

AA2010-6

**AIRCRAFT ACCIDENT
INVESTIGATION REPORT**

**AIR FRANCE
FGSPD**

July 30, 2010

Japan Transport Safety Board

The investigation for this report was conducted by Japan Transport Safety Board, JTSC, about the aircraft accident of Air France, Boeing 777-200, registration FGSPD in accordance with the Act for the Establishment of the Japan Transport Safety Board and Annex 13 to the Convention on International Civil Aviation for the purpose of determining causes of the aircraft accident and contributing to the prevention of accidents/incidents and not for the purpose of blaming responsibility of the accident.

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

Norihiro Goto
Chairman,
Japan Transport Safety Board

AIRCRAFT ACCIDENT INVESTIGATION REPORT

**AIR FRANCE
BOEING 777-200, FGSPD
ABOVE ABOUT 21KM SOUTHEAST OF NIIGATA AIRPORT
AT ABOUT 08:19 JST, MARCH 5, 2009**

June 25, 2010

Adopted by the Japan Transport Safety Board (Aircraft Sub-committee)

Chairman	Norihiro Goto
Member	Shinsuke Endoh
Member	Toshiyuki Ishikawa
Member	Yuki Shuto
Member	Toshiaki Shinagawa

1. PROCESS AND PROGRESS OF AIRCRAFT ACCIDENT INVESTIGATION

1.1 Summary of the Accident

While a Boeing 777-200, registered FGSPD, operated by Air France, which took off from Charles de Gaulle International Airport in Paris on a scheduled flight 276 of the company was flying at about an altitude of 30,600ft, about 21km southeast of Niigata Airport on its descending toward Narita International Airport (Japan), the aircraft was shaken and two flight attendants in the aft galley were seriously injured on March 5 (Thursday), 2009, at about 08:19 Japan Standard Time (JST : unless otherwise stated , all times are indicated in JST).

There were 277 people on board, consisting of the Captain, 15 other crewmembers, and 261 passengers.

The aircraft was not damaged.

1.2 Outline of the Accident Investigation

1.2.1 Investigation Organization

On March 5, 2009, Japan Transport Safety Board designated an investigator-in-charge and two other investigators to investigate this accident.

1.2.2 Representatives from Foreign Authorities

An accredited representative of France, as the State of Registry and Operator of the aircraft involved in the accident, and an accredited representative of the United States of America, as the State of Design and Manufacture of the aircraft, participated in the investigation.

1.2.3 Implementation of the Investigation

March 5, 2009	Aircraft examination and Interviews
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1.2.4 Comments from Parties Relevant to the Cause of the Accident

Comments were invited from parties relevant to the cause of the accident.

1.2.5 Comments from the Participating State

Comments were invited from the participating States.

2. FACTUAL INFORMATION

2.1 History of the Flight

On March 4, 2009, at 21:55 JST, a Boeing 777-200, registered FGSPD (hereinafter referred to as “the Aircraft”) operated by Air France (hereinafter referred to as “the Company”) took off from the Charles de Gaulle International Airport in Paris bound for Narita International Airport on a scheduled flight 276 of the Company.

The outline of the submitted flight plan was as follows:

Flight rules:	Instrument Flight Rules (IFR)
Departure aerodrome:	Charles de Gaulle International Airport
Estimated off-block time:	21:15
Cruising speed:	483kt
Cruising altitude:	Flight Level (FL) 310
Route:	(Omitted) – IGROD (reporting point) – R347 (airway) – NI (Sado NDB) – R347 (airway) – GTC (Niigata VORTAC) – R211 (airway) – LAPIS (reporting point) – R211 (airway) – GOC (Daigo VORTAC) – (Rest is omitted)
Destination aerodrome:	Narita International Airport
Estimated flight time:	10 h and 58 min

At the time of the accident, in the cockpit of the Aircraft, the Pilot in Command (PIC) sat in the left seat as the PNF (pilot not flying: pilot mainly in charge of duties other than flying), the First Officer (hereinafter referred to as “FO”) sat in the right seat as the PF (pilot flying: pilot mainly in charge of flying) and the Second First Officer (hereinafter referred to as “the Second FO”) sat in the observer seat.

The history of the flight up to the time of the accident is summarized below, based on the records of the Digital Flight Data Recorder (hereinafter referred to as “DFDR”) and the Cockpit Voice Recorder (hereinafter referred to as “CVR”), the air traffic control (ATC) communication records, as well as the statements from the flight crewmembers and the flight attendants (FAs).

2.1.1 History of the Flight Based on DFDR, CVR and ATC Communication Records

The Aircraft which kept flying according to flight plan after taking off at Charles de Gaulle International Airport, passed IGROD at FL 370 at about 07:50 on March 5, 2009.

- 08:00:28 The Tokyo Area Control Center (hereinafter referred to as “Tokyo Control”) instructed the Aircraft to fly directly to GTC.
- 08:14:42 Tokyo Control instructed the Aircraft to descend to FL 280 with an altitude restriction of passing AGANO (reporting point) at or below FL 300. PIC read back the instruction.
- about 08:15 The selected altitude of the autopilot (hereinafter referred to as “A/P”) was changed from the previous set value of 37,000 ft to 28,000 ft.
- 08:15:41 The throttle lever angle gradually began decreasing.
- 08:15:47 The Aircraft began descending from FL 370.
- about 08:16:30 – about 08:19:00
The wind direction was gradually changing to the north, from about 270 to

about 300 degrees at about 08:18. Then it gradually moved back to the west to about 285 degrees. The wind velocity decreased about 15kt during the first 50 seconds and increased about 45kt during the next 40 seconds. Then it stabilized between about 125 and 128kt.

- 08:17:25 The Aircraft passed above GTC at about the altitude of 34,900ft.
- 08:17:54 The rate of descent, as it was gradually increasing, reached the highest in this flight: about 4,900 ft per minute. The throttle lever angle began increasing.
- 08:18:18 The throttle levers moved to the idle position.
- 08:18:20 The airspeed of the Aircraft, as it was increasing from starting descent, exceeded 320kt. (the Maximum Operating Limit Speed of the Aircraft is 330kt / MACH 0.87, Mach Number shall be used at the altitude over about 30,000ft.)
About 45 pounds (about 21kg) of force to pull the control column of FO side was recorded.
- 08:18:35 – about 08:18:36
101 pounds (about 46kg) of force to pull the control column of FO side was recorded.
- 08:18:37 – about 08:37:38
At about 21km southeast of GTC and the altitude of about 30,600ft, A/P was disengaged, and the master warning light came on with the warning sound. At that time, the signal of A/P manual disconnect and that of auto-throttle disengagement were not recorded. The pitch angle increased (nose up) rapidly and vertical acceleration of about +2.3G was recorded.
- 08:18:54 A/P was engaged.
- 08:19:35 Tokyo Control instructed the Aircraft to descend to FL 260 and FO read back it to Tokyo Control.
- 08:20:30 The flight crewmembers were informed that some people had been injured over the inter-phone from the aft galley to the cockpit.
- 08:21:13 The Aircraft passed above AGANO at the altitude of about 29,100ft.
- 08:34:35 The PIC requested an ambulance to Narita Operation of the Company over the company radio.
- about 08:51 The Aircraft landed at Narita International Airport.

