

AA2016-9

**AIRCRAFT ACCIDENT  
INVESTIGATION REPORT**

**CIVIL AVIATION BUREAU, MLIT  
J A 0 0 1 G**

**November 24, 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

## AIRFRAME DAMAGE FROM LIGHTNING STRIKE

### IN FLIGHT

CIVIL AVIATION BUREAU, MLIT

GULFSTREAM AEROSPACE G-IV, JA001G

AT AN ALTITUDE OF ABOUT 6,500 FT

ABOUT 4 KM SOUTH OF NIIGATA AIRPORT

AT ABOUT 14:35 JST, MARCH 13, 2015

November 4, 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 INVESTIGATION

<b>1.1 Summary of the Accident</b>	<p>On Friday, March 13, 2015, Gulfstream Aerospace G-IV, registered JA001G, operated by the Civil Aviation Bureau of the Ministry of Land, Infrastructure, Transport and Tourism, received a lightning strike to its airframe in flight for flight inspection over the vicinity of Niigata Airport, and damaged there.</p> <p>There were five people on board the aircraft, consisting of a captain and four crew members. No one was injured.</p>
<b>1.2 Outline of the Accident Investigation</b>	<p>On March 13, 2015, the Japan Transport Safety Board designated an investigator-in-charge and two investigators on March 13, 2015 to investigate this accident.</p> <p>An accredited representative of the United States of America, as the State of Design and Manufacture of the aircraft involved in the accident, participated in the investigation.</p> <p>Comments were invited from parties relevant to the cause of the accident and the relevant State.</p>

## 2. FACTUAL INFORMATION

<p><b>2.1 History of the Flight</b></p>	<p>According to the statements of the captain, the first Officer and the onboard maintenance engineer and the records of the digital flight data recorder, the flight history was as outlined below.</p> <p>Gulfstream Aerospace G-IV, registered JA001G, operated by the Civil Aviation Bureau of the Ministry of Land, Infrastructure, Transport and Tourism (MLIT), took off from Obihiro Airport in accordance with Instrument Flight Rules (IFR) at 11:16 Japan Standard Time (JST: UTC + 9 hrs, all times are indicated in JST on a 24-hour clock) on March 13, 2015, with the captain and four crew members on board, for the purpose of carrying out flight inspection affair (inspections conducted to confirm the required performance of aeronautical navigation facilities).</p> <p>In their pre-departure check on meteorological data, the captain and the first Officer were aware that the weather in Hokkaido and northern Japan was in a recovery trend, and that it was not in a situation indicating the possibility of lightning strikes or other significant weather on the planned flight route of the aircraft, which give specified would impact on the flight. In the cockpit of the aircraft, the captain was in charge of flying in the left seat, on the other hand the first officer was in charge of duties other than flying in the right seat.</p> <p>While the aircraft was flying south-southwest on Airway V31 toward the Niigata VORTAC (aeronautical radio navigation aid) at an altitude 9,000 ft, the captain and the first officer had sighted lower layer of the cloud but had visually confirmed that there was no cloud on the flight route to the vicinity of Niigata Airport. At about 14:32, the aircraft commenced a descending turn from right above Niigata Airport in order to inspect on the next airway. At this time, the captain and the first officer had checked on an indication on the weather radar display of the aircraft showing a precipitation area, albeit not on their route, and were therefore focusing attention in that direction. They then encountered scattered thin cloud, but this was judged not to be thick cloud which might lead to turbulence or thunder. At about 14:35, as the aircraft entered the thin cloud at an altitude about 6,500 ft, a very loud noise was heard on the radio equipment while the captain, the first officer and the onboard maintenance engineer were listening to it. After three to four seconds, the captain and the first officer received an impact accompanied by a loud popping noise, together with a strong flash from the front of the aircraft.</p> <p>While continuing the flight, the captain and the first officer checked the instruments to check whether abnormality had occurred to the aircraft; consequently, they confirmed that discoloration was found on some of the cockpit instrument displays, and that the airborne DME</p>
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(Distance Measuring Equipment) display on the Captain's side had disappeared. However, there was no abnormality in the DME display on the first officer's side and there was no problem with the visibility of the discolored instrument displays; accordingly, they judged there to be no serious abnormality which would affect the flight.

