



Aviation Investigation Factual Report

Location:	IRONWOOD, Michigan	Accident Number:	CHI00MA256
Date & Time:	August 14, 2000, 18:22 Local	Registration:	N85DW
Aircraft:	North American NA-265-80	Aircraft Damage:	Destroyed
Defining Event:		Injuries:	2 Fatal, 2 Serious
Flight Conducted Under:	Part 91: General aviation		

Factual Information

HISTORY OF FLIGHT

On August 14, 2000, at 1822 central daylight time (all times CDT unless noted), a North American NA-265-80, Sabreliner, N85DW, was destroyed during a forced landing when it crashed in a densely wooded area about 3.0 nautical miles (nm) northeast of the Gogebic Iron-County Airport (IWD), Ironwood, Michigan. The 14 CFR Part 91 business flight had departed the Brainerd-Crow Wing County Regional Airport (BRD) at 1747 en route to the Flint/Bishop International Airport (FNT), Flint, Michigan, on an IFR flight plan. The airplane's altitude was approximately 31,800 feet mean sea level (msl) and about 7 nm north of Ashland, Wisconsin, when the airline transport pilot radioed a "MAYDAY" distress call. The pilot reported the airplane had lost power on both engines, and that the airplane had been struck by lightning. The airplane was vectored towards IWD. The airplane was approximately 17,500 feet msl and 12 nm west of IWD when the pilot reported the airplane lost its navigation capability. The airplane continued its descent toward IWD. The airplane impacted the terrain on an approximate heading of 210 degrees. The pilot and copilot received fatal injuries and the two passengers were seriously injured.

The two pilots and passengers had flown in N85DW from FNT to BRD in the morning. The passengers rented a car and conducted their business meetings. The pilots remained at the airport and prepared the airplane for the return flight to FNT. The airplane was refueled with 691 gallons of fuel. The pilot indicated on the flight plan that N85DW had 4:45 hours of fuel on board when it departed BRD.

At 1315:58, the pilot of N85DW called the Federal Aviation Administration's (FAA) Princeton, Minnesota, Automated Flight Service Station (FSS) and spoke to a preflight briefing specialist. The pilot asked if the briefer had information on a severe weather warning that he had seen on television. The briefer replied, "... yes, it's number six eighty five, I was wondering when they would issue that, considering there's been severe thunderstorms up there all day."

The pilot asked if hail was in the forecast. The briefer replied, "... we've had indications of hail...all day." He added that there were, "... two cells, three cells, producing hail, one is just north of Brainerd." The pilot told the briefer he was not familiar with the area, and the briefer confirmed that the pilot was at Brainerd. The briefer described the area of cells as, "... north of you... moving east." The pilot said he would be departing at "six or seven o'clock tonight." The briefer said that thunderstorms were forecast for the Brainerd area, with the strongest activity expected "... right around the dinner hour...six o'clock or so," and added that "... they do look for redevelopment...along a line from about seventy five southwest of your present position up through the Duluth area." The pilot asked, "... what about the hail?" The briefer said, "... a severe weather watch looks for severe thunderstorms which include hail." The briefer stated

that there was no cell currently affecting Brainerd, "... but I dunno what's gonna develop [by] the time you leave...there's a good chance there'll be hail in it."

At 1627:01, the pilot called the FSS again in order to file a flight plan under instrument flight rules (IFR) from BRD to FNT. The pilot filed the flight plan with the FSS Flight Data Specialist. The proposed departure time was 1800, planned altitude was FL330, and the requested route of flight was BRD direct FNT. The pilot then asked for "current and forecast at Flint."

The Flight Data Specialist read the FNT 2053 UTC observation and the FNT Terminal Forecast valid between August 14 at 1800 UTC and August 15 at 1800 UTC. The Flight Data Specialist then asked if the pilot if he needed the convective sigmet for northern Minnesota and northwestern Wisconsin for severe thunderstorms. The pilot replied that he did, and the Flight Data Specialist read Convective SIGMET 56C and Severe Weather Statement WW 685.

The pilot asked the Flight Data Specialist, "... how far south would I have to go to get around it?" The Flight Data Specialist asked, "This activity?" The pilot asked, "If you're saying twenty south of Brainerd?" The Flight Data Specialist said, "the convective sigmet is ... thirty northeast of Brainerd." The pilot asked, "if I went south around twenty or thirty miles, I'll get around it, no?" The Flight Data Specialist replied, "Brainerd to Duluth is where about the southernmost boundary of ... the activity."

The pilot asked the Flight Data Specialist if anyone got hail. He replied that the hail activity was "north of Brainerd" and described that the "heavier activity" was all north of Solon Springs, Wisconsin.

The pilot stated, "So if I'm going south...east I might just skirt the edge of this whole thing." The Flight Data Specialist replied, "if you go to the southeast...you can avoid practically all this stuff... anywhere east of Brainerd is where you're going to get clobbered, to about Cloquet." The pilot said, "You say east, if I go due east?" The Flight Data Specialist replied, "... you'll get clobbered if you go due east."

The passengers returned to the airport at about 1740 for the return flight to Flint. One of the passengers reported that as they were getting in their seats prior to takeoff, the pilot stopped and told him that it would be bumpy for the first 15 to 20 minutes of the flight.

At 1745:57, the pilot called the FAA Air Traffic Control (ATC) and requested an IFR clearance to FNT and said, "...runway five, ready in less than a minute." ATC cleared N85DW, "... as filed, climb and maintain six thousand, squawk six three seven three, report airborne this frequency." The pilot acknowledged the clearance.

At 1748:18 the pilot reported being airborne to ATC.

At 1749:15, ATC advised N85DW, "... radar contact four miles east of the Brainerd Airport, verify leaving three thousand." The pilot replied in the affirmative and ATC instructed him to

climb to 8,000 and contact Minneapolis Center (ZMP) on frequency 121.05.

At 1749:53, the pilot reported on the ZMP sector 10 (R10) frequency, 121.05, and the controller instructed him to climb to Flight Level (FL) 230. Radar returns from ZMP indicated that the aircraft was tracking 110 degrees magnetic. A direct course from BRD to FNT was 108 degrees at 490 nautical miles.

At 1753:00 the pilot requested, "... we'd like a left turn to zero nine zero for weather." R10 replied, "... approved as requested."

