2003-6

AIRCRAFT ACCIDENT INVESTIGATION REPORT

ALL NIPPON AIRWAYS
BOEING 767-200, JA8254
SHIMOJI-SHIMA AIRPORT, OKINAWA, JAPAN
JUNE 26, 2002

November 28, 2003

Aircraft and Railway Accidents Investigation Commission
Ministry of Land, Infrastructure and Transport

The investigation for this report was conducted by Aircraft and Railway Accidents Investigation Commission, ARAIC, about the aircraft accident of All Nippon Airways Boeing 767-200 in accordance with Aircraft and Railway Accidents Investigation Commission Establishment Law and Annex 13 to the Convention of International Civil Aviation for the purpose of determining cause of the aircraft accident and contributing to the prevention of accidents and not for the purpose of blaming responsibility of the accident.

This English version report has been published and translated by ARAIC to make its reading easier for English speaking people those who are not familiar with Japanese. Although efforts are made to translate as accurate as possible, only the Japanese version is authentic. If there is difference in meaning of the texts between the Japanese version and the English version, texts in the Japanese version are correct.

Junzo Sato,
Chairman,
Aircraft and Railway Accidents Investigation Commission

Abbreviated words

Abbreviated words used in this report are as follows:

ＡＤＩ	：	Attitude Director Indicator
ＡＰＵ	：	Auxiliary Power Unit
ＣＡＳ	：	Computed Airspeed
ＣＲＭ	：	Crew Resource Management
ＣＶＲ	：	Cockpit Voice Recorder
ＤＦＤＲ	：	Digital Flight Data Recorder
ＥＭＧ	：	Emergency
ＦＡＭ	：	Familiarization
ＦＢＳ	：	Fixed Based Simulator
ＦＦＳ	：	Full Flight Simulator
ＧＡ	：	Go Around
Ｇ／Ｓ	：	Ground School
ＩＬＳ	：	Instrument Landing System
ＬＣＬ	：	Local
ＬＯＣ	：	Localizer
ＯＢＳ	：	Observer
ＯＪＴ	：	On the Job Training
ＲＵＴ	：	Route
ＳＹＳ	：	System
ＶＦＲ	：	Visual Flight Rules
V_{MCA}	：	Air Minimum Control Speed
V_{REF}	：	Reference Speed

AIRCRAFT ACCIDENT INVESTIGATION REPORT

ALL NIPPON AIRWAYS
BOEING 767-200, JA8254
SHIMOJI-SHIMA AIRPORT, OKINAWA, JAPAN
AT ABOUT 12:54 JST, JUNE 26, 2002

November 12, 2003

Decision by the Aircraft and Railway Accidents Investigation Commission (Air Sub-committee Meeting)

Chairman Junzo Sato
Member Ryouhei Katsuno
Member Susumu Kato
Member Sumio Matsuura
Member Yukiko Kakimoto
Member Kozaburo Yamane

1 PROCESS AND PROGRESS OF THE ACCIDENT INVESTIGATION

1.1 Summary of the Accident

On Wednesday June 26, 2002, a Boeing 767-200 of All Nippon Airways, registration JA8254, was being operated for takeoff and landing training at Shimoji-Shima Airport.

During a landing with a simulated inoperative right engine, after touching down on the runway at around 12:54 the aircraft veered off into a grass field on the east side of the runway and came to a stop there.

Of the three persons aboard the aircraft — the Captain acting as instructor and two pilots undergoing training for promotion to First Officer — one of the trainee pilots sustained minor injuries.

The aircraft was substantially damaged, but there was no fire.

1.2 Outline of the Accident Investigation

1.2.1 The Organization of the Investigation

On June 26, 2002, the Aircraft and Railway Accidents Investigation Commission (ARAIC) assigned an investigator-in-charge and an investigator.

1.2.2 Accredited representative and adviser by Foreign Authorities

Accredited representatives from the United States, the state of design and manufacture of the aircraft, participated in the investigation of this accident.

1.2.3 The Implementation of The Investigation

The investigation proceeded as follows.

June 27–28, 2002	On-site investigation and Interviews the crew.
October 22, 2002	Interviews the crew.
September 2~October 14, 2003	Comment inquiry from the state of design and manufacture.

1.2.4 Hearings from Persons relevant to the Cause of the Accident

Hearings were held.

2 FACTUAL INFORMATION

2.1 History of Flight

2.1.1 Summary of The Flight

On June 26, 2002, a Boeing 767-200 of All Nippon Airways, registration JA8254, took off from Shimoji-Shima Airport at around 11:32 on a flight for takeoff and landing training.

The flight plan of the aircraft submitted to the Shimoji-Shima Airport Office of the Japan Civil Aviation Bureau (CAB) was as follows:

> FLIGHT RULES: VFR, AERODROME of DEPARTURE: Shimoji-Shima Airport, TIME: 11:20, CRUISING SPEED: 250kt, LEVEL: VFR, ROUTE: Traffic Pattern, DESTINATION AERODROME: Shimoji-Shima Airport, FLIGHT PURPOSE: Training Flight, TOTAL EET: 1 hour 40 minutes, ENDURANCE: 6 hrs 32 minutes, PERSONS ON BOARD: 3.

The three persons on board were in the cockpit at the time of the accident: A pilot undergoing training for promotion to First Officer (Trainee Pilot-A) occupying the left pilot's seat, the Captain acting as instructor occupying the right pilot's seat, and another pilot undergoing training for promotion to First Officer (Trainee Pilot-B) occupying the left observer's seat.

First, Trainee Pilot-B made seven landings on runway 17 from the left pilot's seat, including two landings with one engine simulated inoperative (see Note 1), and a go-around with both engines operative. He then changed places with Trainee Pilot-A.

At around that time, the wind direction changed from the south to the west, and the aerodrome control tower instructed a change to runway 35.

Trainee Pilot-A then made two landings on runway 35 with both engines operative, and training then switched to landing with one engine simulated inoperative. The first landing was made with the left engine simulated inoperative. After that, during a landing with the right engine simulated inoperative, the touch down was late and Trainee Pilot-A attempted to go-around with go-around thrust on the left engine only. A few seconds later the instructor increased power on the right engine to go-around thrust, but at that time even though the left engine thrust had started to increase the right engine was still at minimum idle thrust. As a result, a thrust imbalance occurred between the left and right engines while right rudder was being applied, and the aircraft rolled and yawed to the right (East). Although Trainee Pilot-A and the instructor attempted to correct the attitude changes, the aircraft veered off the runway into a grass field on east side of the runway and came to a stop around 1,990m from the point it had first touched down.

The accident occurred at runway 35 of Shimoji-Shima Airport at around 12:54.

Note 1: In one-engine-out landing training, it is specified not to carry out a full-stop landing but to shift to the takeoff training using both engines continuously.

2.1.2 Outline of the Flight based on Digital Flight Data Recorder and Cockpit Voice Recorder

The following is a summary of the flight history before and after the accident occurred based on the data recorded by the Digital Flight Data Recorder (DFDR) and the Cockpit Voice Recorder (CVR). The precise direction of runway 35 is 349.2°.

At 12:52:56, the aircraft was on approach to runway 35 at an altitude of 500 ft, flying at an airspeed (CAS) of 137.8 kt, on aircraft heading (heading) 342.9°, with left engine N_1 at 59.4% and right engine N_1 at 22% (see Note 2 below).

At 12:53:14, the instructor advised Trainee Pilot-A that the aircraft was slightly above on final approach course and that the approach angle was at the upper limit.

At 12:53:20, the aircraft was on the final approach and descending past 96 ft, CAS was 136.5 kt and heading was 344°. At that time, the radar altimeter synthetic voice callout of "One hundred" was issued, which notified the crew that the aircraft was at a height of 100 ft Above Ground Level (AGL).

At 12:53:24, the voice callout of "Fifty" was issued.

At 12:53:25, the instructor advised Trainee Pilot-A of passing the runway threshold. At that time the aircraft was at a height of 32 ft AGL, flying at a CAS of 129.8 kt, almost equal to the V_{REF} (20) value of 128 kt.

At 12:53:26, the voice callout of "Thirty" was issued.

At 12:53:27, the voice callout of "Twenty" was issued.

At 12:53:28, the instructor cautioned Trainee Pilot-A "Timing for power reduction is late". From around that the time the left engine N_1 gradually started to decrease.

At 12:53:29, the voice callout of "Ten" was issued.

At 12:53:30, the instructor again cautioned Trainee Pilot-A "To reduce the power more quickly". The aircraft was descending past 10 ft AGL, at 128.5 kt CAS and heading 345.4°.

At 12:53:32, the instructor advised Trainee Pilot-A "Just all right, just all right". The aircraft was just about to touch down with the left engine brought back to almost idle, at 127.5 kt CAS, heading 345.8° and at a pitch angle of 5.6°.

At 12:53:33, the aircraft was flying at a CAS of 123.8 kt and a pitch of 6.1°, and although it was just about to touch down, pitch angle was increasing.

At 12:53:34, the instructor advised Trainee Pilot-A "Just keep this heading ".

At 12:53:35, the instructor advised Trainee Pilot-A to "Maintain this heading ". The aircraft touched down ('GROUND' was recorded in the DFDR data: see Note 3 below) at a CAS of 123.5 kt, a heading of 344.9°, and at 7.6° pitch. The vertical acceleration at touch down was 1.24G.

At 12:53:35–12:53:36, having touched down, the aircraft became airborne again ('AIR' is recorded in the DFDR data). At 12:53:36, the instructor advised Trainee Pilot-A "That's enough", but Trainee Pilot-A called out "Go-Around" expressing his intention to go-around. At 12:53:37, the instructor said "Wait, continue landing ", and at 12:53:39, he told Trainee Pilot-A "Okay, let's go around".

At 12:53:39, the aircraft touched down again at a CAS of 118.5 kt, a heading of 345.4°, and at 7.0° pitch. The vertical acceleration at touch down was 1.11G.

At 12:53:39–12:53:40, the aircraft had touched down, and then became airborne again.

At 12:53:41, Trainee Pilot-A called "Go-Around". The left engine thrust lever was advanced, and left rudder pedal was applied simultaneously.

At 12:53:43, Trainee Pilot-A called "Two GA" (The letters "GA", meaning go-around, were displayed on the Attitude Director Indicator (ADI)). Because on turbine-engine aircraft, engine thrust response lags thrust lever movement by 6–8 seconds, the aircraft started to yaw to the left (west) due to the effect of the applied left rudder.

At 12:53:44, the amount of left rudder applied started to decrease.

At 12:53:46, Trainee Pilot-A called "Both Engines go-around". The right engine thrust lever had been advanced immediately prior to this. Further, although 5.6° of right rudder pedal was applied between 12:53:45–12:53:47, the aircraft continued to yaw to the left (west) until 12:53:46.

At 12:53:46, the left engine N_1 (31.7%) started to increase, and pitch angle (10.8°) continued to increase.

At 12:53:47, the left engine N_1 reached 43.6% and the aircraft began to yaw to the right (east) (heading 343.1°). Pitch angle continued to increase further (12.7°).

At 12:53:48, pitch angle reached to 13.4°.

At 12:53:49, the aircraft started to roll to the right. Pitch angle was 13.7°.

At 12:53:50, pitch angle reached its maximum value in the accident of 15.3°, and aircraft was rolled 11.3° to the right. Because of the increasing pitch attitude and decreasing speed the stick shaker, which alerts the crew when the aircraft approaches the stall speed, began to operate. At that time the CAS was 108.3 kt and was greater than the V_{MCA} of 103 kt.

At 12:53:51, although the right engine N_1 had started to increase, both thrust levers were closed to almost the idle positions. At that time, pitch angle was 13.3° and roll angle had reached its maximum value during the accident of 17.9° to the right, while the control wheel was turned 64.9° to the left. The CAS was 111.3 kt, and was greater than V_{MCA}.

At 12:53:52, the control wheel had been turned 64.9° to the left, and 15.8° of left rudder pedal had been applied, the maximum value during the accident.

At 12:53:53, the left rudder pedal was moved to 15.1°, the rudder control surface angle indicated 26.4° and heading indicated 14.6°. At that time the aircraft was rolled 10.7° right

and pitch was 14.5°, with the control wheel still turned 64.9° to the left.

Both main landing gear trucks were de-tilted and in contact with the runway between 12:53:55–12:53:56, and then became airborne until 12:54:00. At 12:53:56, the vertical acceleration indicated the maximum value in the accident of 1.68G, and the aircraft was at 11.7° pitch in a 1.9° left roll.

At 12:53:59, heading indicated 344.2°, pitch was 11.2° and the aircraft was rolled 13.4° to the left.

At 12:54:01, the aircraft touched down again. Heading indicated 333.8°, pitch angle indicated 6.9° and roll angle indicated 7.0° left. From this time onwards, both main landing gears were in contact with the ground.

Reverse thrust operated between 12:54:04–12:54:16, beginning at a CAS of 88.3 kt. From that time there were no significant changes in the recorded heading, pitch angle and roll angle, and the aircraft continued to run parallel to runway 35.

At 12:54:22 the aircraft came to a stop.

Note 2: N_1 indicates the rotation speed of the low-pressure turbine, and is indicated as a percentage with 3,432.5 rpm corresponding to 100%. It is used as an indicator for establishing thrust.

Note 3: The left and right the main landing gear each have four wheels attached to a truck. In flight, the trucks are maintained in a tilted position. The trucks will de-tilt as all four tires contact the runway during touchdown. The air/ground indication recorded by the DFDR means that both main gear trucks have de-tilted. A single truck de-tilted will not show as on-ground in the DFDR data.

