

AA2016-2

**AIRCRAFT ACCIDENT
INVESTIGATION REPORT**

**American Airlines, Inc.
N 7 5 1 A N**

March 31, 2016



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

Kazuhiro Nakahashi
Chairman,
Japan Transport Safety Board

Note:

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

AIRCRAFT ACCIDENT INVESTIGATION REPORT

AMERICAN AIRLINES, INC., BOEING 777-200, N751AN
PASSENGER AND CABIN ATTENDANT INJURY
BY THE SHAKING OF THE AIRCRAFT
AT AN ALTITUDE OF APPROXIMATELY 27,000 FT
OVER NORTHERN KANTO, JAPAN
AT ABOUT 19:35 JST, DECEMBER 16, 2014

March 11, 2016

Adopted by the Japan Transport Safety Board

Chairman Kazuhiro Nakahashi
Member Toru Miyashita
Member Toshiyuki Ishikawa
Member Sadao Tamura
Member Keiji Tanaka
Member Miwa Nakanishi

1. PROCESS AND PROGRESS OF THE INVESTIGATION

1.1 Summary of the accident	On Tuesday, December 16, 2014, Boeing 777-200, registered N751AN, operated by American Airlines, Inc., as the scheduled Flight 280, took off from Incheon International Airport for Dallas Fort Worth Airport; thereafter changed its destination and landed at Narita International Airport due to injury of passengers and cabin attendants caused by fierce shake over Japan.
1.2 Outline of the investigation	On December 17, 2014, the Japan Transport Safety Board designated an investigator-in-charge and two investigators to investigate this accident. A representative of the United States of America, as the State of Registry, the Operator, Design and Manufacture of the aircraft involved in this accident, participated in this investigation. Comments on the draft report from parties relevant to the cause of this accident and the relevant State were invited.

2 FACTUAL INFORMATION

2.1 History of the Flight	The history of the flight is summarized as below, based on the statements of Pilot in Command (PIC), First Officer (FO), relief flight
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crewmembers, passengers, cabin attendants and dispatch instructor, as well as records of the flight data recorder (FDR) and the air traffic control (ATC) communications records. The time below is shown in Coordinated Universal Time (UTC).

On December 16, 2014 at 09:15, a Boeing 777-200, registered N751AN, operated by American Airlines, Inc. (hereinafter referred to as "the Company") as the scheduled Flight 280, took off from Incheon International Airport for Dallas Fort Worth International Airport with 255 persons on board, consisting of the PIC, 14 other crewmembers, and 240 passengers.

When this accident occurred, the PIC sat in the left seat as a pilot mainly in charge of duties other than flying, and the FO sat in the right seat as a pilot mainly in charge of flying duties.

(1) Flight planning

Before the flight of the aircraft, a dispatcher in the U.S. confirmed weather information, created a flight plan and sent it with relevant weather information as a Dispatch Flight Plan to a local agent in Incheon International Airport at 06:14.

In the aircraft parked at Incheon International Airport, the PIC received the printed Dispatch Flight Plan from the local agent, and confirmed the flight plan and weather information with the FO and the relief flight crewmembers. The weather information also indicates information related to turbulence, the forecast of turbulence over Japan on the planned profile was as described later in 2.6(1). The PIC e-signed on the flight plan based on these information at 08:21 and did not give any specific instructions about in-flight service to the cabin attendants to have expected a flight condition over Japan.

(2) Premonitory phenomenon of shake

When the aircraft reached the first cruising altitude 27,000 ft after take-off, the PIC made a P.A. announcement that there was no problem regarding the weather along the profile with an ordinary announcement, and turned off seatbelt signs. The cabin attendants started in-flight service such as the provision of meal after the seatbelt signs were turned off.