The captain, the first officer and the onboard maintenance engineer discussed whether they should continue the flight inspection, and although there was thought to be no hindrance to the flight, they decided to suspend its affairs and return to the base of the aircraft at Tokyo International Airport, because they could not confirm damage to the airframe while on board. Thereafter the aircraft landed at Tokyo International Airport at 15:26. The captain and the first officer felt no abnormality when landing.

On the post-flight inspection, damage was confirmed to the left front fuselage outer skins, the front lower fuselage and the left horizontal stabilizer.

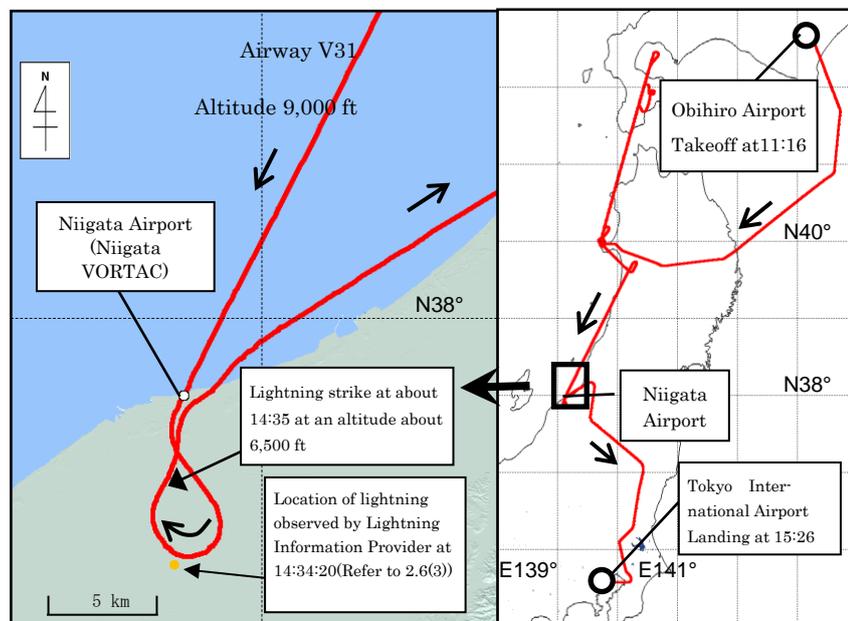
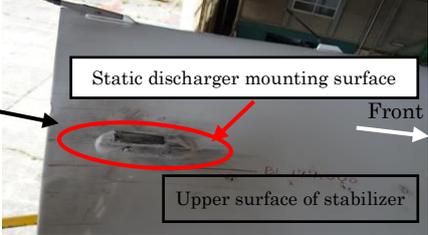
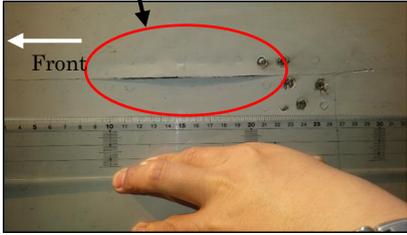


Fig. 1 Estimated flight route of the aircraft (as recorded by the digital flight data recorder)

<p><b>2.2 Injuries to Persons</b></p>	<p>None</p>
<p><b>2.3 Damage to Aircraft</b></p>	<p>Extent of damage to the aircraft: Substantially damaged</p> <ul style="list-style-type: none"> <li>• Cockpit: Captain's side airborne DME display became defect Electronic flight instrument display partially discolored First Officer's side navigation instrument frequency display became defect Right engine (auxiliary instrument panel) fuel flow indicator display became defect</li> <li>• Fuselage: Outer skin of left front lower fuselage damaged (partly required major repair) Outer skins rivets of left front lower fuselage discolored</li> </ul>

