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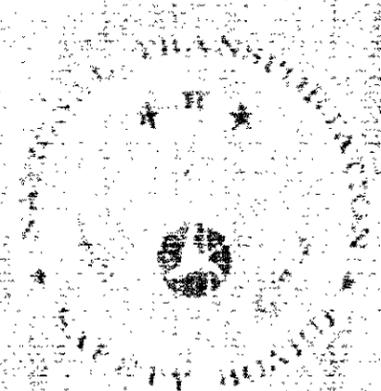
FOR RELEASE:
A.M. 3 OF OCT 14 1970

Report Number:

NTSB AAR 70-20

AIRCRAFT ACCIDENT REPORT

THE DIVISION COMPANY
ACTING COMMANDER 1121 N2361P
FEDERAL RETREAT, VIRGINIA
OCTOBER 31, 1969



NATIONAL TRANSPORTATION SAFETY BOARD
Bureau of Aviation Safety
Washington, D. C. 20591

SA-None

File No. 3-4110

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THE PITTSTON COMPANY
AERO COMMANDER 1121, N236JP
RURAL RETREAT, VIRGINIA
OCTOBER 31, 1969

Adopted: SEPTEMBER 9, 1970

NATIONAL TRANSPORTATION SAFETY BOARD
Bureau of Aviation Safety
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Report Number: NTSB-AAR-70-22

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DEPARTMENT OF TRANSPORTATION
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NATIONAL TRANSPORTATION SAFETY BOARD
DEPARTMENT OF TRANSPORTATION
AIRCRAFT ACCIDENT REPORT

Adopted: September 9, 1970

THE PITTSTON COMPANY
AERO COMMANDER 1121, N236JP
RURAL RETREAT, VIRGINIA
OCTOBER 31, 1969

SYNOPSIS

The Pittston Company's Aero Commander 1121, N236JP, on a flight from LaGuardia Airport, New York, to Tri-City Airport, Johnson City, Tennessee, on the night of October 31, 1969, crashed at approximately 2210 e.s.t. while descending on a radar vector to the final approach course at Tri-City. The crew of two and the one passenger aboard the aircraft were fatally injured.

The aircraft made contact with the ground 2,450 feet above sea level while in an approximately 60° nosedown wings-level attitude. The impact site was about 2 miles northeast of Mountain Empire Airport, Rural Retreat, Virginia. The impact crater was 25 feet in diameter at the top, with a depth of about 18 feet. The left aileron was the only large piece of the aircraft that was visible in the crater. The remainder of the wreckage was below the loose dirt at the 9-foot level or strewn forward along both sides of a wreckage path that extended 500 feet beyond the crater.

The Board determines that the probable cause of this accident was that, following a malfunction or failure in the 115-volt alternating current electrical system, the crew did not take proper action, resulting in the loss of the pilot's flight instruments in instrument flight conditions and subsequent loss of control.

The Board recommends that the Administrator, Federal Aviation Administration, take necessary action to assure that all avionics modifications to aircraft, and their proper use, be documented as amendments to the maintenance and flight manuals, and that this information be disseminated to aircraft owners and pilots.

1. INVESTIGATION

1.1 History of Flight

N236JP, an Aero Commander Model 1121 turbo-jet, was operated by The Pittston Company, 250 Park Avenue, New York, N. Y. 14607, as an executive aircraft in the conduct of company business. On the night of October 31, 1969, two company pilots, with a company employee as a passenger, departed from LaGuardia Airport, New York, for Tri-City Airport, Johnson City, Tennessee.

The flight departed at 2042 e.s.t. ^{1/}on an Instrument Flight Rules (IFR) clearance for the following route of flight:

Echo Lake Eleven Standard Instrument Departure - (radar vector to Sparta, N. J., VORTAC, 119° radial to Sparta) direct Tannersville, Pa., VORTAC, direct Westminster, Md., VORTAC, Jet Route 48 Pulaski, direct Tri-City.

After the aircraft was clear of the terminal area, a climb was made to the assigned flight level (FL), 410. The aircraft entered the Washington Air Route Traffic Control Center (ARTCC) area at approximately 2110. At 2152, when the flight was about 45 miles northeast of Pulaski, Virginia, control of the flight was passed from the Washington ARTCC to the Atlanta ARTCC northeast high-altitude sector controller.