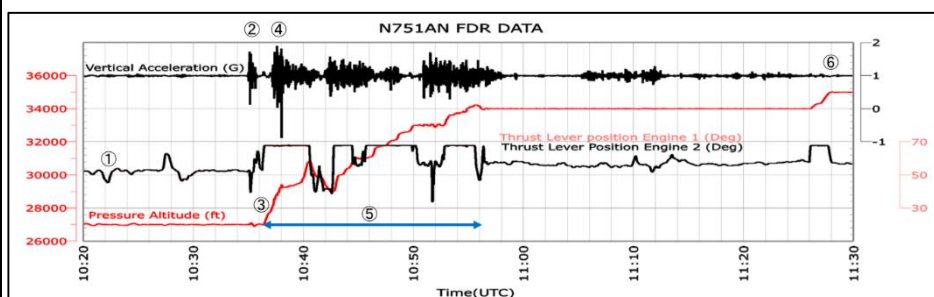


Fig. 1 Data of FDR

The aircraft adopted autopilot and auto-throttle, and the PIC

visually recognized that the thrust leveres moved back ward by auto-throttle (this is one of the representative premonitory phenomenon of shake) and thus turned on the seatbelt signs (Fig. 1 ①). This time, although it was dark and thin cloud were sometimes seen outside the windows of the cockpit, an airborne radar did not display clouds expected to cause a big shake and there was no actual shake, accordingly, the PIC did not give instructions such as calling for attention or seating instruction by P.A. announcements. In the cabin, the cabin attendants confirmed the wearing of seatbelts, and then continued in-flight service. The PIC continued to fly at an altitude of 27,000 ft due to stable conditions of the air current.

Although Passenger A knew that the seatbelt sign was illuminated , the passenger left the seat and went in a lavatory to somewhat rearward of the center of the cabin. If there was a passenger who left a seat during the illumination of the seatbelt signs, the cabin attendants had to urge the passenger to get back to the seat and wear a seatbelt, but did not do due to the busy in-flight service.

(3) Fierce shake

At about 10:35, the first big shake occurred, and the PIC made a P.A. announcement to all including the cabin attendants so as to take a seat and wear a seatbelt (Fig. 1 ②). It was still dark and thin clouds were sometimes seen outside the windows of the cockpit and an air borne radar did not display the clouds expected to cause the big shake. Passenger A stayed in the lavatory following the advice of a cabin attendant in an aisle. The cabin attendants dealt with the shake such as holding a service cart, taking a seat or holding on an armrest.

Although the PIC requested a ATC authority, and then he ascended to a higher altitude to avoid the shake (Fig. 1 ③), the second big shake occurred (Fig. 1 ④) during the ascending. Passenger A in the lavatory and the cabin attendant in an aisle to the somewhat rearward of the center of the cabin were seriously injured by being hit to the ceiling due to those big shakes of Fig. 1 ② and ④ (maximum +1.8G through -0.88G). After that, although the PIC continued to change the altitude where the shake is weakened (Fig. 1 ⑤) while contacting the ATC authority, the fierce shake continued for about 20 minutes after Fig. 1 ④. About one hour later since the first big shake, the shake of the aircraft subsided at the altitude of 35,000 ft (Fig. 1 ⑥).

The relationship among the flight profile of Fig. 1 ①, ② and ④, and cloud observation by the ground weather radar is shown as 2.6(3).

(4) Destination Change

Although the comparatively light shake had continued for about 30 minutes after about 10:58 when the fierce shake subsided, the relief flight crewmembers and the cabin attendants confirmed the damage situation while putting away the fallen service cart, the dispersing food and drink,

tableware, equipment, and passenger's private belongings. The PIC made an inquiry to the head office about the possibility of airframe damage, considering the gravitational acceleration which the PIC sensed. After that, the PIC decided the change of destination, considering the clarified situation of injured persons and the cabin or a concern for airframe damage. At 12:09, it was reported to the ATC authority that the destination was changed to Narita International Airport, and the aircraft landed at Narita International Airport at 15:55 on request the priority to ATC authority.

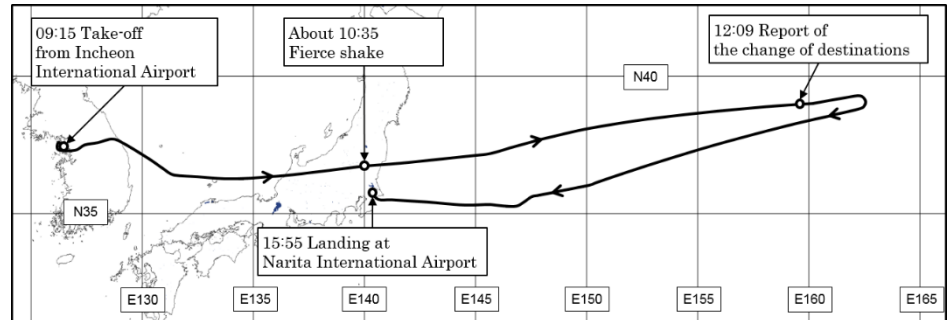


Fig. 2 Estimated flight profile map of the aircraft

The accident occurred at about 10:35-38 on December 16, 2014, at about 27,000-29,000 ft over Northern Kanto (36°43'-46'N, 139°58'-140°33'E).