2.1.3 Statements of the Instructor and Trainee Pilots regarding the History of Flight

(1) Statement of the Instructor (Captain)

"I carried out the pre-flight briefing, and then explained the outline of the training. The training was planned to be touch-and-go training in the traffic pattern for one hour and forty minutes. The weather presented no obstacle to training. The two trainees boarded, and the aircraft took off from runway 17.

"After Trainee Pilot-B had completed seven touch-and-go landings, including single engine inoperative cases, and one both-engines go-around, he changed places with Trainee Pilot-A, after which runway 35 was used.

"After completing two normal touch-and-go landings and one left-engine-out touch-and-go, the trainee was making a right-engine-out touch-and-go, when the accident occurred.

"There were no problems with the approach up to the threshold. After passing the threshold, the trainee was slightly late in closing the thrust levers and the aircraft was floating. Because it looked like we would touch down late, Trainee Pilot-A indicated his

intention to go-around.

"While I had placed my feet lightly on the rudder pedals, I did not put my hands on the control wheel.

"As I judged we had enough runway remaining, I instructed the trainee to continue the landing. However, because the landing had already taken some time, Trainee Pilot-A expressed his intention to go-around again while setting the left engine, which up to that point had been controlled as the operative engine, to go-around thrust. After he had set power, the left engine was late in spooling up [increasing rotation speed], and because I could see no sign of engine acceleration, I advanced the right engine thrust lever. After that, I felt the nose move greatly to the right and although I didn't call out 'I have control', I attempted to recover. However, the aircraft did not respond as expected, and continued further to the right and veered off the right [east] side of the runway. At the time, I still intended to go around. I remember that I thought the aircraft was airborne when we left the runway. The motion to the right [east] stopped, and I next controlled the aircraft to the left, but because I was fully absorbed in control I can't remember at what time, and during that time I felt the aircraft touch down in the grass field. I judged that it would be impossible to lift off again from there, so instead I stopped the aircraft while keeping it heading parallel to the runway.

"After we stopped, I told Trainee Pilot-B, who was occupying the left observer's seat, to go into the cabin to check the aircraft from the inside. It was at that time that I first noticed that the tips of both wings were abraded."

(2) Statement of Trainee Pilot-A

"Runway 17 was in use for Trainee Pilot-B's training, but after we changed places I used runway 35 for the training. This was the first time I had trained using runway 35, so I was a little at a loss in judging the path [the flight path angle of the final approach course], but the instructor turned on the ILS for me so I was able to make corrective actions normally by referring to it. I made three touch-and-go landings including one time left-engine-out landing without accident and then began right-engine-out touch-and-go training. I thought the flight was relatively stable till the threshold. The timing for reducing power was late at landing, and judging that the touch down point would be beyond 2,000 ft, I called 'Go-Around'.

"Because the instructor pilot said 'Wait, continue landing', I continued the landing, but we did not touch down. After that, the instructor said 'Let's go around' so I advanced the left thrust lever, pushed the go-around switch and called 'Two GA'. At the time our speed was about 10 kt lower than the bug speed [bugs are set to indicate target speeds. In this case, the bug indicating the value of the speed V_{REF} at a flap setting of 20° is called V_{REF} (20)], so without ordering flap five I maintained the current pitch while waiting for the left engine to spool up. Around that time, I saw the instructor advance the right engine thrust lever so I called out

'both engine go-around'. At the time, because I reduced left rudder pedal input slightly the aircraft yawed a little to the right (east). Immediately afterwards, we abruptly yawed and rolled to the right (east). Because the yaw and roll happened suddenly, I could not take in for pitch up . I think it was about then that the instructor took over. I thought we could recover, but the aircraft continued yawing and touched down on the right hand side. The stick shaker activated before touch down.

"I did not realize that the left and right wings and the tail had contacted the ground.

"Soon afterwards, we went off the right (east) side of the runway and the instructor stopped the aircraft using reverse.

"I experienced to execute go-around with one engine inoperative just before touch down, because the touch down extended for only one time since I stayed in the training center in Shimoji-Shima."

(3) Statement of Trainee Pilot-B

"I carried out the first half of the take off and landing training, and after changing over with Trainee Pilot-A in flight, I watched from the left observer's seat. The flight continued till the final approach leg without any particular problem. Even after we had turned onto final the approach was stable with little change up, down, left or right. When we flared the touch down was delayed and as far as I could see there was no bump of touch down even passing the fourth touch down marking (2,000 ft), so I judged we had passed the 2,000 ft aiming point specified in the training. Around that time Trainee Pilot-A called out 'go around'. I could not see the movements of control wheel and thrust levers as these were hidden from my view behind the left front seat, so I do not know what operations were carried out. Immediately after the callout by Trainee Pilot-A, while I don't remember the precise words I heard the instruction say something to the effect of 'No, continue landing'. Then after a short pause I heard the instructor say something to the effect of 'we are go-around'. At the time, I glanced at the captain's-side airspeed indicator, saw the needle indicating around 10–15 kt lower than V_{REF} (20), and recognized the airspeed had dropped below V_{REF} (20).

"Thereafter, I did not see any ready increase in speed. We remained at high pitch, and while I don't remember whether or not there was a shock of touch down, I supposed that the aircraft was running with the main gear in contact with the ground and the nose gear lifted off. The reason for this was that trainee pilots at our stage often experience not being able to lower the nose properly after main gear contact and running with the nose gear lifted off, and so I think I remember that attitude.

"Then, there was a slightly large slow yaw to the left (West), and just when I thought the yawing had stopped we yawed abruptly to the right (East) and a large roll to the right began. At that time, the aircraft was pitching up gradually and I couldn't see the ground, only sky.

"Then, I recognized that the aircraft was flying with significant yaw and roll. At that time the instructor took over and I felt he was trying to take off again. I then felt a large momentary shock, then many shocks in succession. During that time my head was hit to the ceiling.

"I could see the coastline in front and we proceeded in that direction, but then the aircraft began to turn to left (West) and then continued to run almost parallel to the runway. Then the sound of the engines increased so I thought reverse was in operation. The aircraft stopped, and I leaned forward to check the instrument readings. Both engines were running normally and there was no fire.

"I went to the aft passenger cabin to check for any abnormality inside, and found abrasions on the both wing tips."

(Refer to Figs. 1, 2, 4-1, 4-2, Photo 1 and Attachment)

2.2 Deaths, Missing Persons and Injuries

Trainee pilot-B sustained slight injuries.

2.3 Damage to Aircraft

2.3.1 Extent of Damage

Moderate damage.

2.3.2 Damage to Aircraft by Part

(1) Lower part of aft fuselage: Skin panels: Abraded
Frames: Damaged
Stringers: Damaged
(2) APU and its attaching mount: Damaged
(3) Both wing tips: Abraded and Destroyed
(4) Both outboard ailerons: Abraded and Destroyed
(5) No. 1 and No. 12 Slats: Damaged
(6) Right horizontal stabilizer tip: Damaged

2.4 Damage to Other than the Aircraft

One Taxi Way Light: Destroyed

2.5 Personnel Information

(1)The Instructor (Captain): Male, aged 44

Airline Transport Pilot License (Airplane) Issued July 18, 1995

Type Ratings

Airplane multiengine (land)	Issued February 13, 1979
Boeing 737	Issued May 30, 1989
Boeing 767-200	Issued November 22, 1990
Class 1 Airman Medical Certificate	
Term of Validity	Until October 3, 2002
Total Flight time	10,375 hours 02 minutes
Time during previous 30 days	13 hours 50minutes
Total Flight time on Boeing 767-200	6,654 hours 32 minutes
Time during previous 30 days	13 hours 50 minutes
Total Flight time as Boeing 767-200 instructor	12 hours 15 minutes
Time during previous 30 days	10 hours 20 minutes
Total Flight time on Boeing 767-200 simulator	514 hours 35 minutes
Time during previous 30 days	14 hours 00 minutes
Total Flight time as Boeing 767-200 simulator instructor	298 hours 00 minutes
Time during previous 30 days	14 hours 00 minutes

(2)Trainee Pilot A: Male, aged 28

Commercial Pilot License	Issued August 27, 1999
Type Ratings	
Airplane multiengine (land)	Issued August 27, 1999
Instrument Rating	Issued August 27, 1999
Class 1 Airman Medical Certificate	
Term of Validity	Until March 24, 2003
Total Flight time	259 hours 10 minutes
Time during previous 30 days	5 hours 10 minutes
Total Flight time on Boeing 767-200	5 hours 10 minutes
Time during previous 30 days	5 hours 10 minutes
Total Flight time on Boeing 767-200 flight simulator	133 hours 40 minutes
Time during the previous 30 days	7 hours 00 minutes

2.6 Aircraft Information

2.6.1 The Aircraft

Type	Boeing 767-200
Serial Number	23433
Date of Manufacture	March 10, 1987
Certificate of Airworthiness	TOU-10-143

Term of validity	From May 19, 1998 until as prescribed in ANA Maintenance Program Manual
Total flight time	35,347 hours 34 minutes
Flight time since scheduled maintenance "C-13" Check of June 3, 2002	116 hours 46 minutes

2.6.2 The Engines

Type: General Electric Model CF-6-80A

	Serial No.	Date of manufacture	Total time in service
No.1	580193	May 31, 1983	36,827 hours 32 minutes
No.2	580227	February 24, 1984	36,399 hours 53 minutes

Time after Date of Return to Service from Approved Repair Station

	At Date of Return to Service	Time after Date of Return to Service
No.1	January 27, 2002	220 hours 25 minutes
No.2	April 30, 2002	49 hours 10 minutes

(Refer to Fig. 3)

2.6.3 Weights and Center of Gravity

The weight of the aircraft at the time of the accident is estimated to have been approximately 214,500 lb, with the center of gravity at 22.6% MAC. Both values are within the allowable limits (maximum landing weight 266,700 lb, with an allowable center of gravity range corresponding to the weight at the time of accident of 11.0–36.0% MAC).

2.6.4 Fuel and Lubricating Oil

The fuel on board was JET A-1. The lubricating oil was ESSO ETO 2197

.

2.7 Meteorological Information

The following table shows METAR information for Shimoji-Shima Airport.

Time of Observation	12:00 JST	12:38 JST
Wind Direction Wind Change	260° 190°–290°	300°
Wind Speed	7 kt	8 kt
Visibility	Greater than 10 km	Greater than 10 km
Cloud amount	1/8	1/8

Cloud type	Cumulus	Cumulus
Height of cloud base	1,500 ft	2,000 ft
Cloud amount	1/8	1/8
Cloud type	Cumulonimbus	Cumulonimbus
Height of cloud base	2,000 ft	2,500 ft
Cloud amount	3/8	–
Cloud type	Altocumulus	
Height of cloud base	6,000 ft	
Temperature	30°C	31°C
Dew point	25°C	23°C
QNH	29.83 inHg	29.84 inHg
Cumulonimbus	South	Southwest

2.8 Information on the CVR and DFDR

The aircraft was equipped with a Fairchild (Loral) CVR (Serial No. 93-A100-80) and a Lockheed Aircraft Service DFDR (Serial No. 10077A500).

2.8.1 CVR

The CVR records voices and sounds in the cockpit on a thirty-minute tape loop. Voices and sounds were recorded on the CVR for the 30 minutes prior to removal of electrical power, and so all voices and sounds immediately before and after the accident were recorded.

2.8.2 DFDR

All data recordings from the time since the aircraft departed its parking spot at Shimoji-Shima Airport until it stopped after the accident occurred were preserved on the DFDR.

2.9 Information on the Accident Site and Aircraft

2.9.1 The Accident Site

The aircraft had stopped with the fuselage axis almost parallel to the runway and the nose pointing nearly north. The left main gear was located approximately 31 m north of the No. 9 runway distance marker light (DML) located on the east side of runway 35 (3000 m x 60 m) and approximately 42 m east of the runway 35 end markings.

Traces on the ground thought to have been caused by abrasion of the aircraft's aft fuselage, right wing and right horizontal stabilizer, and tracks from the left and right main landing gears were found in an area extending from the vicinity of the No. 5 DML of runway

35 to approximately 100 m north of the No. 4 DML. Furthermore, tracks from the left and right main landing gears and nose gear and traces from the aft fuselage and left wing were found in the grass area east of runway 35 from this position to place where the aircraft had come to a stop.

Also, four static dischargers (stick for discharging static electricity), two pieces of APU door seal and a fragment of an aircraft light cover were found on the runway between the No. 4 and No. 5 DMLs, and another static discharger was found in the grass area in the vicinity of No. 4 DML.

(Refer Fig. 2)

2.9.2 Details of Aircraft Damage

The major damage found on examination of the aircraft is described below. All damage had occurred during the time from touch down till the aircraft came to a stop.

(1) Fuselage

① Wrinkles were found in the skin on the right side of the aft fuselage between the horizontal stabilizer and vertical stabilizer.

② Abrasions considered to have resulted from contact with the ground were found on the lower skin of the aft fuselage extending from STA.1629 to approximately 8 m aft (between STA 1629–1702), with parts of some skin panels folded or perforated in places. Scooped up grass and mud was found in the skin perforations and where the skin panels had been folded. The frames and stringers between STA1725–1809.5 were buckled and deformed.

③ The upper surface of the tail cone aft of vertical stabilizer was deformed.

④ APU door was folded and deformed, and the APU attaching mount was damaged.

(2) Wings

① Slats (No.1, No.12) of both wings were damaged by abrasion.

② Abrasions were found on lower surface of the left outboard aileron.

③ The right outboard aileron was broken and abrasions were found on its lower surface. Furthermore, the hinges on the aircraft were damaged.

