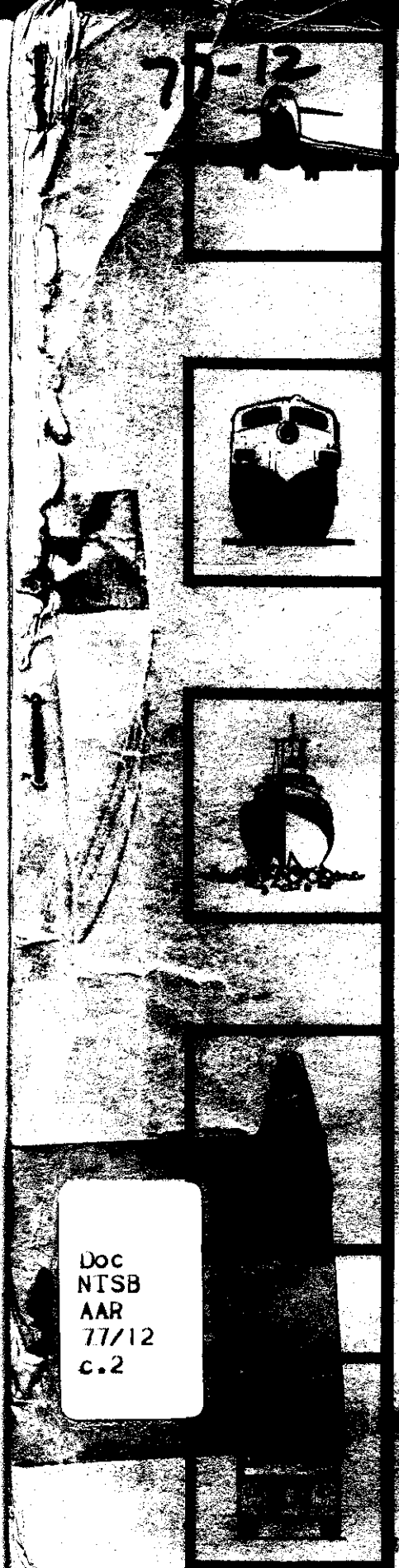

NATIONAL TRANSPORTATION SAFETY 'BOARD

WASHINGTON, D.C. 20594

AIRCRAFT ACCIDENT REPORT

ATLANTIC CITY AIRLINES, INC., DeHAVILLAND DHC-6, TWIN OTTER, N101AC

CAPE MAY COUNTY AIRPORT, NEW JERSEY

DECEMBER 12, 1976

REPORT NUMBER: NTSB-AAR-77-12

UNITED STATES GOVERNMENT

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15. Supplementary Notes

16. Abstract About 2326 e.s.t. on December 12, 1976, an Atlantic City Airlines, Inc. DeHavilland DHC-6 Twin Otter, operating as Allegheny Commuter Flight 977, crashed about 4,000 feet short of the approach end of runway 19 at Cape May County Airport, New Jersey. The flight was making a VOR approach to runway 23 with a circle to land on runway 19. Of the 10 persons aboard, 4 died of injuries received in the crash. The aircraft was destroyed.

About 10 minutes before the accident, according to official observation logs, a Cape May County Airport the sky was obscured with a 400-foot indefinite ceiling; the visibility was 1 mile in fog; and the wind was from 250° at 6 kns. Visibility was 1 mile to the south and west and 1 1/2 miles to the east and north.

The National Trsnportation Safety Board determines that the probable cause of this accident was the flightcrew's 'lack of altitude awareness during a circling approach which permitted the aircraft's flightpath to deviate below a safe approach profile. The aircraft's rate of descent and descent flightpath angle increased as a result of wind shear encountered during the visual approach below minimum descent altitude. The flightcrew did not recognize these flightpath deviations because they were relying on visual references-which were degraded by nonhomogeneous foe and on kinesthetic cues which were adversely affected by the aircraft's forward center of gravity resulting from the improperly loaded aircraft. Contributing to the accident was the lack of company procedures requiring altitude-callouts during the visual portion of an instrument approach.

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SYNOPSIS

About 2326 e.s.t. on December 12, 1976, an Atlantic City Airlines, Inc., DeHavilland DHC-6 Twin Otter (N101AC) operating as Allegheny Commuter Flight 977, crashed about 4,000 ft short of the approach end of runway 19 at Cape May County Airport, New Jersey. The flight was making a VOR approach to runway 23 with a circle to land on runway 19. Of the 10 persons aboard, 4 died of injuries received in the crash. The aircraft was destroyed.

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1. FACTUAL INFORMATION

1.1 History of Flight

Allegheny Commuter Flight 977, an Atlantic City Airlines, Inc., DeHavilland DHC-6 Twin Otter, operated as a scheduled passenger flight from Philadelphia, Pennsylvania, to Cape May County Airport, New Jersey, with an intermediate stop at Bader Field, Atlantic City, New Jersey. Atlantic City Airlines operated the flight under 14 CFR 135, and as a contract replacement carrier for Allegheny Airlines, Inc., under authority of the Civil Aeronautics Board.

Flight 977 departed Philadelphia International Airport about 2235 1/ on December 12, 1976, with 13 passengers and 2 crewmembers aboard. About 2250, the flight made an instrument approach to Bader Field but executed a missed approach because poor weather prevented a landing. Flight 977 then proceeded to National Aviation Facilities Experimental Center (NAFEC), Atlantic City, New Jersey, and landed about 2300.

After discharging five passengers and off-loading about 160 pounds of baggage, Flight 977 departed NAFEC on an instrument flight rules flight plan about 2308. Atlantic City approach control cleared Flight 977 to proceed to the Sea Isle VORTAC 2/ at 2,000 ft 3/. At 2313:04, Atlantic City approach control cleared Flight 977 to cross Sea Isle at 1,600 ft and cleared the flight for a VOR instrument approach to Cape May County Airport. Flight 977 acknowledged the clearance.

At 2321:23, Atlantic City approach control requested that Flight 977 report its arrival time at the Cape May County Airport to the Millville, New Jersey, Flight Service Station. At 2322:48, Atlantic City approach control advised the flight that it was 3 miles southwest of Sea Isle and that radar contact had been lost. The flight did not acknowledge either of these transmissions.

The Atlantic City Airlines station manager at the Cape May County Airport was also a certificated weather observer. He stated that about 2315 he made an official weather observation in preparation for Flight 977's arrival. He recorded the weather as: Sky--obscured, 400-ft indefinite ceiling; visibility--1 mi in fog; wind--250° at 6 kns; altimeter--29.74 in.; visibility--1 mi to the south and west and 1 1/2 mi to the north and east. About 2317, he passed this information by company radio to Flight 977. He said that he also told the flight that the ceiling and visibility were decreasing and then asked the captain, "Are you sure you want to give it a try?" According to the station manager, the captain replied that he would try the approach.

1/ All times are eastern standard based on the 24-hour clock.
2/ VHF omnidirectional range and tactical navigation aid which served as the VOR instrument approach aid for the Cape May County Airport.
3/ All altitudes herein are mean sea level unless otherwise specified.

Several minutes later, the station manager went outside the terminal building and saw that the weather was worsening. He estimated that the ceiling was about 200 ft and the visibility was about 1/2 mi; he saw fog rolling over the top of the terminal building. He later testified that he did not pass this information to Flight 977 because the flight was already **on** final approach and, therefore, **in** his opinion, was in compliance with Federal Aviation Regulations. 4/ About 2326, the station manager heard two small explosions north of the airport.

