AA2022-3

AIRCRAFT ACCIDENT
INVESTIGATION REPORT

ORIENTAL AIR BRIDGE CO., LTD.
J A 8 4 5 A

August 25, 2022

Japan Transport Safety Board

The objective of the investigation conducted by the Japan Transport Safety Board in accordance with the Act for Establishment of the Japan Transport Safety Board and with Annex 13 to the Convention on International Civil Aviation is to determine the causes of an accident and damage incidental to such an accident, thereby preventing future accidents and reducing damage. It is not the purpose of the investigation to apportion blame or liability.

TAKEDA Nobuo
Chairperson
Japan Transport Safety Board

Note:

This report is a translation of the Japanese original investigation report. The text in Japanese shall prevail in the interpretation of the report.

《Reference》

The terms used to describe the results of the analysis in "3. ANALYSIS" of this report are as follows.

i) In case of being able to determine, the term "certain" or "certainly" is used.
ii) In case of being unable to determine but being almost certain, the term "highly probable" or "most likely" is used.
iii) In case of higher possibility, the term "probable" or "more likely" is used.
iv) In a case that there is a possibility, the term "likely" or "possible" is used.

AIRCRAFT ACCIDENT INVESTIGATION REPORT

DAMAGE TO AIRFRAME FROM TAIL STRIKE
ORIENTAL AIR BRIDGE CO., LTD.
BOMBARDIER DHC-8-402, JA845A
FUKUE AIRPORT, NAGASAKI PREFECTURE, JAPAN
AT 09:24:32, OCTOBER 23, 2020

August 5, 2022
Adopted by the Japan Transport Safety Board
Chairperson TAKEDA Nobuo
Member SHIMAMURA Atsushi
Member MARUI Yuichi
Member SODA Hisako
Member NAKANISHI Miwa
Member TSUDA Hiroka

1. PROCESS AND PROGRESS OF THE INVESTIGATION

1.1 Summary of the Accident	When a Bombardier DHC-8-402, registered JA845A and belonging to Oriental Air Bridge Co., Ltd., landed on Runway 03 at Fukue Airport at 09:25 JST (JST: UTC+9 hours, unless otherwise noted, all times are indicated in JST in this report on a 24-hour clock) on Friday, October 23, 2020, the lower side of its tail contacted the runway and sustained damage to the airframe. With 54 persons in total on board, consisting of the captain, three crew members, and 50 passengers, there were no injuries.
1.2 Outline of the Accident Investigation	Upon receipt of the notification of occurrence of the accident, the Japan Transport Safety Board (JTSB) designated an investigator-in-charge and two other investigators to investigate the accident on October 24, 2020. An accredited representative and an advisor of Canada, as the State of Design and Manufacture of the aircraft involved in the accident, participated in the investigation. Comments on the draft Final Report were invited from the parties relevant to the cause of the accident and the Relevant State.

2. FACTUAL INFORMATION

2.1 History of the Flight	According to the statements of the captain and the first officer (FO), flight data recorder (hereinafter referred to as “the FDR”), and cockpit voice recorder (hereinafter referred to as “the CVR”), the history of the flight is summarized as follows: At 08:49 on October 23, 2020, a Bombardier DHC-8-402, registered JA845A and belonging to Oriental Air Bridge Co., Ltd. (hereinafter referred to