④ The lower surface of both wing tips had been scraped away, and four of the right wing's static dischargers and of one of the left wing's static dischargers had been scraped away and lost.

⑤ Fuel leakage was found from the right wing fuel tank.

(3) Right Horizontal Stabilizer

① Abrasions were found on the lower surface of the right horizontal stabilizer, and rear spar was deformed in tip area.

② Wrinkles were found in the upper skin of the right horizontal stabilizer.

(Refer Photos. 1–6.)

2.10 Tests and Research to Find Facts

Based on DFDR data and traces remaining on the ground, the following is the estimated sequence of events from when the aircraft touched down until it came to a stop.

(1) The Time and Position of First Touch Down.

The main landing gear first touched down at 12:53:35, at which time the DFDR recorded a vertical acceleration of 1.24G.

It was 13 seconds before the abrasion of the lower aft fuselage occurred, and calculating from the position [of the abrasions], it is estimated that the aircraft touched down around 700m beyond the threshold of runway 35. Although there were many tire marks in that area, it could not be determined which of these were caused by the aircraft touching down.

(2) The Time and Position of the Second Main Landing Gear Touch Down.

The main landing gear touched down a second time at 12:53:39, at which time the DFDR recorded a vertical acceleration of 1.11G.

It was 9 seconds before abrasion of the lower aft fuselage, and calculating from the position [of the abrasions], it is estimated that the main landing gear touched down approximately 950m beyond the threshold of runway 35.

(3) Traces on the Ground from the Wheels and Aircraft after the Second Touch Down.

① The first traces began around 1,470 m beyond the threshold of runway 35, with scratches around 18 m long slightly west of the runway centerline markings. It is estimated that these scratches were due to contact of the aft fuselage with the ground and were created at 12:53:48, when the pitch angle was 13.4°.

② The second traces around 20 m in length started around 1,620 m beyond the threshold of runway 35. Based on the position of scratches left by the right wing tip described in ③ below, it is estimated that these traces were due to contact of the right horizontal stabilizer with the ground. It is estimated that these scratches were created at 12:53:50, when the pitch angle was 15.3° and the roll angle was 11.3° to the right.

③ Scratches around 60 m in length caused by contact of the right wing with the ground started around 1,640 m beyond the threshold of runway 35. It is estimated that these were created at 12:53:51, when the pitch angle was 13.3° and the roll angle was 17.9° to

the right. Honeycomb material from the wing internal structure were found adhered to the scratches over the first half of their length, and the scratches were sharply excavated over the latter half of their length.

④ Traces from the right main landing gear started from around 1,690 m beyond the threshold of the runway 35 and continued for around 250 m. At first these were marks left by the outboard tires only, but marks from both inboard and outboard tires were left just before the aircraft departed the side of runway 35.

⑤ The next scratches started from around 1,750 m beyond the threshold of runway 35 and continued for around 120 m. Judging from the position of the traces described in ④ above, these were caused by contact of the aft fuselage with the ground. It is estimated that these were created at 12:53:53, when the pitch angle was 14.5° and the roll angle was 10.7° to the right.

⑥ Marks caused by the left main landing gear started from around 1,870 m beyond the threshold of the runway 35, and continued to the place at which the aircraft stopped. At first the marks were caused by the outboard tires only. For the distance of around 90 m for which marks from both [left and right] tires remained, it is estimated that the aircraft ceased its right roll and returned to wings level at 12:53:55–56.

Deeply excavated traces found in the grass area adjacent to the runway were located in the middle of marks from the main landing gears, and so are considered to have been caused by contact of the aft fuselage. It is estimated that these were created at 12:53:56, when the pitch angle was 11.7° and a vertical acceleration of 1.68G occurred.

⑦ The next traces started from around 2,130 m beyond the threshold of the runway 35 and extended around 86 m in length. Judging from the positions of the marks left by the left main landing gear described in ⑥ above, it is estimated that these were caused by the left wing. It is estimated that these were created at 12:53:59, when the roll angle was 13.4° to the left.

⑧ It is estimated that the right main landing gear touched down again around 2,240 m beyond the threshold of the runway 35, and from then on both main landing gears remained in contact with the ground until the aircraft stopped.

⑨ Marks from contact of the nose gear began around 2,350 m beyond the threshold of the runway 35 and continued to the point at which the aircraft stopped. From the fact that pitch angle was 0.4° at 12:54:04, it is estimated that the nose gear touched down at this time.

(4) The Time and Position at which the Aircraft Stopped Completely

It is estimated that the aircraft came to a complete stop at 12:54:22.

From the location of the main landing gear at around 31.4 m north of runway 35's No. 9

DML, it is recognized that the aircraft came to a stop around 2,730 m beyond the threshold of the runway 35.

(Refer Figs. 2, 4-1, 4-2 and 5)

2.11 Other Information

2.11.1 The Career of the Instructor to his promotion to Flight Instructor, and the Training History of Trainee Pilot-A

(1) The Instructor

December 1978: Joined All Nippon Airways.
August 1981: Qualified as Second Officer on Boeing 727.
August 1989: Qualified as First Officer on Boeing 737.
December 1990: Qualified as First Officer on Boeing 767.
September 1995: Qualified as Captain on Boeing 767.
February 2001: Approved as simulator instructor after flight simulator instructor training.
January 2002 Approved as flight instructor after flight instructor training on aircraft.
May 2002: Received periodic instructor assessment.

(2) Trainee Pilot-A

August 1999: Joined All Nippon Airways.
August 2001: Refresher training at Bakersfield Training Center in the U.S. (19:00 hours on Beech 58.)
October 2001: Started general ground school training on operations necessary for qualification as First Officer.
December 2001: Entered the company's Flight Training Center and started the ground school curriculum on aircraft systems and flight, and flight simulator training.
June 17, 2002: Began local flight training on actual aircraft at Shimoji-Shima Airport.

2.11.2 Company Training Regulations

The regulations regarding the training of flight crews conducted by ANA are described in the Operations Manual, Qualifications Manual, and Qualifications Manual Supplement that are subordinate to the company's operating and training assessment regulations.

2.11.2.1 Operations Manual and Qualifications Manual Supplement

Qualification requirements for promotion to flight instructor are described in the

Operations Manual (OM) and in the “details on instructor qualification requirements” in the Qualifications Manual Supplement (QMS). The instructor satisfied all of these requirements.

2.11.2.2 Qualifications Manual

(1) Training for Promotion to Flight Instructor

① The training syllabus and training hours required for promotion to flight instructor prescribed in ANA’s Qualifications Manual (QM) are as follows: Training and Assessment for Flight Instructors

Table 1-① Standards for Flight Instructor required Training and Assessment (Initial Duty)

Training Course		Standard Training Time (Hrs+Mins)/ Number of sessions
G/S		20+00 (1), (2)
Right seat proficiency training	FFS	1 session
	On Aircraft	1+00
Training on Instructional Guidelines	G/S	7+00 (2)
	Practical Training	1 session (3)
Assessment		Assessment for appointment as Flight Instructor or extended assessment of Flight Instructor duties

[Abbreviations: G/S: Ground School, FFS: Full Flight Simulator]

Remarks:(1) Regardless of the type of aircraft, persons who have served as Flight Instructors or Simulator Instructors within the past 3 years require 7+00 (hours).

(2) Current simulator instructors on same type are able to omit the hours.

(3) Practical training conducted during orientation flights is also acceptable.

② Because the instructor was already a qualified simulator instructor at the time of his training to be a flight instructor, he had already received ground school training on the same aircraft type that including the same training specified in the training manual and assessment standards for flight instructors, and so this training was omitted.

Although scenarios of missed approach with one engine inoperative and landing with one engine inoperative were included in one time full flight simulator (FFS) training session (two hours) for right seat proficiency, a go-around with one engine inoperative scenario was not included.

The one hour of actual flight training for right seat proficiency included the same one-engine-inoperative scenarios as the FFS training.

While one 21-minute training session including three times take-off and landing on an actual aircraft was conducted at Shimoji-Shima airport, a simulated one-engine-out go-around was not carried out.

These simulated one-engine-out maneuvers are carried out by the instructor under training himself from the right seat, and does not include training for take-over of control from a trainee pilot.

(2) Training for Promotion to First Officer

① The training syllabus and training hours for the promotion to First Officer described in QM are as follows:

Training and Assessment for Promotion to First Officer

Chart 1-① Training and Examination Standards for First Officer on Boeing 767

Training/Examination Item		Current Aircraft Model/Qualifications Time (Hrs+Mins) andNumber of Training Sessions for Pilots (Persons with Commercial Pilot's License, Multi-Engine Rating and Instrument Rating)
General Operations		135+00
SYS G/S		120+00
EMG		6+30
Flight G/S		35+00
JET FAM		22+00 : 1 Hop (2+00) × 11 times
FBS-B		16+00 : 1 Hop (4+00) × 4 times
FFS	Training	34+00 : 1 Hop (2+00) × 17 times
	Examination	Promotion Examination for First Officer (Proficiency Check) Practical Examination for Rating Change (JCAB)
PRE-LCL		6+00 : 1 Hop (1+00) × 6 times
LCL	Training	7+30 : 1 Hop (0+50) × 9 times
	Examination	Promotion Examination for First Officer (Proficiency Check) Practical Examination for Rating Change (JCAB)
CRM G/S		14+00
Line G/S		28+00
Flight G/S		7+00

Advanced Line Operations 1	16+00 : 1 Hop (2+00) × 8 times
RUT OJT	More than 60 times
RUT Examination	Promotion Examination for First Officer (Route Check)

[Abbreviations: G/S: Ground School, FFS: Full Flight Simulator, SYS: Systems, EMG: Emergency, FBS: Fixed-base simulator, JET FAM: Jet familiarization]

② Trainee Pilot-A carried out the following training thought to be related to the accident on simulators at the company's crew training center in Tokyo:

a. Two "hops" with two missed-approach, and two "hops" maneuver with two single-engine-out maneuver during JET-FAM (jet aircraft orientation using simulator). (A "hop" is a unit for training flights).

b. One "hop" with one go-around during FBS-B (fixed-based simulator: simulator device with no motion system) training.

c. Thirteen missed or discontinued ILS approaches with one-engine-out (12 hops) and 16 single-engine-out landings (9 hops) on full-flight simulator.

After FFS training was complete, Trainee-Pilot A passed the proficiency assessment for training up to that stage.

d. Four missed approaches or go-around (4 hops) and 10 single-engine-out landings (6 hops) during pre-local flight training.

③ After the training described above was completed, Trainee Pilot-A traveled to Shimoji-Shima Airport for local flight training.

Trainee Pilot-A began the 7 hours 30 minutes of local flight training (nine hops of 50 minute duration each), and the accident occurred during the sixth hop.

While local flight training was planned to include one missed approach or go-around (1 hop) and fifteen approaches with one engine simulated inoperative, the QM contained had no training item relating to one-engine-out missed approach and go-around, nor did it describe the number of times these had to be carried out. Up until the time of the accident Trainee Pilot-A had carried out one missed approach or go-around, seven landings with one engine simulated inoperative, and one one-engine-out go-around.

2.11.2.3 Descriptions in Training Manuals regarding Operating Standards for Proficiency Checks

The contents of the required items contained in ANA's standards for proficiency checks after pilots have completed the prescribed training were the same one as those in the operating standards related to practical examination of commercial and private pilots (two-crew aircraft) stipulated by the Civil Aviation Bureau of the Ministry of Land,

Infrastructure and Transport.

The sections relating to the execution of go-around and approaches and landings with one engine inoperative, and the flight simulators or aircraft to be used for these, were as follows:

4-3 Go-around:

After a normal approach normally, at around 50ft or less above the elevation of the touch down zone, instigate a go-around either by providing conditions that should force a go-around decision or by command from a proficiency examiner.

This go-around is to be carried out using a flight simulator with both engines operative.

6-4 ILS Approach (One engine inoperative):

Execute ILS approaches both using the prescribed procedures and with one engine inoperative.

These ILS approaches cases are to be carried out with both engines operative and one engine inoperative, using a flight simulator.

6-5 Missed Approach Procedures:

Execute missed approach in instrument meteorological conditions (IMC).

(Note) If the missed approach follows an ILS approach with one engine inoperative, the missed approach should also be carried out with one engine inoperative.

Missed approach procedures are to be carried out for the two cases of both engines operative and on one engine inoperative, and should use a flight simulator.

The missed approach is to be initiated at the decision altitude or missed approach point, where the decision altitude is in principle 200ft above the touch down zone elevation, and the missed approach point is at a higher altitude than the decision altitude.

8-2 One-engine-out Approach and Landing:

Execute an approach and landing with one engine inoperative.

In this case the approach and landing is made with one engine inoperative, and does not include go-around. While this is executed at the proficiency check on both an actual aircraft and using a flight simulator, it is executed with one engine simulated inoperative if using an aircraft, or with one engine inoperative if using a flight simulator.

2.11.2.4 The Training Center's Training Policy Manual

The Training Center Policy Manual (Training PM) describes the ANA Crew Training

Center's training concepts and basic matters relating to training for Crew Training Center instructors. The following descriptions are contained in the Training Center Policy Manual.

3-10-3 Local (LCL) Training

② General Cautions

(4) Take Over

During training the hands and feet should be placed so as to allow take over instantly, and take over should be made without hesitation. Take over of control should be made clearly, with a call of "I Have (Control)" if taking over, or "You Have (Control)" if making the trainee take over. First advice should be given, then assistance, and finally take over. These should be done in a timely manner.

Described above are the general cautions related to the accident are only. There were no cautions relating to go-around.

2.11.2.5 Training Guidelines

The essential points from the Crew Training Center's concrete training guidelines related to the Boeing 767 are described below.