2.2 Injuries to Persons	One passenger and one cabin attendant were seriously injured; besides, eight passengers and two cabin attendants were minor injured.
2.3 Damage	None
2.4 Personnel Information	<p>(1) PIC Male, Age 60 Airline transport pilot certificate (Airplane) June 8, 2007 Type rating for Boeing 777 March 3, 2013 Class 1 aviation medical certificate Validity: Until January 22, 2015 Total flight time 28,935 hr Total flight time on the type of airplane 1,297 hr 12 min</p> <p>(2) FO Male, Age 52 Airline transport pilot certificate (Airplane) February 28, 2008 Type rating for Boeing 777 August 29, 2013 Class 1 aviation medical certificate Validity: Until May 11, 2015 Total flight time 7,721 hr Total flight time on the type of airplane 644 hr 10 min</p>
2.5 Aircraft Information	<p>(1) Type: Boeing 777-200 Serial number: 30798, Date of manufacture: April 3, 2001 When the accident occurred, the weight and the position of the center of gravity of the aircraft were each within the allowable range.</p>

(2) Flight recorder

Although the aircraft was equipped with a flight data recorder and a cockpit voice recorder, but the records in the cockpit voice recorder at the time of the accident was overwritten and not retained due to the time spent from the occurrence of the accident to the landing.



The aircraft involved in the accident

2.6 Meteorological Information

The weather information related to the airspace (flight profile) where the aircraft was shaken fiercely is as follows. The weather information which the Company uses for operation control, is issued by a company (hereinafter referred to as "Company A") which provide weather information under contract unless it is particularly necessary. The weather information of Japan Meteorological Agency (JMA) was not used also for this issue.

(1) Forecast of turbulence when flight planning

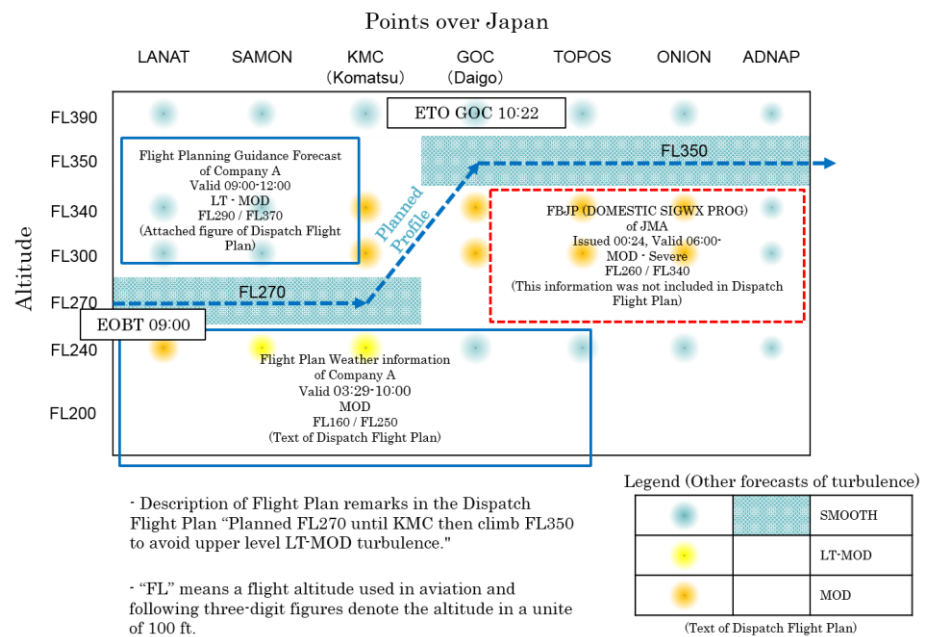


Fig. 3 Forecast related to turbulence (until PIC's signature)

The PIC did not forecast any turbulence along the planned profile (blue dashed line in Fig. 3) from the given weather information. In addition, neither the dispatcher nor the PIC grasped the forecast of turbulence which was able to be read from the FBJP of JMA (it was a range enclosed with a red dashed line, and details in FBJP were shown in 2.6(4)).