(See Figure 2-1 DFDR Records 1, Figure 2-2 DFDR Records 2)

2.1.2 Statements of the Flight Crewmembers

(1) PIC

Passing GTC, the Aircraft was flying to LAPIS in the airway R211. A/P and auto-throttle were used. The weather condition was good and there were no clouds. The weather radar in the Aircraft did not show any signs of shake. I sat in the left seat as PNF, FO in the right seat was PF and the second FO was seated in the observer seat.

I felt weak air turbulence like a mountain wave. It was a slow movement and there was no large upthrust. The scale was in between light and moderate, and I think it continued for about 3 to 5 seconds. It was only once that I felt air turbulence. The Aircraft was flying at 310 to 320kt at that time, which was faster than the target

speed of A/P and was approaching to the Maximum Operating Limit Speed.

There was no trouble in the cockpit but we were informed that two FAs had fallen down and had got injured over the phone from the aft galley.

We did not get any information or forecast for air turbulence. I did not remember clearly but I think that I put the seat belt sign on during the air turbulence. Generally we normally do not put the seat belt sign on when flying at the altitude over 10,000ft.

(2) FO

We had no information for clear air turbulence (CAT). There were no clouds outside and no sign of shaking.

I felt the shake was made up of two combined movements. The slow and deep movement increased the speed of the Aircraft and the other movement was that the Aircraft was suddenly shaken. The shake itself was not a strong one but the amplitude was large.

I retarded the throttle and held the control column with the adjustment of the speed. A/P was disengaged at the first shake. I did not use air-brake and tried to keep the control column from moving greatly in order for the Aircraft to fly as smoothly as possible.

(3) The Second FO

We had no information for air turbulence over the Japanese archipelago when the Aircraft took off from the airport in Paris. After the Aircraft shook, we were informed that some FAs had been injured over the cabin call. The PIC responded to that.

(See Figure 1 Estimated Flight Route)

2.1.3 Flight Attendants in the Aft Galley

(1) Chief Purser (near the entrance of the aft galley)

I was standing facing the back of the Aircraft. After I was thrown up by the shake, I fell down on the Purser who had fallen down on the floor just before me.

(2) Purser (near the entrance in the aft galley, injured)

The weather conditions were good, and no seat belt sign were illuminated. When Chief Purser and I were exchanging information near the aft galley, I think it was 20 to 25 minutes before landing that we had the first weak shake. After a few seconds we had a great pitching. At the moment of the shake, both of us flew in the air and then fell on the floor; I was at the bottom and Chief Purser was on me.

(3) Steward A (in the aft galley, injured)

I was having a meal while clearing away the dishes served to the passengers. Just at the shake, I was strongly hit against the ceiling and then fell down on the floor on my low back.

(4) Steward B (in the aft section of the aft galley)

At first, the Aircraft suddenly fell down and then I was thrown up. I grasped the galley at once, so I was in safe. I think that the injured Purser and Steward A were not hit against the corners of the galley but they fell on the floor as they were.

(See Figure 3 Aft Galley and Flight Attendants, Photo 2 Aft Galley)

The accident occurred at about 08:19 on March 5, 2009, at the altitude of about 30,600ft over about 21 km (Latitude 37°48'37" N, Longitude 139°16'00" E) southeast of Niigata Airport.

2.2 Injuries to Persons

Two FAs (Purser and Steward A) were seriously injured. Other crewmembers and the passengers were not injured.

2.3 Damage to the Aircraft

The Aircraft was not damaged.

2.4 Personnel Information

(1) Captain	Male, Age 50	
Airline Transport Pilot Certificate (Airplane)		April 5, 2007
Type rating for Boeing 777		May 25, 2008
Class 1 Aviation Medical Certificate		
Validity		August 31, 2009
Total flight time		11,177 h 20 min
Flight time in the last 30 days		28 h 50 min
Total flight time on the type of aircraft		520 h 00 min
Flight time in the last 30 days		28 h 50 min
(2) FO	Female, Age 42	
Airline Transport Pilot Certificate (Airplane)		October 26, 1994
Type rating for Boeing 777		Date is unclear
Class 1 Aviation Medical Certificate		
Validity		December 31, 2009
Total flight time		8,732 h 00 min
Flight time in the last 30 days		40 h 00 min
Total flight time on the type of aircraft		5,224 h 00 min
Flight time in the last 30 days		40 h 00 min
(3) Second FO	Male, Age 34	
Airline Transport Pilot Certificate (Airplane)		January 16, 2008
Type rating for Boeing 777		June 15, 2008
Class 1 Aviation Medical Certificate		
Validity		May 31, 2009
Total flight time		2,719 h 00 min
Flight time in the last 30 days		45 h 00 min
Total flight time on the type of aircraft		368 h 00 min
Flight time in the last 30 days		45 h 00 min

2.5 Aircraft Information

2.5.1 Aircraft

Type	Boeing 777-200
Serial number	29005
Date of manufacture	January 9, 1999
Certificate of airworthiness	118018

Validity	January 14, 2010
Category of airworthiness	Airplane, Transport T
Total flight time	49,395 h 00 min
Flight time since last periodical check (S maintenance on March 2, 2009)	43 h 00 min

(See Figure 4 Three Angle View of Boeing 777-200, Photo 1 The Aircraft)

2.5.2 Weight and Balance

When the accident occurred, the Aircraft's weight is estimated to have been 196,000kg and center of gravity is estimated to have been 28.3% mean aerodynamic chord (MAC), both of which are estimated to have been within the allowable range (maximum takeoff weight of 297,556kg, and 14.0 to 42.8% MAC corresponding to the weight at the time of the accident).

2.6 Meteorological Information

2.6.1 General Weather Conditions

According to the Surface Analysis Chart at 09:00 on March 5, 2009, the main island of Japan was widely covered by a high-pressure system over the Sea of Japan, and the west side of it was a pressure trough. Northeastern China (north of Korean Peninsula) and East China Sea were covered by a low-pressure system. Both of the pressure systems were going east.