6-22 Reject Landing and Missed Approach:

1. Key Points

If it is judged that a safe landing cannot be made, a go-around should be made without hesitation. The go-around should be carried out positively based on swift and positive control actions. A go-around should be made in the following circumstances.

(1) If it is necessary to recover from LOC deviation of greater than one dot on short final.

(2) If it is necessary to dive at greater than 1,000 ft/min on short final.

(3) If it is necessary to reduce to Idle Power at passing 500ft.

(4) When the airspeed is greater than bugged value + 15 kt at the threshold and it is thought that touch down will be beyond 2,000 ft.

(the remainder are omitted).

2. Common Errors

(1), (2) Omitted

(3) Control with only one engine operative is prone to be unstable and uncertain.

(4), (5) Omitted

3. Cautions on Instruction

(1) Except when instructed by ATC or the instructor, trainees should habitually use

their own judgment. It should therefore be emphasized that trainees themselves should be aware of the go-around criteria.

(2) Omitted.

(3) Always be prepared for a go-around during approach (including the landing flare), and give clear guidance.

It is necessary to be particularly prepared for go-around nearing “Approach Minimum”.

(4) A go-around should be executed on the judgment of the trainee. (Omitted.) Further, in cases of One Engine Approach, the go-around should be made on one engine.

(5) Omitted

(6) Omitted

(7) The following points should be given particular attention on One Engine Go-Around:

① The thrust lever for the live engine should be rapidly advanced to maximum at the same time as the GA switch is pushed.

② Try to stabilize the aircraft with both hands on the control wheel.

③ The pilot must not control the aircraft mechanically by operating the rudder pedals in synchronization with the increase in thrust.

④ It is easier to maintain stable control if the pilot is aware of the ball position.

⑤ The amount of rudder pedal needed is a little greater than TO-2.

3 ANALYSIS

3.1 Analysis

3.1.1 The instructor (Captain) and Trainee Pilot-A had valid airman proficiency certificates and valid airmen medical certificates.

As described in section 2.11.2.1, the instructor fully satisfied the qualification requirements for a flight training instructor.

3.1.2 The aircraft had a valid certificate of airworthiness, and had been maintained and inspected as specified by the applicable regulations.

At the time of accident, the airplane was fully operational and there were no airplane-related maintenance or material discrepancies discovered that were a causal factor in the accident sequence.

3.1.3 At the time of accident, the wind was blowing from the west (from the left of the aircraft) at around 10 kt. It is not thought that a wind speed of this magnitude would have had a great effect on control of the aircraft at the time of the accident. However, it is thought that if landing or going around with one engine simulated inoperative, control would be comparatively more difficult with the downwind engine inoperative than with the upwind engine inoperative. At the time of the accident, the right (downwind) engine was being simulated as inoperative.

3.1.4 The Judgments and Control Actions of Trainee Pilot-A and the Instructor

3.1.4.1 The period up to the Time of the Second Main Landing Gear Touchdown

(1) Trainee Pilot-A

① Trainee Pilot-A was carrying out a landing training with the right engine simulated inoperative, and so was approaching at a slightly steep approach angle on the final approach path. However, he carried out corrective actions on the advice of the instructor and the aircraft is estimated to have crossed the threshold at about the normal height and at a speed of approximately V_{REF} (20). It is therefore considered that the circumstances did not call for a go-around at the time the aircraft crossed the threshold.

Normally a pilot starts to flare the aircraft to the landing attitude and closes the thrust levers at about 20–30ft AGL, judging the timing of this maneuver from the visual appearance of the runway and the aural [height] callout. However, it is estimated that at the time of the accident, Trainee-Pilot A was a little late in closing the thrust levers. Although the instructor indicated “That’s enough”, Trainee-Pilot A continued to pull

back on the control wheel, and the consequent increased pitch angle caused the aircraft to float so it did not touched down even having passed the normal touch down point. Such cases are often seen in inexperienced trainee pilots, and it is considered that because of an incomplete grasp of the runway appearance and aircraft attitude at touchdown, Trainee-Pilot A continued to pull back on the control wheel mechanically without waiting until touchdown.

② Trainee Pilot-A judged that the aircraft would touch down beyond 2,000 ft beyond the threshold of the runway 35, and at 12:53:36 he expressed his intention to go-around. However, just at that time the aircraft, having already passed 2,000 ft, touched down, but according to his interview statements Trainee Pilot-A did not recognize this.

Although the aircraft then touched down again at 12:53:39, but again according to his statements, Trainee Pilot-A did not recognize this.

(2) The Instructor

① Based on CVR recordings and other data, the instructor advised Trainee Pilot-A about control several times during the approach. The first advice was about the height of the flight path, and it is considered that in response to this advice, Trainee Pilot-A had corrected to almost normal height on passing the threshold.

The next advice concerned the thrust lever control just before touch down, and it is estimated that the thrust lever was closed to almost the idle position at the time when the instructor informed Trainee Pilot-A “Just all right”.

The next advice concerned heading, and it is estimated that this corresponded to the left crosswind that was blowing.

In his statement after the accident, the instructor did not recall his remark “That’s enough” made just before Trainee Pilot-A expressed his intention to go-around, and so it could not be confirmed whether or not this remark related to pitch angle. However, because the pitch angle during landing was greater than normal it is considered that this remark was to advise Trainee-Pilot A there was no need to flare further. Further, it is considered that since Trainee Pilot-A continued to pull the control wheel even after this advice was given, the instructor was not assisting him in the control of the aircraft.

② When Trainee Pilot-A expressed his intention to go-around, the instructor directed to continue the landing as it was. Because the total length of the runway in use was 10,000 ft, it is estimated that he judged there was sufficient runway length remaining (approximately 7,500 ft) to continue the touch-and-go training. Although the aircraft had touched down at that time, judging from his statements it is estimated that the instructor did not realize this. After that, although the aircraft lifted off again and the

pitch angle increased further, it is estimated that the instructor did not give advice or assistance.

③ Two seconds after Trainee Pilot-A had expressed his intention to go-around, the instructor directed him to go-around. It is considered that the instructor ordered the go-around because Trainee Pilot-A did not control the aircraft appropriately as described in section 3.1.5(3), the pitch angle increased and the touchdown was further extended. It is considered that control after this should not have been left to the inexperienced Trainee Pilot-A, and that the instructor should either have taken over and executed a go-around with both engines, or he should have landed the aircraft.

Although the aircraft touched down again at 12:53:39, according to the instructor's statements, it is considered that he did not realize this.

Normally, a pilot experiences touchdown mainly through the shock of impact, but besides this, the aircraft's attitude at touch down and the broad external view including the runway, particularly the judgment of height, depend on the apparent relationship of objects such as the lights situated along the sides of the runway. However, in the accident, neither the instructor nor Trainee Pilot-A were aware that the aircraft had touched down twice. It is considered that this was because since the aircraft's pitch was becoming somewhat greater than normal, and the aircraft did not appear to touch down directly, their attention was concentrated ahead and because of this, they did not take in the broad external view or direct their attention to the apparent relationships between objects. It is thought that since neither the instructor nor Trainee Pilot-A perceived the touchdowns, they did not intend to land but to go-around.

3.1.4.2 The period from the second main landing gear touch down until the aircraft stopped

(1) Trainee Pilot-A

① The control actions for go-around started by Trainee Pilot-A at 12:53:41 were to mechanically control the left rudder pedal in coordination with operating the left thrust lever. Although this resulted in a yaw to the left, it is estimated that he tried to correct this using right rudder pedal.

② At 12:53:46, the instructor operated the right thrust lever without informing Trainee Pilot-A. It is considered that seeing this action, Trainee Pilot-A mechanically applied right rudder pedal in response. The left engine's N_1 started to increase from 12:53:46, and as a result pitch angle began to increase while the aircraft yawed to the right. It is considered that this overlapped the right rudder operation executed up to 12:53:47, causing a still greater yaw and as a result, from 12:53:50 the aircraft started a large skid while pitch was increasing. Consequently, the lift from the swept back left wing

increased while the lift from the right wing decreased, and it is considered that this induced an abrupt roll to right.

It is estimated that the aircraft's empennage contacted the runway at around 12:53:48, according to the statement, after from the crew statements, it is considered that the instructor was controlling the aircraft after this.

③ In large aircraft, because there is a delay of 6–8 seconds between advancing the thrust lever and aircraft response, the effects on the aircraft's motion [pitch up due to increased thrust, yaw due to thrust asymmetry] appear with a similar delay and so the rudder pedals should not be used at the same time as the thrust lever is moved but should be in response to the aircraft's motion. Because Trainee Pilot-A had little experience with large aircraft and did not establish correct rudder pedal control, pitch was continuing to increase, and it was difficult to see the runway, it is estimated that he controlled the rudder pedals mechanically by simply coordinating rudder pedal input with thrust lever operation.

(2) The Instructor

① Although a simulated one-engine-out go-around at low altitude and low speed is more difficult to control than a go-around with both engines operative, according to his statements, the instructor did not have his hands and feet placed so as to be able to control the aircraft. It is considered that because of this, he did not adequately recognize that control had become difficult, and he lacked prudence in respect to control.

② It is thought that the instructor began control to correct the attitude changes to the right from around 12:53:49. It is considered that although at 12:53:51 he made virtually maximum left control wheel and rudder pedal corrective control inputs, but the aircraft continued further to the right.

To counter yawing and rolling from a trimmed flight condition [due to a developing thrust asymmetry], it is difficult to maintain the aircraft's attitude unless rudder pedal and control wheel inputs are timed with the increase in N_1. However, in the case of the accident, it is estimated that the aircraft was not in a trimmed condition before the instructor started to control it, and the timing of the instructor's control actions was late compared to the increase of N_1. It is considered that this was because the instructor intended to let Trainee Pilot-A make the corresponding control actions as much as possible, and while he placed the feet on the rudder pedals, because he did not place his hands on the control wheel, and did not assist with the corrective control, the aircraft became out of trim and corrective control actions were delayed.

It is estimated that the right horizontal stabilizer struck the runway at around

12:53:50

③ In his statements, the instructor stated the following: “The aircraft rolled even more to the right and veered toward right side of the runway. At that time I still intended to go-around. I recall recognizing that we were airborne when we veered off the runway. The drift to the right stopped, and I then controlled the aircraft to the left, but I don't remember when because I was fully absorbed in control. During that time, I felt us touch down on the grass area. I judged it would be impossible to lift off from that time, so I switched to stopping the aircraft…”.

However, both engines thrust levers were closed at 12:53:51 when the aircraft had reached its greatest roll to the right, so it is thought that in fact he abandoned the go-around at that point of time. It is thought that the right wing tip struck the runway at this point of time.

Further, it is thought that the instructor tried to arrest the roll and yaw to the right while the aircraft was continuing to the right, rather than waiting for the motion to the right to stop before controlling to the left, and continuously applied maximum rudder pedal and control wheel inputs.

The motion of the aircraft to the right ceased at 12:53:55–56, and it is estimated that the aircraft veered off the runway with the tail again contacting the runway and grass area.

④ Even after the aircraft veered off into the grass area, the instructor continued applying left control wheel and rudder pedal to make the aircraft run in a direction parallel to runway 35. It is estimated that because he did not neutralize the controls in coordination with the change of direction, the aircraft made a large roll to the left at 12:53:59 and the left wing tip contacted the grass area.

3.1.5 Control of the Go-Around and Take Over by the Instructor

(1) Trainee Pilot-A judged that the aircraft had passed the normal touchdown point and would not touch down within 2,000 ft beyond the threshold of the runway, and indicated his intention to go-around to the instructor. However, the instructor directed that he continue the landing.

In the accident, Trainee Pilot-A's judgments that the aircraft would not touch down even after 2,000 ft and his expression of intent to go around is thought to have been the result of his training. As described in section 2.11.2.5, the training guidelines state under “1. Key Points” paragraph (4) if “it is thought that touch down will be beyond 2,000 ft” then “a go-around should be made without hesitation.” It is therefore thought that Trainee Pilot-A had received such training. However, it is considered that the instructor let the landing continue for reasons such as that he thought that the aircraft would touch down

imminently, that sufficient runway length remained to continue the landing, and he was trying to let Trainee Pilot-A achieve a simulated one-engine-out landing.

The regulation in paragraph (4) of "1. Key Points" that a go-around should be executed if "it is thought that touch down will be beyond 2,000 ft" is stated as relating to the judgment in the case that such a condition is forecast at the time of crossing over the runway threshold before actually passing 2,000 ft. It is thought that essentially, the go-around decision by the instructor or trainee pilot should be made at over the runway threshold, before passing the normal touch down point. In the accident, it is considered that because the aircraft's attitude, CAS, and the approach path angle were within the normal range as the aircraft passed over the runway threshold, neither the instructor nor Trainee Pilot-A felt a go-around to be necessary and continued the approach in order to land. However, it is considered that after that, because the instructor did not give suitable advice and assistance in control to Trainee Pilot-A, the aircraft exceeded the normal landing pitch attitude and floated, Trainee Pilot-A judged that the aircraft would not touch down within 2,000 ft of the threshold, and expressed his intention to go around. It is considered that before reaching that point, the instructor should have judged that Trainee Pilot-A's control inputs exceeded those required for landing and that touchdown point would be beyond 2,000 ft, and that he should have given suitable advice and assistance to Trainee Pilot-A without missing the opportunity, and if necessary should have taken over control at once.