	<p>or burnt (about 20 locations) No.1 DME antenna of front lower fuselage partially damaged</p> <ul style="list-style-type: none"> <li>• Tail Section: Tip of static discharger on left horizontal stabilizer lost trailing edge and end of left horizontal stabilizer damaged</li> </ul> <p>Outer skins around static discharger mounting surface of left horizontal stabilizer discolored and damaged</p> <div style="display: flex; justify-content: space-around;"> <div style="text-align: center;">  <p>Photo 1 The accident aircraft</p> </div> <div style="text-align: center;">  <p>Photo 2 Damage to left horizontal stabilizer</p> </div> </div> <div style="display: flex; justify-content: space-around; margin-top: 20px;"> <div style="text-align: center;">  <p>Photo 3 Location of damage to outer skin of left front lower fuselage</p> </div> <div style="text-align: center;">  <p>Photo 4 Defect of captain's side display(airborne DME)</p> </div> </div>																														
<p><b>2.4 Personnel Information</b></p>	<p>(1) Captain male, Age 42</p> <table style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 60%;">Airline transport pilot certificate (Airplane)</td> <td style="text-align: right;">September 13, 2013</td> </tr> <tr> <td>Type rating for Gulfstream Aerospace G-IV</td> <td style="text-align: right;">January 5, 2007</td> </tr> <tr> <td>Class 1 aviation medical certificate Validity:</td> <td style="text-align: right;">March 11, 2016</td> </tr> <tr> <td colspan="2">Specific Pilot Competence</td> </tr> <tr> <td>Expiry of practicable period for flight</td> <td style="text-align: right;">September 13, 2015</td> </tr> <tr> <td>Total flight time</td> <td style="text-align: right;">4,298 hr 01 min</td> </tr> <tr> <td>Total flight time on the type of aircraft</td> <td style="text-align: right;">3,082 hr 05 min</td> </tr> </table> <p>(2) First Officer male, Age 48</p> <table style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 60%;">Commercial pilot certificate (Airplane)</td> <td style="text-align: right;">June 6, 1995</td> </tr> <tr> <td>Type rating for Gulfstream Aerospace G-IV</td> <td style="text-align: right;">February 6, 2013</td> </tr> <tr> <td>Instrument flight certificate (Airplane)</td> <td style="text-align: right;">January 12, 1999</td> </tr> <tr> <td>Class 1 aviation medical certificate Validity:</td> <td style="text-align: right;">August 14, 2015</td> </tr> <tr> <td colspan="2">Specific Pilot Competence</td> </tr> <tr> <td>Expiry of practicable period for flight</td> <td style="text-align: right;">February 6, 2016</td> </tr> <tr> <td>Total flight time:</td> <td style="text-align: right;">5,572 hr 25 min</td> </tr> <tr> <td>Total flight time on the type of aircraft:</td> <td style="text-align: right;">1,016 hr 20 min</td> </tr> </table>	Airline transport pilot certificate (Airplane)	September 13, 2013	Type rating for Gulfstream Aerospace G-IV	January 5, 2007	Class 1 aviation medical certificate Validity:	March 11, 2016	Specific Pilot Competence		Expiry of practicable period for flight	September 13, 2015	Total flight time	4,298 hr 01 min	Total flight time on the type of aircraft	3,082 hr 05 min	Commercial pilot certificate (Airplane)	June 6, 1995	Type rating for Gulfstream Aerospace G-IV	February 6, 2013	Instrument flight certificate (Airplane)	January 12, 1999	Class 1 aviation medical certificate Validity:	August 14, 2015	Specific Pilot Competence		Expiry of practicable period for flight	February 6, 2016	Total flight time:	5,572 hr 25 min	Total flight time on the type of aircraft:	1,016 hr 20 min
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<p><b>2.5 Aircraft Information</b></p>	<p>(1) Aircraft type: Gulfstream Aerospace G-IV Serial number: 1190</p>																														