According to the Upper Analysis Chart of 300hPa at the same time, a pressure trough corresponding with the surface low pressure system was in the north region of China and a moderate pressure ridge was around Japan area. A jet stream of 300hPa was going southward along the contour of 9,000m (about 30,000ft) in the north of Tibet and was flowing over the middle region of China to the ocean of the east of Japan via the middle of the Sea of Japan. (See Figure 5 Surface Analysis Chart and Upper Analysis Chart (300hPa))

2.6.2 Meteorological Satellite Imagery

According to the infrared image and the visible image at 08:20, the time which was the nearest to that of the accident, around the area where the accident occurred was covered by lower -layer convective clouds and the middle and the upper layer were in the clear region. (See Figure 6 Meteorological Satellite Imagery)

2.6.3 Hourly-Analysis Chart

According to the Hourly-Analysis Chart of Longitude 137.5 deg E at 08:00 on the day of the accident, there was a jet stream of about 140kt around FL 310 but was not seen a clear frontal zone in the lower part of it. But strong vertical wind shear ^{*1} was analyzed in the vicinity of the adjacent altitudes (FL260 ~ FL340) where the accident occurred.

(See Figure 7 Hourly-Analysis Chart)

*1 Vertical wind shear is the difference in wind between the top and bottom layers converted into the difference per 1,000 ft, for the wind direction and velocity at locations obtained through wind analysis. It becomes larger as the change in wind direction or velocity, or both, become larger as the altitude increases.

2.6.4 PIREP

In the PIREPS (Pilot Report) between 06:00 and 09:00 on the day of the accident, there was no information for air turbulence around the area where the accident occurred.

2.7 Information on DFDR and CVR

The Aircraft was equipped with a DFDR (part number: 980-4700-003) and a CVR (part number: 980-6022-001) both of which were made by Honeywell of the United States of America.

All records at the time of the accident were retained on the DFDR and the CVR. The time was determined by correlating the DFDR recorded VHF transmission keying signals with the speaking clock recorded on the ATC communication records.

2.8 Medical Information

The condition of the injured two of the crewmember was as follows.

Flight attendant (Purser)	Female	Age 45
Compression fracture at the twelfth thoracic vertebra		
Flight attendant (Steward A)	Male	Age 39
Compression fracture at the first lumbar vertebra		

2.9 Information on the Rescue of Injured

At about 08:29	One of the ground staff at Narita Operation of the Company received an information that two people were injured in the Aircraft by ACARS (Aircraft Communications Addressing and Reporting System).
At about 08:35	One of the ground staff at Narita Operation of the Company received the company radio message from the Aircraft and requested an ambulance.
At about 08:51	The Aircraft landed on the runway 34R.
At about 09:15	The Aircraft arrived at No. 11 Spot and the injured two were taken to the hospital by an ambulance.

2.10 Additional Information

According to the company of the design and manufacture of the Aircraft, A/P of Boeing 777 may be disconnected during cruise when any of the following occurs:

- (1) A crew pushes MCP*2 or disconnect switches on the control column.
- (2) A crew applies the force more than 60 pounds to the control column or the one more than 40 pounds to the control wheel.

*2 "MCP" stands for Mode Control Panel, meaning the operation panel that controls auto pilot system, etc.

3. ANALYSIS

3.1 Qualification of Personnel

PIC, FO and the Second FO held both valid airman competence certificates and valid aviation medical certificates.

3.2 Airworthiness Certificate of the Aircraft

The Aircraft had a valid airworthiness certificate and had been maintained and inspected as prescribed.

3.3 Weather Conditions along the Flight Route of the Aircraft

According to the descriptions in 2.1.2 and 2.6.2, it is considered highly probable that there were no clouds around the area where the accident occurred.

As described in 2.6.3, there was not a clear frontal zone below the jet stream. However, as of 08:00 of the day at Longitude 137.5 E, while any vertical wind shear was not analyzed at the adjacent altitudes where the accident occurred, strong vertical wind shear was analyzed in the vicinity. Therefore, it is considered possible that the wind velocity was significantly varied according to the change in the altitude and the location at the time and the area of the accident.

According to the descriptions in 2.6.1 and 2.6.3 and to the flight route of the Aircraft, it is considered highly probable that the Aircraft was flying near the strong wind axis of the jet stream.

3.4 Progress of the Accident

3.4.1 The Situation before the Accident Occurred

As described in 2.1.1, the Aircraft began descending at 08:15:47 with the instruction by Tokyo Control. The instruction had an altitude limitation, and it took more than about 7,000ft to arrive at AGANO. It is considered probable that there was no need to make the descent rate larger because there remained enough distance.

As described in 2.1.1, after the Aircraft began descending, the wind direction changed about 30 degrees to the north where the tail wind gradually blew up. During that time, the wind velocity decreased once but began increasing after passing GTC, and it kept increasing rapidly, by about 45kt, for about 40 seconds up to about 08:18. It is considered highly probable that it was because the Aircraft was getting close to the strong wind axis of the jet stream.

As described in 2.1.1, after the Aircraft began descending, the nose was gradually getting down, then at 08:17:54, the descent rate reached about 4,900ft per minute which was the largest during this flight. It is considered highly probable that it was because A/P had tried to maintain the Aircraft's airspeed in the tail wind which kept increasing rapidly from about 08:17:20. It is considered highly probable that the throttle levers were advanced by auto-throttle from about 08:17:54 and A/P increased pitch angle a little, then the descent rate was getting smaller. As the tail wind stopped increasing its velocity at about 08:18:05 and the previous descending with a deep nose down angle increased the airspeed rapidly, it is considered highly probable that FO retarded the throttle levers almost to the idle position at about 08:18:16.

3.4.2 The Situation when the Accident Occurred

According to Figure 2-2 DFDR Records 2, minor fluctuations in the vertical acceleration were recorded from about 08:18:30 and also some of minor fluctuations had been recorded before

that. Therefore it is considered probable that there was some air turbulence.

As described in 2.1.1, A/P was disengaged and the master warning light came on at about 08:18:37. As the signal of A/P manual disconnect was not recorded, it is considered highly probable that it was not because that the crew pushed MCP or the disconnect switch on the control column but because that about 101 pounds force was applied to the control column held by FO at about 08:18:36 and that force satisfied the A/P disconnect condition (A crew applies the force more than 60 pounds force to the control column) described in 2.10 (2).

At about 08:18:38 the pitch angle of the Aircraft rapidly increased more than 4 degrees to the direction of nose up, and at the same time the Aircraft suddenly shook so largely that about + 2.3G vertical acceleration was recorded. Then the descent rate which had been 2,600ft per minute decreased to nearly zero rapidly.

As described in 2.1.1 and 2.1.2 (1), the airspeed of the Aircraft kept increasing and was approaching to the Maximum Operating Limit Speed in spite of the fact that FO retarded the throttle levers to the idle position. Therefore it is considered possible that FO had pulled the control column instantaneously in order to stop the airspeed increasing so that about 101 pounds force was applied to the control column of FO.