At 2153, the crew contacted the Atlanta ARTCC and requested clearance to descend from FL 410. The controller cleared the flight to descend to FL 240 and to change to transponder code 1400. At 2157, control was passed to the low altitude manual sector controller. The flight was about 5 miles northeast of the Washington-Atlanta Center boundary, or about 20 miles northeast of Pulaski at this time, and within 1 minute the crew was instructed to contact the Center on 120.0 MHz. At 2157, they reported descending through FL 250. When the flight reached a position 5 to 6 miles northeast of Pulaski, the pilot was instructed to depart from the Pulaski VORTAC on a 250° heading for a radar vector to the final approach course to the Tri-City Airport. The crew acknowledged. This was followed by a clearance for the flight to continue descent to 8,000 feet. The crew again acknowledged.

At 2207:15, after several calls from the Atlanta Center, the crew replied to a query for their altitude with, "Six JP out of two three oh." Atlanta Center acknowledged with, "Roger, report leaving one seven thousand." The crew acknowledged with, "Six JP." There were no further transmissions from the flight. The radar controller said he observed the target of the aircraft on his radarscope as the

^{1/} All times used herein are expressed in eastern standard time, based on the 24-hour clock.

aircraft continued on course, and at approximately 2209:20 the target of the aircraft disappeared from the radarscope. The controller estimated that when the pilot reported leaving FL 230, the aircraft was 7 or 8 miles northeast of Sugar Grove Intersection, which is located approximately 40 miles southwest of the Pulaski VORTAC. He estimated that the target disappeared from the radarscope about 3 miles west of the position where the crew reported out of FL 230.

Witnesses located between 2 and 4 miles northeast of Mountain Empire Airport, Rural Retreat, Virginia, stated that on the night of the accident they heard the noise of a jet flying over, followed by a sudden thud that shook floors in some houses. They estimated that this occurred about 2210. They described the night as dark and said that the sky was overcast. They were unable to see the aircraft and could not determine the direction it was flying or its location when the noise stopped.

About 1130, November 1, while search parties were in the area looking for the aircraft, the owners of a farm found the wreckage while they were checking their livestock. They notified the Virginia State Police who arrived on the scene at approximately noon. The geographic coordinates of the accident site are:

latitude 36° 55' 15" N.
longitude 81° 18' 50" W.

This position is on a bearing of 024° at a distance of about 10 nautical miles from Sugar Grove Intersection.

1.2 Injuries to Persons

<u>Injuries</u>	<u>Crew</u>	<u>Passengers</u>	<u>Others</u>
Fatal	2	1	0
Nonfatal	0	0	0
None	0	0	

1.3 Damage to Aircraft

The aircraft struck the ground wings level while in a 60° nose-down attitude. The impact crater in the soft ground measured 25 feet in diameter and approximately 18 feet in depth. The distance from the top of the crater to the top of loose earth in the crater was 9 feet. The loose earth concealed some large boulders and most of the heavier aircraft components. Except for a few bits of metal, the only large piece of the aircraft that was visible in the crater was the left aileron. Extensive fragmentation of the aircraft had occurred, leaving bits and pieces of metal around and forward of the crater on a bearing of 170° for a distance of about 500 feet. The largest pieces of wreckage outside of the crater were the control surfaces, right landing gear, and broken wing panels. Some heavy components, such as the engines, most of the empennage, and the left landing gear, were buried in the crater. All principal parts of the

wing and tail surfaces were found at the accident site; however, the landing gear doors were found 2.43 nautical miles from the accident site on a bearing of 314°.

1.4 Other Damage

The impact occurred on an open pasture that is adjacent to Virginia State Road 617. The left wing damaged a wire fence between the road shoulder and the crater. Several small trees were broken off at the base of the trunks by the aircraft.

1.5 Crew Information

Captain Robert Joseph Quint, aged 48, had been employed by The Pittston Company for 6 years. He held airline transport pilot certificate No. 44047-40, with type ratings in the Aero Commander 1121 and the DC-3. He had a total flying time of 7255:10 hours, including 76:50 hours in the last 90 days and 2:35 hours in the 24 hours prior to the accident. His total time in the 1121 was 732:25 hours. His instrument time consisted of 695:50 hours of actual instrument flight and 431:05 hours of simulated instrument flight. His most recent first-class airman's medical certificate was issued on September 27, 1969, with the limitation that correcting glasses be worn while flying. The only evidence of glasses found in the wreckage area were the frames of the pilot's sunglasses. These were in their case and were located approximately 200 feet forward of the crater in mud.