(2) In general, it is thought that trainee pilots should be made to execute go around for the benefit of training. However, in the case of a go-around just before touch down with one engine simulated inoperative, as in the accident, control is difficult because of the low speed with reduced margin over V_{MCA} and stall speed, and with almost no altitude margin, thus it could be said to be a difficult maneuver for an inexperienced pilot. Further, a simulated one-engine-out go-around is not included in the Operating Standards for Proficiency Examination which applies to the examination for promotion to First Officer at ANA. Therefore, if a situation is encountered where sufficient speed or height margin cannot be obtained during a simulated one-engine-out landing and it is thought a go-around may be necessary, it should be the instructor and not the student who judges either to continue the landing or to execute a go-around on both engines, and the instructor himself should carry out the maneuver in order to ensure the safety of the training flight.

(3) At 12:53:41, Trainee Pilot-A began a one-engine go-around on the left engine. At 12:53:46, the instructor advanced the right engine's thrust lever to carry out the go-around on both engines. During that time, Trainee Pilot-A's was controlling the rudder pedals in order to

maintain the aircraft's heading. Because Trainee Pilot-A was applying left rudder pedal mechanically, at first the aircraft yawed to the left. Trainee Pilot-A then tried to return the aircraft by applying right rudder pedal, but when the instructor advanced the right engine thrust lever, the left engine's speed had increased and the aircraft yawed to the right and veered off the runway. It is considered because the inexperienced Trainee Pilot-A was being made to execute a simulated one-engine-out go-around, he controlled the aircraft in a way that the instructor did not expect, and after that was unable to make appropriate fine control to maintain heading.

(4) While Trainee Pilot-A was controlling the aircraft, the instructor did not follow with his hands on the control wheel. However, particularly because a simulated one-engine-out go-around is difficult for a trainee pilot to control, it is considered that to ensure the safety of training flights, the instructor should follow the trainee's control inputs with his hands and feet on the controls, and should conduct the training in such a way that he is prepared to take over immediately if necessary.

3.1.6 Conditions and Procedures for Go-Around Training

(1) Trainee Pilot-A's training up to the time of the accident had been conducting based on chart 1-① in section 2.11.2.2 (2). Also, the 9 hops (7 hours 30 minutes) of local flight training to be carried out at Shimoji-Shima Airport, including the accident flight, were the first training that Trainee Pilot-A had conducted on-aircraft. The accident occurred on the 6th hop of this flight training.

Trainee Pilot-A had already received the go-around training described in section 2.11.2.2 (2) ② before the accident. However, this did not include go-around from severe situations such as those encountered in the accident, with CAS close to V_{MCA} near the time the aircraft was in contact with the ground and pitch attitude higher than normal. It is therefore considered that Trainee Pilot-A could not have predicted the behavior of the aircraft when executing a go-around from such a severe situation as encountered in the accident.

(2) As described in section 2.11.2.3, there was no description of a check item relating to a simulated one-engine-out go-around using an actual aircraft in ANA's Operating Standards for Proficiency Examinations. It is thus considered that it was not necessary to daringly make inexperienced training pilots conduct a simulated one-engine-out go-around as part of their on-aircraft training.

However, as described in section 2.11.2.5, paragraph (4) of "3. Cautions on Instruction" in ANA's training guidelines specifies that trainee pilots should make the judgment for go-around, and it is mentioned that the trainee pilot should conduct the simulated

one-engine-out go-around. Because of this, it is considered that both the instructor and Trainee Pilot-A, who was being trained based on these guidelines, had understood that the go-around on which the accident occurred was part of normal training, and the Trainee Pilot-A had tried to execute a simulated one-engine-out go-around at first.

(3) The following are considered regarding the operating procedures for making trainee airline pilots conduct simulated one-engine-out go-around:

In simulated one-engine-out landing training under the control of the trainee, if it is considered that there is no choice but to go-around, the instructor should take over at an early stage and based on his judgment of whether to go-around or to continue the landing, if he elects to go around, it is considered that the go around should be executed using both engines.

Even if an instructor executes a go-around using both engines, because unlike the case where there is an altitude margin near the touch down there is the possibility of a tail strike or wing contacting the runway, it is considered that a concept for low-level go-around procedures should be adopted such as the establishment of pitch and roll angle limits, delay of landing gear retraction, etc.

Further, it is considered that if a simulated one-engine-out go-around is to be performed intentionally as training, sufficient training should first be carried out using a flight simulator, and then if subsequently carried out on-aircraft, it should be carried out in the air with sufficient margins of speed and altitude while paying attention to improving the trainee's piloting skills.

(4) In the paragraph (4) of section "3. Cautions on Instruction" of the Training Guidelines, regarding the judgment of circumstances in a safe landing cannot be made, it is stated that "a go-around should be executed on the judgment of the trainee" and "in cases of One Engine Approach, the go-around should be made on one engine". However, considering the circumstances for the ANA training at Shimoji-Shima Airport, this has the following interpretations:

① The trainee pilot judges whether or not to go-around.
② In the event of a go-around, the trainee pilot controls the aircraft.
③ During simulated one-engine-out landing training, a go-around should be made with one engine simulated inoperative.

As described in section 3.1.5 (2), a go-around with one engine simulated inoperative is a difficult maneuver for an inexperienced pilot, and it is considered it should not be carried out by a trainee pilot but by the instructor. If a go-around becomes necessary during simulated one-engine-out landing training, it is considered that the following should be

made clear:

a. Regarding description ① above, it is necessary for the trainee to make the judgment on go-around from the point of view of training effectiveness, but the instructor should monitor the trainee's control actions and if necessary, should make a go-around judgment in a timely manner.

b. Regarding description ② above, if a go-around is made, the instructor should perform the maneuver.

c. Regarding the description ③ above, if a go-around is made, it should be executed using both engines.

The following two items should also be added:

d. Even if there is no need to go around, the instructor should take over and continue the landing in a timely manner if he judges that continuing the landing under the control of the trainee will be difficult.

e. Take-over (transfer of control) should be carried out with clear mutual understanding between the instructor and trainee.

(5) It is estimated that this accident occurred when the trainee pilot made go-around with simulated one engine inoperative condition under the order of the instructor during simulated one-engine inoperative landing training. In (3) and (4) above, the measures which should be taken in case that simulated one engine inoperative go-around becomes necessary during simulated one-engine inoperative landing training.

In order to avoid this kind of accident, it is thought desirable to consider the utilization of the simulator for the aircraft in the simulated one-engine inoperative landing training and the related evaluation.

3.1.7 Training and Experience of Flight Instructors

(1) Judging from the total flying hours accumulated by the instructor, while he had sufficient flight experience, almost all of his hours had been logged in normal line operation, and it is considered that he had no experience in recovery from situations where control is difficult, as in the accident.

The training course and training hours required for flight instructors are described in section 2.11.2.2 (1), and the instructor had completed the specified training. However, it is considered that the contents of the training cannot be said to have been sufficient to acquire competency to take over as instructor and recover attitude safely in cases where, due to mishandling of the aircraft by the student, the aircraft is predicted to enter a dangerous situation, such as in the accident.

Further, when the instructor took off with the two trainee pilots at Shimoji-Shima

Training Center, it was his first time in taking charge of students as a flight instructor. It is considered that because he had not much experience in conducting training flights as an instructor, he did not assisted the maneuvers appropriately, and was unable to take over in a timely manner.

(2) The actions of the instructor were analyzed with reference to the relevant contents of the Training PM as described in the section 2.11.2.4, with the following results:

① Regarding the description that "During training the hands and feet should be placed so as to allow take over instantly, and take over should be made without hesitation", the instructor stated that while his feet were placed on the rudder pedals, his hands were not placed on the control wheel. It is thought that the instructor did not follow with his hands on the control wheel because he thought that if he followed with his hands and feet on the controls, the student might feel control become difficult and his reliance on the instructor might be increased. It is considered that in the training where an inexperienced trainee receives such difficult training using big aircraft as go-around at low level altitude with one engine simulated inoperative, like this accident, the instructor should put his hands and feet on controls to monitor his trainee's control inputs, and be prepared to correct his inputs at early stages if necessary. Also, the instructor had little experience in conducting on-aircraft training and it is considered that he did not have clear judgment standards as to what extent to leave things completely to the student, when he should follow with his hands and feet, when he should override the student, and when he should take over. It is estimated that these considerations were the cause of the delay in the instructor taking action.

② Regarding the description that "Hand over of control should be made clearly, with a call of 'I Have (Control)' if taking over, or 'You Have (Control)' if making the trainee take over", it is considered that the instructor pilot did not have time to speak since he his attention was concentrated on responding to the aircraft attitude changes which had far exceeded what was expected.

Since in aircraft accidents a momentary delay in responding can sometimes result in a serious accident, it is considered that control should not be left to the trainee pilot until a point where there is insufficient margin to communicate verbally, but control should be handed over at a stage where mutual understanding can be adequately attained by verbal communication.

③ Regarding the description that "First advice should be given, then assistance, and finally take over. These should be done in a timely manner", although Trainee Pilot-A had flared to a higher than normal pitch attitude, it is considered that the instructor had

not given suitable advice, and had not assisted Trainee Pilot-A in controlling the flare.

Trainee Pilot-A subsequently executed a go-around at the direction of the instructor, but in this case too it is estimated that suitable advice and assistance was not given regarding the mechanical control of the rudder by Trainee Pilot-A.

It is thought that the instructor first took over in the state that Trainee Pilot-A was having difficulty in dealing with the situation. Therefore, if the instructor had given appropriate guidance in the order 'Advice, Assistance, Take over', it is considered possible that the landing training would have proceeded as planned. Further, even supposing a go-around had been performed it is considered possible that it could have been executed safely.

Considering the above, it is estimated that the instructor's training was not adequate for him to learn the training method to be able to respond properly at appropriate time while having sufficient mutual understanding with the student.

(3) As described in section 2.11.2.2, the training syllabus and training hours for flight instructors are described in the QM. In the case that a simulator instructor trains as a flight instructor for the same aircraft type, because the content of the flight instructor ground school training, including training on instructional guidelines, is considered to be equivalent to that of the ground school training for simulator instructors, it is possible to omit it. Because of this, the instructor, having been a simulator instructor, had not received training on instructional guidelines when he became a flight instructor. However, comparing flight simulator training with training on-aircraft, with real aircraft there is always a possibility that mishandling may result in an accident, and because the cautionary matters relating to training are thought to be different, especially relating to the instructor overriding or taking over, it is thought necessary to conduct training on the cautionary matters etc. peculiar to on-aircraft training.

Further, in the flight instructor training curriculum did not include a go-around just before touch down with one engine simulated inoperative, nor did it include training for taking over from a trainee pilot unable to cope.

Given the above, if the instructor gives appropriate advice and takes over in a timely manner in the event of late control or mishandling by a trainee before the aircraft enters a dangerous situation, even if the trainee should mishandle the aircraft the instructor should be able to safely recover the aircraft's attitude. In consideration of this, it is considered necessary to enhance the training of flight instructors relating to methods of carrying out flight training.

(4) There was no clear description regarding the timing of take over in ANA's Training PM or

instructional guidelines, and this was left to the judgment of the instructor. Because the series of training flights including the accident flight was the instructor's first, it is considered that he did not have clear judgment standards for taking over. As a result of this, it is considered that the appropriate timing for taking over control from trainees should be clearly described in the instructional guidelines and the Training PM, and should be thoroughly instilled in flight instructor training.

(5) The instructional guidelines contained no descriptions of common handling errors committed by trainee pilots, or of aircraft behavior and hazards on going around just before touch down after a simulated one-engine-out approach, or caveats when conducting simulated one-engine-out training landing in crosswinds. It is thus considered that it was difficult for the instructor, with his limited experience of on-aircraft flight training, to predict or recognize the risk of accident. As a result of this, it is considered necessary to provide instructors and trainees with information including the above caveats on training by methods such as inclusion in training guidelines as necessary, and to instill this information.

4 PROBABLE CAUSE

It is estimated that the accident was caused as follows:

The aircraft was being operated on a training flight at Shimoji-Shima Airport, and was making a one-engine-out touch-and-go landing with the right engine simulated inoperative. The touch down was late and beyond the normal aim point, and on the direction of the instructor, the trainee pilot attempted to go around on only the left engine. However, the trainee mishandled the aircraft, and then, seeing the instructor advance the right engine's thrust lever, he applied right rudder pedal mechanically. This coincided with an increase in the rotation speed of the left engine, and the aircraft's attitude suddenly changed towards the right. Because the trainee pilot could not fully correct this and the instructor was late in taking over control, the aircraft veered off the east side of the runway into a grass area and was damaged.

Moreover, it is estimated that the following causal factors contributed to the accident:

(1) The instructor did not take over when he directed the trainee to go around, or at an earlier stage, because he thought to allow the trainee pilot to handle the aircraft as much as possible, and because he did not sufficiently recognize that a go-around with one-engine simulated inoperative is a difficult maneuver for an inexperienced pilot.

(2) Regarding the instructor's intent to allow the trainee pilot to handle the aircraft as much as possible, the company's instructional guidelines contained statements meaning that a judgment to go around should be made by the trainee pilot, and that during simulated one-engine-out touch-and-go training landings, the go-around after landing should continue with one engine simulated inoperative.

(3) Regarding the instructor's insufficient recognition of the difficulty of a go-around with one engine simulated inoperative for an inexperienced pilot, the instructor had not been trained to deal with the situation encountered in the accident, and the company's regulations and manuals did not describe considerations on the difficulty of executing a go-around with one-engine simulated inoperative for an inexperienced pilot or on the effects of the wind on such maneuvers.

(4) Regarding the delay in the instructor taking over control of the aircraft, the instructor was not following with his hands on the control wheel and was not in a position to take over immediately if necessary, and when the instructor had changed from being a simulator instructor to a flight instructor, he had not received sufficient training on cautionary matters regarding training in actual aircraft.