A short time later, the station manager was notified by the airport security guard that a crash had been reported north of the airport. The station manager initiated crash notification procedures, About 2340 he noted that the fog had lifted and the visibility had increased to 3 to 4 miles. He thought the surface wind was out of the northwest and had increased to 20 to 30 kns. He did not make an official observation because he was too busy notifying crash/fire/rescue facilities and company officials.

Several surviving passengers recalled that the flight from NAFEC was turbulent, and that they were informed by means of the lighted "seatbelts fastened" sign to keep their seatbelts fastened. None of the surviving passengers saw any objects **on** the ground during the latter portion of the flight. According to one passenger, just before impact, he noted that speed was reduced and that the aircraft wobbled slightly. He looked out the window and saw dense fog. He then heard the first sounds of impact with the trees.

There were **no** witnesses to the accident. However, a local water company employee, who was **in** a trailer-office about 1,700 ft east of the crash site, stated that he heard the aircraft pass north and west of his position; he then heard brief intermittant sounds from the engines followed by silence. He was certain that the aircraft had crashed, ***so*** he went outside the trailer to look for it. He expected to see fire but saw none. He could not see the tops of trees near the trailer because of fog. He estimated that the trees were about ***80*** ft high. Also, he could not see the lights of automobiles traveling toward him on a nearby highway until they were about ***800*** ft from him. He got into his automobile and drove toward the airport. When he was near the north end of runway 19, he met a police car and he stopped to

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4/ 14 **CFR** 135.111(b). If an instrument approach procedure **is** initiated when the latest weather report indicates that the prescribed visibility minimums exists and a later weather report indicating below minimum conditions **is** received after the airplane...is **on** final approach using a radio range station or comparable facility and has passed the appropriate facility and has reached the authorized MDA...such approach **may** be continued and a landing made provided the pilot **in** command upon reaching the authorized MDA...finds that actual weather conditions are equal to or better than prescribed minimums.

discuss the probable location of the crash site with the police officer. At that time, he could see the runway lights along the full length of runway 19, and he estimated that the visibility was about 1 mile. About 20 minutes later, while he was near the crash site directing a U.S. Coast Guard helicopter to the site, he noticed that the fog had dissipated and that the visibility had improved considerably.

The accident occurred at night at an elevation of about 6 ft, and at latitude 39° 01' N. and longitude 74° 54' W.

1.2 Injuries to Persons

Injuries	Crew	Passengers	Other
Fatal	1	2	0
Serious	1	6 5/	0
Minor/None	0	0	0

1.3 Damage to Aircraft

The aircraft was destroyed.

1.4 Other Damage

Numerous trees were destroyed or damaged.

1.5 Personnel Information

Both pilots were qualified as captains with Atlantic City Airlines, and they were certificated for the flight. (See Appendix B.) They had been on duty about 8 1/2 hours at the time of the accident. The designated pilot-in-command was seated in the right-hand (copilot's) seat and the designated first officer was seated in the left-hand (pilot's) seat. The first officer was flying the aircraft. Both pilots had been off duty the required time before they reported for duty on December 12, 1976.

The pilot-in-command could not remember anything associated with his flight activities on the day of the accident. He stated that normal operating procedures permitted the pilots to alternate seats for the purposes of dividing the workload and maintaining proficiency in situations where two captains were assigned to the flight.

5/ One passenger died 1 month after the accident. This passenger was not listed as a fatality because 14 CFR 830.2 defines fatal injury as one which results in death within 7 days of the accident.

According to the pilot-in-command, both he and the first officer had flown the circling approach to runway 19 at Cape May County Airport many times at night. He could not remember any details of the approach on the night of the accident, but he stated that he normally used 10" of flaps for the approach and landing and maintained **100** to 105 kns throughout the circling maneuver. He stated that **in** his experience, Atlantic City approach control usually lost radar identification of the flight when the aircraft was between **800** ft and **500** ft in the descent to minimum descent altitude (MDA) and that two-way radio communications with the flight were lost when the aircraft was near **500** ft.

1.6 Aircraft Information

NlOlAC was owned and operated by Atlantic City Airlines, Inc. It was certificated and maintained in accordance with Federal Aviation Administration (FAA) regulations and requirements. (See Appendix C.)

The aircraft weighed about 9,666 lbs at the time of the accident, which was within prescribed weight limitations. However, its center of gravity (c.g.) was at 15.4 percent mean aerodynamic chord (MAC), which was about 4.6 percent forward bf the forward c.g. limit.

According to the aircraft load schedule, which was recovered from the wreckage, the aircraft's weight at takeoff from NAFEC was 9,763 lbs with a c.g. of 29 percent MAC, the rear baggage compartment contained 188 lbs of baggage, and the forward baggage compartment was empty. The schedule also showed that the passengers were seated farther aft than their positions determined from the investigation. However, examination of the wreckage disclosed that the forward baggage compartment contained about 190 lbs of baggage and that the rear compartment was empty. According to the ramp agent at NAFEC, he unloaded all the baggage from the rear compartment at NAFEC because this baggage belonged to the five passengers who deplaned there. One of the pilots had told him that the baggage in the forward compartment was for the passengers destined for Cape May County Airport.

According to fuel records, flight times, and fuel consumption rates, NlOlAC had about **700** lbs of jet-A fuel **on** board at the time of the accident.

1.7 Meteorological Information

National Weather Service (NWS) synoptic charts for **2200 on** December **12,** 1976, showed a cold front oriented along a northeast-southwest line from eastern New York through eastern West Virginia to western North Carolina. The front was projected to move eastward to a position along a line from west-central Long Island through southeastern New Jersey to southeastern Virginia by **0100 on** December 13, 1976.

The surface weather observations at the following locations and times were:

Bader Field

2200 - Sky--estimated 500 ft overcast; visibility--1 1/4 miles in moderate rain and fog; temperature--38° F; dewpoint--37° F; wind--240° at 5 kn; altimeter--29.81 in.

2300 - Sky--estimated 500 ft broken and 600 ft overcast visibility--1 1/4 miles in moderate rain and fog; wind--250° at 8 kn; altimeter--29.81 in.

Cape May County Airport

2315 - Sky--obscured, 400-ft indefinite ceiling; visibility--1 mile in fog; temperature--49° F; dewpoint--48° F; wind--250° at 6 kn; altimeter 29.74 in.; remarks--visibility 1 mile south and west, 1 1/2 miles east and north.

NAFEC

2258 - Sky--measured 400-ft broken ceiling, 4,500 ft overcast; visibility--2 1/2 miles in fog; temperature--47° F; dewpoint--44" F; wind--260° at 12 kn; altimeter 29.69 in.

2331 - Sky--400 ft scattered, estimated 4,500 ft overcast; visibility--7 miles, wind--270° at 12 kn with gusts to 18 kn; altimeter--29.70 in.

Bader Field and Cape May County Airport had Supplementary Aviation Weather Reporting Stations (SAWRS). Employees of Atlantic City Airlines, who are certificated by the NWS to make weather observations, operated these stations. The weather observations taken by these employees were for the exclusive use of Atlantic City Airlines and were taken irregularly according to the company's need. They did not report, nor were they required to report, these observations to the NWS.

