2. cancel the landing clearance for a landing aircraft and take any other necessary measures or instruct a landing aircraft to execute a go-

[28] The ATMP (18th edition, effective September 25, 2024), Sections 3-1-5, 3-1-10, and 3-1-11, are largely consistent with those of ICAO Doc 4444 (Procedures for Air Navigation Services — Air Traffic Management), Sections 7.4.1.4 and 7.4.1.7, Amendment No. 12, 16th edition, effective November 28, 2024.

around or missed approach as the case maybe;

3. *in all cases inform the aircraft of the runway incursion or obstruction and its location in relation to the runway.*

b. *Pilots and air traffic controllers shall report any occurrence involving an obstruction on the runway or a runway incursion.*

3-1-10 Observed Abnormalities

Whenever an abnormal configuration or condition of an aircraft, including conditions such as landing gear not extended or only partly extended, or unusual smoke emissions from any part of the aircraft, is observed by or reported to the aerodrome controller, advise the aircraft without delay.

3-1-11 Suspected Damage on Departure

When requested by the flight crew of a departing aircraft suspecting damage to the aircraft, the departure runway used shall be inspected without delay and the flight crew advised in the most expeditious manner as to whether any aircraft debris, or bird or animal remains have been found or not.

1.18.3 Sequence of Events

The sequence of events of the occurrence flight is listed in Table 1.18-1.

Table 1.18-1 Sequence of events

Taipei Time	Event	Source
1750	Takeoff from VHHH Airport	FDR
1849:25	CVR recording started	CVR
1916:23	RCTP tower reported wind 100 degrees 21 knots gusting 45 knots for Runway 05L, cleared to land	CVR
1919:41	At 682 feet RA, RCTP tower reported wind 090 degrees at 29 knots gusting 45 knots for Runway 05L	CVR, FDR
1920:03	At 370 feet RA, wind speed increase was noted, and the PF initiated go-around for the first approach	CVR, FDR

Taipei Time	Event	Source
1932:15	RCTP tower reported wind 090 degrees at 30 knots gusting 39 knots for Runway 05L, cleared to land	CVR
1934:44	At 527 feet RA, RCTP tower reported wind 100 degrees at 29 knots gusting 43 knots for Runway 05L	CVR, FDR
1934:52	At 428 feet RA, the PF initiated go-around for the second approach	CVR, FDR
1951:06	The crew informed RCTP approach of the decision for another approach	CVR
2003:55	RCTP tower reported wind 090 degrees at 26 knots gusting 38 knots for Runway 05L, cleared to land	CVR
2005:50	RCTP tower reported wind 090 degrees at 28 knots gusting 38 knots	CVR
2006:24	RCTP tower local controller cleared BR6032 to land on Runway 05L in a landing sequence number two	Radio Transcripts
2007:01	The PM called out "one thousand feet stable sinks eight hundred"	CVR
2007:04	The PF called out "runway in sight"	CVR
2007:37	The PM called out "five hundred feet stable sinks eight hundred"	CVR
2007:43	At 430 feet RA, autopilot disconnected	FDR
2008:05	At 185 feet RA, autothrottle disconnected	FDR
2008:14	Auto altitude callout "fifty"	CVR
2008:15	Auto altitude callout "forty"	CVR
2008:16	Auto altitude callout "thirty"	CVR
2008:17	Auto altitude callout "twenty"; Thrust levers (ALL) were moved to idle position	CVR, FDR
2008:18	Auto altitude callout "ten"	CVR
2008:21	The aircraft touched down; Speedbrake lever began moving toward "UP" and speedbrakes began to extend	CVR, FDR
2008:22	The PM called out "…speedbrakes up keep right wing down right wing down" The No. 1 forward thrust lever was advanced out of idle position;	CVR, FDR

Taipei Time	Event	Source
	Speedbrake lever moved back toward "DOWN" and speedbrakes were retracted after one second	
2008:23	The No. 2, No. 3, and No. 4 reverse thrust lever were raised to idle reverse	FDR
2008:24	The aircraft reverted to AIR mode for approximately 1.75 seconds; The aircraft reached a roll angle of 9.2 degrees to the left	FDR
2008:26	The PM called out again "right wing down"	CVR
2008:27	The aircraft reverted to AIR mode for approximately 1.25 seconds;	FDR
2008:27-2008:30	The aircraft yaw increased to the right from 57.7 degrees to 61.9 degrees while the rudder input increased from 1.5 degrees left to 15.8 degrees left	FDR
2008:28	No.1 Engine N1 reached a maximum value of 70.2%, while the N1 values of No. 2, No. 3, and No. 4 engines were 37.1%, 36.9% and 37.1%	FDR
2008:29	The aircraft reverted to AIR mode for approximately 1.25 seconds; The control wheel position was at a maximum of 67.8 degrees to the right	FDR
2008:30	The aircraft reached an attitude of pitch angle 1.4 degrees and roll angle 9.2 degrees to the right; No.1 forward thrust lever was retarded to the idle position while No. 2, No. 3, and No. 4 reverse thrust levers raised to maximum reverse thrust; The PM called out "right wing down"	CVR, FDR
2008:30	The RCTP tower local controller and local monitor reported visually observing the aircraft during its landing. Upon main landing gear touchdown, the aircraft exhibited an unstable attitude characterized by lateral oscillations, appearing as though a go-around might be initiated. Shortly thereafter, sparks were observed emanating from the aft section of the aircraft, prompting an exclamation from the controllers regarding the presence of sparks. The aircraft's attitude	Controllers' Statements

Taipei Time	Event	Source
	subsequently stabilized, and it vacated the runway	
2008:31	The aircraft settled on the runway; Speedbrake lever moved toward "UP" and speedbrakes were fully extended after one second	FDR
2008:34	Autobrake system activated	FDR
2008:35	The PM called out "right wing down there we go"	CVR
2008:37	The PM called out "reversers are normal"	CVR
2008:40	The ACM called out "no reverse number one"; The No. 1 reverse thrust lever was raised to idle reverse	CVR, FDR
2008:41	The No. 1 reverse thrust lever was raised to maximum reverse	FDR
2008:47	The PF called out "brakes"; The brake pedal input was applied	CVR, FDR
2009:21	RCTP tower local controller instructed 5X61 to contact ground controller	Radio Transcripts
2009:48	The ACM called out "engine four reverse" of the EICAS message	CVR
2009:58	The aircraft vacated Runway 05L	FDR
2012:00	BR6032 notified RCTP tower local controller that the aircraft was vacating runway and reported there was an aircraft part on the runway	Radio Transcripts
2012:17	BR076 contacted RCTP tower local controller for an ILS approach on Runway 05L. The controller instructed BR076 to continue approach	Radio Transcripts
2012:22	RCTP tower notified the Airside Management Department that BR6032 had reported possible aircraft debris on Runway 05L after landing. Consequently, runway operations were temporarily suspended	Interphone Transcripts
2012:30	RCTP tower local controller instructed BR6032 to contact ground controller	Radio Transcripts
2012:57	RCTP tower local controller instructed BR076 to discontinue the approach due possible FOD on Runway 05L	Radio Transcripts
2019	RCTP Airside Management Department inspected Runway 05L	Tower Duty Log
2020:59	The flight crew of 5X61 notified the RCTP tower local	CVR, Radio