(2) Forecast of turbulence by the time from take-off to shaking, after flight planning.

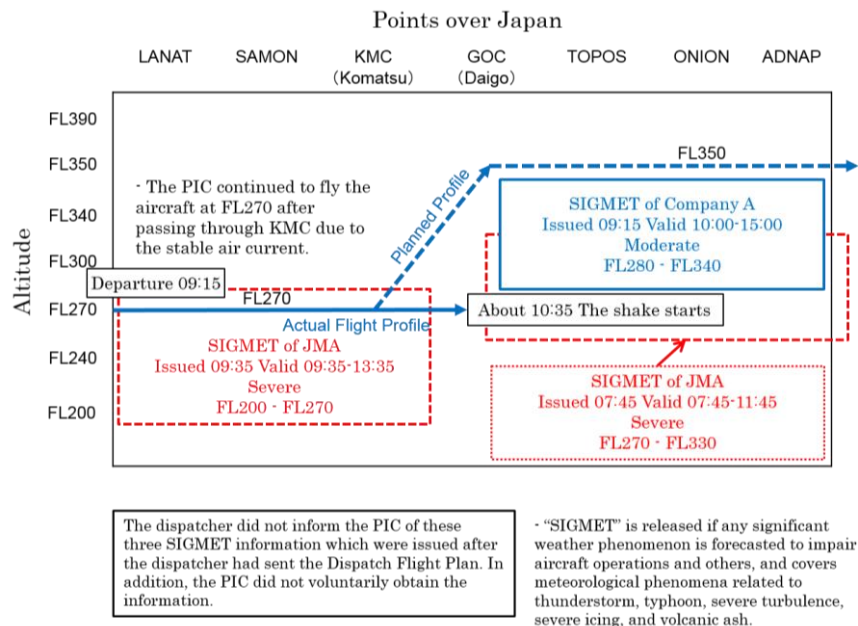


Fig. 4 Forecast related to turbulence (by the time from take-off to shaking, after flight planning)

The PIC continued to fly at FL270 (blue solid line of Fig. 4) after passing through KMC (Komatsu at 10:17) because the air current at FL270 through which the aircraft had flown according to the planned profile was stable and the PIC did not grasp the forecast of turbulence which was able to be read from FBJP of JMA shown in Fig. 3. Although the forecast of turbulence related to the planned profile and the actual flight profile had issued from Company A (the range enclosed by blue solid line) and JMA (the range enclosed by red dashed line), the PIC did not grasp these three SIGMET.

(3) Observation by ground weather radar (as of 10:40)

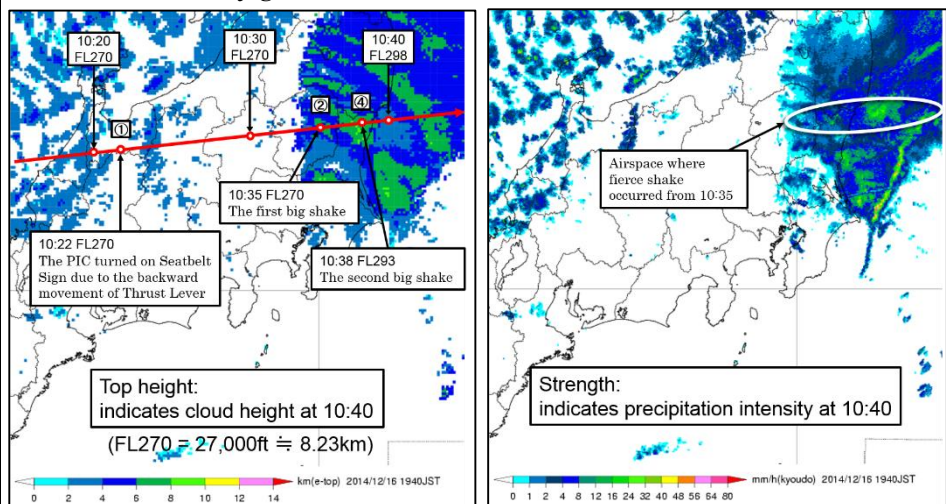


Fig. 5 Observation information by ground weather radar (when encountering the fierce shake)

Focusing on the cloud height (Top height) and rainfall intensity (Strength) at the point of the first big shake (②) and near the point of second big shake (④) in the actual flight profile (red bold solid line of Fig. 5), the rainfall intensity was weakly observed in the airspace where the cloud reached the altitude almost equivalent to the actual flight profile.