	<p>Date of manufacture July 9, 1992  Certificate of airworthiness No. TO-26-139  Validity July 21, 2015  Category of airworthiness Airplane Transport T  Total flight time 9,964 hr 46 min</p> <p>(2) The aircraft was equipped with a digital flight data recorder and a cockpit voice recorder.</p> <p>The digital flight data recorder retained records at the time of the accident; however, there were no records indicating an abnormality related to the accident. Besides, the cockpit voice recorder did not retain any voice records during flight since they had been overwritten.</p> <p>(3) It is estimated that both the weight and the position of the center of gravity were within the allowable range when the accident occurred.</p>
<p><b>2.6 Meteorological Information</b></p>	<p>(1) Aeronautical weather observations for Niigata Airport during the flight time of the aircraft were as follows.</p> <p>14:00 Wind direction: 300° Wind velocity: 11 kt  Prevailing visibility: 10 km or more Weather: Light showers  Cloud: amount 1 / 8, cumulus cloud base 1,000 ft  Cloud: amount 5 / 8, cumulus cloud base 1,500 ft  Cloud: amount 6 / 8, cumulus cloud base 2,500 ft  Temperature: 6°C Dew point: 3°C  Altimeter setting (QNH): 29.99 inHg</p> <p>14:37 Wind direction: 300° Wind velocity: 07 kt  Prevailing visibility: 10 km or more  Weather: Light thunderstorm  Cloud: amount 1 / 8, cumulus cloud base 1,000 ft  Cloud: amount 6 / 8, cumulus cloud base 2,000 ft  Cloud: amount 2 / 8, cumulonimbus cloud base 2,500 ft  Temperature: 5°C Dew point: 2°C  Altimeter setting (QNH): 29.99 inHg  Lightning (light) observed  Thunderstorm is observed at 10 km southeast, moving to eastward.</p> <p>(2) The weather situation around Niigata Airport was as follows.  (See the Fig. 2, Fig. 3)</p> <p>A winter pressure pattern centered on northern Japan was present. The strong winter pressure pattern of the previous day had begun to loosen gradually, but cold air still remained up in the sky.</p> <p>The Niigata Local Meteorological Observatory had issued gale and lightning advisories. A convection cloud region was developing on the Sea of Japan coast side and many lightning had been detected; besides, the possibility of lightning occurring near Niigata Airport was reported in the terminal aerodrome forecast (TAF).</p>

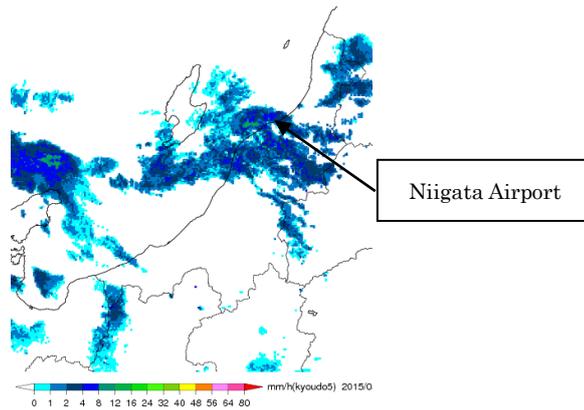


Fig. 2 Radar Echo Image by Japan Meteorological Agency (As of 14:35, March 13)

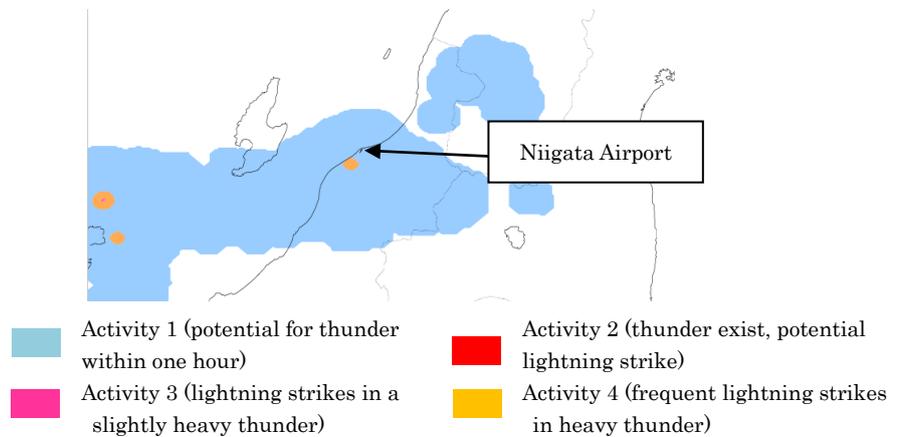


Fig. 3 Thunder Nowcast(\*1) by Japan Meteorological Agency (As for 14:40, March 13)