Also, it is considered probable that the Aircraft was flying near the strong wind axis of the jet stream as described in 3.3 and there was some air turbulence as described in 3.4.2 in a rapid change of the wind velocity as described in 3.4.1. Therefore it is considered possible that these factors contributed to the Aircraft's shake.

3.5 Background of the Injury and the Handling after That

Judging from the description in 2.1.3 and 3.4.2, it is considered highly probable that because the pitch angle of the Aircraft rapidly increased and the aft section of it suddenly fell down, four FAs near the aft galley were thrown up in the air, Chief Purser fell down over the Purser who had fallen down first, and as a result, the underlain Purser was injured. It is also considered highly probable that Steward A was thrown up in the air as he was having his meal and could not do anything toward the sudden shake of the Aircraft and that he fell down on the floor and was injured. Actually, there was no handle to brace.

As described in 2.1.1, 2.1.2 (1) and 2.9, it is considered highly probable that PIC recognized that some people had got injured over the phone from the aft galley at 08:20:30 and that he requested an ambulance over the company radio after reporting the accident to Narita Operation of the Company by ACARS.

4. PROBABLE CAUSE

It is considered highly probable that this accident occurred as follows:

As the Aircraft was severely shook suddenly while it was descending toward Narita International Airport, the FAs who had been at the aft section of the Aircraft were thrown up in the air and then fell down on the floor and two of them were seriously injured.

It is considered possible that the severe shake of the Aircraft occurred because FO pulled the control column instantaneously in order to prevent the airspeed from increasing. It is also considered possible that the factor that the Aircraft was flying near the strong wind axis of the jet stream was relevant to the Aircraft's shake.

