National Transportation Safety Board
Aviation Accident Final Report

Location:	Gulf of Mexico, GM	**Accident Number:**	ERA09FA389
Date & Time:	07/08/2009, 1452 EDT	**Registration:**	N4467D
Aircraft:	CESSNA 421C	**Aircraft Damage:**	Destroyed
Defining Event:	Loss of control in flight	**Injuries:**	5 Fatal
Flight Conducted Under:	Part 91: General Aviation - Executive/Corporate		

Analysis

Prior to the accident flight, the pilot indicated that he was aware of the thunderstorm activity along his route of flight and that he anticipated deviating around the weather as necessary. While enroute to his destination, the pilot requested and was provided both weather information and pilot reports from other aircraft by air traffic control (ATC). Upon encountering an area of thunderstorm activity that extended east-to-west across the route of flight, the pilot reported encountering significant turbulence, and then downdrafts of 2,000 feet per minute. He then requested a course reversal to exit the weather before he declared an emergency and advised ATC that the airplane was upside down. There were no further transmissions from the pilot and radar contact with the airplane was lost. Review of radar data revealed that the pilot had deviated south and then southwest when the airplane entered a strong and intense echo of extreme intensity. Visible imaging revealed that the echo was located in an area of a rapidly developing cumulonimbus cloud with a defined overshooting top, indicating the storm was in the mature stage or at its maximum intensity. Two debris fields were later discovered near the area where the cumulonimbus cloud had been observed. This was indicative that the airplane had penetrated the main core of the cumulonimbus cloud, which resulted in an inflight breakup of the airplane. Near the heavier echoes the airplane's airborne weather radar may have been unable to provide an accurate representation of the radar echoes along the aircraft's flight path; therefore the final penetration of the intense portion of the storm was likely unintentional.

Probable Cause and Findings

The National Transportation Safety Board determines the probable cause(s) of this accident to be:
The pilot’s decision to operate into a known area of adverse weather, which resulted in the inadvertent penetration of a severe thunderstorm, a subsequent loss of control, and in-flight breakup of the airplane.

Findings

Personnel issues	Incorrect action selection - Pilot (Cause)
Environmental issues	Thunderstorm - Decision related to condition (Cause)

Factual Information

HISTORY OF FLIGHT

On July 8, 2009, at 1452 eastern daylight time, a Cessna 421C, N4467D, was destroyed after it impacted the waters of the Gulf of Mexico, about 25 nautical miles northwest of Port Richey, Florida. The instrument-rated commercial pilot and 4 passengers were fatally injured. Instrument meteorological conditions prevailed in the area of the accident and an instrument flight rules (IFR) flight plan had been filed for the flight, which departed Collin County Regional Airport (TKI), McKinney, Texas destined for Tampa International Airport (TPA), Tampa Florida. The corporate flight was conducted under 14 Code of Federal Regulations Part 91.

According to voice data provided by the Federal Aviation Administration (FAA), The pilot of indicated that he had reviewed the weather conditions when he called the Houston Automated Flight Service Station to file his IFR flight plan prior to departure. At that time the pilot indicated he was aware of the thunderstorm activity over the Gulf of Mexico and Florida, and that he was anticipating deviating around the weather as necessary.

According to radar and voice data provided by the FAA, just prior to the accident, the pilot had been in communication with the Jacksonville Air Route Traffic Control Center (ARTCC). During the flight the pilot requested and had been provided both weather information along his route of flight and "ride reports" from other aircraft.

At 1446:34, the pilot reported to ARTCC that he was encountering turbulence and requested directions to get out of the turbulence. The pilot was then advised by the controller that if he continued straight ahead for about two minutes, he should be clear of the weather.

At 1446:56 the pilot advised ARTCC that he was experiencing a two thousand foot per minute descent rate. At 1447:02 the controller then asked him if he would like to turn around and go back in the opposite direction, to which the pilot responded that he would.

At 1847:07, the pilot was cleared to reverse course. Sixteen seconds later, the pilot declared an emergency, and advised that the airplane was "upside down". There were no further transmissions from the pilot, and radar contact was lost with the airplane when it descended below the radar coverage area.