Taipei Time	Event	Source
	controller that they had experienced a heavy engine nacelle strike during landing; a runway inspection was required	Transcripts

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Chapter 2 Analysis

2.1 General

The crew of the occurrence flight was properly certificated and qualified in accordance with applicable U.S. federal regulations. There was no evidence to indicate that medical conditions, fatigue, medication use, alcohol, or other drugs impaired the crew's performance during the occurrence flight.

The occurrence aircraft was properly certificated, with no reported anomalies in the flight control systems. The aircraft's weight and balance remained within approved operational limits throughout the occurrence flight. Upon landing, the remaining fuel was sufficient for the aircraft to attempt additional approaches or to divert to its alternate airport.

This analysis covers two areas: Flight Operations and Tower Control Operations.

2.2 Flight Operations

The Flight Operations section first reviews the meteorological conditions around the time of the occurrence and examines the crew's decision-making regarding the go-around maneuvers during the first and second approaches. It then examines the approach conditions from the third approach through touchdown. The primary focus of this section is the crew's operations during the landing roll, the phase in which the occurrence took place. Finally, it discusses the combination of factors contributing to the occurrence.

2.2.1 Meteorological Conditions

At around the estimated arrival time of the occurrence flight, meteorological conditions at RCTP were influenced by Typhoon Podul, resulting in significant crosswind and gusty conditions; however, visibility remained good (greater than 10 kilometers), with no precipitation reported.

Table 2.2-1 summarizes the wind conditions and corresponding crosswind components received by the crew during the three approaches. According to the UPS B747 Aircraft Operating Manual (AOM), the maximum crosswind component for takeoff and landing in manual operations is 30 knots. In view of the dynamic weather conditions at RCTP, the crew decided to request updated wind information from ATC at a lower altitude during the final approach to obtain the most current runway wind conditions.

Table 2.2-1 Wind conditions and calculated crosswind components for the three approaches

Time	**Source**	**Wind Direction (°)**	**Wind Speed[1] (kt)**	**Crosswind Component[2] (kt)**	**Within Crosswind Limits**
1st Approach					
1916	Tower	100	21G45	15**G32**	**No**
1919	Tower	090	29G45	17G26	Yes
2nd Approach					
1931	ATIS S	090	28G39	17G23	Yes
1932	Tower	090	30G39	18G23	Yes
1934	Tower	100	29G43	21**G31**	**No**
3rd Approach					
1948	Approach	100	21G36	15G26	Yes
2001	ATIS T	100	23G36	17G26	Yes
2003	Tower	090	26G38	15G22	Yes
2005	Tower	090	28G38	17G22	Yes

Notes:
1. Wind speeds and wind components were rounded to the nearest knot.
2. Wind components were calculated using the magnetic runway heading of 054° for RCTP Runway 05L

2.2.2 First and Second Go-Around Decision-Making

At 1919, during the first approach, when the aircraft was passing 682 feet RA, the crew obtained the reported wind for Runway 05L, which was 090 degrees at 29 knots, gusting to 45 knots. This resulted in a maximum right crosswind component of 26 knots, which was still within the crosswind limit. Nevertheless, at 370 feet RA, the crew noted an increase in wind speed and initiated a go-around.

At 1934, during the second approach, when the aircraft was passing 527 feet RA, the crew obtained the reported wind for Runway 05L, which was 100 degrees at 29 knots, gusting to 43 knots. This resulted in a right crosswind component of 31 knots, which exceeded the crosswind limit. The crew subsequently initiated a second go-around.

Both approaches were otherwise uneventful and conducted in accordance with the operator's standard operating procedures.

2.2.3 Third Approach

According to the CVR data, the crew completed the descent checklist and approach checklist at 1954:14 and 1954:20 respectively for the third approach. The reference speed, or $V_{REF,}$ for the approach was 157 knots[29], and the autobrake was set to 3. Throughout the third approach, the reported winds remained within the 30-knot crosswind limitation for a manual landing (see Table 2.2-1). Although the crew had considered conducting an autoland, the wind conditions were outside the 25-knot headwind and crosswind limitations specified in the AOM for autoland operations. Accordingly, the flight crew decided to continue with a manual landing.

The approach speed, or V_{APP}, was determined in accordance with guidance provided in the B747 Flight Crew Training Manual (FCTM). When the

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29 The calculations were based on an estimated landing weight of 698,000 lb and flaps 25.

autothrottle is planned to be disconnected prior to landing, as required for a manual landing, the FCTM recommends calculating the V_{APP} by adding one-half of the reported steady headwind component, plus the full gust increment above the steady wind to the V_{REF}. The minimum value of V_{APP} is V_{REF} + 5 knots; and the maximum value should not exceed V_{REF} + 20 knots when making adjustments for winds. Based on the reported wind conditions, the resulting V_{APP} for the third approach was 177 knots.

According to the CVR and FDR data, the aircraft was in the landing configuration, with flaps set to 25, and the landing checklist was completed as the aircraft descended through a barometric altitude of 3,105 feet at 2004:45. The latest wind report was received at 2005:50, indicating wind from 090 degrees at 28 knots gusting to 38 knots, which resulted in a right crosswind component of 22 knots.

As the aircraft descended through 1,000 feet height above touchdown[30] (HAT), it was at 3.16 nautical miles from the runway threshold, at an airspeed of 179 knots and the sink rate was 880 feet per minute, and the PM called "one thousand feet stable sinks eight hundred." Passing through 500 feet HAT, the airspeed was 173 knots, and the PM called "five hundred feet stable sinks eight hundred." Throughout the final approach, the airspeed and sink rate remained within the tolerance specified in the operator's Flight Operations Manual (FOM), and the aircraft remained on the proper glide path for landing.

The investigation determined that, during the third approach, the crew had established and maintained a stabilized approach in accordance with the

[30] According to the electronic aeronautical information publication (eAIP) published by the Taiwan Civil Aviation Administration, the touchdown zone elevation of RCTP Runway 05L is 74 feet.

operator's stabilized approach criteria[31].