Post-mortem examinations of the crew were not performed. The pilot's Federal Aviation Administration (FAA) medical certification records were reviewed back to 1965. There was no documentation on any FAA form records during this period to indicate that the pilot had consulted a physician for a medical complaint.

Mr. Quint retired from the United States Air Force (USAF) in 1963. His medical records were obtained from the Air Force for the period prior to 1965, and a review of these records showed that after military retirement, medical care was sought for bilateral tinnitus (ringing in the ears) at Lowry AFB Dispensary and at Fitzsimmons General Hospital. He was first seen for this complaint in November 1963, at which time he related a 3 week history of tinnitus with no history of vertigo. He was treated with Arlidin and nicotinic acid. He was last seen for this complaint on January 27, 1964, and reported no improvement at that time. There was a history of progressive bilateral hearing loss in the high frequencies since 1952. There is no record of significant medical complaints after January 27, 1964. His vision defect consisted of a distant vision reading uncorrected of 20/50, corrected to 20/15.

Copilot Walter Julius Gilly, aged 38, was employed by The Pittston Company in June 1968. He held private pilot certificate No. 1383202, with aircraft single-engine land rating. He was not instrument rated.

He had a total flying time of 421:10 hours, of which 227:30 were as copilot and 75:40 as third crewman in the Aero Commander 1121. His total flying time during the last 90 days was 81:25 hours as copilot, of which 2:35 hours were flown in the 24 hours prior to the accident. There is no record of any instrument time, actual or simulated. His most recent second-class physical was issued July 22, 1968, with the limitation that correcting glasses be worn while flying. He held Aircraft and Powerplant Mechanic Certificate No. 1388935.

1.6 Aircraft Information

N236JP was an Aero Commander Model 1121, serial No. 116, with an airworthiness issuance date of October 27, 1967. The aircraft had accumulated a total of 746:45 hours' operating time since new. The two General Electric CJ610-1 engines installed in the aircraft had accumulated 746:45 hours of operating time since new. According to the aircraft records, the last periodic inspection was performed on October 24, 1969, at which time the Nos. 1 and 3 main bearings in No. 2 engine were replaced, and minor foreign object damage was repaired. A hot-section inspection was conducted on both engines. The total time on the aircraft and engines on October 24 was 733:30 hours.

The aircraft records showed that the required inspections had been performed at prescribed time intervals and nonroutine maintenance items had been corrected. Service bulletins and service letters had been complied with, except for Service Bulletin J-7. This bulletin pertains to the installation of fuel shutoff valve switch guards and inspection of fuel supply lines.

N236JP was certificated for a maximum gross takeoff weight of 17,500 pounds. The fuel capacity was 926 gallons. According to fueling records at LaGuardia, 400 gallons of fuel were added before the last flight. The total fuel aboard at takeoff could not be determined; however, the pilot showed 2 hours and 30 minutes of fuel on his flight plan. According to Pittston Company pilots, this is a standard fuel load for the flight from LaGuardia to Tri-City and amounts to about 740 gallons, or 5,000 pounds. ^{2/} Based on a fuel consumption rate of about 300 gallons per hour, it is estimated that about 300 gallons remained at the time of the accident.

1.7 Meteorological Information

According to witnesses, the weather in the Rural Retreat area at the time of the accident was rainy and foggy with low clouds. Some witnesses reported strong winds between 2200 and 2300.

Surface weather charts issued by the U. S. Weather Bureau showed an occluded front extending southeastward from southeastern Minnesota to western Kentucky, and then southwestward to the Gulf of Mexico.

^{2/} Based on a weight of a standard U. S. gallon of kerosene of 6.75 pounds.

In advance of the front, including the accident site, extensive areas of multilayered clouds were reported, with intermittent, mostly light rain. At the time of the accident, these prefrontal conditions had advanced as far eastward as Bluefield, West Virginia, and Greenville, South Carolina. Overcast cloud conditions were being reported by official weather observation stations at Bristol, Tennessee; Bluefield, West Virginia; Hickory, North Carolina; Roanoke, Virginia; Greensboro, North Carolina; and other stations to the north, west, and south of the accident site.