5 FINDDINGS

This accident occurred while an inexperienced trainee pilot was carrying out maneuvering training on a large aircraft. To ensure the safety of training flights in such cases, it is considered necessary to take the following measures and to instill them into instructors and trainees in order to implement them thoroughly:

(1) Because a go-around with one engine simulated inoperative is a difficult maneuver for trainee pilots, to ensure the safety of training flights with simulated one-engine-out landings, the instructor should monitor the trainee's control actions by following with his hands and feet on the flight controls, and should be trained to be prepared to take over control at once if necessary.

(2) In simulated one-engine-out landing training, if it is anticipated that there will be no choice but for the trainee to execute a go-around, the instructor should take over at an early stage and based on his judgment, should either go around using both engines or continue the landing. When going around even using both engines, if, unlike cases where there is a margin of altitude, there is a possibility of a tail strike or the wings contacting the runway, a concept of low-level go-around procedures should be introduced including the establishment of pitch and roll angle limits, delaying landing gear retraction etc.

(3) In order to ensure flight safety during on-aircraft training, it is necessary to train flight instructors thoroughly in instruction and training methods, such as take over of control from the trainee pilot immediately if necessary during flight training.

6 MATTERS FOR REFERENCE

6.1 All Nippon Airways submitted an interim report “The accident in which a training aircraft veered off the runway at Shimoji-Shima Airport dated July 15, 2002 to the Section of Airmen Licensing, Department of Engineering, Civil Aviation Bureau, Ministry of Land, Infrastructure and Transport. ANA submitted its final report dated August 26, 2002 titled “Measures for preventing recurrence of the accident to training aircraft JA8254 at Shimoji-Shima Airport”. The main contents of these reports were as follows.

(1) Clarification of essential points for go-around and take over in on-aircraft training

① Safety Guidelines for Landing Training

The aircraft touch down point on landing and target limits of speed and pitch attitude were established.

② Clarification of Take Over

③ Clarification of essential points for Go-Around

a The instructor should take over in the case of a go-around after passing the threshold.

b A go-around following on from simulated one-engine-out conditions should be made using both engines.

c If the judgment of the instructor differs at the time a trainee pilot calls go-around, the instructor should take over.

(2) Review of examination of promotion training for Flight Instructors

① The ground school training which simulator instructors training to be flight instructors were permitted to omit was reviewed, and a new seven hours of training on points specific to on-aircraft training was added.

② The training hours on simulator and on actual aircraft were increased and take-over of control etc. was recognized as maneuvers to be conducted from the right seat.

(3) Review of the Training Syllabus

① Pre-Local Training

One HOP was newly added to pre-local training, and one-engine-out training was reinforced.

② On-Aircraft Training

The altitude for carrying out the all engines go-around element of on-aircraft

training, which had not been established previously, was established at 50ft.

③ Revisions to Training Manuals

The standards for the number of training hours and sessions specified in training manuals will be revised.

6.2 After the accident, Boeing that designed and manufactured this airplane notified All Nippon Airways of the cautions related to the on-aircraft training.

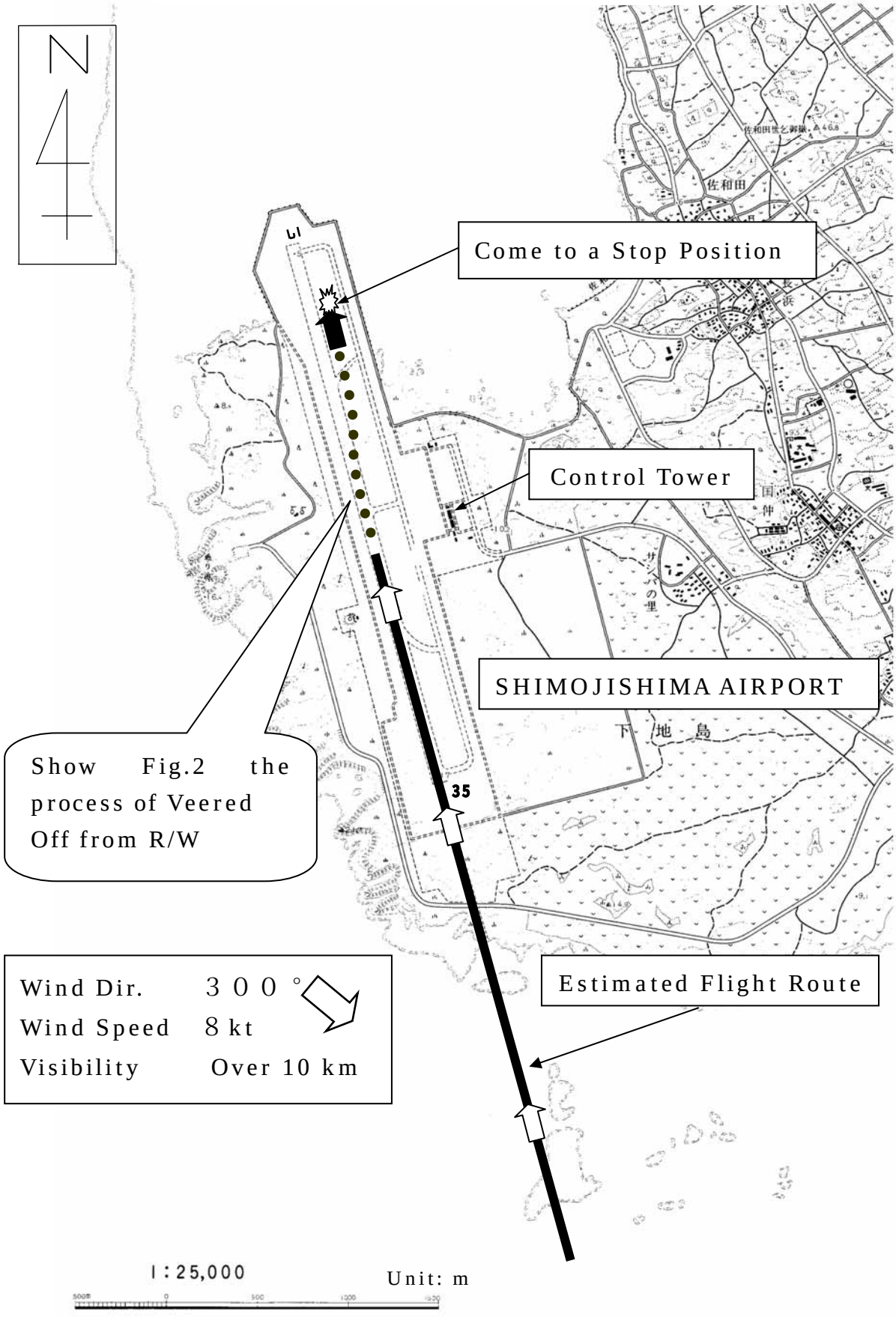
7 COMMENT OF USA

Aircraft and Railway Accidents Investigation Commission, ARAIC, received the official comments on the draft final report from the accredited representative of the United States of America, the state of Design and Manufacture.

One of these comments, which has not been reflected in the findings of the report, is described hereunder, based on this request.

We suggest the draft report could also carry forward to the Japan Civil Aviation Bureau in paragraph 5, a suggestion to explore the further use of modern simulators in the training and evaluation of air transport pilot candidates. Such a progression would reduce the exposure to risk of training accidents, save material and monetary resources, protect the environment, and appears to be in line with the practices adopted by other states during the last decade.