### (3) Lightning observations by Lightning Information Provider

Lightning Information Provider is a company that provides weather information mainly concerning lightning. It has set up lightning sensors in 30 locations around Japan, which it uses to observe lightning strikes.

In its observation between 14:20 and 14:50 on the day of the accident, the provider confirmed one lightning strike near the flight route of the aircraft at 14:34:20. The observed lightning strike was about 5 km away from the south of the point where the aircraft is estimated to have been struck by lightning. According to information from the provider; however, in the case of wintry lightning, the discharge path is often formed in a horizontal direction or diagonally, and in such cases the locational error can be in excess of 5 km .

※1 The thunder nowcast is one of the Japan Meteorological Agency forecast system, and it analyzes the violence of the thunder and a possibility of the thunder by 1 km grid unit, predicts it until the one hour later ( ten minutes – 60 minutes destination ) renews every ten minutes and offers it.

### 3. ANALYSIS

<b>3.1 Involvement of Weather</b>	Yes
<b>3.2 Involvement of Pilots</b>	None
<b>3.3 Involvement of Aircraft</b>	None
<b>3.4 Analysis of Findings</b>	<p>(1) Time and location of lightning strike</p> <p>It is highly probable that the aircraft was struck by lightning at an altitude of about 6,500 ft about 4 km south of Niigata Airport at about 14:35 while commencing a descending turn after passing over the airport.</p> <p>(2) Involvement of weather</p> <p>It is highly probable that electrically charged cumulus clouds were distributed over a wide area at low altitude along the flight route of the aircraft, since observed information shows that the weather situation near the airport on the day of the accident was a winter pressure pattern with high pressure in the west and low in the east; moreover, because cold air still remained up in the sky around the time when strong winter pressure pattern of the previous day had begun to loosen gradually.</p> <p>It is probable that the lightning strike that damaged the aircraft had the properties of wintry lightning caused by cumulus clouds distributed over a wide area at low altitude, which frequently occur on the Sea of Japan side in winter, unlike localized cumulonimbus clouds that frequently occur in the summer.</p> <p>It is probable that, although the captain and the first officer had entered into scattered thin cloud while commencing a descending turn and were aware that a precipitation area was indicated on the airborne weather radar display, the aircraft came closer to the electrically charged cumulus clouds and encountered lightning strike in a situation in which it was difficult to predict and avoid lightning strike in the scattered thin cloud. In addition, just before an impact due to the lightning strike, the captain, the first officer and the onboard maintenance engineer heard noise with the radio equipment they were listening to, but it is probable that this was due to the effect of the lightning.</p> <p>(3) Cause of damage</p> <p>The damage to the outer skin of left front lower fuselage and the end of left horizontal stabilizer, the burn out of the rivets and the loss of the static discharger are commonly found in aircraft having struck by lightning. Therefore, it is probable that when the lightning strike, a lightning discharge path was formed from the left front of the fuselage to the left horizontal stabilizer and the static discharger. In addition, it is probable that the malfunction of</p>

	the cockpit instrument display was affected by the fact that locations impacted by the lightning strike were close to the cockpit.
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#### 4. PROBABLE CAUSES

It is probable that this accident occurred because the aircraft sustained damage to the outer skins of its left front lower fuselage as a result of being struck by lightning to the airframe in flight.

It is probable that the lightning strike was occurred because the aircraft came close to the electrically charged cumulus clouds in the scattered thin cloud where it was difficult to predict lightning.