The 1900 Huntington, West Virginia, radiosonde ascent showed very moist air from about 21,000 to 30,000 feet m.s.l. and saturated conditions about 23,000 feet, with high moisture content also indicated from 6,000 to 9,000 feet. The freezing level was at 8,800 feet m.s.l. The 1900 Nashville, Tennessee, ascent showed high moisture content at all levels from near 5,000 feet to above 25,000 feet with saturated air from 6,000 to 16,000 feet. The freezing level was at 8,700 feet m.s.l.

The Weather Bureau forecast available prior to departure from LaGuardia called, in part, for occasional moderate or greater clear air turbulence in a layer 25,000 to 40,000 feet, as well as for occasional moderate turbulence below 9,000 over the mountains of southwestern Virginia. The forecasts called for layered clouds with tops up to 18,000 feet over western Virginia. At 1845, the Weather Bureau at LaGuardia provided a preflight weather briefing for the flight of N236JP.

1.8 Aids to Navigation

Pulaski VORTAC is located approximately 89 nautical miles from Tri-City Airport on a bearing of 070°. The vector of 250° from Pulaski lies approximately halfway between Victor Airway 16 and Victor Airway 16N, passing a mile south of Mountain Empire Airport and 4.5 miles north of the Sugar Grove Intersection.

The Atlanta radar site for the northeast low altitude sector is located at Lynch, Kentucky, about 78 nautical miles west of the accident site. The antenna rotates at 6 r.p.m. MPI $\frac{3}{4}$ circuitry is employed. On the date of the accident, circular polarization was used. The radar display was on the 150-mile range, centered.

1.9 Communications

There were no reported problems with communications.

1.10 Aerodrome and Ground Facilities

Not involved.

1.11 Flight Recorder^s

None installed nor required.

3/ Moving Target Indicator.

1.12 Aircraft Wreckage

There was a "V" shaped depression on either side of the crater, perpendicular to the line of flight. The depression on the left side of the crater, looking toward the direction of flight, extended onto the shoulder of State Road 617. The distance between the ends of these depressions was 43 feet. The left depression contained a foot-long piece of the balance weight and skin from the leading edge center of the left aileron. The crater wall and the sides of the two depressions away from the direction of flight (north) were in line with the broken branches of a tree, forming an angle of 60° to the horizon. The elevation at the point of ground impact is 2,450 feet m.s.l.

The wreckage was almost equally distributed about 200 feet on either side of the wreckage path for a distance of 500 feet forward of the main impact center. Pieces from the left wing and left side of the fuselage were generally on the left of the wreckage path center-line and, correspondingly, pieces from the right side of the aircraft were found on the right of the wreckage path. A crane and a power shovel were used to remove wreckage from the crater.

The major components found in the crater were the two engines, the left landing gear, and the major portion of the empennage. Their position in the crater corresponded to their positions on the aircraft prior to impact. The right landing gear, right aileron, and a portion of the right wing inboard aft of the main spar were located a few feet to the right of the crater.

It is estimated that 99 percent of the aircraft was recovered. Most of the engine instruments and some flight instruments were located along the center of the wreckage path up to 320 feet from the crater, in and on both sides of a creek. Examination of the aircraft components revealed the following:

Structures

a. Fuselage, Wings, and Empennage

Most of the fuselage, wings, and empennage were recovered. There were no indications of major in-flight structural failure.

b. Control Surfaces

All of the control surfaces were recovered at the crash site. Inspection revealed impact failure at the attaching points and impact damage on the leading edges.

c. Control Cable Torque Tubes and Quadrants

The right elevator reducer tube bearing surface (Part No. 5463001-19) had an area of high polish and indications of multiple strike damage from the inner race of the bearing (Part No.

KP21BS). (Service Bulletin J-6 had been accomplished on this aircraft.)

Reconstruction and examination of the remaining control system did not disclose evidence of any in-flight malfunction or failure.

d. Main Landing Gear

- (1) The main landing gear up-locks were recovered undamaged.
- (2) The main landing gear doors separated from the aircraft in flight and were located approximately 2.43 miles from the crash site. The two doors were about 300 feet apart.
- (3) The four main landing gear actuators received extensive impact damage with the pistons in a midcylinder position. This corresponded to a landing gear position between extended and retracted.
- (4) Impact damage to the wheels and brake disc assemblies was from a force against the inside front of each wheel.

e. Nose Landing Gear

The nose gear strut assembly outer cylinder was split open in the area of the trunnion mount, and the inner cylinder was inserted into the outer cylinder up to the axle.

f. Speed Brakes

The left speed brake separated at the piano hinge area and at the actuator rod eye. The actuator was found in the extended position.