At 1753:49, the pilot requested a further left turn to a heading of 080 for weather, which R10 approved. Radar data indicated the aircraft was tracking 085 degrees. At 1754:30, the radar track indicated 113 degrees, and at 1756:30, the track indicated a course of 070.

At 1757:00, the pilot asked R10, "... are you painting anything up ahead of us, ah, we don't have any cells but, ah, it looks pretty grim up there." R10 replied, "... you can deviate as necessary for weather north or south, just keep me advised." The pilot asked, "... how's it looking, ah, to the north, northeast?" R10 replied, "... I'm showing just moderate precip towards the northeast. I don't think there's any significant cells. I think most of them have dissipated, but there is a significant one to your, ah, one o'clock clockwise to your three o'clock about thirty miles in diameter that you're skirting the edge of right now."

The pilot replied, "Okay, we're gonna go, ah, zero four zero to get around it."

At 1758:12, R10 instructed N85DW to contact ZMP sector 11 (R11) on frequency 133.4, and the pilot acknowledged.

At 1758:41, N85DW reported on R11's frequency, and the controller asked, "... how long do you expect to be on that heading?" The pilot replied, "Well til we're around the weather. We, ah, let you know, okay. He said it was thirty miles wide, ah, for us...." R11 acknowledged and instructed the pilot to proceed direct to FNT when able, and to climb to FL330. The radar track indicated the aircraft's approximate heading was 055 degrees.

At 1759: 23, the Cockpit Voice Recorder (CVR) indicated that the copilot said, "Through eighteen. Altimeters? Got it? Anti-ice?"

At 1759:32, the CVR indicated the pilot responded, "As required off."

At 1759:33, the CVR indicated the copilot said, "Okay, I'm going to go on oxygen."

AT 1759:35, the CVR indicated the pilot said, "Rec lights off."

At 1759:43, the CVR indicated the copilot said, "Through eighteen thousand complete."

At 1759:53, R11 broadcast, "Attention all aircraft. Ah, Kansas City Convective, ah, Sigmet five niner Charlie for Minnesota, Wisconsin, Michigan, and Lake Superior available through HIWAS flight watch or through flight service". Neither the ATC transcript nor the CVR transcript indicated that N85DW attempted to obtain information about the convective sigmet.

The Convective SIGMET 59C was issued at 1757 on August 14, 2000, and was valid until 1955. The advisory covered portions of Michigan, Minnesota, Wisconsin, and Lake Superior, and was enclosed by the following navigation points:

From 70 miles west-southwest of Thunder Bay, Ontario (YQT), to 40 miles south of Thunder Bay (YQT), to 60 miles northwest of Rhinelander, Wisconsin (RHI), to 50 miles north-northeast of Minneapolis-St. Paul, Minnesota (MSP), to 40 miles north of Brainerd, Minnesota (BRD), to 70 miles west-southwest of Thunder Bay (YQT). The Convective SIGMET was issued for an area of severe thunderstorms moving from 290 degrees at 35 knots with tops above 45,000 feet. The advisory warned of tornadoes, hail to 2 inches, and wind gusts to 70 knots were possible. The issuance of the Convective SIGMET also implied a potential for severe or greater turbulence, severe icing, and low level wind shear.

At 1800:14, the CVR indicated the pilot said, "Visible moisture."

At 1800:38, R11 instructed N85DW to contact ZMP sector 34 (R34) on frequency 134.55, and the pilot acknowledged.

At 1800:54, the pilot reported on to R34's frequency and advised the controller 85DW was "deviating for weather." R34 instructed the pilot to "... let me know when you're able direct Flint." The pilot acknowledged and asked, "... are you painting anything, ah, at zero nine zero, ah, from us right now?"

At 1801:18, R34 replied, "... that heading for about another thirty miles and then if you start heading east ...you're gonna probably stay north of some of the heavier weather."

Radar data indicated that N85DW was approximately 25 miles southwest of Duluth, Minnesota (DLH).

At 1803:09, the CVR indicated the pilot said, "... 'cause at ninety four miles, I'm gonna turn east. We got visible moisture and we got negative five so we got icing conditions. And we're not climbing... we're down to two twenty and I can't do anything about it... so we're gonna have to nurse it up to uh, twenty-nine. He's givin' us thirty-three... okay, we got Brainerd back. Ninety four miles would be thirty. I don't see anything out here. Tell 'em we'll take zero six zero right now. See what happens."

At 1804:09, the pilot of N85DW reported that he was turning to heading 060, the aircraft was approximately 5 miles south of DLH.

At 1804:52, R34 broadcast Weather Watch 686.

Weather Watch 686 was issued for the potential of tornadoes over portions of Minnesota and Wisconsin and was valid from 1815 to 2300. The axis of the weather watch box was identified from 65 statute miles north and south of a line from 30 miles south of Alexandria, Minnesota, to 20 miles south of Rhinelander, Wisconsin. Hail surface and aloft to 2 inches, wind gusts to 70 knots, with maximum tops to 55,000 feet, and mean storm motion vector from 260 degrees at 35 knots.

At 1805:42, the pilot of N85DW asked R34, "Where's Alexandria, Wisconsin, sir ...?" R34 replied, "... from your position, ah, six o'clock and, ah, a hundred twenty five miles." The pilot responded, "Okay, thank you."

At 1805:50, the CVR indicated the copilot said, "We like things that way."

At 1805:57, the CVR indicated the copilot said, "There it is. Back there."

N85DW was at that time approximately 20 miles north of the area described by WW686.

At 1809:22, the CVR recorded, "sound similar to hydraulic pump cycling."

At 1811:35 the CVR recorded the sound of a "thud" followed by the "sound similar to decrease in engine RPM." The copilot made the statement, "That wasn't good."

At 1811:37, the CVR recorded the "sound similar to decrease in engine RPM."

At 1811:50, N85DW was at approximately FL312 and the pilot transmitted, "Mayday, Mayday, Mayday, eight five delta whiskey lost both engines." R34 replied, "...the Ashland, Wisconsin airport [ASX] is aaahh, one o'clock, one thirty and about ten miles."

The pilot of N85DW asked how long the runway was at Ashland.

At 1812:14, the CVR recorded the copilot saying, "Try a re-light."

At 1812:20, R34 replied, "... runway two zero and two is, ah, five thousand one hundred and ninety nine feet by one hundred."

At 1812:27, N85DW reported, "Okay, request a vector, we got hit by lightning."