(4) FBJP of JMA

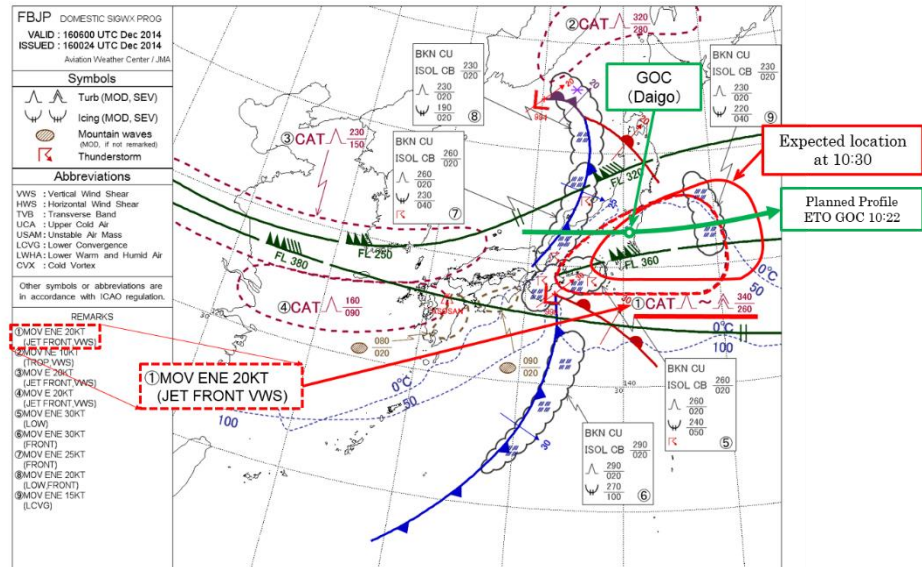


Fig. 6 Effective FBJP when the aircraft passed over Japan (partly added)

The weather information related to planned profile and the actual flight profile of the aircraft is the one enclosed by red dashed line in the left REMARKS column of Fig. 6, and in the figure of the right chart part, moderate to severe CAT (clear air turbulence) was expected as ①CAT Δ ~ Δ 340/260 in the airspace enclosed by red dashed line. The location of this airspace expected at 10:30 was added as "Expected location at 10:30" to the figure of the right chart part by red solid line. In the planned profile (added by green bold solid line) in which the aircraft was scheduled to pass through GOC (Daigo) at 10:22 (ETO GOC at 10:22), the aircraft was scheduled to fly across the airspace of CAT shown in "Expected location at 10:30" during the same time period.

2.7 Additional Information

(1) Display of terminal used by the Company for operation control

The terminal unit used for operation control can display weather information necessary for creating flight plans or managing individual flights. The weather information provided by Company A is displayed at first and other information including issued by JMA and others can be displayed with the optional selection of the dispatcher.

In addition, during flight it is possible to inform the flight crewmembers of these weather information by using data communication.

	<p>(2) Confirmation of weather information by flight crewmembers</p> <p>In airports other than the hub airports for the Company such as Incheon International Airport, the flight crewmembers are to confirm the printed Dispatch Flight Plan and make an inquiry to a dispatcher about any questions of the flight plan or the weather information by telephone and other things, if they have the question.</p> <p>In hub airports, the flight crewmembers are able to confirm weather information and other things by arbitrary terminals as well as the dispatcher.</p>
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3 ANALYSIS