	as "the Company"), took off from Fukuoka Airport for Fukue Airport as its scheduled flight 93. The captain sat in the left seat as PF*1 and the FO sat in the right seat as PM*1. When the Aircraft was cruising at an altitude of 10,000 ft, the captain and the FO made preparations for instrument approach landing on Runway 03 at Fukue Airport, and the captain held an approach briefing. As the calculated reference landing speed (hereinafter referred to as "the V_{REF}") was 119 kt at this time, the captain added 10 kt and set the target approach speed to 129 kt. The captain told the FO to approach changing from Instrument Flight Rules (IFR) to Visual Flight Rules (VFR) if there was no problem in weather. When the captain and the FO checked the aerodrome routine meteorological reports (METAR) for the Airport reported at 09:00, it was under visual meteorological conditions and the wind direction and velocity were also within the limitations for landing at the Airport, which were stipulated in the Company's route manual. In addition, the wind conditions for the airport confirmed by company radio were within the limitations despite some changes in the wind direction and velocity. At about 09:10, as the captain and the FO visually recognized Fukuejima Island where the Airport is located, the captain changed the flight rule from IFR to VFR and started to descend. There was air current disturbance at an altitude of 5,000 ft or below while descending, and the Aircraft continued descending while shaking intermittently. At about 09:12 when the Aircraft established communication with Fukue Remote*2 and was informed of the wind direction and velocity at the Airport, the wind conditions were within the wind direction and velocity limitations established by the Company. Therefore, the captain continued approaching. At 09:21:13, the Aircraft reported to Fukue Remote that it had reached the Runway 03 right base. At about 09:23, the Aircraft was approaching at an altitude of about 1,200 ft over the Runway 03 final approach course, and at 09:23:42, the captain disengaged the autopilot system and switched to manual control at an altitude of about 700 ft. As the wind direction was 340° to 350° and the wind velocity was 20 to 30 kt and turbulent air was generated in the area around the final approach course according to on-board observation, the Aircraft was approaching while shaking intermittently. At this time, the Aircraft approach angle went below 3° approach path and its airspeed was also increasing. When the Aircraft was passing the altitude of about 600 and 450 ft, the airspeed increased and exceeded the target approach speed that is a reference speed, and thus the FO made a deviation call to inform the captain of the excessive speed. Although the Aircraft frequently changed the approach path and its speed during the final approach, the captain continued to approach targeting somewhere in the middle between the aiming point marking and the runway touchdown zone marking in front as its aiming point*3 while performing corrective operation repeatedly, and the Aircraft passed the runway threshold at a speed of 131 kt. At 09:24:29, the airspeed indicator in the right seat

momentarily showed that the airspeed decreased to 118 kt at an altitude of about 30 ft AGL and the aiming point also moved close to the runway touchdown zone marking in front. Therefore, the FO made a deviation call. The captain continued to approach the runway and commenced to flare at an altitude of about 20 ft AGL because the airspeed indicator in the left seat showed 124 kt and the touchdown point would usually be extended by flaring. The captain lifted the nose of the Aircraft as usual, but the Aircraft did not stop sinking (the descent rate was not reduced), thus the captain pulled the control column to nose up. When flaring the Aircraft, the captain intended to adjust the attitude of the Aircraft for the touchdown after he stopped sinking by performing a nose-up operation, however, the descend rate was not reduced as the captain had expected, and the Aircraft touched down at 09:24:32.

After the Aircraft touched down, the warning light in the cockpit came on and a message indicating that the fuselage had touched the runway was displayed. When the captain performed visual inspections after landing, traces of contact with the runway surface were confirmed on the outer skin of the lower aft fuselage. After that, a detailed examination of the damage to the Aircraft performed by a mechanic confirmed not only damage to the outer skin but also damage and deformity on the structural members inside the Aircraft.

The FDR records of the data during landing are shown in Appended Figure 1.