PERSONNEL INFORMATION

According to FAA records, the pilot held a commercial pilot certificate with airplane single engine land, airplane multi-engine land, and instrument airplane ratings. His most recent FAA second-class medical certificate was issued on April 23, 2009. He reported 1,940 total hours of flight experience on that date.

AIRCRAFT INFORMATION

According to FAA and maintenance records, the airplane was manufactured in 1979. It was a two engine, pressurized, 7 seat airplane of conventional construction. It was approved for day and night IFR operations and was equipped with weather radar, a Stormscope weather mapping sensor, and an XM satellite receiver which enabled the pilot to receive the XM weather data stream.

It had been modified from its original configuration by RAM Aircraft LP and was equipped with winglets, spoilers, and vortex generators. It was powered by two Continental GTSIO-520-L engines, each producing 375 horsepower. It could cruise at 228 knots, had a range of 1,487 nautical miles, and could operate at altitudes up to 30,000 feet msl.

The airplane's most recent annual inspection was completed on August 18, 2008. The last maintenance action was performed on the airplane on July 6, 2009. At the time of the last maintenance action, the airplane had accrued 4,325.6 total hours of operation.

METEOROLOGICAL INFORMATION

According to the National Weather Service at the time of the accident, an area of IFR conditions existed over southern Georgia into northern Florida generally north of the accident airplane's route of flight. Associated with these conditions was a large area of reduced visibility in moderate to heavy rain. Surrounding that area was an area of marginal visual flight rules (MVFR) conditions over portions of Georgia and northern Florida, and two other areas across central Florida over the eastern and western portions of the state associated with thunderstorms and rain showers.

The National Center for Atmospheric Research (NCAR) Regional Radar Mosaic Chart which was valid for the time of the accident also depicted a band of "intense to extreme" intensity echoes which extended across the Alabama and Florida panhandle into southern Georgia, and was associated with strong to potentially severe thunderstorms. A second east-to-west band of echoes associated with thunderstorms and rain showers also extended from the east to west coast of central Florida into the Gulf of Mexico. This band was characterized as a broken area of strong to intense cells along the southern portion with an extensive area of stratiform precipitation of light to moderate intensity echoes extending northward.

The reported weather at Hernando County Airport (BKV), Brooksville, Florida approximately 47 miles east-north-east of the debris fields, at 1453, one minute after the accident, included: wind, 340 at 9 knots, visibility 1and 3/4 miles in light thunderstorms and rain showers mist, few clouds at 200 feet, broken clouds at 2,600 feet, overcast at 3,400 temperature 24 degrees C, dew point 23 degrees C, altimeter setting of 29.98 inches of mercury, and lightning in the distance, all quadrants.

Four minutes later, the reported weather at BKV, included: wind calm, visibility 1/2 mile in heavy thunderstorms and rain showers, fog, few clouds at 200 feet, scattered clouds at 1,000 feet, overcast at 2,400 feet, temperature 24 degrees C, dewpoint 23 degrees C, altimeter setting of 29.98 inches of mercury, and lightning in the distance, all quadrants

WRECKAGE AND IMPACT INFORMATION

Search and rescue operations were undertaken by the United States Coast Guard (USCG), St. Petersburg Sector, utilizing surface vessels and aircraft. A 2-mile-long by 100-yard-wide debris field was located on the surface of the water at approximately 2000 on the day of the accident.

On July 9, 2009, a second larger debris field was also discovered floating on the surface of the water approximately 4 miles northeast of the first debris field. At 1555, The Safety Board was advised by the USCG that no survivors had been found and that search and rescue operations had been suspended.

Follow on searches by a contractor utilizing side scan sonar were conducted and multiple targets were detected. The search was suspended however, before the targets could be examined by divers, and the wreckage was never recovered.

TESTS AND RESEARCH

The debris fields were located near one of the stronger cells on the southern side of the band of echoes which had been depicted on the NCAR Regional Radar Mosaic Chart.