The Atlantic City Airlines employees who took the weather observations at Bader Field and Cape May County Airport on December 12, 1976, were certificated and qualified in accordance with NWS regulations.

The NWS did not issue terminal forecasts for either Bader Field or Cape May County Airport. The NWS Forecast Office in Boston, Massachusetts, issued a forecast at 1642 for NAFEC which was valid for a 24-hour period beginning at 1700. This forecast was, in part:

1700 - 0300 - Scattered clouds at 500 ft, and a ceiling of 4,500 ft overcast variable to 500 ft broken; visibility 2 mi in fog.

At 2115, the forecast was amended for the period 2100 on December 12 to 1700 on December 13, 1976. The amended forecast, was, in part:

2100 - 0300 - Ceiling at 200 ft, sky obscured; visibility 1/2 mi in fog, with the ceiling variable to 500 ft broken, 1,000 ft overcast and visibility to 1 1/2 mi in fog.

During the evening of December 12, 1976, FAA pilots and technicians operated an instrumented Aero Commander on instrument approaches to NAFEC as part of a wind shear data collection and measurement 'program. They made the last approach between 2247 and 2249 and recorded the following data:

Altitude (ft)	Wind Direction/Speed (kns)
1,000	265°/40
900	261°/35.0
800	264°/34.5
700	272°/25.2
600	271°/22.0
500	244'124.3
400	248°/19.9
300	248°/14.4
200	251°/15.6
100	285°/9.0
34	259'16.0

During the investigation, an FAA meteorologist interpreted the data collected. He identified two distinct layers of wind shear: One between 950 ft and 610 ft with a shear of 12 kns in the layer, and the other between 580 and 370 ft with a shear of 10 kns in the layer. He classified both shears as moderate in accordance with criteria set forth at the International Civil Aviation Organization's Fifth Air Navigation Conference.

The Superintendent of Meteorology for Northwest Airlines, Inc., testified that Northwest Airlines had issued a wind shear forecast for the evening of December 12, 1976. This forecast involved airports in Washington, D.C., and Philadelphia, Pennsylvania, during the period 1515 to 2100, and was based on Northwest's identification of a warm front which formed south of Washington, D.C., and moved rapidly northeastward. Northwest's later analysis showed that the warm front passed the Cape May County Airport about 2340 and that it was moving at an average speed of 40 kns. At that time, the cold front shown on Northwest's charts and the NWS's charts was about 50 mi west of the Cape May area.

1.8 Aids to Navigation

Cape May County Airport had one VOR instrument approach procedure. This approach was based on the Sea Isle VORTAC, which provided a straight-in approach capability to runway 23. (See Appendix D.) The MDA for this approach was 440 ft for Atlantic City Airlines aircraft. Since runway 23 was not equipped with runway lights, from a VOR instrument approach at night, pilots were required to circle to land on runways equipped with runway lights. The MDA for circling approaches to all runways was 480 ft for Atlantic City Airlines' aircraft and the visibility minimums were 1 mi.

1.9 Communications

Cape May County Airport is an uncontrolled airport. Flight 977's only en route communications were with Atlantic City approach control and the company. There were no communications problems with Atlantic City approach control, and company personnel stated that there were no problems in their communications with Flight 977.

1.10 Aerodrome and Ground Facilities

Cape May County Airport is about 5 mi northwest of Wildwood, New Jersey. The airport has 4 runways--1-19, 5-23, 10-28, and 14-32. The first three runways are 5,000 ft long and the latter is 4,000 ft long. All runways are 150 ft wide and have asphalt surfaces. Airport elevation is 22 ft.

Runway 1-19 was equipped with high intensity runway lights and runway 10-28 was equipped with medium intensity runway lights. The other runways had no lights. Runway 10-28 was closed for construction and was not lighted. None of the runways was equipped with approach light systems.

Runway 1-19 was equipped with nonstandard visual approach slope indicators (VASI). The VASI for runway 19 was a 2-box configuration. The boxes were located 75 ft from the left side of the runway and 500 ft and 1,200 ft from the threshold, respectively. The visual approach slope was 3° and the approach slope intercepted the runway 850 ft from the threshold of runway 19. In the plane of the visual approach slope, the full complement of VASI lights was visible within about a 15° angle of either side of a line parallel to the runway centerline and connecting the centers of the two boxes.

1.11 Flight Recorders

Flight recorders were not installed in the aircraft, nor were they required.

1.12 Wreckage and Impact Information

N101AC's right wing first struck a tree at an elevation of 63 ft; the outboard 5 ft of this wing was severed. The aircraft struck numerous other trees while it continued to descend to the ground. It came to rest about 267 ft from the point of initial impact, and its final descent angle was about 12°. The first trees struck by N101AC were about 3,900 ft north of the threshold of runway 19 and about 746 ft east of its extended centerline. The aircraft's path through the trees was aligned about 238° from magnetic north.

From damage to trees, it was determined that the aircraft was in a 10° left bank when it struck the first two trees. Both wings separated from the fuselage at the wing root fittings. The wing flaps were extended to 10°.

Except for the cockpit, the occupiable area of the fuselage remained essentially intact. The cockpit roof and its supporting structure were crushed aft. The windshield had separated from the aircraft. The area on the left side of the cockpit had been penetrated by trees, which demolished the left side of the cockpit structure including the left instrument panel area. The cockpit bulkhead behind the left pilot seat was displaced aft into the cabin and exhibited severe vertical compressive buckling. The left pilot seat was displaced to the right; the left side of the seat pan was compressed rearward and had collapsed downward. The right pilot seat was partially detached from its supporting structure and also had collapsed downward. All passenger seats remained in their relative positions. The occupied seats exhibited a variety of typical overload failures such as sheared floor track fittings and bent or collapsed legs. None of the seatbelts had failed.

The empennage was attached to the tail cone, which had been displaced 90° to the right. The right horizontal stabilizer and its elevator and the vertical stabilizer were intact. The left horizontal stabilizer was separated about 25 ins outboard of the stabilizer root. The elevator control system was intact and continuous except for separation of the push rod and pulley bracket from the control column.

Both engines were separated from their respective wings. The propellers and all accessories remained with the engines. The left propeller was in the feathered position; however, the blades had twisted in their clamps, and scratches and dents on the inner surface of the left spinner matched the counterweights when the blades were between 45" and 50°.

The power turbine cases and exhaust cases of both engines were distorted. The outer shrouds around the turbine blades and the outer seals in the turbine cases were heavily rubbed. The reduction gears, gas generator turbines, and compressors were undamaged.

On the left propeller, the spring retainer pilot was broken at the forward end. The three blades had dents around the pilot holes on the butt ends of the blades. When the dents on one of the'bladeswere aligned with a matching mark on the propeller hub, the blade was at an angle of 41.

The three blades of the right propeller had dented areas around the pilot holes which matched similar areas on the hub bosses at blade angles of 41°, near feather, and less than 10°, respectively. A mark on the oil transfer tube matched the forward end of the spring retainer at 2 7/8 in. from feather and the aft end of the retainer at 1 in. from feather.

The Pitot-static system was examined. The static ports and lines were unobstructed. The drain traps in the pitot pressure lines were clear. The altimeters could not be functionally tested because of internal damage. The barometric scale on the pilot's altimeter was at 29.62 in. The front of the instrument remained in the instrument panel, but the case was free. The pointers indicated 8,330 ft. The barometric scale on the copilot's altimeter was at 29.70 ins. The instrument glass was broken and the case was cracked. The pointers indicated 1,600 ft.