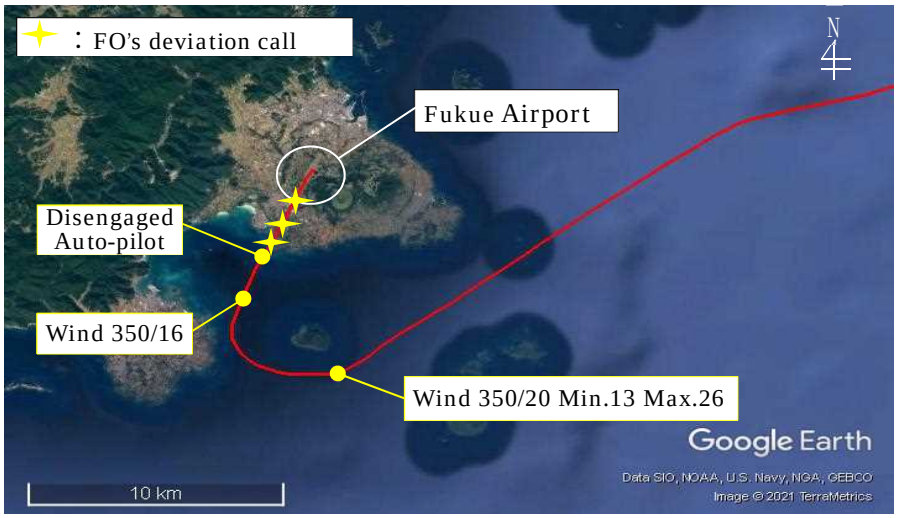


Figure 1 Estimated flight track

The accident occurred on Runway 03 at Fukue Airport in Nagasaki Prefecture (32'39"39 N, 128'49"44 E) at 09:24:32 on October 23, 2020.

2.2 Injuries to	None

*1 "PF" and "PM" are terms used to identify pilots with their different roles in aircraft operated by two persons. The PF abbreviates Pilot Flying and is mainly responsible for maneuvering the aircraft. The PM abbreviates Pilot Monitoring and mainly monitors the flight status of the aircraft, cross checks operations of the PF, and undertakes other non-operational duties.

*2 "Remote" is a call name of the Remote Air to Ground Facility (RAG: Remote Air Ground Communication). No airport traffic control tower or the airport mobile communication station are located at Fukue Airport, the presiding Flight Service Center at Fukuoka Airport provides the air traffic information and relays air traffic control clearances.

*3 "Aiming point" is the point on the runway intersecting the extending line of the flight path of the aircraft on the final approach.

Persons	
2.3 Damage to the Aircraft	Extent of damage to the Aircraft: Substantial damage The outer skin of lower fuselage: damaged The partial structural members of lower fuselage: damaged and deformed
2.4 Personnel Information	(1) Captain: Age 67 Airline transport pilot certificate (airplane) August 12, 2009 Type rating for Bombardier DHC-8 December 12, 2018 Class 1 aviation medical certificate Validity: January 4, 2021 Total flight time 18,157 hours 41 minutes Flight time in the last 30 days 50 hours 06 minutes Total flight time on the type of aircraft 947 hours 07 minutes Flight time in the last 30 days 50 hours 06 minutes (2) First Officer: Age 31 Commercial pilot certificate (airplane) February 25, 2010 Type rating for Bombardier DHC-8 April 24, 2014 Instrument flight certificate (airplane) April 30, 2010 Class 1 aviation medical certificate Validity: August 16, 2021 Total flight time 3,587 hours 44 minutes Flight time in the last 30 days 38 hours 34 minutes Total flight time on the type of aircraft 1,866 hours 18 minutes Flight time in the last 30 days 38 hours 34 minutes
2.5 Aircraft Information	Aircraft type Bombardier DHC-8-402 Serial number 4096 Date of manufacture October 3, 2004 Certificate of airworthiness No.Tou-24-310 Validity: During the period from October 2, 2012, in which the aircraft is maintained in accordance with the maintenance manual (All Nippon Airways Co., Ltd.). Category of airworthiness: Airplane, Transport Total flight time 32,073 hours 46 minutes When the accident occurred, weight and position of the center of gravity of the Aircraft were within allowable ranges.
2.6 Meteorological Information	(1) Aerodrome routine meteorological report (METAR) at the airport 09:00 Wind direction 340°; Wind velocity 18 kt; Maximum instantaneous wind velocity 31 kt; Wind direction fluctuation 310° to 010°; Prevailing visibility 10 km or more Cloud amount 1/8; Type: Cumulus, Cloud base 3,000 ft; Cloud amount 3/8; Type: Cumulus, Cloud base 3,500 ft; Temperature 15℃; Dew point 7℃; QNH 29.92 inHg (2) Wind direction and velocity observations for the Airport provided by Fukue Remote to the Aircraft. About 09:12 (at the time of establishing communication) 350°20 kt Minimum 14 kt; Maximum 32 kt About 09:21 (at the time of reaching the right base)