At 1812:35, CVR recorded the pilot saying, "Okay, you fly the airplane." The copilot responded, "Me fly?" The pilot said, "Yeah."

At 1812:40, R34 instructed N85DW to fly heading 180, and gave the pilot the identifier for Ashland, ASX.

At 1812:54, the CVR recorded, "ramping sound similar to engine ignition starts and continues." At 1813:06, the "ramping sound similar to engine ignition stops." The radar data indicated that N85DW was at about 30,300 feet mean sea level (msl).

At 1813:06, the CVR recorded the copilot saying, "Going to fly one seventy for best glide." The pilot responded, "Yeah."

At 1813:19, the CVR recorded, "ramping sound similar to engine ignition starts." At 1814:24, the "sound similar to engine ignition stops." The radar data indicated N85DW descended from about 29,200 feet to 26,700 feet during the 65 seconds of engine ignition sounds.

At 1813:32, the pilot reported that he would need a visual (approach) and asked for the weather at ASX. R34 read the ASOS weather report for ASX. R34 advised the pilot a VOR or GPS approach served runway 2, and repeated the identifier at the pilot's request. At this time the aircraft's radar returns indicated a ground track of approximately 180 degrees, 3.5 miles east of ASX.

At 1814:27, R34 advised the pilot that the weather at Ironwood, Michigan [IWD] was better. R34 advised the pilot it was about thirty-five miles east, and asked if he would like to try that airport. The pilot concurred and requested vectors to IWD.

At 1814:52, R34 instructed the pilot to "... make a left turn to a heading of ah zero six zero." R34 provided the identifier for IWD to the pilot and advised him that the weather was "... clear, ah visibility ten, the wind zero six zero at niner." The pilot requested a vector for IWD.

At 1815:27, the pilot said that he showed 28.9 miles west of IWD and R34 concurred. Radar data indicated the aircraft was 28.9 miles west of IWD.

At 1815:49, the CVR recorded, "sound similar to hydraulic pump cycling."

At 1815:54, the CVR recorded the copilot saying, "One seventy one on the speed." The pilot responded, "Yeah."

At 1816:04, R34 instructed the pilot to change to frequency 133.55.

At 1816:24, the CVR recorded, "sound similar to precipitation."

At 1816:53, the pilot transmitted, "... not getting ya on thirty three four." R34 advised the pilot to remain on the current frequency, and advised him that the IWD runway length was 6,500 feet by 150 feet.

At 1817:06, the pilot asked, "... is there an approach there?"

At 1817:08, the CVR recorded, "sound similar to heavy precipitation."

R34 replied, "... an ILS 27 or a VOR DME GPS 27 or VOR GPS runway nine." The pilot asked for the ILS frequency, and R34 replied, "Ironwood VOR one zero eight point eight."

At 1817:26, R34 advised, "... we show you right on the approach course for the VOR GPS runway nine right now." Radar data indicated the aircraft was 20 miles west of the airport at FL201.

At 1817:43, the CVR recorded, "sound similar to precipitation continues."

At 1817:43, the pilot requested, "... talk us down, keep us on the approach course for zero nine." R34 acknowledged.

At 1818:06, R34 advised the pilot the IWD field elevation was 1,230 feet.

At 1818:07, the CVR recorded, "ramping sound similar to engine ignition starts." The sound continued for about 2 minutes. The radar data indicated N85DW's altitude was about 19,600 feet msl.

At 1818:17, the CVR recorded, "sound similar to precipitation increases in volume."

At 1818:21, R34 advised the pilot "... I'm showing you one one miles, ah, south or southwest of the final approach fix."

At 1818:30, the pilot replied, "We show ourselves fifteen miles out. Keep us vectors, we're gonna need vectors all the way in." R34 confirmed that the aircraft was 15 miles from the VOR, and that the VOR was collocated on the airport.

At 1818:41, the pilot of N85DW said, "... we're gonna need you to keep us on course right on the centerline of the runway."

At 1818:59, R34 replied, "... we show you right on the approach course, ah, ten miles from the four DME fix, fourteen miles from the airport." Radar data indicated that N85DW was at FL187.

At 1819:12, the CVR recorded the copilot reporting to R34, "give me VOR... ah, we're losing the radios."

At 1819:18, the last transponder return was received from N85DW. N85DW was 12.7 miles west of IWD VOR and at 17,500 feet. Although the transponder return was no longer received, the ATC Host computer could still associate N85DW's track with a radar target until 1820:29, when it went into a "coast" mode.

At 1819:27, the CVR recorded, "sound similar to landing gear being extended."

At 1819:32, R34 advised the pilot, "... we show you a little bit to the right of the final approach radial. The zero seven nine inbound. Turn five degrees left."

At 1819:49, the CVR recorded the pilot saying, "We lost our...."

At 1819:53, the copilot reported, "We've lost navibility up here, so we're relying on your vectors."

At 1820:08, R34 asked the pilot to report the airport in sight. The pilot replied, "We're solid."

At 1820:09, the CVR recorded, "ramping sound similar to engine ignition stops." The radar data indicated N85DW's altitude was about 16,000 feet msl.

At 1820:19, R34 asked if the pilot would like emergency equipment standing by. The pilot replied, "absolutely, affirmative, give us vectors down, cause we don't have any navibility at all. We've lost it all."

At 1820:36, the pilot requested the weather at IWD. R34 reissued the weather at IWD, "... wind three two zero at zero six, visibility nine, with, ah thunderstorm, sky clear though."

At 1821:04, the pilot requested, "Give us a vector for the airport now."

At 1821:07, R34 replied, "... we've lost the transponder, we've lost the transponder, and from the last position, five degrees left. The airport should have been about eleven thirty and eight miles."

At 1821:27, the CVR recorded the copilot saying, "... lose it, we're losing everything... I have no nav." The pilot responded, "Okay."

Between 1819:18 and 1821:32, the recorded radar data indicated that no radar targets appeared along the VOR approach course between 12.5 and 3.5 miles from the VOR.

At 1821:32, a primary radar target was received 3.5 miles west of the airport.

At 1821:38, R34 advised the pilot, "I believe, ah, we have you in the primary, ah, radar, that I believe the, tra, the airport is about twelve o'clock and seven miles. You're going right at the airport."

At 1821:54, R34 asked the pilot, "... when able can you give me the number of pe people on board and, ah, fuel remaining?"