The battery was in place and undamaged; its voltage was 26.7 to 26.8 volts. Both static inverters were intact and undamaged.

The antenna for the emergency locator transmitter (ELT) was broken. The ELT functioned, but its signal was weak.

The No. 1 COM/NAV receivers were set at 124.60 MHz, the Atlantic City approach control frequency and 114.80 MHz, Sea Isle VOR frequency. The No. 2 COM/NAV receivers were set at 113.00 MHz, the company frequency, and 114.80 MHz. All receivers operated satisfactorily during functional tests. The distance measuring equipment (DME) control panel. was set at 114.80 MHz. The function selector switch was on "miles." The electronic' range indicator display was blank.

The heading pointer on the pilot's directional indicator was indicating 242°. The heading pointer on the copilot's instrument was indicating 255°. The pilot's course indicator was at 233°; the copilot's course indicator was at 230°.

1.13 Medical and Pathological Information

The first officer and two passengers were fatally injured. The first officer received crushing type injuries to the chest causing a laceration of the heart and a rupture of the aorta. He also had multiple skull fractures and spinal injuries. Toxicological examinations of the first officer disclosed no ethyl alcohol, drugs, or carbon monoxide.

One of the fatally injured passengers was seated in the first row of seats on the left side of the cabin and directly behind the displaced cockpit bulkhead. This passenger received an extensive contre-coup type brain injury and crushing type chest injuries. The other fatally injured passenger was seated in the second row of seats on the right aisle side. This passenger had multiple fractures of the left ribs with laceration of the left lung--he died about 44 hours after the crash.

The captain and six passengers survived the accident with severe injuries. The captain received multiple severe lacerations of the scalp, fractures of the right leg and right scapula, and internal injuries. The passengers received progressively less severe injuries the farther aft their seat locations. The most severe injury was received by the passenger in the first row on the right side--he suffered a traumatic contusion of the brain. He was comatose and never regained consciousness. He died 1 month after the crash.

The other surviving passengers sustained rib fractures, fractured legs, and severe scalp lacerations. One of these passengers, who was seated in the second row on the left, had his head on his knees when the crash occurred because he felt airsick. His most serious injury was a depressed nasal bone fracture.

1.14 Fire

There was no fire.

1.15 Survival Aspects

Survivability in the cockpit was marginal because the left side was penetrated by trees which destroyed the structural integrity of that area of the cockpit. However, the right side of the cockpit and all of the passenger area remained relatively intact; the seats remained in their relative positions; and there were no seatbelt failures. All passengers were seated in the first 4 rows in the cabin.

Although a considerable amount of fuel escaped from ruptured tanks, there was no fire. Had fire ensued, at least four severely injured passengers would not have escaped from the aircraft. The pilot's seats were not equipped, nor were they required to be equipped, with shoulder harnesses.

Middle and Lower Township police departments were notified of the accident about 2335. Search parties and rescue personnel were notified, including the U.S. Coast Guard Station at Cape May. Rescue personnel found the wreckage about 30 minutes later and gave first aid to the survivors. A U.S. Coast Guard helicopter arrived at the scene about 0004 and provided

overhead illumination from a "night sun" spotlight on the helicopter. The helicopter was unable to land or otherwise provide rescue assistance because of the trees which covered the area. The survivors were carried out of the wooded area on stretchers and were transported to hospitals in ambulances.

1.16 Tests and Research

None

1.17 Other Information

1.17.1 Company Operational Information

Neither Atlantic City Airlines' DCH-6 Flight Manual nor its Operations Manual contained recommended procedures for either straight-in instrument approaches or circling approaches. A company line pilot testified that on a typical nonprecision instrument approach, he would fly the aircraft at an indicated airspeed of 120 kns from the final approach fix (FAF) until he leveled the aircraft at MDA and was about 1 1/2 mi from the missed approach point *(MAP).* At that point, he would reduce the airspeed to 100 kns and then extend the wing flaps to 10°. When the aircraft was 1 mi or closer to the runway threshold, and he had the runway in sight, he would extend the flaps to 20° and reduce the airspeed to **80** or **85** kns. He would maintain that airspeed until he began the roundout for landing.

On a circling approach, this pilot stated that he would begin the circling manuever at MDA when the airport was in sight and the aircraft was about **1** mile **or** more from the runway threshold. He would maintain 100 kns airspeed and MDA until the aircraft was nearly aligned with the landing runway. At that point, he would extend the flaps to 20°, reduce the airspeed to about **85** kns, and begin to descend below MDA.

The company Operations Manual provided: "Before starting every approach, the Captain will first call for the landing checklist. Upon completion of the checklist, he will brief the Co-pilot on the approach he plans to use and procedures he intends to follow including...

IFR - (a) type of approach and landing runway,

(b) approach speed and expected point and degree of flap extension,

(c) MDA or DH, and

(d) missed approach procedures if a miss is a possibility.

"The Co-pilot will assist the Captain in accomplishing the planned procedures including monitoring the aircraft's progress on the approach. The Co-pilot will review and familiarize himself with the proposed approach and provide a continual cross-check for the Captain. During the approach the Co-pilot will call out altitudes at 1,000 ft above minimums, 500 ft above minimums and every 100 ft after 500 ft until MDA or DH has been reached. When weather at a destination airport is at or near minimums and a missed approach is a possibility, the Captain will thoroughly brief his Co-pilot...."

The company Operations Manual contained no guidance or procedures concerning altitude awareness during visual flight below MDA or DH.

The Airman's Information Manual (AIM), Part 1, July 1976, contained the following discussion regarding circling minimums:

> "The circling minimums published on the instrument approach chart provide adequate obstruction clearance and the pilot should not descend below circling altitude until the aircraft is in a position to make final descent for landing. Sound judgment and knowledge of his and the aircraft capabilities are the criteria for the pilot to determine the exact maneuver in each instance since airport design and the aircraft position, altitude, and airspeed must all be considered."

The AIM specified that the pilot is not restricted from passing over the airport or other runways during the circling maneuver. The AIM further specified that "If visual reference is lost while circling to land from an instrument approach, the missed approach specified for the particular procedure must be followed (unless an alternate procedure is specified by Air Traffic Control)."

The FAA principal operations inspector who was assigned to Atlantic City Airlines testified that he had inspected the company's operations for many years. However, during that time he had not checked any of the weight and balance computations for accuracy. Similarly, although Part 135 Operations Bulletin 75-4, issued October 14, 1975, required that the inspectors review commuter operators initial and recurrent training programs to insure that all aspects on wind shear were included in the programs, the inspector stated that he had not checked to see that such a training program had been established. The company% director of flight operations stated that no formal wind shear training program existed.

1.17.2 Performance Data and Analysis

Based on airplane performance characteristics, on several hypotheses about the nature of the wind conditions in the Cape May area, and on the airplane's approach profile and configuration, the possible effects of wind shear on the airplane's approach profile were assessed.