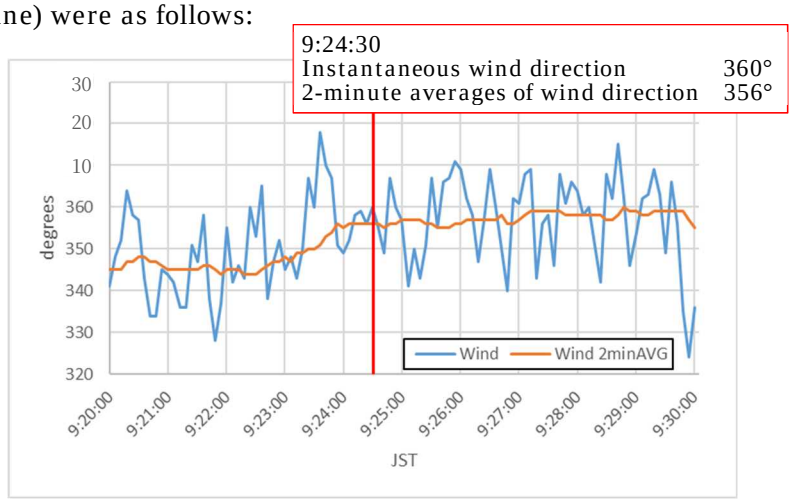
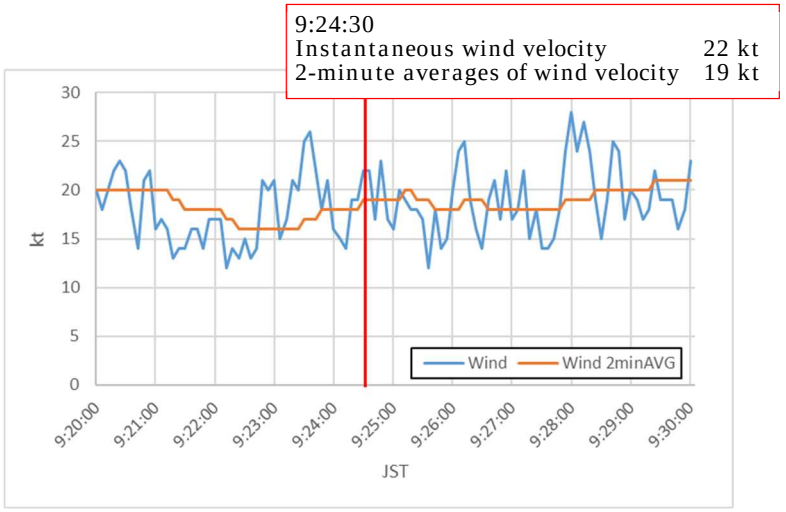
	350°20 kt Minimum 13 kt; Maximum 26 kt About 09:23 350°16 kt (3) The observation values of wind direction and velocity around Runway 03 at the Airport Wind direction and velocity around the time of the accident occurrence observed (at 6-second intervals) by the wind vane/anemometer installed near the aiming point marking on Runway 03 (about 320 m from the inside of the runway threshold, about 70 m east-southeast of the runway centerline) were as follows:  Figure 2 Wind direction  Figure 3 Wind velocity
2.7 Additional Information	(1) State of damage to the Aircraft Skin abrasion (including cracks) was found in an area about the overall length about 2.1 meters and a maximum of about 0.6 meter wide on the lower aft fuselage. The partial structural members inside this part were damaged and deformed.