Figure 1 Estimated Flight Route

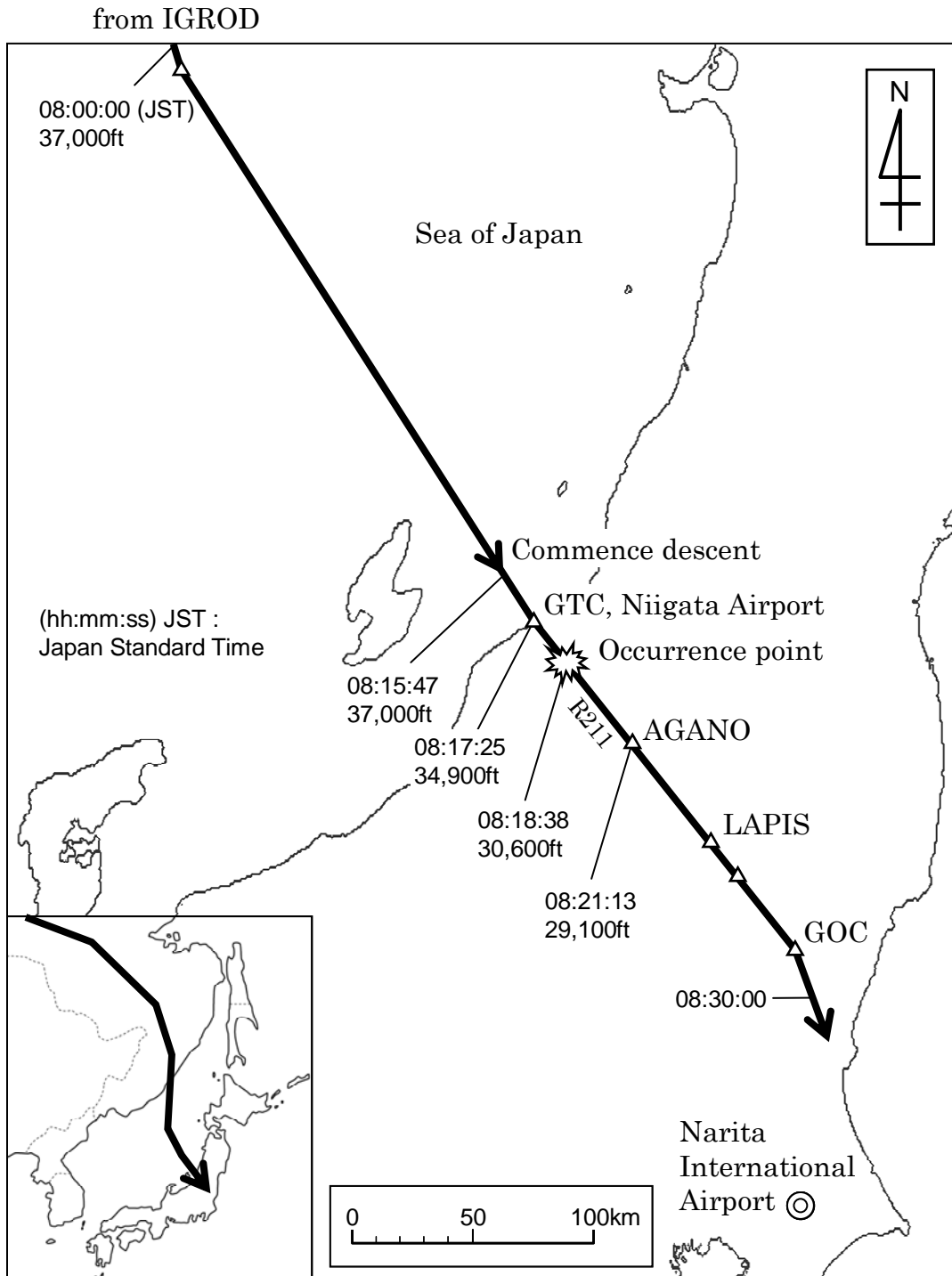


Figure 2-1 DFDR Records 1

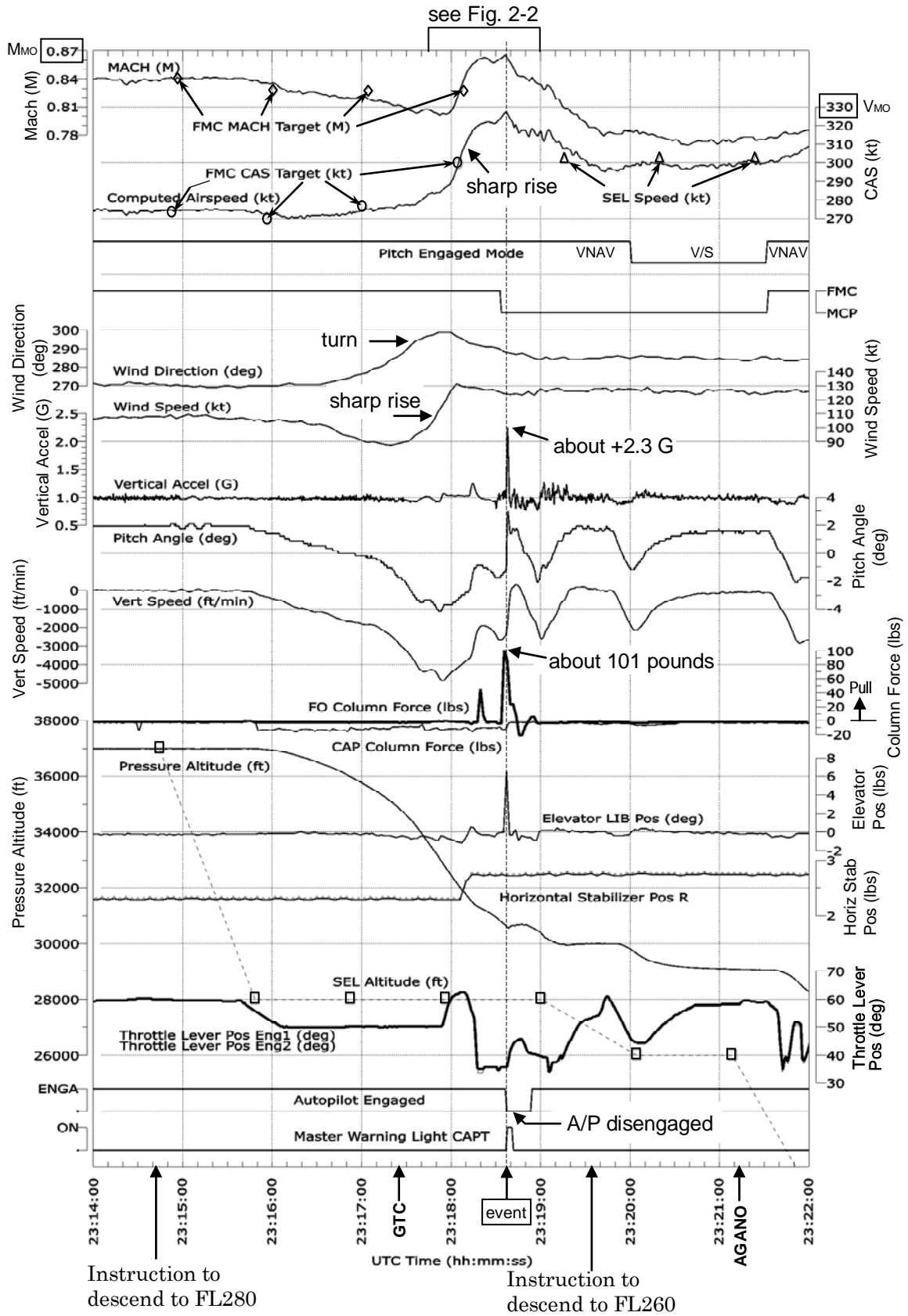


Figure 2-2 DFDR Records 2

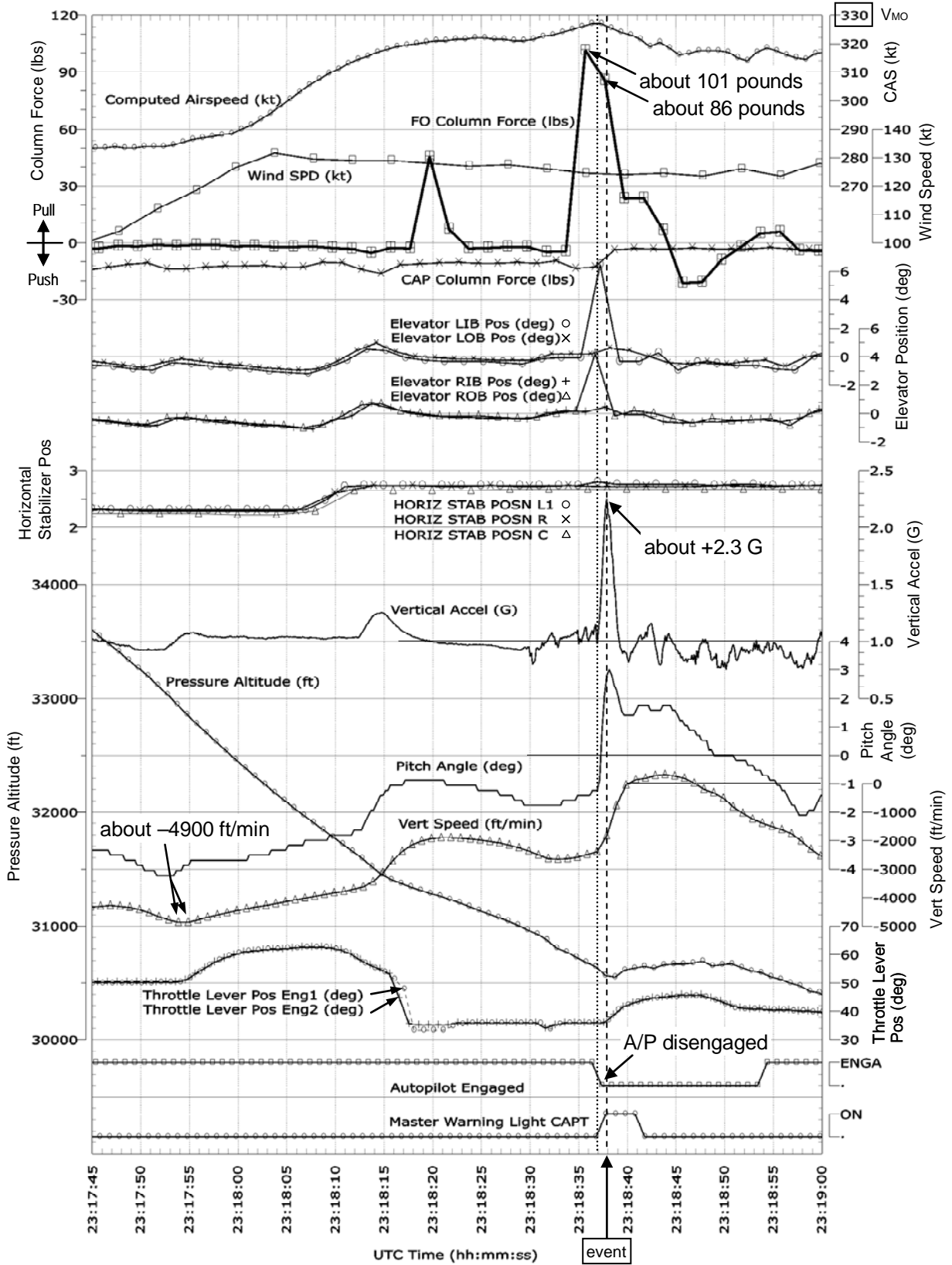


Figure 3 Aft Galley and Flight Attendants