Figure1 Estimated Flight Route



（Source: the National Land Agency 1/25,000）

Figure2 Traces on the ground

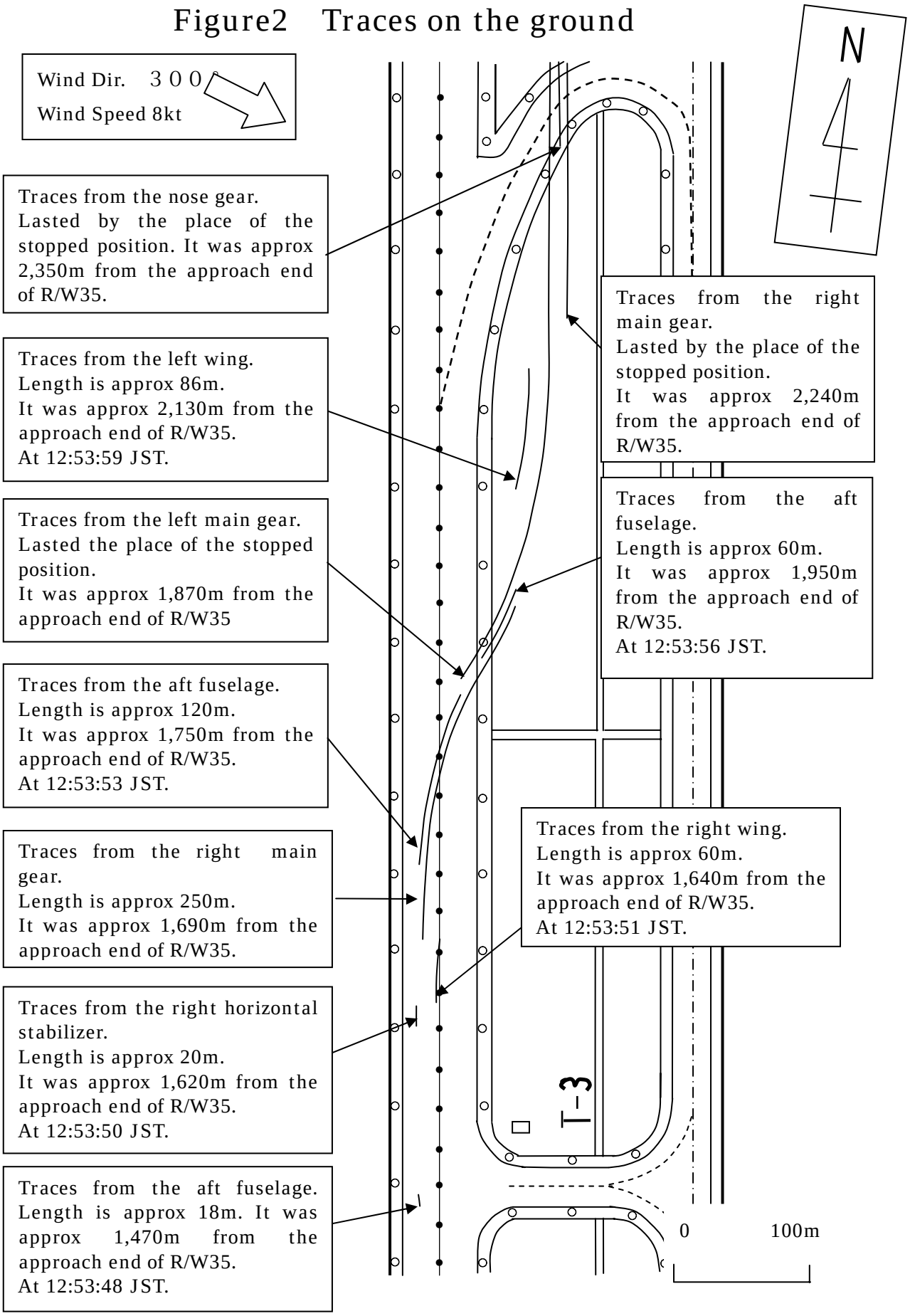


Figure 3 Three angle view of Boeing 767-200

Unit; m

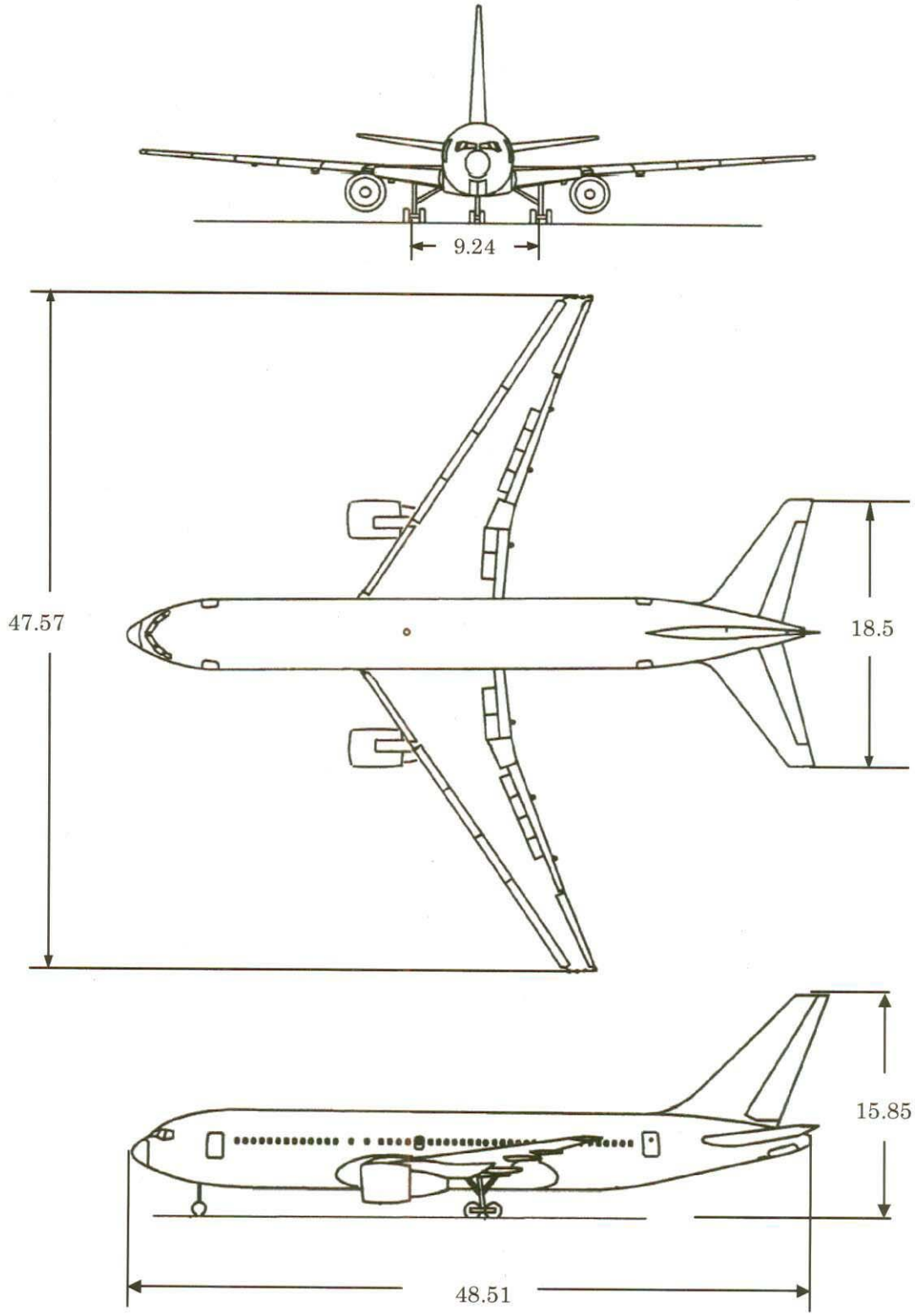
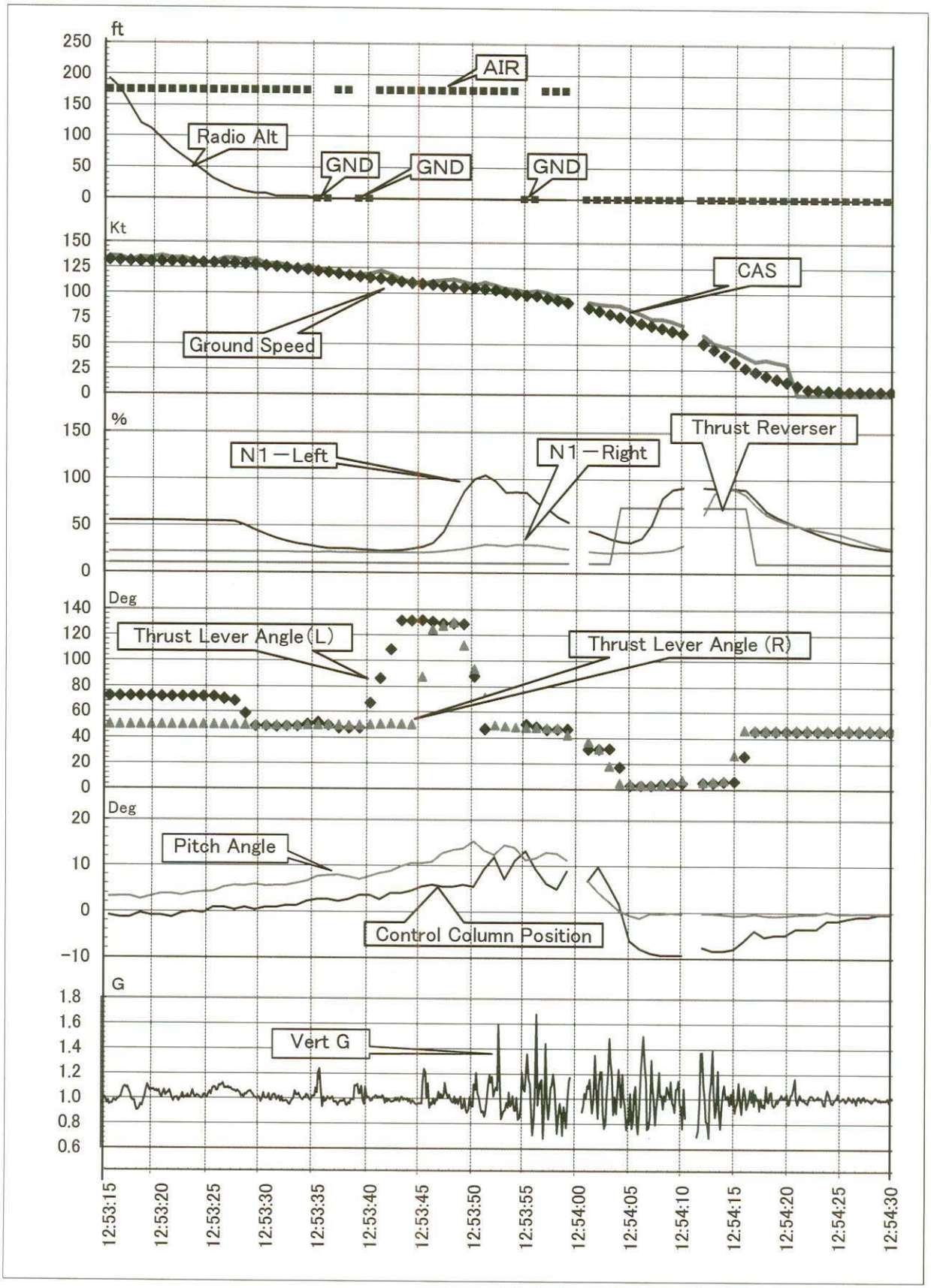
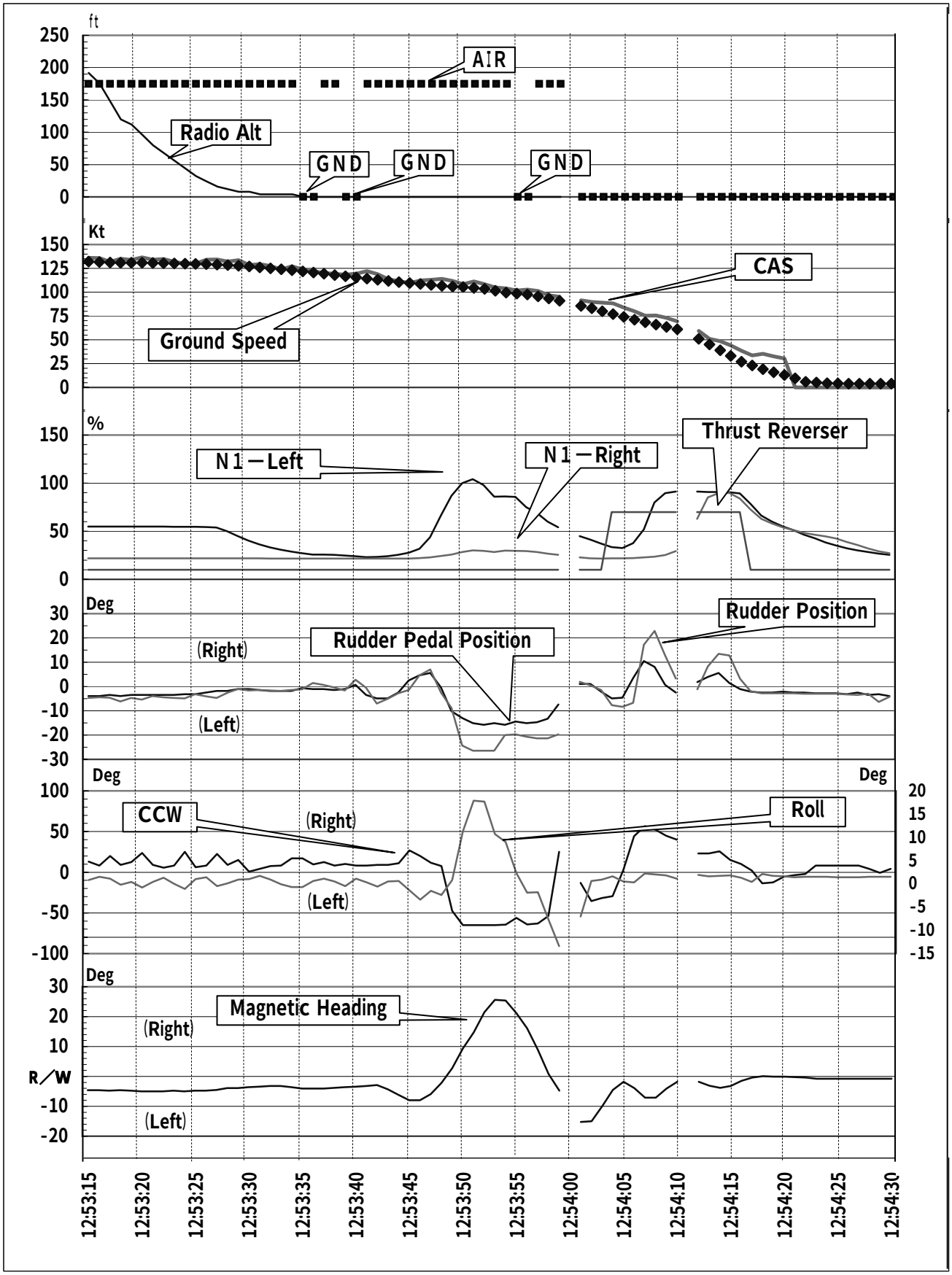


Figure 4-1 DFDR Recording



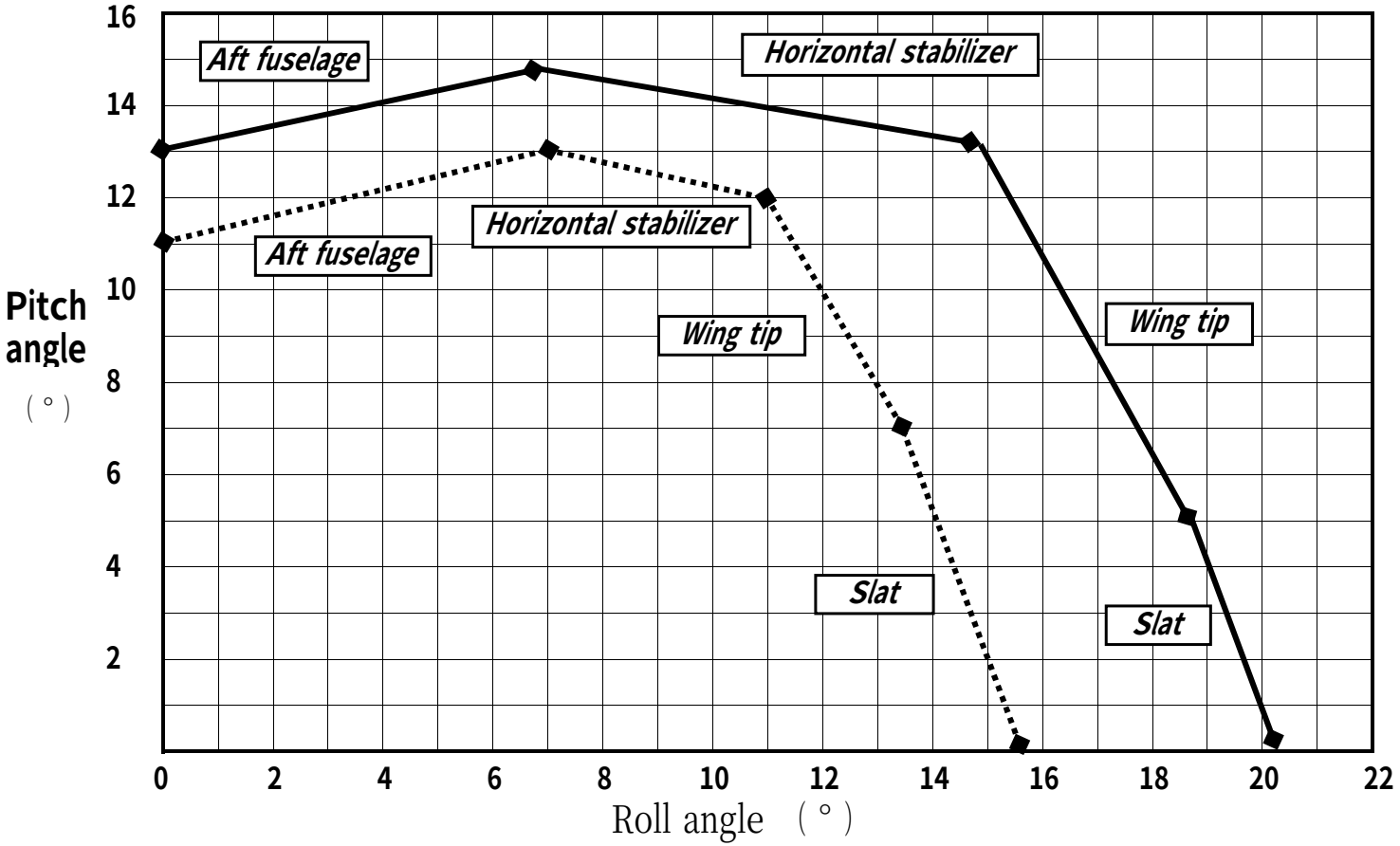
Blank of the line shows the lack of data at that time.