At the time of the accident, The National Oceanic and Atmospheric Administration (NOAA) operated 159 high-resolution Doppler weather radar sites as part of the next generation radar network (NEXRAD). According to NOAA, these NEXRAD sites were equipped with Weather Surveillance Radar-1988, Doppler (WSR-88D) weather surveillance radar units which emit pulses of energy into the atmosphere at regular intervals. When this energy encounters something (a raindrop, a snowflake, a mountain, etc.), some of the energy is scattered back to the radar dish.

The amount of energy, which was received at the radar dish, was measured in units (decibels) of Z (dBZ). It is a meteorological measure of equivalent reflectivity (Z) of a radar signal reflected off a remote object. The higher the dBZ value the larger the object i.e. large raindrops and hail produce high dBZ values. In general, dBZ values greater than 15 indicate areas where precipitation is reaching the ground. On the other hand, dBZ values less than 15 usually are an indication of very light precipitation which in most cases is evaporating in the atmosphere before it reaches the ground.

The closest WSR-88D was located approximately 43 miles southeast of the debris fields. A review of WSR-88D radar data and satellite imagery by a Safety Board meteorologist revealed that the airplane had been operating through an area of echoes of 20 to 30 dBZ consistent with those associated with moderate rain. Approximately 4 minutes prior to the accident, the airplane then entered an area of echoes of 35 to 40 dBZ associated with heavy rain in convective activity. The airplane next deviated to the south and then southwestward into the stronger and more intense portion of the echoes with reflectivities of 50 dBZ or "extreme" intensity.

Onboard Lightning Detector

The airplane was equipped with an onboard lightning detector which could calculate the direction and severity of lightning by using radio direction-finding techniques together with an analysis of the characteristic frequencies that were emitted by the lightning. Distance was estimated by using signal frequency and attenuation.

Since lightening detectors use attenuation, they sometimes mistakenly indicate a weak lightning strike nearby as a strong one further away, or vice-versa.

Tests of lightning detectors by the National Aeronautics and Space Administration (NASA) also indicated that even with precipitation intensity levels of three and occasionally four (heavy to very heavy) being indicated on radar, a lightning detection system may not activate and that a clear display only indicates the absence of electrical discharges.

Onboard Weather Radar

According to the FAA, The primary use of onboard weather radar is to aid the pilot in avoiding thunderstorms and associated turbulence. The proficient operator manages antenna tilt control to achieve best knowledge of storm height, size, and relative direction of movement.

Airborne weather radar is for avoiding severe weather, not for penetrating it. Whether to fly into an area of radar echoes depends on echo-intensity, spacing between the echoes, aircraft capabilities and pilot experience. Weather radar detects only precipitation drops; it does not detect minute cloud droplets, nor does it detect turbulence. Therefore, the radar provides no assurance of avoiding instrument weather in clouds and fog. The indicator may be clear between intense echoes; this clear area does not necessarily mean it is safe to fly between the storms and maintain visual sighting of them.

An extremely important phenomenon for the weather radar operator to understand is that of attenuation. When a radar pulse is transmitted into the atmosphere, it is progressively absorbed and scattered so that it loses its ability to return to the antenna. This attenuation or weakening of the radar pulse is caused by two primary sources, distance and precipitation. It is therefore up to the operator to understand the radar's limitations in dealing with attenuation.

Attenuation because of distance is due to the fact that the radar energy leaving the antenna is inversely proportional to the square of the distance. For example, the reflected radar energy from a target 60 miles away will be one fourth of the reflected energy from an equivalent target 30 miles away. The displayed effect to the pilot is that as the storm is approached, it will appear to be gaining in intensity.