2.2.4 Landing

The CVR and FDR data indicated that the autopilot was disengaged by the PF at 426 feet RA and the autothrottle was disconnected at 185 feet RA.

Due to crosswind conditions, the approach was flown with a right crab angle to maintain alignment with the extended runway centerline. The PF initiated the decrab maneuver during flare, consistent with the techniques recommended in the FCTM. At approximately 40 feet RA, the PF initiated the flare by increasing the pitch attitude to reduce the rate of descent. All four forward thrust levers were retarded at approximately 25 feet RA and reached the idle position at approximately 15 feet RA. At approximately 20 feet RA, left rudder input was applied to decrab the aircraft, accompanied by into-wind (right) aileron input to keep wings level and maintain lateral control.

The aircraft touched down at approximately 1,405 feet beyond the runway threshold, with a pitch attitude of 1.1 degrees nose up, a heading of 58.4 degrees, and a roll attitude of 2.5 degrees left wing down. The left wing landing gear contacted the runway first, followed by the remaining three main landing gears within 0.5 seconds. The recorded peak vertical acceleration was 1.2g's. Based on

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[31] According to the UPS FOM, the operator's stabilized approach criteria are as follows:

1000 FEET HAT:

Aircraft is in the landing configuration and the Landing Checklist has been completed; Airspeed is within +20 or -5 knots of V_{APP}; Sink rate is 1000 feet per minute or less*; Aircraft is on a vertical path that will result in landing within the TDZ (Touchdown Zone).

500 FEET HAT:

Airspeed is within 5 knots of V_{APP}; Engine thrust is stabilized at a level that results in target speed.

200 FEET HAT:

Aircraft is aligned with the lateral confines of the runway.

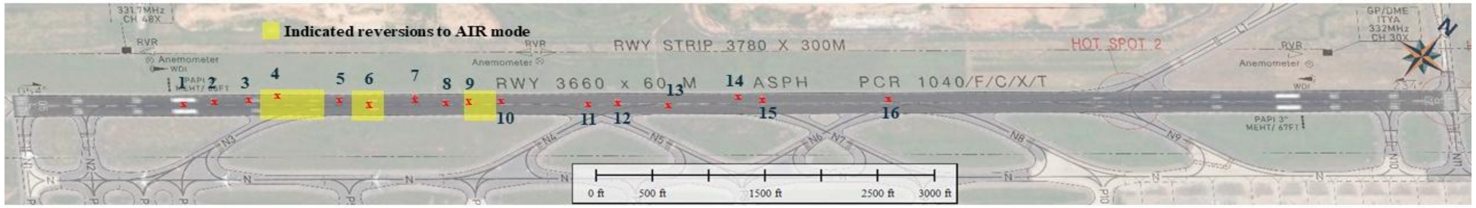
NOTE:

*Vertical speed up to 1200 feet per minute may be acceptable under approach conditions that require higher airspeeds/groundspeeds due to a steep glidepath, heavy gross weight or non-normal aircraft system configuration. This will be discussed during the approach briefing.

the recorded data, the landing and touchdown were normal.

2.2.5 Landing Roll

The aircraft touched down on Runway 05L at 2008:21. A sequence of events occurred during the landing roll between touchdown and the No. 4 engine nacelle strike at 2008:30. These events are analyzed in detail in the following subsections. Figure 2.2-1 provides an overview of the events during the landing roll. Figure 2.2-2 shows selected FDR-recorded parameters, including aircraft speed and attitude, flight crew control inputs, and the status of the engines and deceleration devices.



No.	hh:mm:ss	FDR read-out	CVR transcripts
1	2008:21	• Occurrence aircraft touched down on runway 05L • Speedbrake lever began moving toward "UP"; speedbrakes began to extend (auto extension)	
2	2008:22	• No. 1 forward thrust lever advanced out of idle • Speedbrake lever moved back toward "DOWN"; speedbrakes retracted after 1 second (auto retraction)	CAM-2:...speedbrakes up keep right wing down right wing down
3	2008:23	• No. 1 forward thrust lever reached approximately 57° TRA • No. 2–4 reverse thrust levers raised to idle reverse; No. 1 remained stowed	
4	2008:24	• Aircraft reached 9.2° left-wing-down attitude	
5	2008:26		CAM-2: right wing down
6	2008:27	• Aircraft yaw increased to the right from 57.7° to 61.9°; rudder input increased from 1.5° left to 15.8° left	
7	2008:28	• No. 1 engine N1 reached 70.2%; No. 2–4 at 37.1%, 36.9%, and 37.1%	
8	2008:29	• PF applied maximum 67.8° right control wheel input	
9	2008:30	• Aircraft reached 9.2° right-wing-down attitude with 1.4° nose-up pitch; No. 4 engine nacelle struck runway • No. 2–4 thrust reversers deployed • No. 2–4 reverse thrust levers raised to maximum reverse • No. 1 forward thrust lever retarded to idle	CAM-2: right wing down
10	2008:31	• Aircraft settled on the runway • Speedbrake lever moved toward "UP"; speedbrakes fully extended after 1 second (backup auto extension)	
11	2008:34	• Autobrake system activated	
12	2008:35		CAM-2: right wing down there we go
13	2008:37		CAM-2: reversers are normal
14	2008:40	• No. 1 reverse thrust lever raised to idle reverse	CAM-3: got that no reverse number one
15	2008:41	• No. 1 reverse thrust lever raised to maximum reverse	
16	2008:47	• PF applied manual braking	CAM-1: brakes

Note: CAM-1 : Voice identified as left seat pilot ; CAM-2 : Voice identified as right seat pilot ; CAM-3 : Voice identified as observer seat crew