At 1821:58, the CVR recorded, "ramping sound similar to engine ignition starts." The radar data indicated N85DW's altitude was about 13,200 feet msl to 11,600 feet msl.

At 1821:58, the CVR recorded the pilot replying, "We have four people on board, and uh, really don't know how much fuel remaining. We're out of engine."

At 1822:13, the CVR recorded, "ramping sound similar to engine ignition stops." The radar data indicated N85DW's altitude was about 11,600 feet msl to 8,800 feet msl.

At 1822:13, the CVR recorded the pilot saying, "Okay, we're done... we got nothin'."

Three more primary radar returns were received. The last at 1822:20 indicated the airplane was approximately 1.4 miles north of the airport.

At 1822:21, R34 asked, "... do you happen to have the airport in sight?" No reply was received.

At 1821:21, the CVR recorded the copilot saying, "Negative, negative."

R34 called to N85DW three more times but with no reply from N85DW.

The CVR recorded the following excerpted transmissions, but they could not be time stamped with accuracy:

The copilot said, "We're losing electrical." The pilot said, "Okay, okay, we're gonna dead stick it here. We're seven miles. When we come out of this, you wanna look behind us for the airport." The copilot responded, "Absolutely."

The pilot said, "Take a, runw... I'll take an airport. I'll take a freeway. We got the gear down, three green."

The copilot said, "Got a good descent, get below before we lose our gyros."

The pilot said, "There's the ground. Suggest a left turn."

The CVR recorded a pilot saying, "There you go. One seventy on the speed. You got it?"

The copilot said, "Left turn, left turn, standard left turn."

The CVR recorded a pilot saying, "There's * over there, left turn ninety degrees. Left turn."

The CVR recorded, "sound similar to hydraulic pump cycling."

The CVR recorded:

"Is that a clearing? Are you sure?"

"Seat belts on? Put your seatbelt on."

"I have mine on."

No further CVR transmissions were recorded.

The Minneapolis ATC manager notified the Gogebic County Sheriff at 1820 that an aircraft in distress was inbound to IWD and requested emergency equipment. At 1828, the sheriff informed the Minneapolis ATC that the aircraft had not landed at IWD. At 1839, ATC notified the Air Force Rescue Coordination Center and FAA Great Lakes Regional Communication Center, and a search and rescue operation commenced. Rescue personnel reached the airplane wreckage and the two surviving passengers at about 0830 on August 15, 2001. (See the Air Traffic Control Group Chairman's Factual Report and the CVR Group Chairman's Factual Report)

The wreckage site was located at 46 degrees 34.424 minutes North latitude, 90 degrees 04.484 minutes West longitude. The site was about 3.0 nautical miles northeast of IWD. IWD is about 166 nautical miles from BRD on a heading of 083 degrees magnetic.

PERSONNEL INFORMATION

The pilot was an airline transport rated pilot with single engine land and multi-engine land ratings. He held a commercial single engine sea rating. He was a certified flight instructor with single engine land, multi-engine land and instrument instructor ratings. He held a First Class Medical certificate. He had type ratings in the Cessna Citation CE-500, Lear Jet, and Sabreliner NA-265.

The pilot had about 13,037 hours of total flight time. The pilot had attended NA-265-80 recurrent ground school and simulator training at Flight Safety International, St. Louis, Missouri, on December 14 to December 17, 1999. The pilot flew about 72 hours in the accident airplane in the last 90 days, and 30 hours in the last 30 days. The pilot's complete logbooks were not recovered and the number of total flight hours and the total hours in type and model aircraft could not be accurately determined, therefore, the totals presented are estimations based on available records.

The copilot was a commercial pilot with single engine land, multi-engine land, and single engine sea ratings. He held certified flight instructor ratings as a single engine land, multi-engine land, and instrument instructor. He held a Second Class medical certificate.

The copilot had a total of about 5,600 hours of total flight time. The copilot had received NA-265-80 initial ground school and flight training from Markette and Associates, Inc., Valparaiso, Indiana, on February 2 to February 3, 2000. The copilot had about 135 hours of flight time in the accident airplane. The copilot flew about 70 hours in the accident airplane in the last 90 days, and 30 hours in the last 30 days. The copilot's complete logbooks were not recovered and the number of total flight hours and the total hours in type and model aircraft could not be

accurately determined, therefore, the totals presented are estimations based on available records.

AIRCRAFT INFORMATION

The airplane was a twin engine North American, NA-265-80, Sabreliner, serial number 380-27. The airplane seated nine and had a maximum takeoff gross weight of 23,300 pounds. The engines were GE CF-700 turbofan jet engines capable of producing 4,500 pounds of thrust each. The last Continuous Airworthiness inspection was conducted on July 7, 2000. The maintenance records indicated there were no outstanding Airworthiness Directives (AD's). The airplane had flown about 30 hours since the last inspection and had a total time of about 7,185 hours.

METEOROLOGICAL INFORMATION

The IWD automated weather observation at 1815 indicated the following weather: Wind from 320 degrees at 6 knots, visibility 9 miles in thunderstorm, sky clear below 12,000 feet, temperature 23 degrees C, dew point 17 degrees C, altimeter 29.93 inches of Hg. Remarks; automated weather observation without precipitation sensor, lightning distant all quadrants, thunderstorm began at 1759.

The IWD automated weather observation at 1835 indicated the following weather: Wind from 350 degrees at 8 knots, visibility 5 miles with thunderstorms in the vicinity, scattered clouds at 3,900 feet, ceiling broken at 4,500 feet, broken clouds at 8,000 feet, temperature 23 degrees C, dew point 17 degrees C, altimeter 29.95 inches of mercury (Hg). Remarks; automated weather observation system without precipitation sensor, lightning distant all quadrants, precipitation since last hour 0.01 inches.

John F. Kennedy Memorial Airport (ASX), located 2 miles southwest of the city of Ashland, Wisconsin, was the closest reporting point to the location of the reported lightning strike and the declared emergency. The following weather conditions were reported surrounding the time of the reported lightning strike on August 14, 2000:

ASX special automated weather observation at 1738, wind from 010 degrees at 23 knots gusting to 33 knots, visibility 1 3/4 mile in a thunderstorm, heavy rain, and mist, ceiling broken at 100 feet, broken clouds at 1,100 feet, and overcast layer at 3,700 feet, temperature 21 degrees C, dew point 20 degrees C, altimeter 29.93 inches of Hg. Remarks; automated observation system, peak wind from 010 degrees at 33 knots occurred at 1734, lightning distant all quadrants, thunderstorm began at 1657 and rain began at 1618, pressure rising rapidly, precipitation since last hourly observation 0.04 inches.