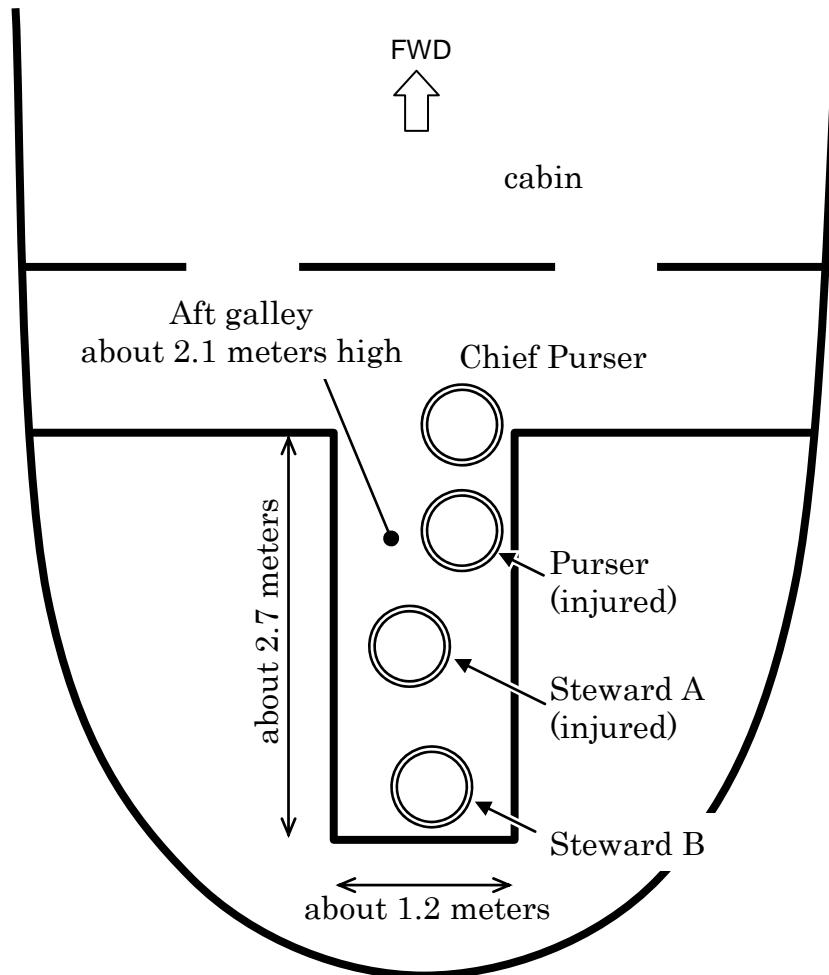


Figure 4 Three Angle View of Boeing 777-200

Unit : m

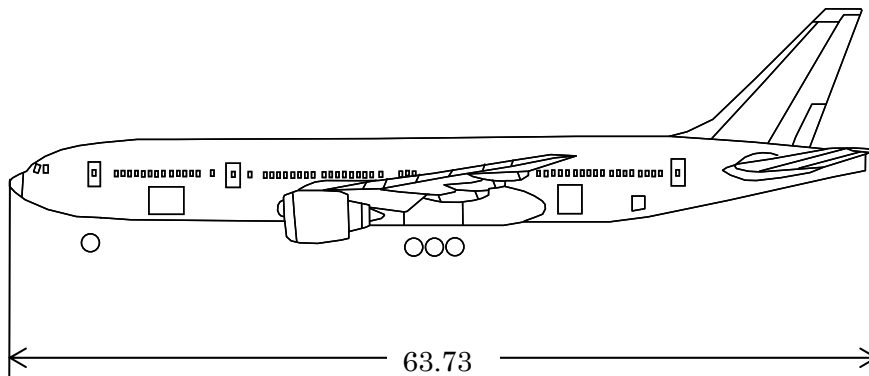
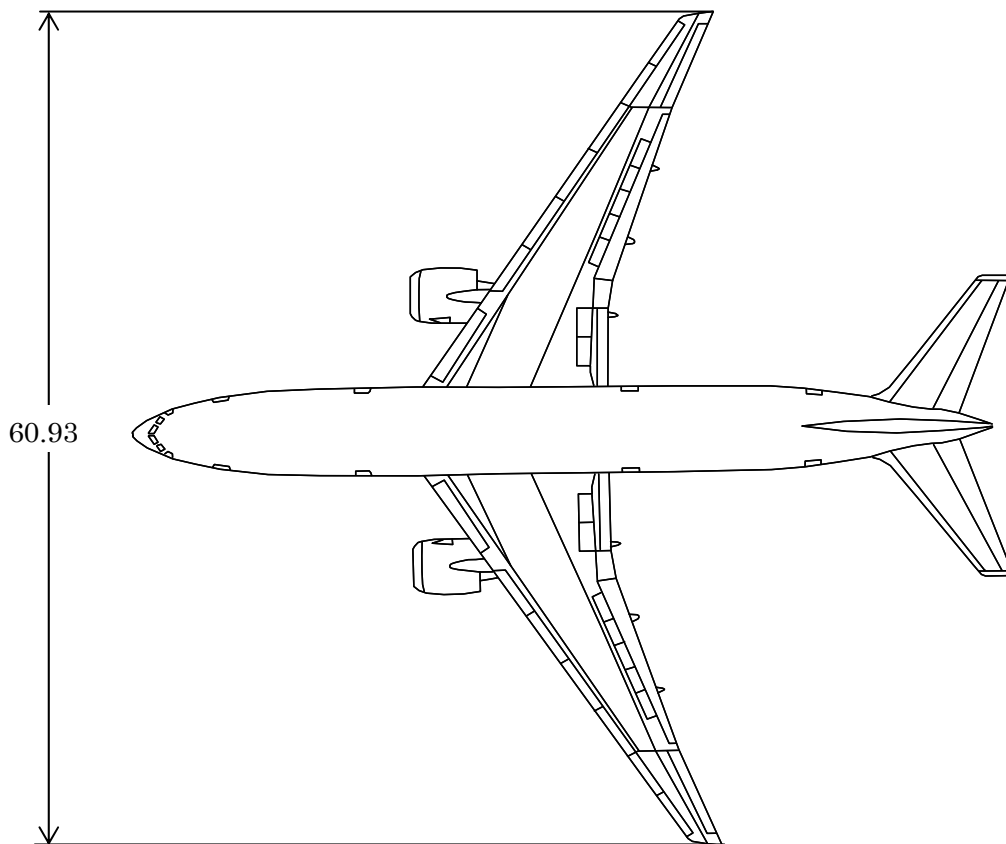
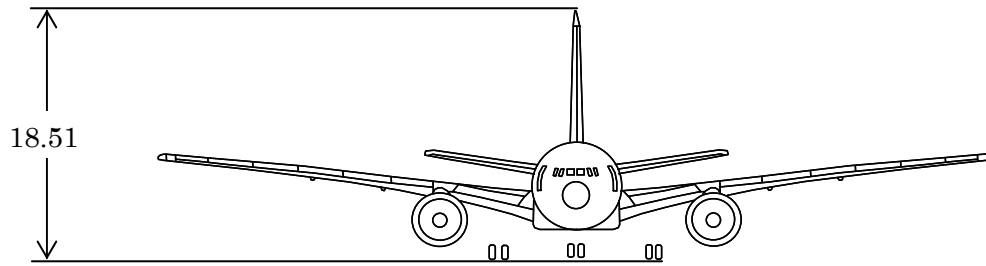