Figure 2.2-1 Sequence of events and FDR/CVR data during the landing roll

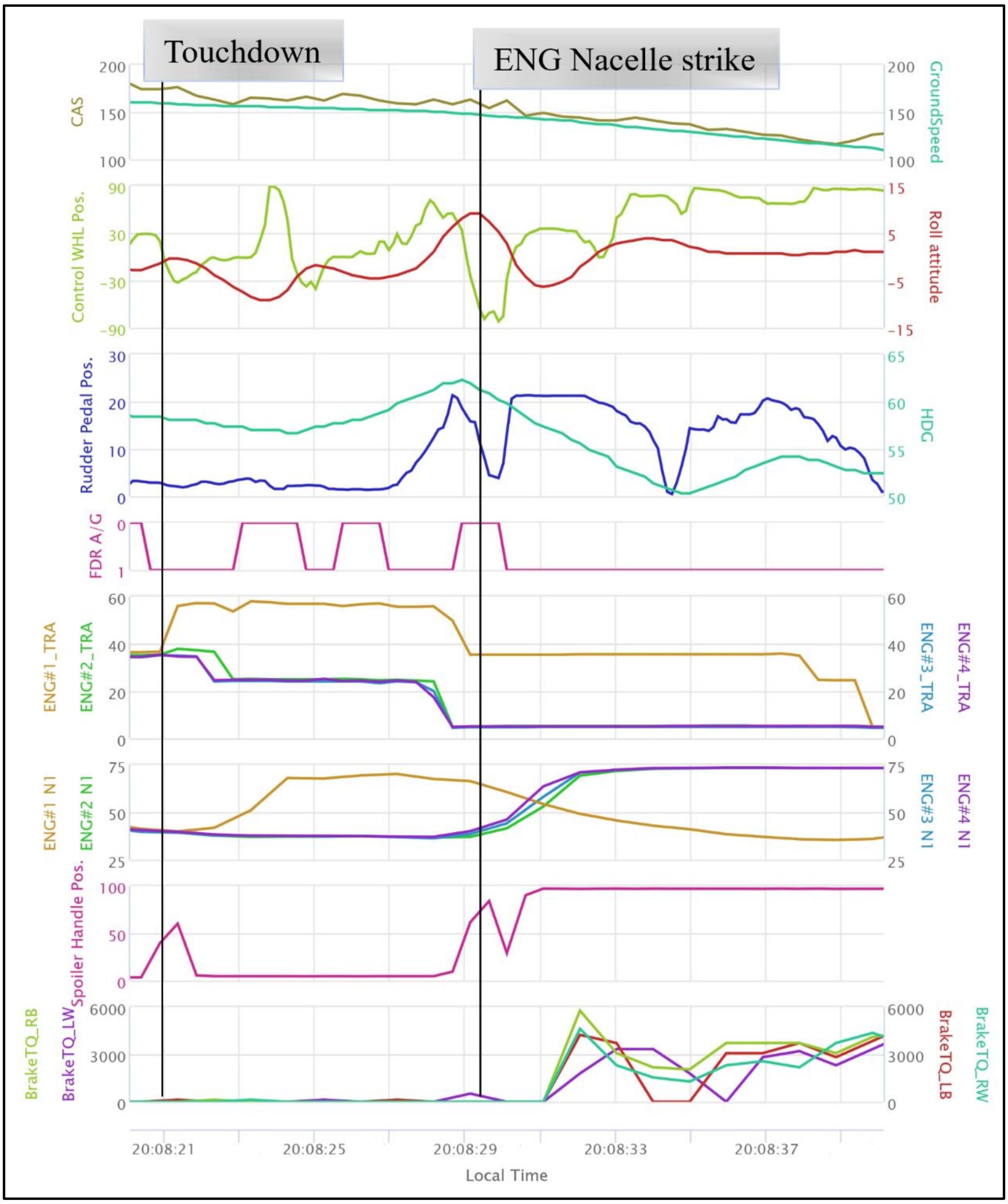


Figure 2.2-2 Selected FDR-recorded parameters during the landing roll

2.2.5.1 Advancement of the No. 1 Forward Thrust Lever

According to the FDR data, one second after touchdown, the No. 1 forward thrust lever was advanced to a throttle resolver angle (TRA) value of approximately 57 degrees, corresponding to a thrust lever angle (TLA) change from 0 degrees (idle) to 22 degrees above idle, resulting in an increase in No. 1 engine thrust. Due to the latency of the turbofan engine, the N1 indication of No.

1 engine reached a peak value of 70.2% approximately seven seconds after touchdown.

This advancement, however, was not perceived by the crew. According to the PF's statement, "*...I was also not aware that I had inadvertently advanced thrust of number 1 engine when my hand was removed from thrust reverser levers to respond to 'No reverse number one' call by jumpseater.*" This statement suggests that the advancement was inadvertent and that the PF was not aware of the actual timing of the forward thrust lever advancement.

2.2.5.2 Use of Deceleration Devices

The B747 is equipped with multiple deceleration devices, including speedbrakes (ground spoilers), wheel brakes, and thrust reversers, to reduce aircraft speed following touchdown and achieve the expected landing distance. This discussion describes the function of each system and examines their operations during the landing roll.

Speedbrakes

Speedbrakes are designed to reduce aerodynamic lift after touchdown by spoiling airflow over the wings. This reduction in lift increases the load on the landing gear and improves wheel brake effectiveness during the landing roll. Under the B747 speedbrake system logic, upon main landing gear touchdown, the speedbrake lever is automatically driven to the "UP" position when the speedbrake lever is set to "ARMED", and the No. 1 and No. 3 forward thrust levers are at idle. If the speedbrake lever is not armed, a backup automatic extension is provided when the No. 1 and No. 3 forward thrust levers are at idle and either the No. 2 or No. 4 reverse thrust lever is selected to the reverse idle detent while on the ground.

During the occurrence flight, the speedbrake lever began moving toward the

"UP" position at touchdown, and the speedbrakes initially began to extend. Approximately one second after touchdown, however, the No. 1 forward thrust lever was advanced beyond idle, triggering the automatic retraction logic. Consequently, the speedbrake lever did not reach the "UP" position and was driven back toward the "DOWN" position, and the speedbrakes were retracted approximately two seconds after touchdown. The speedbrakes remained retracted until the PF retarded the No. 1 forward thrust lever back to idle. Meanwhile, the other three reverse thrust levers were pulled beyond the reverse idle detent, and as the aircraft settled on the runway at 2008:31, the backup automatic extension was triggered.

Wheel Brakes

Wheel brakes provide deceleration by actuating the brake assembly to slow wheel rotation, converting kinetic energy into heat. This reduction in wheel speed creates controlled tire slip, enabling effective friction between the main landing gear tires and the runway surface, which generates the force needed to slow the aircraft. Braking effectiveness depends on the load on the wheels and the coefficient of friction between the tires and the runway. On transport category aircraft, the autobrake system applies a preselected level of wheel braking after touchdown to maintain a steady deceleration rate until it is transitioned to manual braking by the pilot.

According to B747 autobrake logic, activation requires all thrust levers at idle, the main landing gear on the ground, and wheel spin-up. Once activated, advancing any forward thrust lever will cause the system to disarm.

During the occurrence flight, following the initial touchdown at 2008:21, the aircraft reverted to AIR mode three times. Each momentary return to GROUND mode was too brief to allow wheel spin-up detection. Consequently, the autobrake did not activate and remained armed until the aircraft finally settled on the runway during the fourth runway contact.

The engine nacelle strike occurred at 2008:30, at which time the No. 1 forward thrust lever was retarded to idle. The aircraft settled on the runway one second later at 2008:31. The autobrake activated at 2008:34 and remained engaged until the PF applied manual braking at 2008:47.