Figure 4 Location of damage to the airframe damage

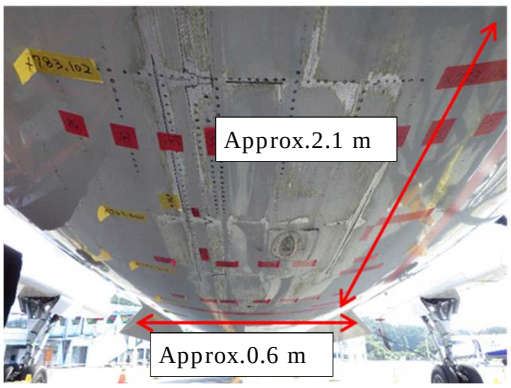


Figure 5 Damage to lower aft part of the airframe (viewing the fuselage from aft to forward)

(2) State of the accident site

Fukue Airport was at 251 ft elevation and has a runway 03/21 (magnetic bearing 033°/ 213° with a length of 2,000 m and a width of 45 m). The on-site investigation found contact marks in an area about 7.7 meters long and a maximum of about 0.6 meter wide from a point about 152 meters from the threshold of Runway 03. In addition, judging from the position relation between the tire marks of the Aircraft and the contact marks, it was found that the Aircraft touched the ground in the following order with slight time difference, although those parts touched down almost simultaneously.

1. left main wheel
2. right main wheel and
3. lower surface of the fuselage

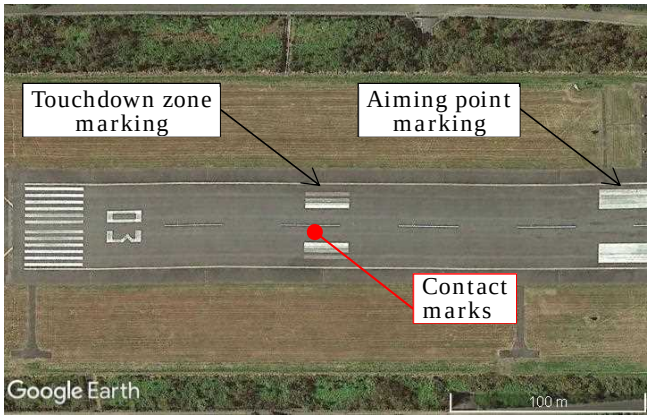


Figure 6 Location of contact marks on runway

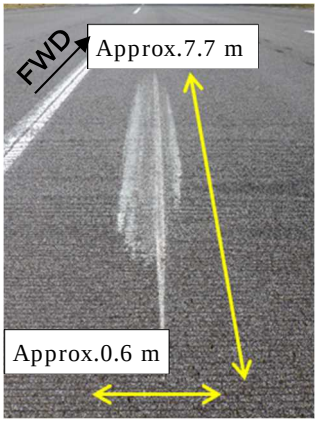


Figure 7 Contact marks

(3) Wind direction and velocity limitations

The Aircraft Operation Manual (AOM) of the Company stipulates that the aircraft crosswind limitations during take-off and landing shall be 32 kt on dry runway surfaces.

In addition, the Company established limitations during take-off and landing at the Airport on the wind direction and velocity and stipulates it in their Route Manual. And the limitations to set the wind velocity to 25 kt or