The assumptions regarding conditions on the initial approach were: A DHC-6 weighing 9,666 lbs, trimmed for zero pitch control force, descending wings-level at 500 fpm with wing flaps extended to 10° and at an indicated airspeed of 100 kns into a steady headwind of 25 kn. Additionally, while circling during the descent, the airplane suddenly encountered a wind shear characterized by a headwind decrease of 5 kns per 100 ft of descent. By applying the laws of motion to the forces which act on an airplane under these conditions as it descends through a dynamic wind field the changes in the airplane's flightpath angle and rate of descent were calculated. These calculations were made assuming that the pilots failed to recognize the effects of the shear. The pitch attitude change needed to keep the airplane on a safe approach path and the control forces required to change the pitch attitude were also calculated, assuming that the pilots recognized the effects of the shear but did not add thrust.

Based on the initiai conditions, the airplane's descent flight-path angle would have been about 3.8°. After entering the shear the airplane, because of its inherent longitudinal stability, would have pitched in the direction needed to maintain its trim (zero control force) airspeed. Assuming that the pilot did not exert any control force after entering the shear, the airplane would have pitched down and the rate of descent would have increased from 500 fpm to 886 fpm. It would have stabilized at the latter rate. After descending through 300 ft of shear, the headwind would have been 10 kn and the airplane's descent flightpath angle would have increased to 5.6".

If, after entering the shear layer, the pilot had recognized the increase in descent flightpath angle and he had applied a pull force on the control column to increase the pitch attitude and slow the airplane to 1.3 V_S (77.3 kns), its rate of descent would have stabilized about 470 fpm. After descending 300 ft through the shear, the descent flightpath angle would have been about 3.9°.

Airplane characteristics were further analyzed to determine the initial pitch attitude of the airplane before entering the shear, the approximate change in pitch attitude had the airplane maintained trimmed airspeed of 100 kns after entering the shear, and the approximate change in pitch attitude necessary to slow the airplane to about 1.3 Vs. This analysis showed that the airplane's initial pitch attitude would have been about 5.5° nosedown. After entering the shear, the airplane would have pitched down to about 7.7". Finally, to slow the airplane to

about 1.3 V_S to maintain the initial descent flightpath angle of 3.8° the airplane's pitch attitude would have to be increased to 1.4° nosedown. Therefore, although the flightpath angle only increased about 1.8°, a 6.3° change in pitch attitude would have been required to maintain the original flightpath angle.

Assuming that the airplane was initially trimmed for zero pitch control forces at 100 kns, the control forces required to make the 6.3° pitch attitude change were calculated for various locations of the airplane's c.g. Data provided by the manufacturer indicated that adequate elevator trim was available to provide zero control column force in the landing configuration at 1.4 V_S with up to 500 shaft horsepower on each engine and with the c.g. at 15 percent MAC. At lower power settings, adequate trim was available to provide zero elevator control forces at speeds less than 1.4 V_S.

With the c.g. near the middle of the certificated limits, at the forward limit, and at 4.6 percent forward of the forward limit, pull forces of 16 lbs, 22 lbs, and 25 lbs, respectively, would have been needed to make the 6.3° change in pitch attitude. The latter force assumes a linear variation of control forces with movement of the c.g. forward of the forward limit. Additionally, to maintain the load factor associated with a 30° banked turn under any of the above conditions, 4 lbs additional pull' force would have been needed.

2. ANALYSIS

The pilots were certificated properly and were qualified for the flight. They had received the off-duty time required by regulations, and there was no evidence that medical or physiological problems affected their performances. Although the pilot-in-command was seated in the copilot's seat, the first officer was a fully qualified captain and according to approved procedures was authorized to fly the aircraft from the left seat.

The aircraft was certificated, equipped, and maintained in accordance with regulations and approved procedures. There was no evidence of a pre-impact failure or malfunction of the aircraft's structure, powerplants, flight controls, or systems. Although the witness who heard the aircraft pass near his ground position described brief intermittent engine sounds, the passengers were not aware of any variations in engine sounds before the aircraft struck the trees. Therefore, the Safety Board concludes that the intermittent sounds were produced after the propellers struck the first trees.

Although damage to the altimeters precluded functional tests, the static pressure lines to both altimeters were clear and it is unlikely that both altimeters would have malfunctioned simultaneously. With regard to the difference between the reported altimeter setting of 29.74 in and the barometric setting found in the pilot's altimeter, 29.62 in, if the latter setting had existed in flight, the aircraft's actual altitude would have been about 120 ft higher than the altitude indicated on the altimeter. Therefore, this difference could not account for the aircraft's lower-than-normal altitude.

According to aircraft performance data, the aircraft's c.g. condition would not have seriously affected controllability about the aircraft's pitch axis because adequate noseup elevator trim was available to provide zero elevator control forces for the range of configurations, power selections, and airspeeds that probably existed during Flight 977's approach. However, as shown in the performance analysis, the forward c.g. condition would have altered the pitch control forces needed to maintain a constant descent flightpath angle under certain circumstances. From this standpoint and, since under the conditions prevalent during the approach, kinesthetic cues from pitch forces would have been important to the pilot, the Safety Board concludes that the aircraft's reinforced longitudinal stability, particularly the increased elevator control forces required to deviate from a trimmed airspeed, resulting from the forward c.g. condition probably was a factor in the accident.

Since the aircraft crashed about 4,000 ft short of the runway and since there was no evidence of a malfunction of the flight instruments or of flightcrew disability, the pilots either misinterpreted their flight instruments or did not seek information from the instruments. It is unlikely that two experienced and qualified captains who had flown the approach many times would have misinterpreted their flight instruments. Therefore, the analysis of the circumstances indicates that the pilots did not seek information from the flight instruments and, consequently, were vulnerable to the combined effects of a number of factors. Moreover, the Safety Board believes that the combined effects probably caused the accident and that no single factor alone would have produced the same result. These factors are: (1) Low visibility, (2) wind shear combined with the aircraft's forward c.g. condition, (3) visual illusions, and (4) the type of approach.

Low Visibility--The low visibility conditions in the Cape May area on the night of the accident were produced by advection fog; that is, fog produced by the movement of warm moist air over colder ground or water. This type of fog tends to deepen at moderate surface wind speeds (5 to 15 kns). At wind speeds greater than 15 kns, the fog tends to develop into low stratus or stratocumulus clouds. The mixing action produced by moderate winds creates a nonhomogeneous fog condition wherein horizontal visibilities fluctuate rapidly. Also, turbulence may develop which will make instrument flying and aircraft control more difficult.

According to the passengers of Flight 977, turbulence existed throughout the flight from NAFEC, including the final minutes of the flight. Also, the station manager observed fluctuating surface visibilities because of both horizontal and vertical movement of the fog. Surface winds were moderate with stronger winds aloft. Therefore, the Safety Board concludes that visibilities in the approach area were essentially as reported but were variable because of nonhomogeneous fog conditions. Also, the horizon was not visible because it was obscured by darkness and fog.

Wind Shear Combined with the Aircraft's Forward c.g. Condition--An analysis of the weather conditions that existed in the Atlantic City area on the night of the accident shows that wind shear existed at low altitudes and that the wind shear was associated with a warm front that moved rapidly northeastward through the area. The wind shear measurement made by the FAA at NAFEC clearly defined two distinct layers of shear.

Although these measurements were made about 30 mi northeast of Cape May County Airport and were made about 37 min before the accident, the warm front sloped toward the northeast and passed across the Cape May area at the surface about 2340. Therefore, the Safety Board concludes that similar wind shear conditions existed in the Cape May area when the accident occurred. Moreover, the wind shear probably existed at lower altitudes and the magnitudes of the shears probably exceeded those measured at NAFEC.