ASX automated weather observation at 1753, wind from 350 degrees at 10 knots, visibility 1 1/2 mile in a thunderstorm, heavy rain, and mist, ceiling broken at 100 feet, overcast layer of clouds at 3,900 feet, temperature and dew point 21 degrees C, altimeter 29.98 inches of Hg.

Remarks; automated weather system, peak wind from 010 degrees at 33 knots occurred at 1734, lightning distant all quadrants, thunderstorm began at 1657 and rain at 1718, sea level pressure 1015.4 mb, precipitation in the last hour 0.13 inches, temperature and dew point 20.6 degrees C.

ASX special automated weather observation at 1815, wind from 110 degrees at 7 knots, visibility 4 miles in a thunderstorm, light rain, and mist, scattered clouds at 100 feet, ceiling broken at 2,300 feet, overcast layer at 4,800 feet, temperature and dew point 21 degrees C, altimeter 29.92 inches of Hg. Remarks; automated observation, lightning distant all quadrants, precipitation since 1753 reported at 0.13 inches.

The National Lightning Detection Network (NLDN) detected 158 cloud-to-ground lightning strikes between 1757 and 1812 within a 20 mile radius of Ashland, Wisconsin. The NLDN detected 322 cloud-to-ground strikes during the 15 minute period within a radius of 50 miles from Ashland. The larger range indicated several other clusters of lightning to the east through the south-southwest from where the reported lightning strike took place.

Weather data indicated that during the time period between 1808:36 and 1813:28, radar echoes ranged from 25 to 30 dBZ along the flight track while the aircraft had climbed from 29,200 feet to 31,300 feet. At 1811:50, the flight crew made its "MAYDAY" report and indicated they had lost both engines. At 1812:29, N85DW was located 22 miles north-northwest of a 57 dBZ or VIP Level 6 extreme intensity center of convection. Immediately following the reported lightning strike, the flight track indicated the aircraft had descended from 29,300 to 19,300 feet and turned to the south and then turned eastward. The turn to the east was after the flight was informed of a thunderstorm in progress at Ashland. The flight was then given radar vectors towards Ironwood. This path took the aircraft into reflectivities of 52 dBZ, or NWS VIP level 5 (intense precipitation). Between 1818:36 and 1823:28, the flight track shows the aircraft descended from 18,900 feet to its last contact point at 8,800 feet. The aircraft passed through the northern edge of a 54.5 dBZ cell, with reflectivities of 22 dBZ to 51.5 dBZ along the flight track. (See Meteorology Factual Report)

WRECKAGE AND IMPACT INFORMATION

The airplane impacted into a heavily wooded forest area on a heading of about 210 degrees. The airplane hit a cedar tree about 50 to 60 feet in height. The distance between the impact of the first tree and the impact with the ground was approximately 220 feet. The angle of descent was approximately 15 degrees. The main wreckage was located about 250 feet from the first impact point. The total distance of the wreckage path was approximately 340 feet.

The main wreckage was found inverted and facing the opposite direction of the wreckage path. The nose of the airplane and cockpit had broken away from the main fuselage, and parts from the nose and cockpit were found between the first impact point and the main wreckage. The pilot's seat was found about 220 feet from the first impact point. The copilot's seat was found about 240 feet from the first impact point. The left wing had separated from the

fuselage. Its parts were found broken between the first impact point and the main wreckage. The right wing had broken away from the fuselage but was found lying next to the fuselage. The right engine was still loosely attached to the fuselage. The left engine was separated from the fuselage and found about 25 feet northwest of the rear of the fuselage. The horizontal stabilizer and rudder were located 310 feet from the first impact point. The horizontal stabilizer and elevators had separated from the horizontal stabilizer, and they were found about 220 feet from the first impact point. The cabin of the airplane was inverted and a large section of the left cabin fuselage had been broken away, exposing the inside of the cabin.

The wreckage field was searched for static dischargers and lightning diverters. The static dischargers that were found exhibited no abnormal wear or they had been broken during impact. The metal pins of the static dischargers were sharp and exhibited no evidence of burning, arching, or rounding of the pins. The two lightning dischargers were examined and no anomalies were found. The diverter strip located in the radome was removed and examined. It showed evidence of discoloration at the midpoint of the four pieces of the strip.

No external evidence of a lightning strike was found on any of the wreckage parts, fuselage skin, or engines. A magnetic compass was placed near the left engine and the needle deflected, but no needle deflection was exhibited on the right engine when the compass was placed near it.

The onsite inspection of the engines revealed the as-found position of the demand spindle of the left engine fuel control to be at approximately 70 degrees, and that of the right engine fuel control to be at approximately 15 degrees. Debris was found in the inlets of both engines. The inlet guide vanes and airfoils of both engines appeared to be undamaged. The igniter boxes, ignition harnesses, and igniters were intact on both engines. Combustor borescope ports on both engines were opened. The left engine had no debris visible at this location and the right engine had only a few small pieces of vegetation visible at this location. The left oil tank was dented and torn.

The Narco ELT 10 was found in the wreckage. The switch was found in the OFF position. When the unit was turned on, it emitted a signal. When it was placed in the ARMED position and jarred, the ELT emitted a signal. The portable antenna was intact, but the external antenna was broken off at the connector. (See photos and wreckage diagram)

MEDICAL AND PATHOLOGICAL INFORMATION

Autopsies were performed on the pilot and copilot at the Gogebic County Medical Examiner's Office, Grand View Hospital, Ironwood, Michigan.

Forensic Toxicology Accident Reports were prepared by the FAA Aeromedical Institute. The report concerning the pilot was negative. The report concerning the copilot indicated the following results:

Carbon monoxide not performed.

Cyanide not performed.

Ethanol detected in kidney.

43 (mg/dL, mg/hg) ethanol detected in muscle.

2 (mg/dL, mg/hg) acetaldehyde detected in kidney.

5 (mg/dL, mg/hg) acetaldehyde detected in muscle.

3 (mg/dL, mg/hg) n-butanol detected in muscle.

2 (mg/dL, mg/hg) n-propanol detected in muscle.