Figure 4-2 DFDR Recording



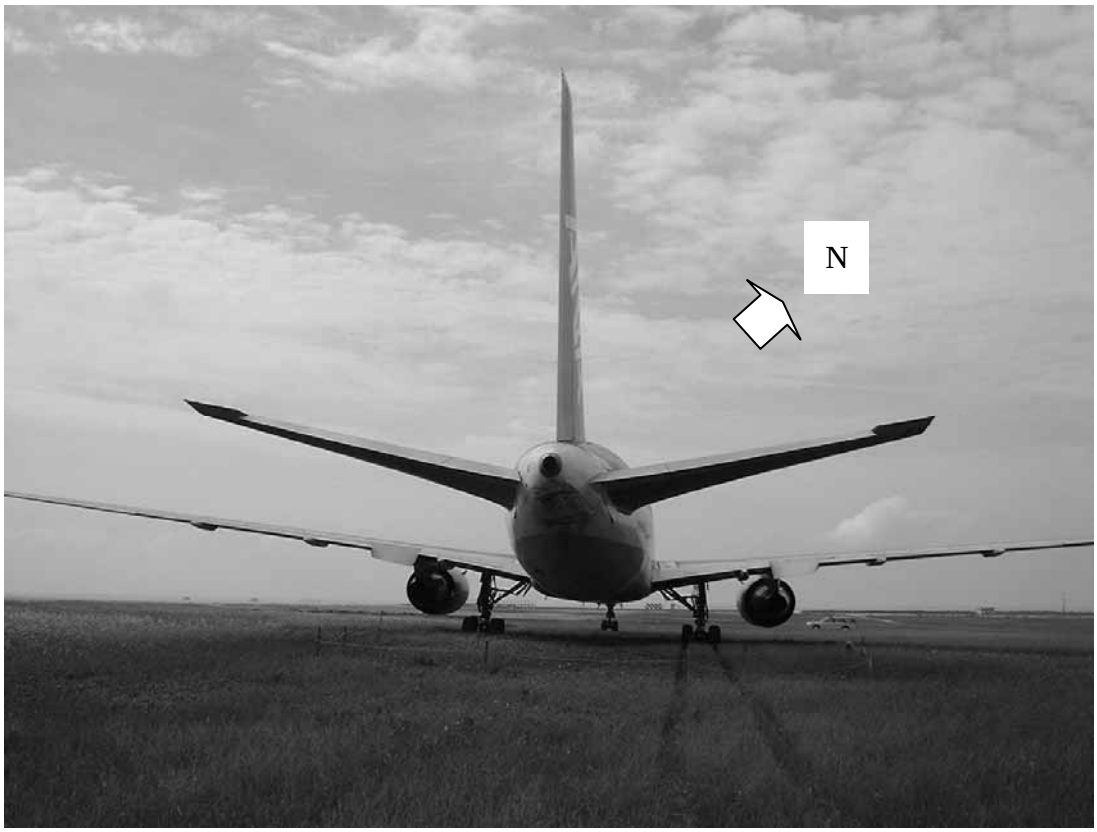
Blank of the line shows the lack of data at that time.

Figure 5 Plane Position and Possibility of strike



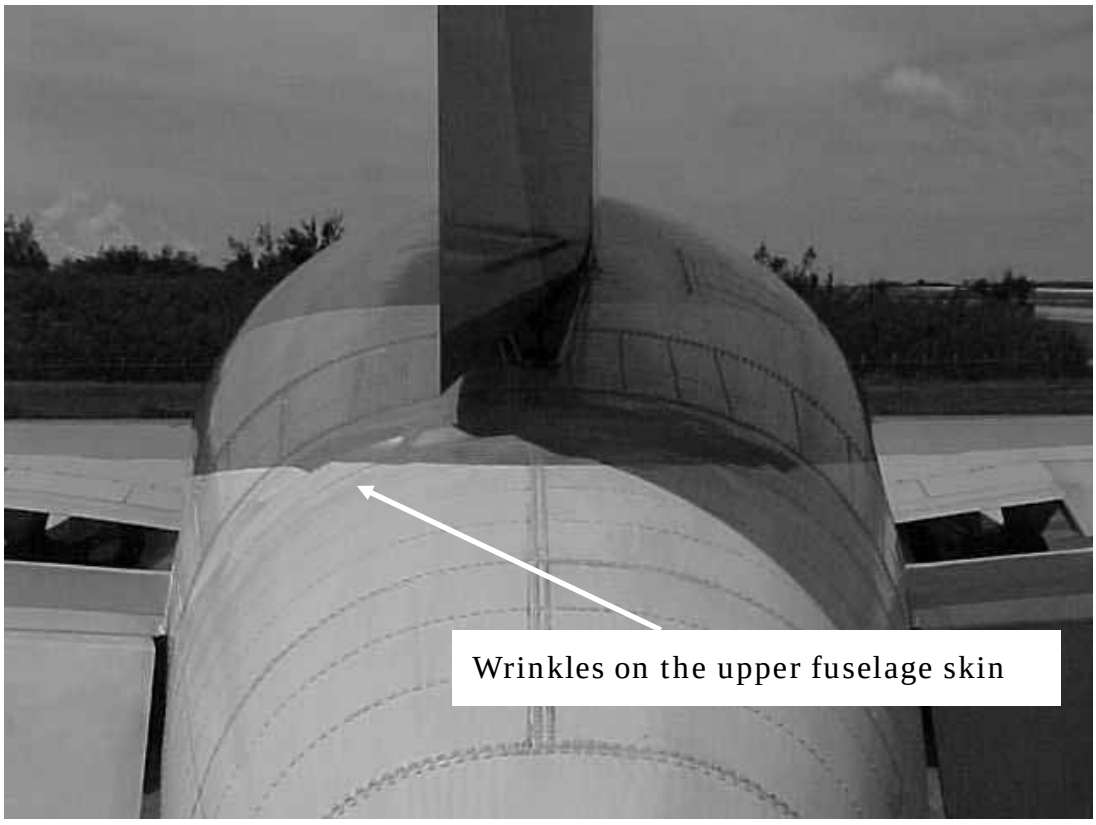
—: condition that the oleo was full expanded. ・・・: condition that the oleo was shrinked.

Photograph 1　Accident aircraft



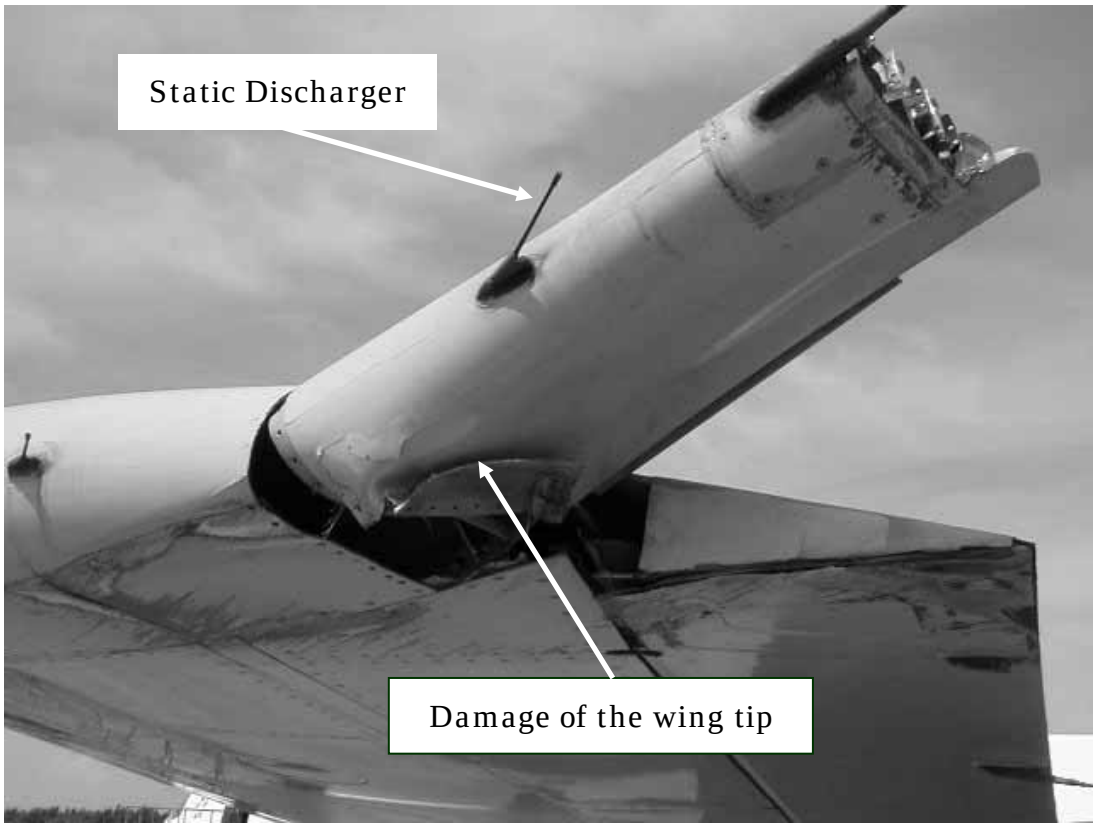
Photograph 2　Damage of the aft fuselage

Photograph 3　Wrinkles on the upper fuselage skin

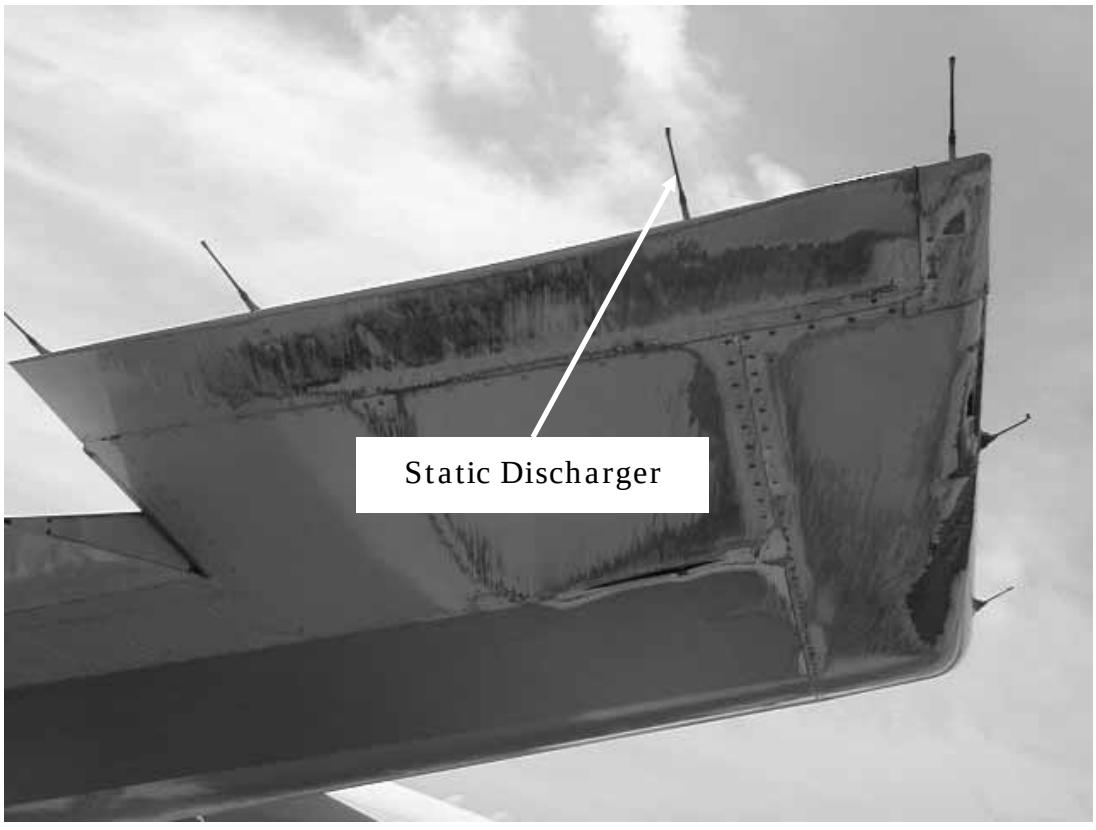


Photograph 4　Damages of the right wing

Photograph 5 Damage of the left wing



Photograph 6 Damage of the right horizontal stabilizer



CVR TRANSCRIPT

Attachment

JST	Speaker	Content	Remarks
12:50:15	Trainee (Observer's sheet)	Shimoji Tower. All Nippon 8254. On down wind. Request Touch and Go. After Touch and Go, enter low downwind.	
12:50:22	ATC	Clear for Touch and Go. Wind 290 at 6.	
12:50:26	Trainee (Observer's sheet)	Clear for Touch and Go. All Nippon 54.	
12:53:14	Instructor (Cap.)	This is the upper limits (Path).	
12:53:24			Fifty
12:53:25	Instructor (Cap.)	Threshold.	
12:53:26			Thirty
12:53:27			Twenty
12:53:28	Instructor (Cap.)	Timing for power reduction is late.	
12:53:29	Trainee	Yes.	Ten
12:53:30	Instructor (Cap.)	To reduce the power more quickly.	
12:53:31	Trainee	Understand.	
12:53:32	Instructor (Cap.)	Just all right. All right.	
12:53:33	Trainee	Yes.	
12:53:34	Instructor (Cap.)／Trainee	Just keep this heading. ／ Yes	
12:53:35	Instructor (Cap.)	Maintain this heading.	
12:53:36	Instructor (Cap.)／Trainee	That's enough. ／ Go around.	
12:53:37	Instructor (Cap.)	Wait. Continue Landing.	
12:53:39	Instructor (Cap.)	OK. Let's go around.	
12:53:41	Trainee	Go around.	
12:53:42	Instructor (Cap.)	OK.	
12:53:43	Trainee	2GA.	
12:53:44	Instructor (Cap.)	OK.	
12:53:45	Trainee	Too tough for me.	
12:53:46	Trainee	Both engines go around.	
12:53:47	Instructor (Cap.)	OK.	
12:53:50			Shaker sounds