The right speed brake also separated at the piano hinge area and at the actuator rod eye. The actuator was attached to the spar and the cylinder was split the entire length, with the piston in a near fully retracted position. The speed brakes are electrically actuated and hydraulically operated.

g. Flaps

The flap surfaces were found in the main wreckage area. The two actuator cylinders were separated, both from the flaps at the rod eye and at the spar attachment. The cylinders were undamaged and the pistons were found in the retracted position. This corresponds to the fully retracted flaps position.

h. Trim

- (1) The aileron tab was still attached to the left aileron and was observed to be in a faired position.

- (2) The rudder tab was separated completely but received symmetrical impact damage on the leading edge.
- (3) The horizontal stabilizer trim actuator separated from the horizontal stabilizer at impact and the actuator was attached to a part of the fuselage structure. The eye of the right actuator rod end was still attached to the horizontal stabilizer. The right actuator was reassembled and the physical measurement between the centers of the attach points was 15.56". Noseup trim limit is 13.99 ± .012" and nosedown trim limit is 16.12 ± .012". The angular relationship of the trim limit switches was measured. From this it was determined that the stabilizer trim was positioned at approximately zero degrees on impact (neutral).

Systems

a. Hydraulics

Inspection of the hydraulic cylinders indicated that fluid was available in the primary hydraulic system at impact.

b. Electrical/Electronics

Most components of both electrical systems were destroyed by impact; however, examination of the recovered components revealed the following:

- (1) The right d.c. 4/ generator and drive shaft did not indicate that any malfunction had occurred prior to impact.
- (2) There was no evidence of an electrical short or fire.
- (3) The filament of the aircraft tail position light, powered by the No. 1 d.c. bus, showed evidence of extensive elongation damage in two directions while in a ductile state.
- (4) Two of the six 28 v.d.c. 5/ operated remote control circuit breakers (RCB's) were found. Damage showed they were in the energized position at impact.
- (5) The 329B-7A Flight Director Indicator and the 331A-6A Course Indicator used in the FD108 received extensive impact damage. These units were taken to the Collins Radio Company plant for disassembly and inspection. The following information was disclosed during disassembly:

Collins 329B-7A Flight Director Indicator - the mechanical attitude display was intact and visible. The indicators were jammed in the following positions:

Bank Attitude - 20° right-wing-down (this presentation will result if 115 v.a.c. 6/power is removed with the aircraft in this attitude).

4/ d.c. - direct current.

5/ v.d.c. - volts direct current.

6/ v.a.c. - volts alternating current.

Pitch Attitude - 90° pitchup (the indicator will move to this position with loss of 115 v.a.c. power).

Mode selector switch - "Heading."

Remaining displays, including pitch command knob, glide slope pointer and flag, localizer pointer and flag, gyro flag, computer flag, inclinometer, and command bars, were either completely missing or so badly deformed that no reliable indications were present.

Collins 331A-6A Course Indicator - the displays were badly deformed and the azimuth card was missing. Disassembly inspection indicated the following:

Course Selector Indicator - 225°.

Heading Selector - about 250° magnetic.

Aircraft Heading - about 235° magnetic.

Distance Measuring Equipment (DME) - 48 nautical miles.

(6) The copilot's Sperry GH102 vertical gyro (Part No. 2595618-400) was indicating wings level and approximately 60° nosedown at impact. This gyro is self-contained and powered from the No. 2 a.c. 7 bus.

(7) The Copilot's Course Indicator (Collins 331A-3F) revealed the following:

Aircraft Heading - 230° to 240° magnetic.

Course selected - between 225° and 250° magnetic.

NAV flag - appeared to have been in the window.

Powerplants

Both engines had sustained extensive fragmentation, and no component was considered sufficiently whole to submit for test. The bullet noses of both engines were evenly displaced axially rearward. The compressor centerlines of both were displaced upward with respect to the turbine centerlines with the No. 1's displacement approximately 5 inches and the No. 2's approximately 2½ inches. Horizontal displacement was not evident on the major assembly alignment.

Axial compression was extensive primarily in the combustion case regions with the No. 2 engine most severe with the turbine case compressed through the combustion case to the plane of the aft flange of the main frame. Neither engine showed evidence of external fire or hot spots.