Note: The ethanol found was from postmortem ethanol formation and not from the ingestion of ethanol.

No drugs detected in kidney.

TESTS AND RESEARCH

The left and right GE CF-700 engines were disassembled and inspected at Bizjet, Tulsa, Oklahoma, on September 25 to September 26, 2000. The inspection of the engines revealed no preexisting anomalies that would preclude normal engine operation. The left and right engine starter drive shafts were found intact. The igniter plugs were bench tested and showed continuous rapid sparking over the entire voltage range from 28 volts down to 14 volts.

A Gauss-Meter was held near the left and right engine compressor rotors. The Gauss-Meter read zero when held near the right engine compressor rotors. When the Gauss-Meter was held near the left engine compressor rotors, readings between -20 and +20 readings were recorded. (See GE Aircraft Engines report dated February 9, 2001)

The left and right engine ignition system exciters and leads were tested at Unison Industries, Jacksonville, Florida. Both exciters and all four leads passed the electrical operation tests.

Fuel samples recovered from the wreckage and during the engine inspections exhibited no visible water contamination. The fuel sample from the left engine fuel shutoff valve and a fuel sample from the right engine low pressure fuel filter were sent to the DuPage County Sheriff's Office Crime Laboratory, Wheaton, Illinois, for analysis. The results revealed the presence of a heavy petroleum distillate. Jet-A aviation fuel is an example of a heavy petroleum distillate.

The anti-ice control panel was sent to the National Transportation Safety Board's Materials

Laboratory for examination of the engine inlet anti-ice control switch. The switch was found in the "ON" (down) position. The examination of the shoulders of the switch plate, where the switch would be in the "OFF" position, appeared shiny. When the switch was moved to the "OFF" position, the examination revealed that the shoulders of the switch plate on the lower side, where the switch would be in the "ON" position, did not appear shiny.

The back of the engine inlet anti-ice control switch was examined. An area of damage was observed on the lower side of the engine inlet switch hole, which corresponds to the "OFF" position. The damage to the upper side of the engine inlet switch hole, which corresponds to the "ON" position, was primarily limited to the orange-colored coating, and deformation of the underlying metal was minimal. (See NTSB Materials Laboratory Factual Report)

The FAA published a handbook in September 1989 titled, "Aircraft Lightning Protection." Concerning Turbine Stalls, it stated:

"Reported lightning effects on turbo-jet engines show that these effects also are limited to temporary interference with engine operation. Flameouts, compressor stalls, and roll-backs (reduction in turbine rpm) have been reported after lightning strikes to aircraft with fuselage mounted engines. This type includes military aircraft with internally mounted engines and fuselage air intakes, or other military and civil aircraft with engines externally mounted on the fuselage.

There have been no attempts to duplicate engine flameouts or stalls with simulated lightning in a ground test, and there has been no other qualitative analysis of the interference mechanism; however, it is generally believed that these events result from disruption of the inlet air by the shock wave associated with the lightning channel sweeping aft along a fuselage. This channel may indeed pass close in front of an engine intake, and if a restrike occurs, the accompanying shock wave is considered sufficient to disrupt engine operation. The steep temperature gradient may also be important. These effects have been reported as occurring more often on smaller military or business jet aircraft than on larger transport aircraft. Thus, smaller engines are probably more susceptible to disrupted inlet air than are their larger counterparts.

Operational Aspects: In some cases a complete flameout of the engine results, while in others there is only a stall or roll-back. There is no case on record, however, in which a successful restart or recovery of the engine to full power was not made while still in flight. Perhaps because of this, together with the impracticality of a laboratory simulation, there had been little research into the problem. Nevertheless, operators of aircraft with engines or inlets close to the fuselage should anticipate possible loss of power in the event of a lightning strike and be prepared to take quick corrective action.

There have been only a few reports of lightning effects on wing mounted turbojet engines, since these are usually large engines in which the shock wave from a lightning flash is probably inadequate to noticeably disrupt inlet air flow. There are no reports of power loss of

turboprop engines as a result of lightning strikes."

The GE Aircraft Engine report dated February 9, 2001, revealed that the historical records available from the GE Data Center were searched for records of flameouts of CF700 and CJ610 engines associated with lightning strikes, thunderstorms, or turbulence. Historical records indicated that possibly seven engine flameouts between 1975 and 1995 were associated with lightning and thunderstorms. The records indicated that possibly eight flameouts between 1983 and 1995 were associated with turbulence. The report stated the following:

"... it must be kept in mind that clarity and accuracy of reporting might contain some human error. In some instances, a crew comment of a 'lightning strike' or 'turbulence' might have been recorded in reference to an event without adequate consideration of possible alternative causes. In addition, the data does not contain details regarding re-start efforts. Thus, the information from the Data Center helps to provide a perspective from which to analyze lightning strikes and storm activity. However, because it is based on comments and perceptions, it does not provide a completely reliable answer regarding the cause of engine power loss events on aircraft operation in thunder and lightning storms." (See GE Aircraft Engines report dated February 9, 2001)

GE Aircraft Engines issued a letter concerning "Adverse Weather Conditions" relating to CJ610/CF700 engines on November 8, 1990. The letter stated the following:

"In April 1990, a CJ610 powered Learjet took off at night into one of the worst storms of the year and lost power on both engines, could not relight either engine and made a "dead stick" landing. Fortunately, no one on board was injured.

Prior to takeoff, weather reports indicated level 4, 5, and 6 thunderstorms were in the area with clouds up to 65,000 feet. Level 4, 5, and 6 thunderstorms have rainfall quantities from 2.5 inches per hour to more than 7.1 inches per hour. Certainly, that is a description of violent thunderstorms which are usually accompanied by severe turbulence, hail, downdrafts and reduced visibility covering a large area. In this case, the pilot reported the aircraft pitch varied from plus 25 degrees to minus 10 degrees and bank angle varied from 65 to 89 degrees. One engine flamed out due to turbulence and the other from the effect of golf ball sized hail. The air starts were not available due to blockage of the inlet from hail. Apparently, the batteries were not strong enough to rotate the engines to light-off speed so neither engine could be restarted.

Operators are cautioned to consider the weather carefully, while the CJ610 powered Learjet is a proven aircraft in high altitude operation, when the weather is severe, there is an increased risk of in-flight problems. Before taking off into an area of known violent thunderstorms, the risks should be carefully weighted versus the need to reach the destination."