Figure 5 Surface Analysis Chart and Upper Analysis Chart (300hPa)

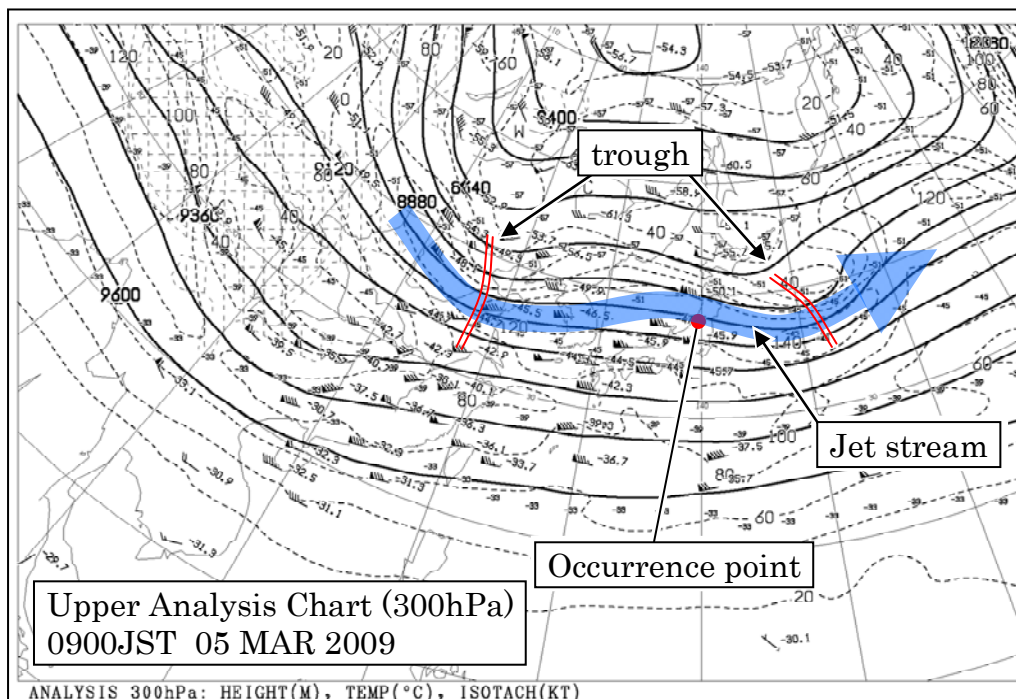
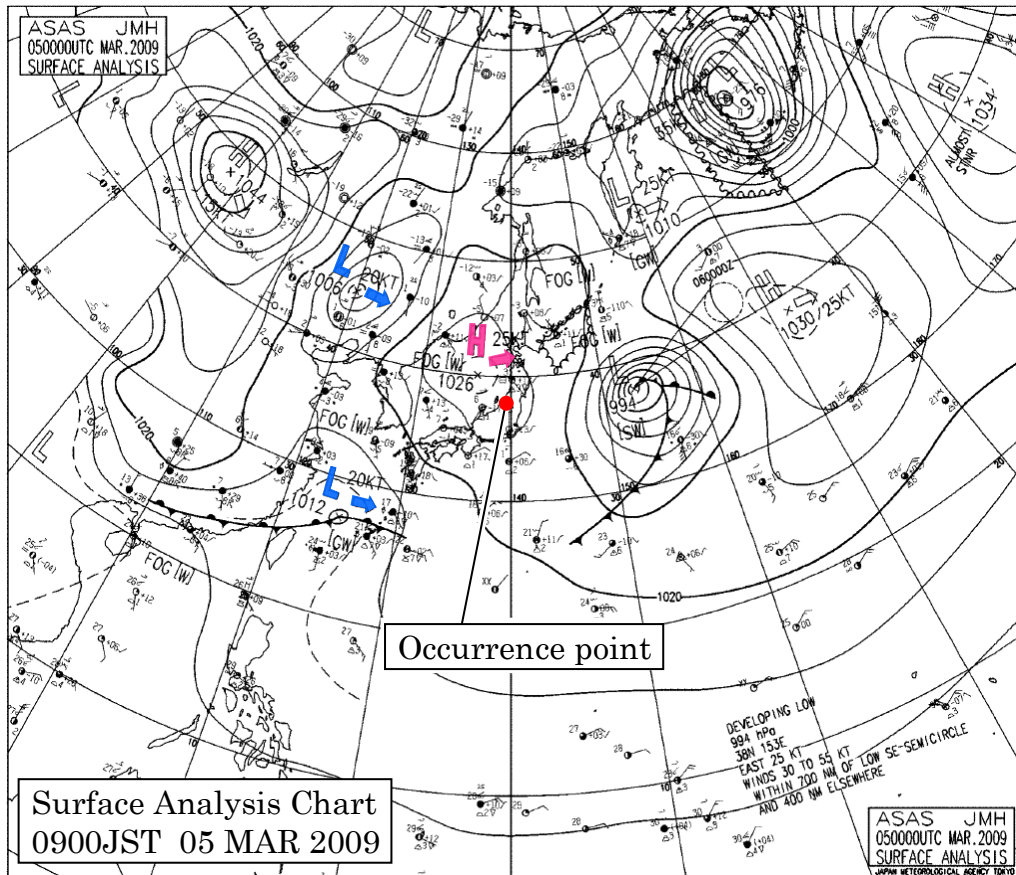