	below when the wind direction is 290° to 340° were applied to the captain who had logged more than 300 hours of flight as a PIC on the type of aircraft. Besides, it is stipulated that average wind velocity shall be applied basically, however, when the maximum wind velocity exceeds the average wind velocity of 10 kt or more, the speed correction shall be made to add one half of the value gained by subtracting average wind velocity from the maximum wind velocity. (4) Meteorological characteristics at the Airport With respect to turbulence during take-off and landing, the meteorological characteristic information on the airport in the Company Route Manual provided to the flight crewmembers includes the following descriptions. (excerpts) *I. At the time of landing on RWY03 in winter, the aircraft often encounters turbulence at an altitude of 600 ft or below.* *II. MOD TURB occurs mostly when the wind direction of ground winds is the west-northwest to the northwest to the north, the average wind velocity is 11 to 20 kt, and gusts exceeds 24 kt.* *III. Up Wash and Down Wash often occur at the same time on RWY03, however, Down Wash occurs relatively commonly on RWY21.* (5) Stabilized approach With respect to stabilized approach, the AOM of the Company states as follows. (excerpts) *LANDING CHECK LIST shall be completed and the aircraft shall be stabilized before passing an altitude of 1,000 ft above the runway (an altitude of 500 ft above the runway in case of circling approach). An aircraft is stabilized when the following conditions are met.* - *The aircraft is in an appropriate attitude and position.* - *The airspeed and descending rate are within the designated range.* - *The engine thrust is appropriate.* *If the stabilized approach cannot be established by the time when passing the above mentioned altitude, the aircraft has to execute a go-around. It also has to execute a go-around when the non-stabilized state continues at an altitude lower than the above mentioned altitude.* In addition, in the Airplane Operations Reference (AOR*4) of the Company the following descriptions are included for delivering judgment on the stabilized state in the stabilized approach. (excerpts) *However, for instance, even if the parameter values related to the stabilized approach exceed the roughly estimated criteria of the significant deviation due to a sudden change of wind direction or disturbance in air stream, the values exceeding the criteria are allowed if it is temporary, could be adjusted, and is being adjusted proactively..* (6) Landing for the same type of aircraft With respect to precautions to take at the time of landing, the Company's Airplane Operating Manual states that if the aircraft takes nose-up attitude

*4 The "AOR" of the Company is a reference material for the flight of the same type of aircraft and gives addendum and explanation to the AOM.

	exceeding 6° during the landing flare, the aft part of the fuselage may contact with the runway. And regarding the flare, it states that when the rate of descent becomes high, a corrective operation should be performed by adding power so that the descent rate become reduced and the nose-up attitude may not exceed 6°. (7) Regulations on callout The deviation call is specified in the Company's Airplane Operating Manual as follows: a call shall be made by PM when the airspeed fluctuates beyond the target approach speed of +10 kt or -5 kt after passing an altitude of 1,000 ft above the runway during the landing approach.

3. ANALYSIS

3.1 Involvement of Weather	Yes
3.2 Involvement of Pilot	Yes
3.3 Involvement of Aircraft	None
3.4 Analysis of Findings	(1) Meteorological conditions As the Aircraft was shaking at an altitude of 5,000 ft or below during the descent, turbulence was most likely generated at the bottom layer of the airspace around the airport. In addition, judging from the wind direction and velocity values observed at the Airport at around the time of the accident, the north-northwest winds with gusts of wind were likely prevailing, around the final approach course, turbulence was possibly generated amid the influence of geographical features on the windward side. The data of pressure altitude and airspeed after passing the runway threshold were taken every one second and recorded in the FDR of the Aircraft, in which the difference between the right and left and the variation width fluctuated widely. However, while the pressure altitude fluctuated widely, the radio altitude uniformly varied at a rate of 10 ft/sec. So, certainly, the Aircraft was descending with the descent rate of 600 ft/min after passing the runway threshold. As a result, the values of the pressure altitude of the Aircraft most likely fluctuated due to a disturbance surrounding the Aircraft, and turbulence was generated over the runway of the Airport. Besides, as the airspeed was largely reduced compared to the ground speed change calculated with the track information on the GPS and others, after the Aircraft passed the runway threshold, fluctuating wind direction and velocity due to turbulence most likely resulted in a rapid decrease in the headwind component to the Aircraft. (2) Final approach During the Aircraft's final approach, it was most likely that large pitch attitude and airspeed fluctuations occurred due to the rough air.Therefore, it was more likely that the captain made an approach while performing a corrective operation frequently on the final approach to maintain the target