ADDITIONAL INFORMATION

The Sabreliner, Model NA 265-80, Airplane Flight Manual (AFM) stated the following information concerning Continuous Ignition:

"It is recommended that the IGNITION switch be placed in the CONTINUOUS position for (1) takeoffs, (2) landings, and (3) flight in turbulent air."

The CVR recording indicated that neither pilot called for the ignition switch to be placed in the CONTINUOUS position. The CVR did not record any "ramping sound similar to engine ignition" at any time prior to the reported lightning strike and the dual engine flameouts.

The AFM stated the following information concerning anti-icing and deicing:

"Without deicer boots, the airplane is not to be dispatched or flown into areas of known or anticipated icing conditions.

In the event icing conditions are encountered (without deicer boots) the procedures provided in this section for engine inlet, ram air inlet, forward windshield and pitot-static and stall warning anti-icing system operation will apply."

The AFM further stated:

"Anti-icing systems are not to be used as deicing systems. An anti-icing system should be turned on before areas of suspected icing conditions (visible moisture) are entered.

1. ENGINE INLETS anti-icing control switch.

When the ENGINE INLETS switch is placed in the ON position, anti-icing of the engine compressor front inlet guide vanes, engine inlet struts, and engine nose fairing is accomplished with engine compressor air.

ENGINE INLET switch - ON

(a) TAKEOFF - With an outside air temperature of +5 degrees C or below with visible moisture such as fog, rain, or wet snow.

CAUTION

To prevent the possibility of a compressor stall during climb, reduce climb power setting by 2% Ng before turning off engine anti-ice at altitudes above 25,000 ft.

(b) INFLIGHT - An abnormal increase in EGT accompanied by a decrease in EPR may be an indication of engine inlet icing. IF atmospheric conditions are such that icing conditions may exist, turn on engine anti-icing immediately."

The Sabreliner, Model 265-80, Pilot's Checklist lists the following steps in the Cruise checklist:

1. Cruise thrust and DC electrical systems	Set 2. Pressurization system Check 4. ANTI-ICE control panel	Check 3. AC As required
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Flight Safety International's Sabreliner 80/80C Pilot's Checklist listed the following steps for the 18,000 feet (Transition Altitude) checklist:

1. Altimeters (2) As required	29.92 2. Lights (Strobe and Recognition) Immediately available	4. Cabin Pressurization System Check/Set 5. Anti-icing Complete
3. Oxygen Masks As required	6. 18,000 Feet (Transition Altitude)	

The CVR recorded the following conversation between the pilot and copilot:

At 1759:23, the copilot stated, "Through eighteen. Altimeters? Got it? Anti-ice?"

At 1759:32, the pilot stated, "As required off."

At 1759:33, the copilot stated, "Okay, I'm going on oxygen."

At 1759:35, the pilot stated, "Rec lights off."

At 1759:43, the copilot stated, "Through eighteen complete."

The CVR recording indicated that neither pilot called for the engine anti-ice switch to be placed in the ON position after the 18,000 feet checklist. However, the CVR indicated that at 1800:14, the pilot said, "Visible moisture." Also, at 1803:09, the pilot stated, "We got visible moisture and we got negative five so we got icing conditions."

At 1804:43, the pilot stated, "... the best we can do is one point four, four three." The altitude was approximately 26,600 feet and the outside air temperature was approximately -24 degrees C.

At 1809:31, the pilot stated, "Well we're warm. We're heavy and we're warm. Look it, it's only uh, plus uh, minus ten." The altitude was approximately 30,100 feet and the outside air temperature was approximately -32 degrees C. The airplane's free air temperature (FAT) gauge is located directly above the caution panel warning lights and is visible to both pilots.

The Sabreliner AFM Performance Data section provides a means of calculating the Engine Pressure Ratio (EPR) for a given pressure altitude and Total Air Temperature by using the Maximum Continuous Thrust (Climb) EPR Setting for Two Engine Operation with Cabin Pressure ON - Anti-Ice OFF, or Cabin Pressure On - Anti-Ice ON charts. The Sabreliner Manager

of Flight Operations reported that using the chart for Cabin Pressure On - Anti-ice ON, the calculated EPR setting for 26,600 feet with a calculated FAT of -4 degrees C, would be about 1.43 EPR. The calculated EPR setting for 30,100 feet with a reported FAT of -10 degrees C, would be about 1.44 EPR. If the chart for Cabin Pressure On - Anti-Ice OFF is used, the calculated EPR setting for 26,600 feet with a calculated FAT of -4 degrees C is about 1.52 EPR. If the chart for Cabin Pressure On - Anti-Ice OFF is used, the calculated EPR setting for 30,100 feet with a reported FAT of -10 degrees C is about 1.53 EPR.

The AFM, Emergency Procedures section, stated the following information concerning IMMEDIATE ENGINE AIR START:

1. Power Lever (affected engine) IDLE 2. AIR START switch (affected engine)
LEFT or RIGHT ON 3. AIR START switch OFF after
relight

If immediate relight is unsuccessful, proceed with the ENGINE AIR START procedure.

ENGINE AIR START

See Engine Air Start Envelope. Figure 2-1, for windmilling air start altitude and airspeed range. Starter assisted air starts are not recommended due to the possibility of shearing the starter shaft.

Phase I and II

1. Power lever (affected engine) OFF 2. Airspeed and altitude
See Fig 2-1 for recommended airspeed and altitude for air start 3. FUEL selector
switch X-FEED 4. FIRE PULL "T" handle Check
in 5. FAN SYNC switch OFF 6. ENGINE master switch (affected
engine) ON 7. AIR START switch LEFT HAND ON or
RIGHT HAND ON, as required 8. Power lever (engine being started) IDLE,
then as required

Phase III

1. AIR START switch OFF 2. FUEL selector switch
NORM

The CVR recording indicated that the pilots did not execute the IMMEDIATE ENGINE AIR START or the ENGINE AIR START procedures using a challenge and response reading of the checklist items. The CVR indicated that neither pilot called for the checklists to be used.

The AFM, Emergency Procedures section, Figure 2-1, indicated the following information concerning the Engine Air Start Envelope:

The upper altitude limit of the restart envelope was 28,000 feet at airspeeds from 210 to 240 kts. The minimum allowable airspeed for restart is 160 kts. The maximum altitude for attempting restart at an airspeed of 170 kts is approximately 25,500 feet.