Aircraft performance calculations based on the conditions hypothesized show that, in moderate wind shear of 5 kns per 100 ft, the aircraft would have tended to pitch nosedown to maintain its trimmed airspeed, and its rate of descent and descent flightpath angle would have increased significantly if the pilot took no corrective action. The aircraft's tendency to pitch nosedown would have been reinforced by the increased longitudinal stability associated with its forward c.g. condition. To prevent the descent flightpath angle from increasing without increasing the noseup pitch trim, it would have been necessary for the pilot to apply and hold substantial amounts of back pressure on the control column which, assuming a constant thrust condition, would have caused the airspeed to decrease. Because of the aircraft's forward c.g. location, the amount of back pressure needed to maintain a constant descent flightpath angle would have increased by 56 percent over that required for a DHC-6 with a midrange c.g. location, which is approximately the location calculated by the flightcrew. Consequently, unless the pilot was aware of the need for substantially increased pitch control forces, the associated kinesthetic cues could have led him to use less pull force than needed to maintain a constant descent flightpath angle, and the aircraft would still have pitched nosedown in response to the wind shear, but at a lesser angle than for the zero control force situation.

Visual Illusions--Visual illusions within nonhomogeneous visual fields are well known hazards associated with a pilot's reliance on visual references to conduct an approach and landing in conditions of low visibility. 6/ A pilot will be influenced by these illusions when his visual range is shortened by a sudden reduction in visibility, such as that encountered when the aircraft enters nonhomogeneous fog. The shortened visual range creates the illusion that the aircraft is too high and is going higher. Unless this illusion is recognized and consciously resisted, the pilot will decrease the aircraft's pitch attitude (and increase the descent flightpath angle) in an attempt to make the visual range increase and appear normal again. Additionally, if the visual range is shortened to the extent that visual references are lost completely, the pilot may believe that the aircraft's pitch attitude has increased substantially and he may further reduce the pitch attitude in an attempt to reacquire the visual references, which will induce high rates of descent from which recovery, at low altitudes, may be difficult if not impossible.

Type of Approach--The typical procedure used by Atlantic City Airlines' pilots, including the captain of Flight 977, for making a circling approach to runway 19 at Cape May County Airport consisted of the following in a DHC-6: While inbound to the airport from the FAF (Sea Isle VOR), descend the aircraft to MDA and slow it to 100 kns; when the aircraft is at 100 kns, extend wing flaps to 10°, and when the aircraft is 1 to 1.5 mi from the airport and the airport is visible, begin the circling maneuver.

The circling maneuver consisted of a right turn to a westerly heading followed by a left turn to a southerly heading for alignment with runway 19. The pilot would descend the aircraft below MDA during the latter portion of the manuever with the expectation of placing the aircraft on a normal 3° approach slope when aligned with runway 19. Under normal circumstances, the aircraft would be so aligned about 1/2 mi from the threshold. Consequently, to achieve the desired approach slope position when lining up with the runway, the pilot would have to descend the aircraft about 320 ft below MDA.

This circling approach is complex since it requires that the airplane be banked, turned, and descended simultaneously to place it in the proper position in space from which a landing can be completed. Moreover, the maneuver involves variable flight control forces, particularly pitch control forces, which make trimming for zero pitch control forces difficult and probably impossible.

6/ "Pilot Factors Considerations in See-To-Land," Technical Report AFFDL-TR-76-52, The Bunker Ramo Corporation, May 1976.

Based on the location of the wreckage, descriptions of a typical VOR instrument approach to runway 23 with a circle to land on runway 19, and the need to land on runway 19 because of the lack of runway lights on the other runways, the Safety Board concludes that the aircraft was on a circling approach to runway 19 when it crashed. Given the reported weather conditions, the pilots probably saw the airport and the first officer began the circling maneuver for alignment with runway 19 near the expected position--about 1.5 mi northeast of the threshold for runway 23 and at an altitude near MDA.

With the airport and the lighted runway in sight at the beginning of the maneuver, the first officer's attention primarily would have been directed toward the maintenance of those visual references. Additionally, since there was no company requirement that the nonflying pilot call out airspeeds, altitudes, or rates of descent for visual flight below MDA, both pilots probably were concentrating on those visual references.

When the aircraft was turned toward the west and the descent below MDA was begun, it is probable that all four factors--low visibility, wind shear combined with the aircraft's forward c.g. condition, visual illusions, and type of approach--combined to produce a complex, unstabilized. and illusory approach profile. The aircraft's entry into a diminishing headwind shear condition would have caused the aircraft's nose to pitch down and would have caused the descent flightpath angle and rate of descent to increase. As these effects materialized, it is likely that nonhomogeneous fog conditions were encountered. Under these conditions, the pilots' reactions to the illusion created by the reduced visual range could have caused additional increases in the descent flightpath angle and rate of descent, or at least, could have made the pilots comfortable with the increases induced by the wind shear. Additionally, the circling maneuver itself, which is an inherently unstable maneuver, probably disguised pitch control forces and other forces that might have provided the pilot with kinesthetic cues about the aircraft's actual position and condition.

Based on all the evidence, the Safety Board concludes that the aircraft encountered at least moderate wind shear and entered non-homogeneous fog during its descent below MDA, and that the wind shear induced increases in the aircraft's descent flightpath angle and rate of descent which, when combined with the increased pitch control forces associated with a forward c.g. and the visual illusions created by the aircraft's entry into the nonhomogeneous fog, resulted in a descent into the trees, far short of the runway threshold. Finally, since the crash site was well within the 15° viewing angle of the VASI, the Safety Board concludes that the pilots probabiy lost all visual references that would have provided altitude information shortly before the aircraft struck the trees.

This accident clearly demonstrates that adverse factors can, without warning, combine and quickly place a pilot in a situation where his senses are unreliable and his control of the aircraft is in jeopardy. Under these circumstances, his only recourse is to rely on information from the flight instruments. Since factors such as optical accommodation, instrument interpretation, and pilot reaction time become critical at low altitudes, the better source of instrument information is from oral communication by the pilot who is not flying the aircraft. For this reason, we believe that Atlantic City Airlines' lack of altitude awareness procedures for visual flight below MDA or DH must be considered contributory to this accident. Additionally, we believe that the captain, knowing that the approach was begun under decreasing visibility conditions, should have been prepared to immediately execute a missed approach when visual references were degraded or lost.

The first officer's injuries were typical of those associated with forceful impact with solid nonyielding objects. The severe head and internal injuries suggest that these injuries were caused by the trees which penetrated the left side of the cockpit. Although shoulder harnesses were not provided in the cockpit, the availability of such restraining devices would not have prevented the first officer's injuries. However, the captain probably would have received lesser injuries, and perhaps could have avoided the head injuries and the internal injuries had a shoulder harness been available and worn.

The extent of the damage to the occupied seats, both in the cabin and in the cockpit, indicates that the forces involved in the deceleration of the aircraft equalled or exceeded the limits to which these seats are designed. 7/ It is estimated that the mean decelerative forces in this crash were in the range of 12 to 15 G's.