<u>Thrust Reversers</u>

Thrust reversers redirect engine exhaust forward to provide deceleration during the landing roll and are most effective at high airspeeds. The operator's AOM specifies that immediately upon main gear touchdown, all reverse thrust levers should be raised to the interlocks (idle reverse thrust) and held until the interlocks release (indicating deployment).

During the occurrence flight, the aircraft touched down at 2008:21, and the No. 2, No. 3, and No. 4 reverse thrust levers were raised to the interlocks position approximately two seconds after touchdown. The No. 1 reverse thrust lever, however, remained at the full down (stowed) position because the No. 1 forward thrust lever had been advanced beyond the idle position, and the system logic prevented it from being raised.

At 2008:30, coincident with the engine nacelle strike, the PF raised the No. 2, No. 3, and No. 4 reverse thrust levers to the full (maximum) reverse thrust position and retarded the No. 1 forward thrust lever to idle. However, the No. 1 reverse thrust lever remained in the full down position until the ACM called "no reverse number one" at 2008:40, after which the PF raised the No. 1 reverse thrust lever to full reverse approximately one second later.

It should also be noted that the AOM includes the following warning:

<u>WARNING</u>: AFTER THE REVERSE THRUST LEVERS ARE MOVED, A FULL STOP LANDING MUST BE MADE. IF AN ENGINE STAYS IN

REVERSE, SAFE FLIGHT IS NOT POSSIBLE.

Accordingly, at the time the reverse thrust levers were raised, the occurrence aircraft was committed to landing, and a go-around was no longer an available option.

2.2.5.3 Landing Distance

According to the AOM, with flaps 25 selected and on a dry runway, and based on the conditions of the occurrence flight[32], the factored landing distance for a normal configuration landing using autobrake 3 was 10,551 feet, which did not exceed the 12,008 feet landing distance available of RCTP Runway 05L, as published in the eAIP. In the case of maximum manual braking, the corresponding factored landing distance was 5,924 feet. These landing distance calculations include a 15% safety margin, as specified in the AOM.

The FDR data indicated that the aircraft touched down approximately 1,405 feet beyond the runway threshold, around the midpoint of the touchdown zone (TDZ). The advancement of the No. 1 forward thrust lever resulted in a delay in the application of deceleration devices, with the exception of the No. 2, No. 3, and No. 4 thrust reversers. The speedbrakes extended approximately 11 seconds after the touchdown, and the No. 1 thrust reverser was deployed 21 seconds after touchdown. The autobrake system activated 13 seconds after the initial touchdown, when the aircraft was 4,520 feet from the runway threshold. Manual braking was applied 13 seconds later, by which time the aircraft was 7,217 feet from the runway threshold and had a ground speed of 92 knots. Nevertheless, the aircraft continued to decelerate and reached the N9 high-speed taxiway intersection, located 8,664 feet from the runway threshold, where it vacated the

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[32] The calculations are made with weight adjustment of a landing weight of 691,689 lbs., no altitude adjustment, wind adjustment of a 22 knot headwind, temperature adjustment of 31 degree Celsius, approach speed adjustment of 24 knots above V_{REF} (V_{APP}=177 knots and V_{REF}=153 knots according to performance table in the AOM), and reverse thrust adjustment of two reversers.

runway in accordance with the tower instruction to vacate via N8 or beyond, without further incident.

2.2.5.4 Monitoring of Deceleration Devices

Monitoring and the use of standard callouts are essential for maintaining shared situational awareness on the flight deck, as they support cross-checking of aircraft configuration and system status and facilitate timely recognition of abnormal conditions. According to the AOM, the task sharing and standard callouts during landing are specified in Chapter 03 NORMAL, Subsection 03.15.01.12, as shown in Table 2.2-2:

Table 2.2-2 Flight crew task sharing and standard callouts during landing

03.15.01.02 LANDING PROCEDURE

PILOT FLYING	PILOT MONITORING
Disconnect autothrottles no later than 100 feet HAT unless conducting an autoland.	
Verify the thrust levers are closed. Verify the SPEEDBRAKE lever is UP.	Verify the SPEEDBRAKE lever is UP. Call *"SPEEDBRAKES UP."* If speedbrake lever is not UP, call *"SPEEDBRAKES NOT UP."*
NOTE: If SPEEDBRAKE lever does not move to UP position after reverse thrust is selected, the SPEEDBRAKE lever must be manually moved to UP immediately.	
Monitor the rollout progress.	
Verify correct autobrake operation. If autobrake system disarms, call: *"MANUAL BRAKING."*	
WARNING: AFTER THE REVERSE THRUST LEVERS ARE MOVED, A FULL STOP LANDING MUST BE MADE. IF AN ENGINE STAYS IN REVERSE, SAFE FLIGHT IS NOT POSSIBLE.	
Immediately upon main gear touchdown, raise all reverse thrust levers to the interlocks and hold light pressure until the interlocks release. Apply reverse thrust as needed. **NOTE:** Idle reverse thrust is preferred unless conditions dictate otherwise.	Verify the forward thrust levers are closed. When all REV indications are green, call *"REVERSERS NORMAL."* If there is no REV indication(s) or the indication(s) stays amber, call *"NO REVERSER(S) ENGINE NUMBER ___" or "NO REVERSERS."*
By 60 knots, start movement of the reverse thrust levers to be at the reverse idle detent before taxi speed.	Call *"60 KNOTS."*
After the engines are at reverse idle, move the reverse thrust levers full down.	
Before taxi speed, disarm the autobrakes. Use manual braking as needed.	
If F/O is PF, the Captain will initiate a positive transfer of control, saying *"I HAVE THE AIRCRAFT."* The F/O will respond *"YOU HAVE THE AIRCRAFT,"* and will leave the aircraft configuration unchanged when relinquishing control.	
Before turning off the runway, disconnect the autopilot.	

According to the procedure, both the PF and PM are required to verify that the speedbrake lever is in the "UP" position, and the PM should make the callout "speedbrakes up" or "speedbrakes not up," as appropriate.

In the occurrence flight, the speedbrake lever began to move toward the "UP" position at touchdown; however, it did not reach the "UP" position and subsequently moved back toward the "DOWN" position due to the advancement of the No. 1 forward thrust lever approximately one second after touchdown. At about the same time, the PM called, "…speedbrakes up, keep right wing down, right wing down." This indicates that, although the movement of the speedbrake lever may have been perceived, the final lever position was not positively confirmed, and the PM's attention was likely directed outside the cockpit at that time.