The engines were examined by representatives of the General Electric Company who concluded that both engines were at a power state of approximately flight idle, when impact occurred, and that there was no evidence to indicate other than normal engine operating capability.

7 a.c. - alternating current.

Part of the engine instruments were recovered along the wreckage path wherein some were impact frozen and were readable as follows:

- (1) Right and left engine tachometers indicated 57 percent r.p.m.
- (2) One exhaust gas temperature indicator needle read slightly less than 400° C.
- (3) Two fuel temperature gages indicated plus 4° C.
- (4) One fuel pressure gage indicated approximately 20 p.s.i.
- (5) One engine oil temperature gage indicated 60° C.

Fuel

A considerable amount of kerosene was found in a pocket of earth beneath the south wall of the crater. In addition, the shovelful of mud taken from the bottom of the crater were saturated with kerosene.

1.13 Fire

There was no evidence of in-flight or ground fire.

1.14 Survival Aspects

This was a nonsurvivable accident.

1.15 Tests and Research

Radar tracking flight tests were conducted on November 17th in the vicinity of the crash site, using a helicopter and a military jet aircraft. The purpose was to determine if the radar controller on duty the night of the accident could confirm the position of the aircraft in relation to Sugar Grove Intersection, when the pilot reported descending through FL 230 and when the aircraft disappeared from the radar screen. The controller's best revised estimate placed the aircraft about 1 mile southeast of the Mountain Empire Airport at FL 230 and about 3 miles west-southwest of the airport when it disappeared from the radarscope. The latter position is 4.5 miles southwest of the accident site.

Radar contact could be maintained on the military jet transponder target above 4,800 feet m.s.l., both climbing and descending.

A detailed system analysis was conducted to determine if pitfalls existed in the total aircraft electrical/electronic systems, which would result in loss of attitude information to the pilot. The system was found to be extremely complex, with backup capability equivalent to that of a commercial transport.

Extensive Jet Commander flight simulator tests and two separate flight tests were conducted in an effort to reveal any obscure deficiencies in the electrical/electronic systems and to check flight characteristics

of the aircraft. It was determined that the aircraft will reach or exceed the limiting airspeed/Mach number rapidly, when the nose attitude goes 10° or more below the horizon. No surprise deficiencies in the electrical/electronic systems were disclosed.

1.16 Pertinent Information

It was learned from Pittston Company pilots that the crew of N236JP was experiencing difficulty with the left a.c. generator system when they landed at LaGuardia prior to the last flight. After landing, the copilot/mechanic requested by a telephone call to another company pilot/mechanic that he be met at Tri-City Airport, because the left a.c. "generator-out" light had come on during the landing at LaGuardia. He said he didn't know if it was caused by a loose connection or by a shaft failure, and, if required, he wanted some assistance and a special wrench with which to remove the generator when the flight arrived at Tri-City Airport.

This aircraft was equipped with a 250 v.a. ^{8/} static inverter to provide essential 115 v.a.c. power to the pilot's essential flight instruments in the event the aircraft a.c. power system failed. The static inverter is powered by 28 v.d.c. from the pilot's radio essential bus. The pilot's radio essential bus is normally connected to the battery bus, but can be shifted to the No. 1 d.c. bus. The static inverter provides 115 v.a.c. to the pilot's Flight Director System, the 26 v.a.c. instrument transformer and the other essential 115 v.a.c. requirements. The pilot's Flight Director System operation can be maintained as long as any 28 v.d.c. is available in the aircraft.

In the event of failure of either a.c. generator, the other a.c. generator takes over automatically, providing the faulty generator switch remains "on." Either a.c. generator is capable of carrying the entire a.c. load at approximately 80 percent of generator capacity. If the left a.c. generator fails and that generator switch is turned "off," the static inverter switch must then be turned "on" to get a.c. power to the pilot's essential flight instruments.

The copilot's vertical gyro is powered by the No. 2 115 v.a.c. constant frequency bus. This instrument cannot receive a.c. power from the static inverter but must receive a.c. power from an operating a.c. generator. The attitude information on this gyro is reliable for a period of 5 to 7 minutes after the removal of all 115 v.a.c. electrical power. Examination showed that this instrument was displaying an accurate indication at impact.

2. ANALYSIS AND CONCLUSIONS

2.1 Analysis

An evaluation of all the evidence indicates that the crew experienced a loss of electrical power about a minute after their last transmission and the aircraft crashed approximately 1 minute later.