Attenuation due to precipitation is far more intense and is less predictable than attenuation due to distance. As the radar pulses pass through moisture, some radar energy is reflected. But much of that energy is absorbed. If the rain is very heavy or extends for many miles, the beam may not reach completely through the area of precipitation. The weather radar has no way of knowing if the beam has been fully attenuated or has reached the far side of the precipitation area. If this beam has been fully attenuated the radar will display a "radar shadow" which appears as an end to the precipitation when, in fact, the heavy rain may extend for many more miles. In the worst case, precipitation attenuation may cause the area of heaviest precipitation to be displayed as the thinnest area of heavy precipitation. It may cause one cell containing heavy precipitation to totally block or shadow a second heavy cell located behind the first cell and prevent it from being displayed on the radar.

Pilots should never fly into radar shadows and never believe that the full extent of heavy rain is being seen on radar unless another cell or a ground target can be seen beyond the heavy cell. Proper use of the antenna tilt control can help detect radar shadows.

Attenuation can also be a problem when flying in a large area of general rain. If the rain is moderate, the radar beam may only reach 20 or 30 miles before it is fully attenuated. The pilot may fly along for many miles seeing the same 20-30 nautical miles of precipitation ahead on the radar when, actually, the rain may extend a great distance. If there is suspicion that the radar is attenuating due to precipitation, pilots should exercise extreme caution and ask air traffic control (ATC) what they are showing. Often the ground based ATC controller's radar will have a better overall picture of a large rain area and the pilot can compare the controller's information with his own radar picture to avoid the strongest cells in a general area of rain.

ADDITIONAL INFORMATION

Advisory Circular 00-24B

According to FAA Advisory Circular (AC) 00-24B, a thunderstorm contains multiple weather hazards and reminds pilots to never regard any thunderstorm lightly, even when radar observers report the echoes are of light intensity. Avoiding thunderstorms is the best policy.

The AC also provides guidance in the form of thunderstorm avoidance, preparation, and, inadvertent penetration, in the form of listed "do's and don'ts".

1. Following are some do's and don'ts of thunderstorm avoidance:

- Don't land or take off in the face of an approaching thunderstorm. A sudden gust front of low level turbulence could cause loss of control.
- Don't attempt to fly under a thunderstorm even if you can see through to the other side. Turbulence and windshear under the storm could be disastrous.
- Don't fly without airborne radar into a cloud mass containing scattered embedded thunderstorms. Scattered thunderstorms not embedded usually can be visually circumnavigated.
- Don't trust the visual appearance to be a reliable indicator of the turbulence inside a thunderstorm.
- Do avoid by at least 20 miles any thunderstorm identified as severe or giving an intense radar echo. This is especially true under the anvil of a large cumulonimbus.
- Do circumnavigate the entire area if the area has 6/10 thunderstorm coverage.
- Do remember that vivid and frequent lightning indicates the probability of a severe thunderstorm.
- Do regard as extremely hazardous any thunderstorm with tops 35,000 feet or higher whether the top is visually sighted or determined by radar.

2. If you cannot avoid penetrating a thunderstorm, following are some do's BEFORE entering the storm:

- Tighten your safety belt, put on your shoulder harness if you have one, and secure all loose objects.
- Plan and hold your course to take you through the storm in a minimum time.
- To avoid the most critical icing, establish a penetration altitude below the freezing level or above the level of -15 °C.
- Verify that pitot heat is on and turn on carburetor heat or jet engine anti-ice. Icing can be rapid at any altitude and cause almost instantaneous power failure and/or loss of airspeed indication.
- Establish power settings for turbulence penetration airspeed recommended in your aircraft manual.
- Turn up cockpit lights to highest intensity to lessen temporary blindness from lightning.
- If using automatic pilot, disengage altitude hold mode and speed hold mode. The automatic altitude and speed controls will increase maneuvers of the aircraft thus increasing structural stress.
- If using airborne radar, tilt the antenna up and down occasionally. This will permit you to detect other thunderstorm activity at altitudes other than the one being flown.

3. Following are some do's and don'ts DURING the thunderstorm penetration:

- Do keep your eyes on your instruments. Looking outside the cockpit can increase danger of temporary blindness from lightning.
- Don't change power settings; maintain settings for the recommended turbulence penetration airspeed.
- Do maintain constant attitude; let the aircraft "ride the waves." Maneuvers in trying to maintain constant altitude increase stress on the aircraft.
- Don't turn back once you are in the thunderstorm. A straight course through the storm most likely will get you out of the hazards most quickly. In addition, turning maneuvers increase stress on the aircraft.