	approach speed and approach path. During the final approach, the target approach speed of the Aircraft changed and exceeded the airspeed as registered in the Company's Airplane Operating manual for the Aircraft, which resulted in the FO's deviation call. This is probably because the airspeed of the Aircraft momentarily changed due to the wind direction and velocity fluctuations (gusts of wind) as a result of turbulence. Furthermore, during the final approach of the Aircraft, without making the speed, pitch attitude and power setting settled and stable, the captain continued to approach up to the runway threshold while performing a corrective operation. The Company's Airplane Operating Manual stipulates that a go-around should be performed when the non-stabilized state continues at an altitude of 1,000 ft or below over the runway, however, in the AOR, it is permitted to continue to approach when such conditions are temporarily and remain within a corrective range, and the corrective operations are proactively performed. Therefore, the captain probably continued to approach while performing corrective operations. (3) Condition of the Aircraft after passing the runway threshold According to the FDR records (Figure 1), the engine torque dropped from about 19 to 12 % after the Aircraft passed the runway threshold. And the airspeed in the left seat (captain's side) was 131 kt (V_{REF}+12 kt) when it passed the runway threshold but decreased to 116 kt (V_{REF} – 3 kt) at the time of touchdown. As the airspeed of the Aircraft dropped 15 kt in speed in the left seat and 11 kt in the right seat for four seconds from when the Aircraft reached the runway threshold to when it touched down, the airspeed decreased most likely at the deceleration rate of about 3 kt/sec from when the Aircraft passed the runway threshold to when it touched down. This airspeed reduction was most likely caused by the decrease in headwind component because the change in ground speed was small.However, the deceleration rate of about 3 kt/sec was too large for the speed change after passing the runway threshold, therefore, it is highly probable that the Aircraft was flaring while greatly decreasing the airspeed. Most likely the lift of the Aircraft decreased as the airspeed decreased, and therefore, probably the control column input during flare operations was not enough to stop descent. For this reason, it is probable that as the captain continued to pull the control column to stop the descent, the Aircraft was in an excessive nose-up attitude with the pitch angle reaching a maximum value of 9° immediately before touchdown, the Aircraft touched down before stopping descent, and the lower side of its tail contacted the runway. In addition, because the Aircraft was flaring while greatly decreasing its airspeed after the Aircraft passed the runway threshold, it probably became difficult for the captain and the FO to predict the Aircraft behavior and they failed to make a proper judgement on power adjustment or go-around within a little time to touchdown. The Company's AOR stipulates that even if the parameter values related

	to the stabilized approach exceed the estimated criteria of the significant deviation due to a sudden change of wind direction or disturbance in air stream, the values exceeding the criteria are allowed if it is temporary, could be adjusted, and is being adjusted proactively. However, in this case, it is important to make the aircraft parameters settled and stable by performing corrective operations. Besides, even after passed the runway threshold, it is desirable to perform a go-around proactively when the aircraft behavior becomes different from pilots' prediction due to disturbance in air stream or others, because it is difficult to take the appropriate responses within a little time to touchdown.

4. PROBABLE CAUSES

In this accident, the JTSB concludes that the probable cause of this accident was that the Aircraft was most likely in an excessive nose-up attitude and the lower side of its tail contacted the runway because the captain continued the nose-up operation until moments before the touchdown since the Aircraft did not stop descending due to the airspeed reduction caused by turbulence during the landing flare.

5. SAFETY ACTIONS

Measures taken by the Company as Safety actions after the accident are as follows:

(1) Relevant flight crewmembers

The Company implemented retraining regarding procedures for the items possibly caused by the crewmembers' operations and knowledge and made an extraordinary examination.

(2) All flight crewmembers

The Company made the outline of the accident well known to all flight crewmembers and issued the relevant instructions to reconfirm precautions for landing in turbulence generated due to strong winds.

(3) Development of rules and regulations

i. In order to take advantage of the PM's monitoring and assertion, the Company revised the AOR (Airplane Operations Reference) and specified that the PM should call, "PITCH" when the pitch angle exceeds 5° after passing the runway threshold.

ii. The Company analyzed the meteorological characteristics at remote islands airports where its service is provided and documented precautions for aircraft operations.

iii. In regard to flight operations for the same type of aircraft, the Company documented precautions for landing and approaching including technological considerations.

(4) Education and training

To the flight crewmembers who have few experience in flights to and from remote islands in service of the Company, metrological characteristics according to each airport were made known again.

Appended Figure 1: FDR Records (09:24:10 to 09:24:40)