^{8/} v.a. - volt ampere.

The last transmission from the crew was at 2207:15, when they reported descending through FL 230. The radar controller, watching the aircraft's progress on his radarscope, observed the disappearance of the radar target at 2209:20 at a location approximately 3 miles west of the point where the crew reported descending through FL 230. (The point at which the target disappeared is 3 to 4 miles west or to the right of the track the aircraft was making good between Pulaski and Tri-City.)

The computed angle of impact at which the aircraft struck the ground was approximately 60°. This angle coincides with the reading on the copilot's Sperry GH102 vertical gyro, which indicated wings level and 60° nose-down at impact.

The loss of electrical power occurred while the aircraft was on a heading of approximately 235° as indicated on both directional gyros. The pilot's Flight Director Indicator (FDI) showed a pitch attitude of 90° nose-up. This is the resultant presentation when 115 v.a.c. power is removed. It also showed a 20° right-wing-down attitude. The FDI will retain a 20° right-wing-down attitude if 115 v.a.c. power is removed during a 20° right bank. This failure of the Flight Director System (FDS) indicates that it was not receiving power from either a.c. generator bus or from the static inverter.

Failure or malfunction of one a.c. generator while in flight would normally not present a problem because the other a.c. generator will automatically take over the entire a.c. electrical load, providing the failed generator's switch is not turned off.

The left generator-out light came on during the landing at LaGuardia. The reason for the apparent malfunction is not known nor is it known if the left generator was functioning at takeoff. Had the crew departed with an inoperative left generator and subsequently experienced a failure of the right generator, they would have been aware of the source of trouble and would most likely have turned on the static inverter to regain power on the flight instruments. The system is designed so that in the event one a.c. generator fails or malfunctions, the other a.c. generator assumes the entire a.c. load, provided the switches are left on. If the left a.c. generator-out light came on, indicating a failure, and the crew turned off the left a.c. generator switch, the right a.c. generator would not assume the load. However, the static inverter would supply a.c. power to the Flight Director System, providing the static inverter switch was turned on. The fact that the FDS was not getting power from either of the a.c. generators or the static inverter indicates: (1) a failure of all three power sources, or (2) that the crew mis-managed the electrical system following the failure of either the left a.c. generator or both left and right a.c. generators. A failure of all three power sources is most unlikely.

The facts indicate that the loss of electrical power occurred suddenly and that the static inverter was not employed to provide alternate 115 v.a.c. power to the pilot's essential instruments. The static inverter is powered by 28 v.d.c. from the pilot's radio essential bus. Normally, the pilot's radio essential bus is connected to the battery bus, but it can be shifted to the No. 1 d.c. bus. The static inverter provides 115 v.a.c. to the pilot's Flight Director System, the 26 v.a.c. instrument transformer, and other essential 115 v.a.c. requirements. The significance of this is that the pilot's FDS operation can be maintained as long as any 28 v.d.c. is available in the aircraft. The extended speed brakes, the tail position light, and the remote circuit breakers (RCB's) all indicate the availability of a 28 v.d.c. power source.

The copilot's Sperry GH102 vertical gyro receives power from the No. 2 a.c. bus and does not receive a.c. power from the static inverter. This instrument was indicating properly at impact; however, it will provide reliable information for 5 to 7 minutes if electrical power is suddenly removed. This indicates that at least one of the two a.c. generators was functioning at the moment of impact or the total a.c. power failure occurred shortly before impact. Failure of both a.c. generators and the static inverter is considered highly remote in view of (1) the lack of any indications of other than normal flight up to the crew's last transmission that the aircraft was descending through FL 230, and (2) the electrical systems are independent of each other and provide redundancy of operation.

The pilot's and copilot's course indicators lost compass and directional gyro information at the same time, since each instrument displayed a heading of approximately 235° when disassembled. This compares with an actual heading at impact of approximately 170°. This also indicates the loss of the 26 v.a.c. reference voltage to the indicators in flight. The 26 v.a.c. transformers supplying the reference voltage receive electrical power from the No. 1 115 v.a.c. constant frequency bus.

Normal procedure prior to penetrating cloud conditions is to turn on anti-icing equipment. This additional electrical load may have been enough to fail an already malfunctioning a.c. generator or it may have overloaded a single functioning a.c. generator, causing it to cut off. Had the former occurred, no emergency would have existed; however, the crew might have suspected that one existed and turned off the switch of the failed generator as a corrective measure. This action would have removed 115 v.a.c. power from the FDS. On the other hand, if one generator were inoperative and the other became overloaded and cut off, it is conceivable that the crew might have lost control of the aircraft while attempting to restore power.