History of Flight

Enroute-cruise	Windshear or thunderstorm
	Turbulence encounter
	Loss of control in flight (Defining event)
	Aircraft structural failure

Pilot Information

Certificate:	Commercial	**Age:**	33, Male
Airplane Rating(s):	Multi-engine Land; Single-engine Land	**Seat Occupied:**	Left
Other Aircraft Rating(s):	None	**Restraint Used:**	
Instrument Rating(s):	Airplane	**Second Pilot Present:**	No
Instructor Rating(s):	None	**Toxicology Performed:**	No
Medical Certification:	Class 2 With Waivers/Limitations	**Last FAA Medical Exam:**	04/23/2009
Occupational Pilot:	Yes	**Last Flight Review or Equivalent:**	08/04/2008
Flight Time:	1940 hours (Total, all aircraft)		

Aircraft and Owner/Operator Information

Aircraft Make:	CESSNA	**Registration:**	N4467D
Model/Series:	421C	**Aircraft Category:**	Airplane
Year of Manufacture:		**Amateur Built:**	No
Airworthiness Certificate:	Normal	**Serial Number:**	421C0634
Landing Gear Type:	Retractable - Tricycle	**Seats:**	7
Date/Type of Last Inspection:	08/18/2008, Annual	**Certified Max Gross Wt.:**	7610 lbs
Time Since Last Inspection:	141 Hours	**Engines:**	2 Reciprocating
Airframe Total Time:	4326 Hours at time of accident	**Engine Manufacturer:**	Continental
ELT:	Installed, not activated	**Engine Model/Series:**	GTSIO-520-L
Registered Owner:	Q4 Aviation LLC	**Rated Power:**	375 hp
Operator:	Q4 Aviation LLC	**Operating Certificate(s) Held:**	None

Meteorological Information and Flight Plan

Conditions at Accident Site:	Instrument Conditions	**Condition of Light:**	Day
Observation Facility, Elevation:	BKV, 76 ft msl	**Distance from Accident Site:**	47 Nautical Miles
Observation Time:	1457 EDT	**Direction from Accident Site:**	45°
Lowest Cloud Condition:	Few / 200 ft agl	**Visibility**	8 Miles
Lowest Ceiling:	Overcast / 2400 ft agl	**Visibility (RVR):**	
Wind Speed/Gusts:	7 knots / 15 knots	**Turbulence Type Forecast/Actual:**	/
Wind Direction:	10°	**Turbulence Severity Forecast/Actual:**	/
Altimeter Setting:	29.98 inches Hg	**Temperature/Dew Point:**	24°C / 23°C
Precipitation and Obscuration:	Heavy - Thunderstorms - Rain; Fog		
Departure Point:	McKinney, TX (TKI)	**Type of Flight Plan Filed:**	IFR
Destination:	Tampa, FL (TPA)	**Type of Clearance:**	IFR
Departure Time:	1002 CDT	**Type of Airspace:**	

Wreckage and Impact Information

Crew Injuries:	1 Fatal	**Aircraft Damage:**	Destroyed
Passenger Injuries:	4 Fatal	**Aircraft Fire:**	None
Ground Injuries:	N/A	**Aircraft Explosion:**	None
Total Injuries:	5 Fatal	**Latitude, Longitude:**	28.445556, -83.122500 (est)

Administrative Information

Investigator In Charge (IIC):	Todd G Gunther	**Report Date:**	06/27/2011
Additional Participating Persons:	James E Davidson; FAA/FSDO; Orlando, FL Michael L Koonce; Cessna Aircraft Company; Wichita, KS		
Publish Date:	04/28/2015		
Note:	The NTSB traveled to the scene of this accident.		
Investigation Docket:	http://dms.ntsb.gov/pubdms/search/dockList.cfm?mKey=74235		