Figure 6 Meteorological Satellite Imagery

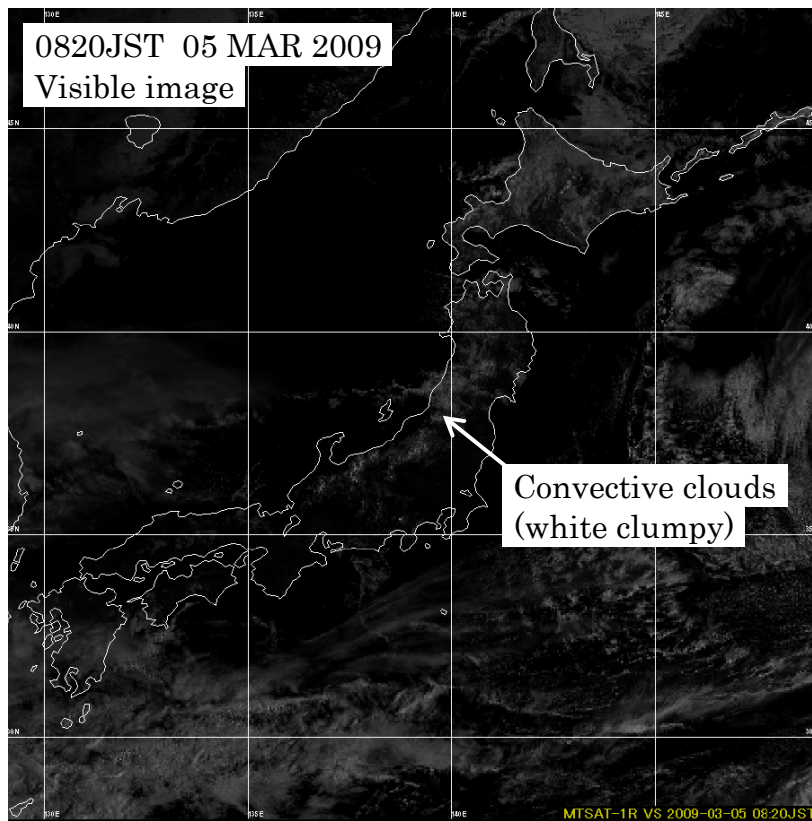
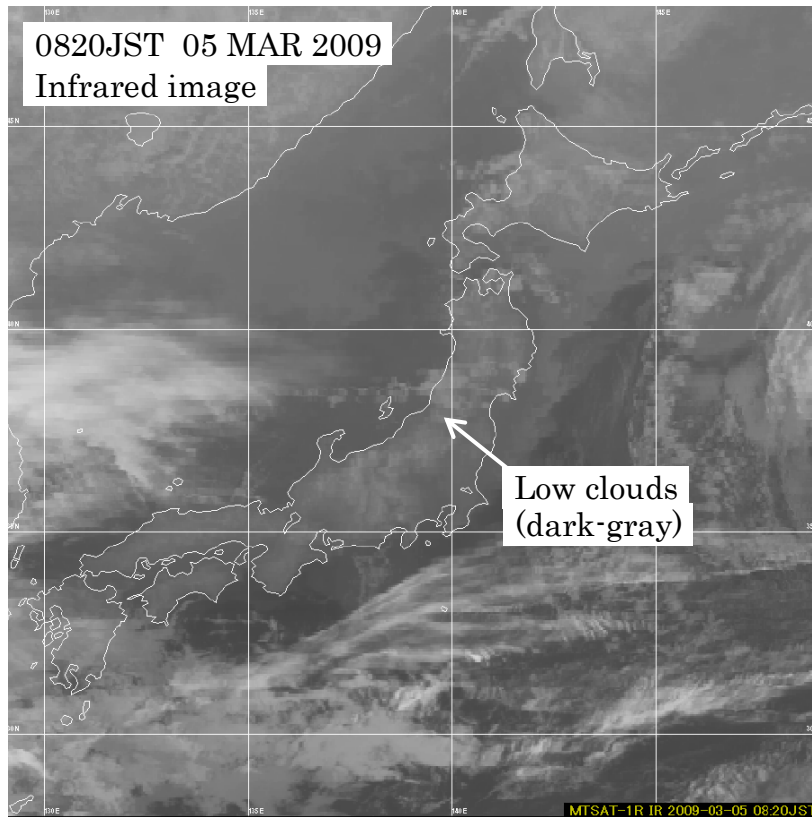


Figure 7 Hourly-Analysis Chart

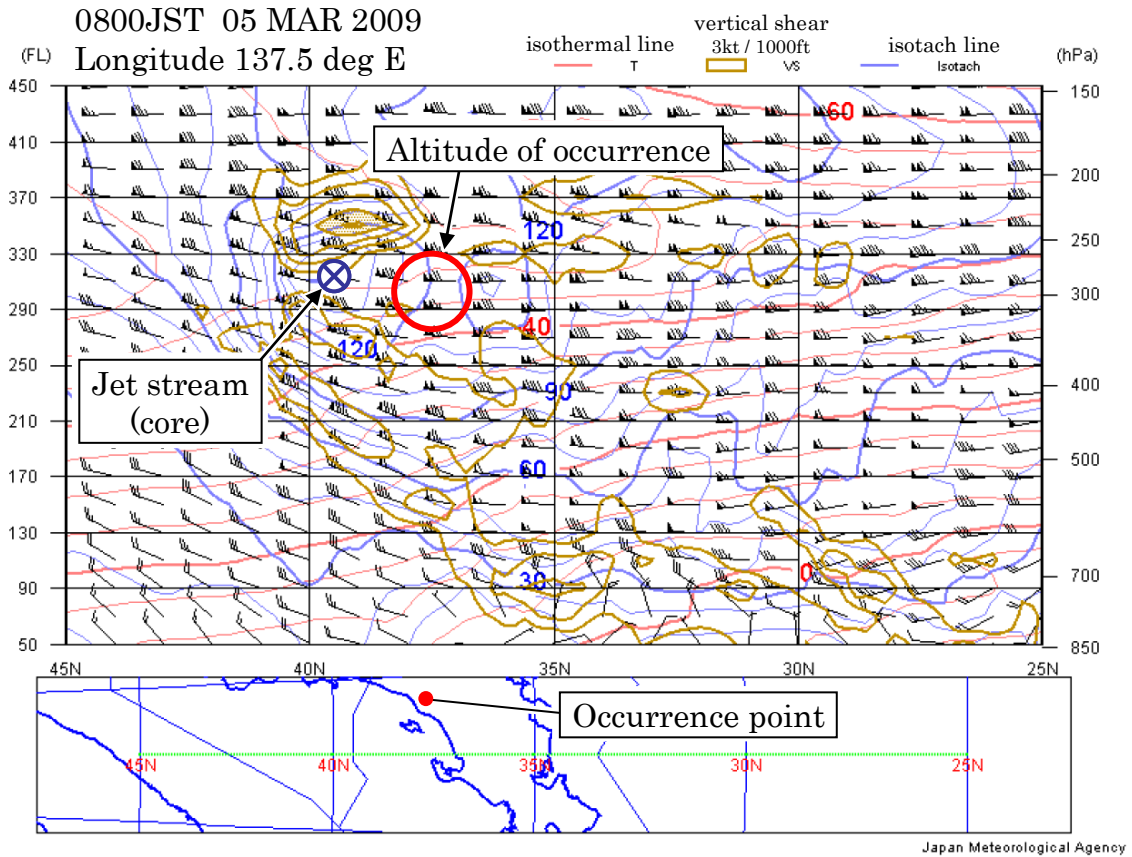


Photo 1 The Aircraft



Photo 2 Aft Galley