The CVR indicated that the copilot attempted to hold an airspeed of 170 kts after the engine flameouts "... for best glide." The Engine Air Start Envelope indicates the airspeed for engine restarts ranges between 160 kts to 350 kts, with an average airspeed of 255 kts.

The CVR indicated that the first and second "sound similar to decrease in engine rpm" occurred at 1811:35 and 1811:37, respectively. At 1812:54, the CVR recorded ramping sounds similar to ignition starts that stopped at 1813:06. The altitude was about 30,300 feet.

The second time the CVR recorded "ramping sounds similar to an engine start" was between 1813:19 and 1814:24, and the altitude was between 29,200 feet and 26,700 feet.

The third time the CVR recorded "ramping sounds similar to an engine start" was between 1818:07 and 1820:09, and the altitude was between 19,600 feet and 16,000 feet.

The fourth time the CVR recorded "ramping sounds similar to an engine start" was between 1821:58 and 1822:13, and the altitude ranged between 13,200 feet and 8,800 feet.

The Sabreliner, Model 265-80, Pilot's Checklist Emergency Procedure section, FAILURE OF BOTH DC GENERATORS, states that, "Approximately 30 minutes of usable battery power is available to the essential bus." The engines flamed out at 1811:37 and the airplane impacted the ground at about 1822. At 1821:37, the copilot said, "...lose it, we're losing everything...I have no nav."

The CVR indicated that a "sound similar to hydraulic pump cycling" was heard two times after the engine flameouts, once at 1815:19 and shortly before the impact with the ground. At 1819:27, the CVR indicated the "sound similar to landing gear being extended." According to Electrical Load Analysis conducted by the Marathon Power Technology Company, the company that manufactured the airplane's batteries, the airplane's hydraulic pump draws 170 amps per hour and would require more power for activation than any other component on the airplane. The CVR indicated that neither of the pilots discussed load shedding electrical components after the loss of power.

Neither the AFM or the Sabreliner Pilot's Checklist discuss dual engine failures or procedures for load shedding of electrical equipment in the event of a dual engine failure.

One of the passengers described the events surrounding the lightning strike. He reported that he felt an explosion and a concussion. He reported he looked at the left engine and he saw a "... brilliant white circle around the engine."

Parties to the investigation included the FAA, GE Aircraft Engines, and the Sabreliner Corporation.

The wreckage was released to ACE USA, Chicago, Illinois.

Pilot Information

Certificate:	Airline transport	Age:	60, Male
Airplane Rating(s):	Single-engine land; Single-engine sea; Multi-engine land	Seat Occupied:	Left
Other Aircraft Rating(s):	None	Restraint Used:	
Instrument Rating(s):	Airplane	Second Pilot Present:	Yes
Instructor Rating(s):	Airplane multi-engine; Airplane single-engine; Instrument airplane	Toxicology Performed:	Yes
Medical Certification:	Class 1 Valid Medical--w/ waivers/lim	Last FAA Medical Exam:	July 6, 2000
Occupational Pilot:	Yes	Last Flight Review or Equivalent:	
Flight Time:	13037 hours (Total, all aircraft), 2560 hours (Total, this make and model), 72 hours (Last 90 days, all aircraft), 30 hours (Last 30 days, all aircraft), 2 hours (Last 24 hours, all aircraft)		

Aircraft and Owner/Operator Information

Aircraft Make:	North American	Registration:	N85DW
Model/Series:	NA-265-80 NA-265-80	Aircraft Category:	Airplane
Year of Manufacture:		Amateur Built:	
Airworthiness Certificate:	Transport	Serial Number:	380-27
Landing Gear Type:	Retractable - Tricycle	Seats:	9
Date/Type of Last Inspection:	July 7, 2000 Continuous airworthiness	Certified Max Gross Wt.:	23300 lbs
Time Since Last Inspection:	30 Hrs	Engines:	2 Turbo jet
Airframe Total Time:	7185 Hrs	Engine Manufacturer:	GE
ELT:	Installed, not activated	Engine Model/Series:	CF700
Registered Owner:	COLONELS INC.	Rated Power:	4500 Lbs thrust
Operator:		Operating Certificate(s) Held:	None
Operator Does Business As:		Operator Designator Code:	

Meteorological Information and Flight Plan

Conditions at Accident Site:	Visual (VMC)	Condition of Light:	Day
Observation Facility, Elevation:	IWD ,1320 ft msl	Distance from Accident Site:	3 Nautical Miles
Observation Time:	18:35 Local	Direction from Accident Site:	30°
Lowest Cloud Condition:	Scattered / 3900 ft AGL	Visibility	5 miles
Lowest Ceiling:	Broken / 4500 ft AGL	Visibility (RVR):	
Wind Speed/Gusts:	8 knots / None	Turbulence Type Forecast/Actual:	/
Wind Direction:	350°	Turbulence Severity Forecast/Actual:	/
Altimeter Setting:	29 inches Hg	Temperature/Dew Point:	72°C / 62°C
Precipitation and Obscuration:	No Obscuration; No Precipitation		
Departure Point:	BRAINERD (BRD)	Type of Flight Plan Filed:	IFR
Destination:	FLINT (FNT)	Type of Clearance:	IFR
Departure Time:	17:47 Local	Type of Airspace:	Class E

Airport Information

Airport:	GOGEBIC-IRON COUNTY IWD	Runway Surface Type:	
Airport Elevation:	1230 ft msl	Runway Surface Condition:	
Runway Used:	0	IFR Approach:	
Runway Length/Width:		VFR Approach/Landing:	Forced landing

Wreckage and Impact Information

Crew Injuries:	2 Fatal	Aircraft Damage:	Destroyed
Passenger Injuries:	2 Serious	Aircraft Fire:	None
Ground Injuries:	N/A	Aircraft Explosion:	None
Total Injuries:	2 Fatal, 2 Serious	Latitude, Longitude:	46.449306,-90.149162(est)

Administrative Information

Investigator In Charge (IIC):	Silliman, Jim
Additional Participating Persons:	WES KRAFT; GRAND RAPIDS , MI JOHN MECALO; ST. LOUIS , MO MARK TAYLOR; LYNN , MA
Report Date:	August 21, 2001
Last Revision Date:	
Investigation Class:	Class
Note:	
Investigation Docket:	https://data.nts.gov/Docket?ProjectID=49997

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