In addition, the PM is required by the procedure to verify that the forward thrust levers are closed (at idle position), and then to make the appropriate callouts based on the indication(s) of the thrust reversers. In the occurrence flight, however, the callout was delayed until approximately 14 seconds after the reverse thrust levers were raised. The PM called "reversers are normal" followed by the ACM's callout of "no reverse number one" approximately three seconds later.

With regard to autobrake operation, the AOM specifies that both the PF and PM are required to verify proper system operation and to call "manual braking" if the system disarms. During the occurrence flight, as the aircraft did not fully settle on the runway until approximately 10 seconds after initial touchdown, autobrake activation occurred thereafter. Approximately 13 seconds after autobrake activation, the PF called "brakes" and applied brake pedal input, transitioning to manual braking.

The FDR and CVR data indicated that the aircraft experienced a left roll tendency during the landing roll, and the PM made multiple "right wing down" callouts. These observations suggest that the crosswind conditions and resulting aircraft attitude required increased attention to aircraft control. Consequently, the crew's attention was directed outside the cockpit, reducing the opportunity to effectively monitor and verify cockpit indications before making the associated callouts. This contributed to the premature speedbrake callout and the delayed thrust reverser callout during the landing roll.

Nevertheless, despite the delayed deployment and activation of deceleration devices, which reduced the stopping margin during the landing roll, the aircraft decelerated to exit speed prior to the Taxiway N9 intersection and vacated the runway there, in accordance with tower instructions, as noted previously.

2.2.6 Combination of Factors Contributing to the No. 4 Engine Nacelle Strike

The wind conditions at the time of landing, together with the high residual lift retained after the automatic retraction of the speedbrakes, the delayed deployment of deceleration devices, and the subsequent development of asymmetric thrust, increased the complexity of controlling the aircraft during the landing roll. This section examines how these factors interacted and contributed to the occurrence.

Wind Conditions

The instantaneous wind conditions recorded by the AWOS [33] between touchdown (2008:21) and the engine nacelle strike (2008:30) are presented in Table 2.2-3, which shows the wind conditions in the vicinity of the Runway 05L threshold and in the mid-runway section of Runway 05L/23R, covering the portion of the runway from the aircraft's touchdown point to the engine nacelle strike location.

[33] The locations of the anemometers are shown in Figure 1.7-2.

Table 2.2-3 AWOS instantaneous wind conditions between touchdown and engine nacelle strike

Time	AWOS 05L		AWOS 05L/23R	
	Wind Direction (°)	**Wind Speed (kt)**	**Wind Direction (°)**	**Wind Speed (kt)**
2008:21	87	30.3	105	33.4
2008:22	87	30.3	104	31.9
2008:23	83	29.9	104	30.3
2008:24	79	29.4	104	28.8
2008:25	76	29	104	28.8
2008:26	76	29	104	27
2008:27	76	29	104	25.1
2008:28	76	29	104	23.3
2008:29	76	29	104	23.3
2008:30	76	29	104	23.3

Although not directly observed by the AWOS, the FDR data indicated multiple instances during the landing roll where the aircraft's ground speed decreased while the airspeed increased (see Figure 2.2-3), suggesting that the aircraft was affected by gusting wind conditions. In combination with the presence of a high residual lift associated with the delayed deployment of the speedbrakes, these conditions may have contributed to the three transitions of the aircraft from GROUND mode back to AIR mode following touchdown and the observed lifting tendency of the right (upwind) wing.

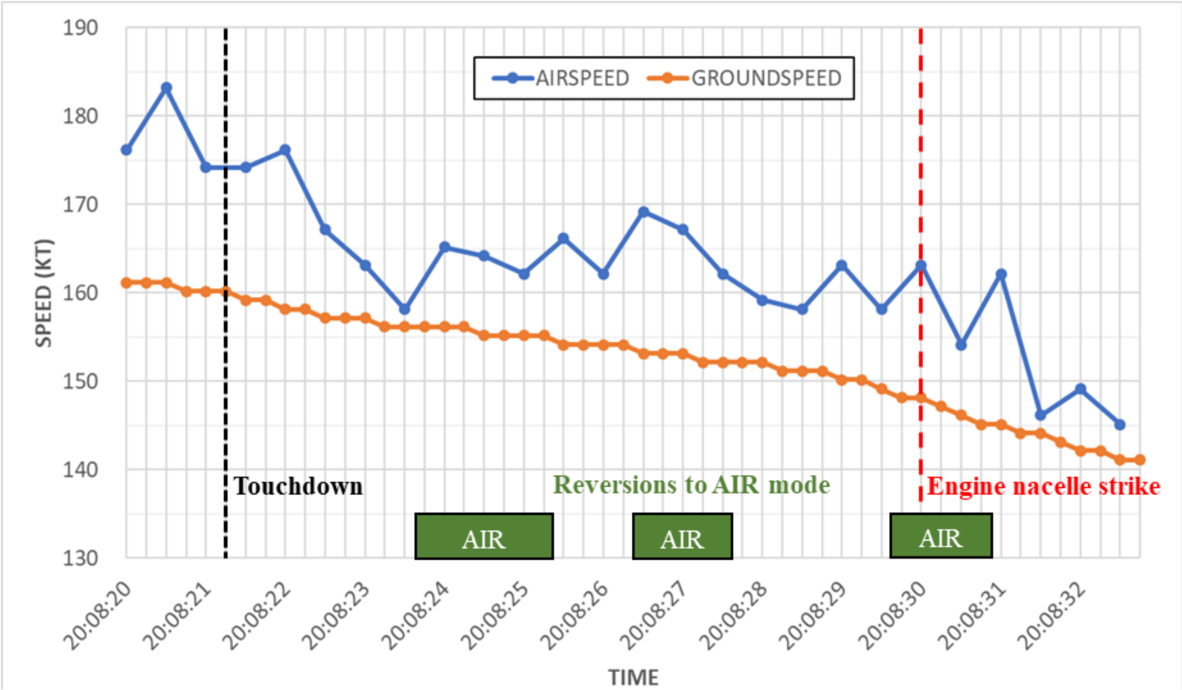

Figure 2.2-3 Airspeed and groundspeed during the landing roll

Asymmetric Thrust Condition

The inadvertent advancement of the No. 1 forward thrust lever, in contrast, led to an asymmetric thrust condition in the aircraft. As the No. 1 engine produced forward thrust while the No. 2, No. 3, and No. 4 engines were in reverse, the asymmetry intensified. This condition can generate yawing and rolling moments toward the side of less forward thrust (or greater reverse drag); in this occurrence, it caused the aircraft to yaw to the right and develop a right bank, thereby increasing pilot workload and reducing directional control margins. During the landing roll, additional control inputs would have been required to counter the asymmetry and maintain directional control.