A loss of control is evidenced by the fact that the aircraft, which was already in a 20° right bank when the power went off, went

into a high-speed dive to the right from which the pilot could not recover without instrument reference.

2.2 Conclusions

(a) Findings

1. The crew was properly certificated for the flight involved
2. The aircraft was properly certificated.
3. The weight and balance and center of gravity of the aircraft were within limitations at departure from LaGuardia and at the time of the accident.
4. Weather conditions near the accident site were IFR with layered clouds up to 18,000 feet and little or no visible horizon above that altitude.
5. There was no fire in flight nor on the ground.
6. There was no structural failure during the flight other than the loss of landing gear doors.
7. There was no malfunction or failure of the flight control system.
8. There was no evidence of crew incapacitation although no post-mortem examinations were conducted.
9. The left a.c. generator malfunctioned or became inoperative in flight.
10. Electrical power was not continuously supplied to the pilot's (captain's) essential flight instruments, particularly the Flight Director System. This could have been accomplished by:
 - a. either leaving the left generator switch on, thus allowing the right generator to assume the load;
 - b. or, if the left generator switch is turned off, turning on the static inverter switch.
11. At the time of the a.c. electrical power loss, the aircraft was in a 20° right bank.
12. The aircraft impacted the ground with the engines at idle power, the speed brakes extended, and the landing gear partially extended.

13. The aircraft turned right approximately 280° and descended from approximately 18,000 feet above the ground in the last minute of flight, as evidenced from the position of the landing gear doors 2.4 miles northwest of the crash site.
14. The pilot attempted to slow the aircraft and regain control during the dive by reducing power to idle, extending the speed brakes, and lowering the landing gear.

(b) Probable Cause

The Board determines that the probable cause of this accident was that, following a malfunction or failure in the 115-volt alternating current electrical system, the crew did not take proper action, resulting in the loss of the pilot's flight instruments in instrument flight conditions and subsequent loss of control.

3. RECOMMENDATION

As a result of this investigation, Commodore Aviation, Inc., is changing the emergency procedures section of the Jet Commander flight manual to provide a warning that the generator switch of a failed generator must stay in the "ON" position to maintain the automatic load transfer function.

This accident points up the need for owners and pilots of aircraft to be informed of the installation and utilization of complex avionics equipment. Aircraft maintenance and flight manuals should be updated by supplemental documentation whenever avionics modifications are made to the aircraft. This is not now being done on a standardized basis. Activities installing supplemental type certificate (STC) modifications should be required to provide the owner of the aircraft with appropriate instructions for the proper operation and maintenance thereof.

The Board, therefore, recommends that:

The Administrator, Federal Aviation Administration, take necessary action to assure that all avionics modifications to aircraft, and their proper use, be documented as amendments to the maintenance and flight manuals and that this information be disseminated to aircraft owners and pilots.

BY THE NATIONAL TRANSPORTATION SAFETY BOARD:

/s/ JOHN H. REED
Chairman

/s/ OSCAR M. LAUREL
Member

/s/ FRANCIS H. McADAMS
Member

/s/ LOUIS M. THAYER
Member

Isabel A. Burgess, Member, did not participate in the adoption of this report.

September 9, 1970.

INVESTIGATION AND HEARING

1. Investigation

The Board received notification of the accident at approximately 0940 e.s.t., on November 1, 1969. The Investigator-in-Charge was dispatched immediately to the scene from the Washington Field Office at Dulles International Airport with technical assistance from Washington, D. C. Working groups were established for operations, witnesses, structures, powerplants, aircraft and maintenance records, systems, and human factors. Parties to the investigation were The Pittston Company, the Federal Aviation Administration, Commodore Aviation, Inc., and General Electric Company. The on-scene phase of the investigation was completed in about 7 days because of fragmentation of the aircraft and the need for utilization of a crane and shovel in the salvage operations. Extensive tests, research, and failure analyses were continued for several months thereafter at headquarters and other locations.

2. Hearing

There was no public hearing.

3. Preliminary Reports

An interim report of investigation summarizing the facts disclosed by the first phase of the investigation was published on January 27, 1970.