The fatal injuries sustained by the passenger seated in the first row on the left side of the cabin are typical of bodily contact with a solid object. While it is possible that the bulkhead in front of this passenger was forced back far enough to make contact, there is evidence that this passenger did not have her seatbelt fastened and was thrown against the bulkhead, causing contre-coup and chest injuries. The fatal injuries received by the passenger seated in the second row on the right aisle side were probably associated with the collapse of his seat. It is possible that this passenger sustained chest injuries when his seat collapsed downward, causing his chest to contact the lower edge of the seat in front of him.

In summary, the principal injury mechanism in this severe crash deceleration was the violent contact between the unrestrained upper torso and environmental aircraft structures or penetrating

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7/ 14 CFR 23.561, Emergency Landing Conditions.

external objects. However, an unusual pattern of severe scalp lacerations was observed. The cause of these injuries was not evident. The injuries could have been caused by heads striking portions of the seat frame in front of the passengers. It was observed that ashtrays, which are Integral to the seat back moulding, protrude 2 ins. from the seatback and could inflict such wounds during impact. In this accident, evidence does not link the ashtrays with the scalp lesions. However, such unyielding protrusions within striking range are contrary to established crash safety design standards and practices.

The Safety Board is concerned about the deficiencies in the FAA's surveillance of Atlantic City Airlines. We believe these deficiencies directly reflect corresponding deficiencies in the carrier's operation which compromise safety and which defeat the purpose of surveillance. Although as noted in previous accident investigations and in the Safety Board's Air Taxi/Safety Study 8/, the number and type of inspectors assigned for surveillance purposes to commuter carriers are probably inadequate, we also believe the FAA can and should improve its surveillance of these type operators in accordance with our recommendations to that effect which were issued as the result of the above study.

3. CONCLUSIONS

3.1 Findings

1. There was no evidence of a malfunction or failure of the aircraft's structure, powerplants, flight instruments, flight controls, or other systems before the aircraft struck the trees.

2. The aircraft was improperly loaded which resulted in a c.g. 4.6 percent MAC forward of the prescribed balance limit; the flightcrew's calculations were correct but were based on a loading which differed from the actual load,

3. The imbalance probably did not affect the aircraft's controllability about its pitch axis but did affect the amount of control force needed to increase the aircraft's pitch attitude from a trimmed zero control force condition.

4. The weather conditions at Cape May County Airport were essentially as recorded by the station manager except the ceiling and visibility were fluctuating because of nonhomogeneous fog conditions.

8/ Report Number NTSB-AAS-72-9, September 21, 1972.

5. *An* unforecast and unreported warm front moved north-eastward across the Cape May area about the time the aircraft crashed.

6. Moderate wind shear in the form of a diminishing headwind affected Flight **977** during its descent from MDA to impact.

7. Flight **977** was conducting a circling approach to runway 19 at Cape May County Airport; the designated first officer was flying the aircraft from the left seat.

8. The pilots relied exclusively on visual references to conduct the circling approach to runway 19 and while descending below MDA.

9. The wind shear probably induced a higher-than-desired rate of descent and descent flightpath angle during the aircraft's descent below MDA.

10. The pilots probably were influenced by visual illusions created by fluctuating visibility in the nonhomogeneous fog.

11. The visual illusions probably induced the pilots to accept a higher-than-desired rate **of** descent and descent flightpath angle.

12. The pilots probably .lost all visual references as the descent progressed or became visually disoriented and did not initiate missed-approach procedures in time to avoid impact with the trees because they were not monitoring altitude instruments.

13. The company had no altitude awareness procedures for visual flight below MDA or **DH.**

14. The Federal Aviation Adminstration's surveillance of Atlantic City Airlines was inadequate in that weight and balance computations were not monitored and a formal wind shear training program did not exist.

15. The accident was survivable in the passenger cabin. Survivability in the cockpit was marginal because penetration by trees destroyed integrity of the left side of the cockpit. While the use of a shoulder harness probably would have lessened the severity of the captain's injuries, the availability of a shoulder harness to the first officer would not have prevented his fatal injuries.

3.2 Probable Cause

The National Transportation Safety Board determines that the probable cause of this accident was the flightcrew's lack of altitude awareness during a circling approach which permitted the aircraft's flightpath to deviate below a safe approach profile. The aircraft's rate of descent and descent flightpath angle increased as a result of wind shear encountered during the visual approach below minimum descent altitude. The flightcrew did not recognize these flightpath deviations because they were relying on visual references which were degraded by nonhomogeneous fog and on kinesthetic cues which were adversely affected by the aircraft's forward center of gravity resulting from the improperly loaded aircraft. Contributing to the accident was the lack of company procedures requiring altitude-callouts during the visual portion of an instrument approach.

BY THE NATIONAL TRANSPORTATION SAFETY BOARD

/s/ KAY BAILEY
Acting Chairman

/s/ FRANCIS H. McADAMS
Member

/s/ PHILIP A. HOGUE
Member

/s/ JAMES B. KING
Member

November 23, 1977

4. APPENDIXES

APPENDIX A

INVESTIGATION AND HEARING

1. Investigation

The National Transportation Safety Board was notified of the accident about 0005 on December 13, 1977. The Safety Board immediately dispatched investigative personnel to the scene. Investigative groups were established for operations, air traffic control, weather, human factors and witnesses, structures, powerplants, and systems.

Parties to the investigation were: The Federal Aviation Administration, Atlantic City Airlines, Inc., DeHavilland Aircraft of Canada, Ltd., the County of Cape May, New Jersey, and the Division of Aeronautics, New Jersey Department of Transportation.

2. Hearing

A public hearing was held in Wildwood Crest, New Jersey, on February 22 and 23, 1977. Parties to the hearing were: The Federal Aviation Administration, Atlantic City Airlines, Inc., Allegheny Airlines Inc., National Weather Service, the County of Cape May, New Jersey, and the Division of Aeronautics, New Jersey Department of Transportation.

APPENDIX B

PERSONNEL INFORMATION

Captain John A. Brier

Captain Brier, 36, was employed by Atlantic City Airlines, Inc., on September 15, 1970, and he was promoted to captain on July 6, 1972. He holds Airline Transport Pilot Certificate No. 1771973, with commercial privileges, and airplane single-engine and multi-engine land ratings. He also holds Flight Instructor Certificate No. 1771973. His first class medical certificate was issued October 27, 1976, with the limitation that he wear corrective glasses for both near and distant vision while flying.

Captain Brier passed his last proficiency check on September 25, 1976. As of December 1, 1976, he had accumulated 7,428 flight-hours, of which about 5,200 hours were in the DHC-6 and 724.8 were instrument flight-hours. In the 24-hour, 30-day, and 90-day periods preceding the accident, he had flown 4.3, 80.1 and 255.4 hours, respectively.

Captain Jon R. Scheaffer

Captain Scheaffer, 32, was employed by Atlantic City Airlines, Inc., on June 14, 1973, and he was promoted to captain on June 1, 1976. He held Airline Transport Pilot Certificate No. 1899843, with commercial privileges, and single-engine and multi-engine land ratings. He also held Flight Instructor Certificate No. 1899843. He held a first class medical certificate which was issued with no limitations on December 1, 1976.

Captain Scheaffer passed his last proficiency check on November 24, 1976. As of December 1, 1976, he had accumulated 4,306.1 flight-hours, of which 282.1 were instrument flight-hours. In the preceding 24-hour, 30-day, and 90-day periods, he had flown 4.3, 81.6, and 249 hours, respectively.