Increased Complexity of Aircraft Control

In addition, the FDR data suggested that the nose landing gear was not in contact with the runway from touchdown until the engine nacelle strike, likely due to a high level of residual lift. The combined effects of asymmetric thrust and reduced nose landing gear contact further degraded the directional control of the aircraft, making it more susceptible to the gusty right crosswind. This condition was particularly apparent in the three seconds preceding the engine nacelle strike, during which the FDR data showed that the PF progressively increased left rudder input from 1.5 degrees left to 15.8 degrees left, while the aircraft heading continued to yaw to the right, changing from 57.7 degrees to 61.9 degrees.

This assessment is consistent with the PF’s statement that his primary focus at the time was maintaining directional control of the aircraft. Despite these conditions, the aircraft remained on the runway centerline with minimal deviation. The FDR data indicated that the PF’s rudder input increased over time while the aircraft remained with little localizer deviation.

Meanwhile, the FDR data indicated that the aircraft rolled to the left several times, likely associated with the gusty right crosswind, during the landing roll. This abnormal aircraft attitude drew the flight crew’s attention outside the cockpit. This was supported by the PM’s multiple callouts of “right wing down,” recorded in the CVR data during that period, as well as by the PM’s statement.

Approximately three seconds after touchdown, the aircraft rolled to the left, reaching a maximum left roll angle of 9.2 degrees, which exceeded the B747-8 ground contact angle limits specified in the FCTM. However, because the aircraft was in AIR mode and retained sufficient height above the runway, no ground contact occurred. From approximately five seconds to six seconds after touchdown, the aircraft began to roll to the left again, and the PF applied right control wheel input to counter the roll. During this period, the aircraft simultaneously began to yaw to the right and reverted to AIR mode. The PF maintained control using large right control wheel inputs, reaching a maximum of 67.8 degrees. The aircraft subsequently continued to roll to the right, reaching a right-wing-down attitude of 9.2 degrees, which again exceeded the B747-8 ground contact angle limits[34]. The No. 4 engine nacelle struck the runway at 2008:30, approximately nine seconds after touchdown.

In summary, the occurrence resulted from a complex interaction between adverse meteorological conditions, an inadvertent thrust lever input, and automated system logic during the landing roll. One second after touchdown, the No. 1 forward thrust lever was inadvertently advanced beyond idle, triggering speedbrake retraction and causing the aircraft to retain high residual lift. Under the prevailing gusty crosswind conditions, this led to repeated transitions back to AIR mode and delayed the effectiveness of the deceleration devices. The unstable aircraft state was further exacerbated by the resulting asymmetric thrust condition, which adversely affected directional and lateral controllability. As the aircraft experienced repeated rolling tendencies, it became increasingly difficult to maintain lateral stability despite the application of large corrective control inputs, and the aircraft subsequently developed an excessive right-wing-down attitude of 9.2 degrees, resulting in the No. 4 engine nacelle striking the runway surface.

2.3 Tower Control Operations

The Tower Control Operations section first examines the advising of observed abnormalities, outlining the applicable requirements for controllers and describing the RCTP tower controller's response to observed visible sparks resulting from the engine nacelle strike. It further reviews the principles of team resource management, its role within the tower environment, and the potential operational impact of ineffective application in addressing observed abnormalities.

[34] Given that the pitch attitude at the time was approximately 1.4 degrees nose-up, a roll angle of approximately 7 degrees or greater would have resulted in contact between the outboard engine nacelle and the runway. However, the actual ground contact angles during normal landing may have varied due to dynamic maneuvering and structural flexing.

2.3.1 Advising of Observed Abnormalities

At 2008:30, the RCTP tower Local Controller and Local Monitor observed the occurrence aircraft exhibiting an abnormal attitude, with sparks emanating from its aft section during landing. According to the ATMP, Sections 3-1-10 and 3-1-11, which are largely consistent with ICAO Doc 4444 (Procedures for Air Navigation Services — Air Traffic Management), Section 7.4.1.7, aerodrome controllers are required to advise an aircraft without delay whenever an abnormal configuration or condition—such as unusual smoke or, in this case, visible sparks—is observed.

Despite this visual indication of a possible abnormal runway contact or mechanical failure, the RCTP tower controller did not advise the occurrence flight crew of the visible sparks during the subsequent radio frequency change at 2009:21.

In parallel, due to the lack of clear indications in the cockpit, the occurrence flight crew did not become aware of the damage until the post-landing walk-around inspection after the aircraft had parked. The crew did not notify the RCTP tower until 2020:59, when they reported an engine nacelle strike during landing and requested a runway inspection.

Prior to this notification, at 2011, debris and detached components from the occurrence aircraft's engine nacelle strike during landing were scattered on the runway, resulting in minor damage to a subsequently landing B777F cargo aircraft (flight BR6032).

Timely communication between the tower Local Controller and the occurrence flight crew could have facilitated earlier recognition of a possible engine nacelle strike and enhanced shared situational awareness of foreign object debris on the runway and its associated risks at an early stage, thereby preventing damage to subsequent landing or departing aircraft.

2.3.2 Team Resource Management (TRM)

The tower environment is a team-based operation where situational awareness must be shared among all positions. A key part of TRM is the "Local Monitor" role, which provides redundant safety support to the Local Controller, especially during high-workload or complex weather operations, such as the passage of Typhoon.

In this occurrence, factual information indicates that both the Local Controller and the Local Monitor visually observed sparks emanating from the occurrence aircraft at 2008:30. Under TRM principles, any team member observing such an abnormality would normally initiate a "Challenge-and-Response" process. Although both personnel observed the event, there is no evidence that the Local Monitor prompted the Local Controller to take the safety actions required under ATMP section 3-1-10, including advising the flight crew. This suggests that the available observation was not effectively translated into mutual support or assertive communication to address the potential operational risk.

Chapter 3 Conclusions

In this Chapter, the Taiwan Transportation Safety Board presents the findings derived from the information gathered during the investigation and the analysis of the occurrence. The findings are presented in three categories: **findings related to probable causes, findings related to risk,** and **other findings.**

The **findings related to probable causes** identify elements that have been shown to be directly causal to the occurrence, or almost certainly contributed to the occurrence. These findings are associated with unsafe acts, unsafe conditions, or safety deficiencies associated with safety significant events that played a major role in the circumstances leading to the occurrence.

The **findings related to risk** identify elements of risk that have the potential to degrade aviation safety. Some of the findings in this category identify unsafe acts, unsafe conditions, and safety deficiencies including organizational and systemic risks, that made this occurrence more likely; however, they cannot be clearly shown to have operated in the occurrence alone. Furthermore, some of the findings in this category identify risks that are unlikely to be related to the occurrence but, nonetheless, were safety deficiencies that may warrant future safety actions.