3.1 Involvement of Weather	Yes
3.2 Involvement of Pilots	None
3.3 Involvement of Equipment	None
3.4 Analysis of Findings	<p>(1) Fierce shake</p> <p>It is probable that the aircraft was flying to glaze thin clouds near the top of the cloud over Japan. In addition, according to the ground weather radar, there was developed cloud near the point where the aircraft encountered the fierce shake. However, the clouds at the flight altitude were weak in rainfall intensity and there was no cloud which can cause big shake on airborne radar display of the aircraft. However, it is probable that these were thin cloud. After encountering the shake, the aircraft ascended to a high altitude to avoid the developed clouds; however the fierce shake still continued.</p> <p>In addition, the aircraft was flying for a long time in the airspace where severe CAT was expected according to FBJP; the jetstreams were diverted in the airspace; therefore, it is probable that the occurrence of CAT was expected.</p> <p>From these, it is highly probable that the fierce shake of the aircraft was caused by CAT, and the aircraft had flown for a long time (about 20 minutes) in the airspace with CAT; therefore, it is probable the big shake continued.</p> <p>(2) Flight planning and e-signature of PIC</p> <p>The weather information referred by the dispatcher was sent to the PIC with the flight plan as the Dispatch Flight Plan, in which there was nothing to be forecasted to cause the shake of the aircraft including a forecast of turbulence; therefore, it is probable that the PIC e-signed the flight plan without doubting the weather information.</p> <p>This time, it is probable that the PIC who did not grasp the information of FBJP of JMA in which severe turbulence was expected at some of flight altitude including the 27,000 ft was aware that the air</p>

current would be stable condition if he will continue to fly at an altitude 27,000 ft after passing over KMC (Komatsu) in the planned profile.

(3) Issued additional turbulence information

The turbulence information of moderate or less intensity issued from Company A was not admitted to be particularly necessary because there were a number of the same type information, and two severe turbulence information issued from JMA was not confirmed due to the fact that its information was not usually used including FBJP. Therefore, it is probable that it was because these information was not confirmed that the dispatcher did not inform the PIC of three important information from the viewpoints of time and airspace in the profile on the flight plan in SIGMET related to turbulence issued after the Dispatch Flight Plan was sent.

The PIC who perceived the premonitory phenomenon of turbulence from the backward movement of the thrust levers at about 10:22 turned on seatbelt signs but did not give any instructions such as calling for attention and seating instruction by P.A. announcement, and did not take any measures to avoid the turbulence such as the change of the altitudes. It is probable that the fact that the PIC was not able to grasp any of three SIGMET was involved in these.

(4) Situations of the cabin after the seatbelt signs were illuminated

The cabin attendants confirmed the seatbelts of passengers because the seatbelt signs were illuminated at 10:22; however, they were not able to urge the Passenger A to get back to the seat and wear the seatbelt. It is somewhat likely that this was because the cabin attendants missed it or its opportunity due to in-flight service.

In addition, it is somewhat likely that crewmembers did not sufficiently get across to Passenger A about what measures passengers should take when the seatbelt signs were illuminated; thus, Passenger A left the seat when the seatbelt signs illuminated.

A passenger who is in a lavatory when the seatbelt sign was illuminated is usually led by cabin attendants to a nearby seat and takes a seat. In this case, although Passenger A remained in the lavatory following the advice of the cabin attendant, it is probable that the facts that there was a possibility of re-occurrence of big shake during the movement to the nearby seat and that it was all the cabin attendants could do to protect themselves while holding service carts and other things were involved.

(5) Destination Change

It had passed more than one hour and a half before the aircraft reported the change of destination to the ATC authority since the first big shake occurred. During that time, the aircraft was flying under the conditions where the fierce shake continued for the first about 20 minutes and the comparatively light shake continued for the following

	<p>about 30 minutes.</p> <p>In the shaking aircraft, the crewmembers conducted the inspection and dealt with scattered matters in the cabin after the aircraft shaking while paying attention to the re-occurrence of big shake and the PIC made an inquiry about airframe conditions and other things to the head office. As the result of discussing the damage conditions in the aircraft and the possibility of damage to the airframe, it is probable that it was unavoidable for taking additional about 40 minutes before the PIC finally reported the change of destination.</p>
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4 PROBABLE CAUSES

In this accident, it is probable that the aircraft was fiercely shaken because it unexpectedly penetrated the airspace with CAT, causing the passenger and the cabin attendant were seriously injured.

It is probable that the unexpected penetration to the airspace with CAT was because the PIC and the dispatcher could not predict the occurrence of the CAT which could interfere with the flight, this is because it is somewhat likely that the method for utilization of weather information in the Company was involved.

5 SAFETY ACTIONS

Upon the occurrence of the accident, the Company has strengthened Internet environment in order to enable the flight crewmembers to acquire necessary weather information with portable terminals in all airports which the Company flies into in the same mannar as hub airports.