APPENDIX C

AIRCRAFT INFORMATION

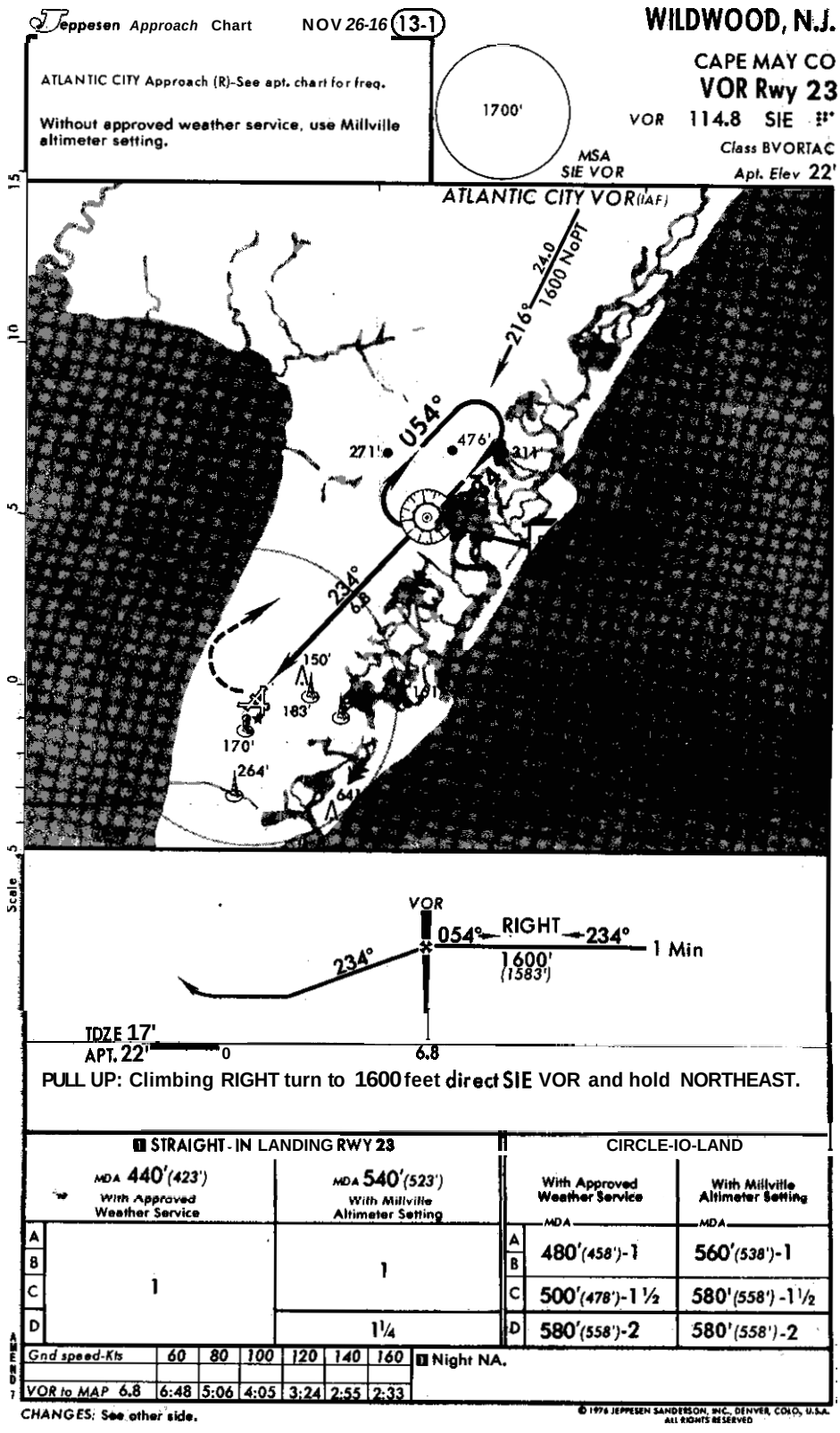
N101AC was a DHC-6, Twin Otter, Series 300, and was manufactured by DeHavilland Aircraft of Canada, Ltd.; it was assigned serial No. 262. This type aircraft was certificated under the Civil Air Regulations, Part 3, as amended to May 15, 1969. The aircraft was modified to comply with Special Federal Aviation Regulation 23.

N101AC was powered by two Pratt and Whitney PT6A-27 turbine engines, which were equipped with Hartzell HCB3TN-3D propellers. Pertinent powerplant data are as follows:

Engine Position	Serial No.	Total Time (hrs)	Time Since Overhaul (hrs)
1	PCE 40234	8,099.5	3,139.5
2	PCE 40205	12,336.8	7,723.8

Propeller Position	Serial No.	Total Time (hrs)	Time Since Overhaul (hrs)
1	BU2676	5,191.7	1,189.7
2	BU2622	6,162.3	2,808.3

APPENDIX D1



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WILDWOOD, NJ.

CAPE MAY COAPT.

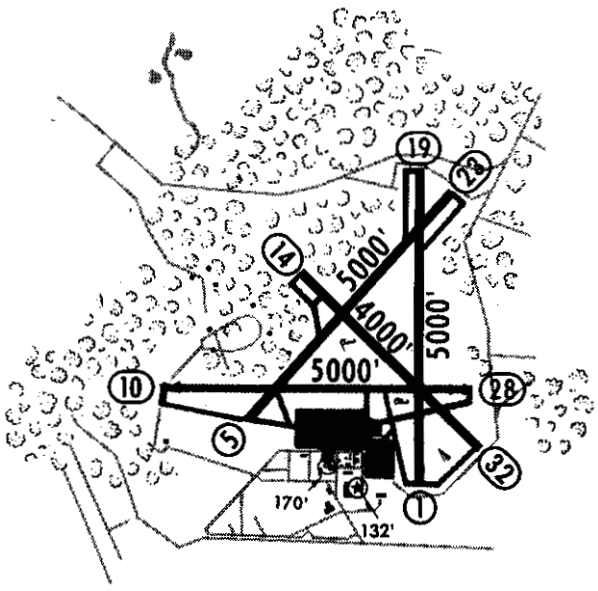
Elev 22' 39°00'N 74°55'W

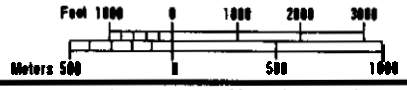
13-1 NOV 26-76 Jeppesen Approach Ch

ATLANTIC CITY Approach (R) 124.6

Departure (R) 119.55

r 10°W WWD UNICOM 122.8





ADDITIONAL RUNWAY INFORMATION

RWY		USABLE LENGTHS LANDING BEYOND Threshold	Glide Slope	TAKE-OFF	WIDT
1	MIRL VASI(non-std)				150
5 19 23					150
10 ❶ 28	MIRL				150'
14 32					150'

❶ Closed for construction.

❶ TAKE-OFF			FOR FILING AS ALTERNATE
	AIR CARRIER (FAR 121, 123 & 129) If Wx below Lndg Mim, T/o Altn	GENERAL	
2 9 .4 ng	1/4	1 . 1/2 .	A B C D NA

❶ Rwy 14, 700 ceiling-1 required or charted minimums with a minimum climb of 200' per NM to 800'.

CHANGES: Rwy 10-28 closed.

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