Other findings identify elements that have the potential to enhance aviation safety, resolve a controversial issue, or clarify an ambiguity point which remains to be resolved. Some of these findings are of general interests that are often included in the ICAO format accident reports for informational, safety awareness, education, and improvement purposes.

3.1 Findings Related to Probable Causes

1. At the time of the occurrence, meteorological conditions at Taiwan Taoyuan

International Airport were influenced by Typhoon Podul, resulting in strong and gusty winds with a significant right crosswind component on Runway 05L used by the occurrence aircraft for landing. (1.7, 2.2.1, 2.2.6)

2. One second after touchdown, the No. 1 forward thrust lever was inadvertently advanced beyond the idle position, triggering automatic speedbrake retraction and causing the aircraft to retain high residual lift after touchdown. (1.11.2, 2.2.5.1, 2.2.5.2)

3. The combination of high residual lift and the gusty right crosswind resulted in three transitions of the aircraft's air/ground sensing system back to AIR mode, delaying the deployment and activation of the aircraft's deceleration devices. The resulting unstable aircraft state, together with the development of asymmetric thrust and the adverse wind conditions, further increased the complexity of aircraft control during the landing roll. (1.11.2, 2.2.5.2, 2.2.6)

4. During the landing roll, the occurrence aircraft experienced multiple left roll tendencies associated with gusty right crosswind conditions. To counter these tendencies, large right control wheel inputs were applied by the Pilot Flying. The aircraft subsequently developed an excessive 9.2-degree right-wing-down attitude, exceeding the B747-8 ground contact angle limits, resulting in the No. 4 engine nacelle strike. (1.11.2, 1.12, 2.2.6)

3.2 Findings Related to Risk

1. The delayed deployment of the speedbrakes and the No. 1 thrust reverser, together with the delayed application of wheel braking, reduced the stopping margin during the landing roll. (1.11.2, 2.2.5.2, 2.2.5.3)

2. During the landing roll, the abnormal aircraft attitude directed the flight crew's attention outside the cockpit, reducing the effectiveness of instrument monitoring. This contributed to both premature and delayed callouts related to

deceleration devices and reduced the crew's shared situational awareness of the abnormal aircraft configuration. (1.11.2, 1.18.1, 2.2.5.4)

3. The occurrence aircraft's engine nacelle strike during landing resulted in debris and detached components being scattered along the runway surface. Consequently, a subsequently landing B777F cargo aircraft sustained damage to three main landing gear tires, as well as multiple scratches and punctures to its belly composite panels. (1.4, 1.12.2, 2.3.1)

4. Timely communication between the tower Local Controller and the occurrence flight crew could have facilitated earlier recognition of a possible engine nacelle strike and enhanced shared situational awareness of foreign object debris on the runway and its associated risks at an early stage, thereby preventing damage to subsequent landing or departing aircraft. (1.18.2.2, 1.18.3, 2.3.1)

5. Both the tower Local Controller and the Local Monitor observed sparks emanating from the occurrence aircraft; however, this abnormality was not communicated to the occurrence flight crew, indicating ineffective application of Team Resource Management in addressing the potential operational risk. (1.18.2.2, 1.18.3, 2.3.2)

3.3 Other Findings

1. The flight crew was properly certificated and qualified in accordance with applicable U.S. federal regulations. There was no evidence to indicate that medical conditions, fatigue, medication use, alcohol, or other drugs impaired the crew's performance during the occurrence flight. (1.5, 2.1)

2. The occurrence aircraft was properly certificated, with no reported anomalies in the flight control systems. (1.6.2, 2.1)

3. The aircraft's weight and balance remained within approved operational limits throughout the occurrence flight. Upon landing, the remaining fuel was sufficient for the aircraft to attempt additional approaches or to divert to its alternate airport. (1.6.3, 2.1)

4. During the first and second approaches, the flight crew determined that the crosswind conditions exceeded the operator's limitations and executed go-arounds in accordance with standard operating procedures. (1.7, 1.18.1, 1.18.2.1, 2.2.1, 2.2.2)

5. During the third approach, the reported wind conditions were within the operator's approach limitations, and the crew established and maintained a stabilized approach in accordance with the operator's stabilized approach criteria. (1.7, 1.11.2, 1.18.2.1, 2.2.3)

6. During the flare and initial touchdown of the third approach, the aircraft was handled in a manner consistent with the operator's recommended crosswind landing techniques, and the flare and touchdown were within normal limits. (1.11.2, 1.18.2.1, 2.2.4)

Chapter 4 Safety Recommendations

4.1 Transportation Safety Recommendations

To UPS Airlines

UPS Airlines advised that a number of proactive safety actions had been completed or were underway following the occurrence, as detailed in Section 4.2.1. As these actions addressed the safety issues identified by the investigation, no safety recommendations have been issued in this report.

To Taiwan Civil Aviation Administration

1. Enhance training programs for tower controllers on Air Traffic Management Procedures, emphasizing that visual indications such as sparks require immediate advisory to the aircraft concerned and an assessment of runway integrity[35].（TTSB-ASR-26-08-001）

2. Strengthen Team Resource Management practices among Air Traffic Controllers to ensure that, when abnormalities are observed by any team member, timely and appropriate safety actions are initiated[36].（TTSB-ASR-26-08-002）

4.2 Safety Actions

4.2.1 UPS Airlines

1. The event crew was retrained via UPS internal processes immediately after the event.

2. The 2026 UPS B747 Flight Crew Continuing Qualification (CQ) training program was modified to include a 2-hour simulator session that concentrates

[35] This safety recommendation was developed in response to Item 4 of Section 3.2, "Findings Related to Risk."
[36] This safety recommendation was developed in response to Item 5 of Section 3.2, "Findings Related to Risk."

on manual flying skills, crosswind landing skills, and general aircraft handling.

3. The simulator session is titled "Flight Path Management, Special Procedures and Operational Training." The highlights include a minimum of 5 manually flown approaches per pilot (10 total) focused on:
   - Crosswind landings with components up to 30 knots
   - Pod strike bank angle demonstration
   - General manual flying practice
   - Pilot Monitoring skills
4. In addition to the B747 simulator program, UPS is taking the following steps:
   - All UPS fleets are incorporating enhanced landing awareness training mirroring the B747 to be fully implemented in 2027 CQ.
   - Advanced Qualification Program (AQP) data is being reviewed regularly and any findings, trends, or issues identified are continually used to improve the CQ curricula.
   - The Flight Operations Technical and Safety department is working with the UPS Airline Safety Flight Operational Quality Assurance (FOQA) department to develop triggers to monitor inadvertent thrust lever advancement on landing.

End of report