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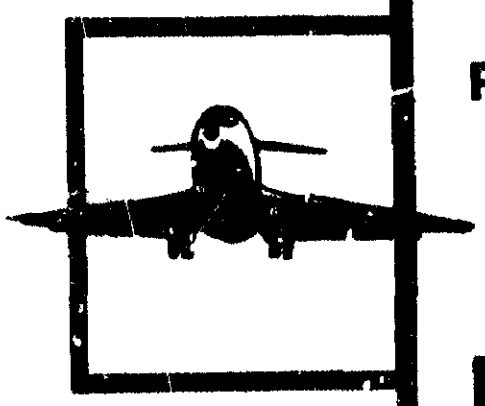

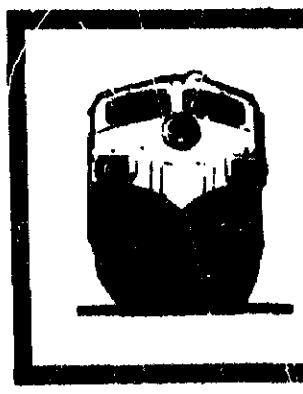

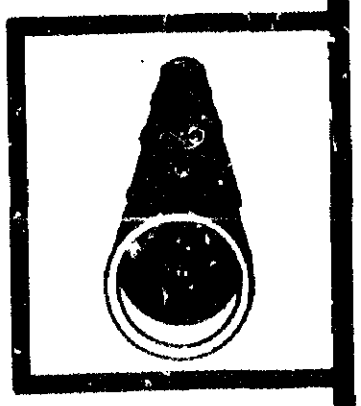

NATIONAL TRANSPORTATION SAFETY BOARD

WASHINGTON, D.C. 20594

AIRCRAFT ACCIDENT REPORT

PILGRIM AIRLINES, INC.,
FOKKER F27-100, N148PM
JOHN F. KENNEDY INTERNATIONAL AIRPORT
JAMAICA, NEW YORK
JANUARY 13, 1984

NTSB/AAR-84/12

UNITED STATES GOVERNMENT

TECHNICAL REPORT DOCUMENTATION PAGE

1. Report No. NTSB/AAR-84/12	2. Government Accession No. PB84-910412	3. Recipient's Catalog No.
4. Title and Subtitle Aircraft Accident Report—Pilgrim Airlines, Inc., Fokker F27-100, N148PM, John F. Kennedy International Airport, Jamaica, New York, January 13, 1984.		5. Report Date October 16, 1984 6. Performing Organization Code
7. Author(s)		8. Performing Organization Report No.
9. Performing Organization Name and Address National Transportation Safety Board Bureau of Accident Investigation Washington, D.C. 20594		10. Work Unit No. 3896-A 11. Contract or Grant No.
12. Sponsoring Agency Name and Address NATIONAL TRANSPORTATION SAFETY BOARD Washington, D. C. 20594		13. Type of Report and Period Covered Aircraft Accident Report January 13, 1983 14. Sponsoring Agency Code
15. Supplementary Notes		

16. Abstract At 1442 on January 13, 1984, Pilgrim Airline Flight 35, a scheduled 14 CFR Part 121 flight with 21 passengers and a crew of 3 took off from runway 4L at John F. Kennedy International Airport, Jamaica, New York, en route to Ottawa, Canada. The weather was, in part, ceiling 2,700 feet overcast, visibility, 7 miles; wind, 050° at 14 knots; and temperature, 26°. As the captain raised the landing gear, the propeller on the left engine autofeathered. The captain initiated emergency procedures and told the first officer that he was retarding the power lever for the left engine. Concurrently, according to the cockpit voice recorder, the right engine experienced a power loss, and the airplane began to descend. The first officer, who was flying the airplane, maintained directional control, and the captain immediately put the landing gear lever down. However, the airplane struck the runway before the landing gear extended fully, and slid about 1,200 feet before stopping near the intersection of taxiway "G" and runway 4L. The captain and 13 passengers received minor injuries, and the flight attendant received a fracture of the spine. The airplane was damaged substantially but there was no postcrash fire.

The National Transportation Safety Board determines that the probable cause of this accident was the flightcrew's failure to use engine anti-ice on the inbound flight to JFK, the captain's failure to conduct a thorough preflight inspection, and the flightcrew's decision to use engine anti-ice on takeoff from JFK which led to power losses on both engines.

17. Key Words Engine anti-ice/deice, ingestion of ice, inadequate preflight inspection, improper use of engine anti-ice, emergency landing, landing gear up, autofeather, emergency evacuation, crash/fire/rescue, FAA surveillance.		18. Distribution Statement This document is available to the public through the National Technical Information Service Springfield, Virginia 22161	
19. Security Classification (of this report) UNCLASSIFIED	20. Security Classification (of this page) UNCLASSIFIED	21. No. of Pages 35	22. Price

NTSB Form 1765.2 (Rev. 9/74)

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Adopted: October 16, 1984

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SYNOPSIS

At 1442 on January 13, 1984, Pilgrim Airline Flight 35, a scheduled 14 CFR Part 121 flight with 21 passengers and a crew of 3 took off from runway 4L at John F. Kennedy International Airport, Jamaica, New York, en route to Ottawa, Canada. The weather was, in part, ceiling 2,700 feet overcast, visibility, 7 miles; wind, 050° at 14 knots; and temperature, 26°. As the captain raised the landing gear, the propeller on the left engine autofeathered. The captain initiated emergency procedures and told the first officer that he was retarding the power lever for the left engine. Concurrently, according to the cockpit voice recorder, the right engine experienced a power loss, and the airplane began to descend. The first officer, who was flying the airplane, maintained directional control, and the captain immediately put the landing gear lever down. However, the airplane struck the runway before the landing gear extended fully, and slid about 1,200 feet before stopping near the intersection of taxiway "G" and runway 4L. The captain and 13 passengers incurred minor injuries, and the flight attendant incurred a fracture of the spine. The airplane was damaged substantially; there was no postcrash fire.

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1. FACTUAL INFORMATION

1.1 History of the Flight

At 1309, 1/ on January 13, 1984, N148PM departed Groton-New London Airport, Connecticut, as Pilgrim Airlines Flight 215 to John F. Kennedy (JFK) International Airport, Jamaica, New York. The airplane arrived at the airport at 1346. During the inbound flight, light icing conditions were encountered near Deer Park, New York, at an altitude of 4,000 feet. 2/ The captain stated that the ice disappeared from the airplane's structure in the course of its descent as it reached 3,000 feet. The airplane wing de-icing and engine cowling de-icing/anti-icing systems were not used during the inbound flight. The same flightcrew and airplane were scheduled to continue to Ottawa, Canada, as Pilgrim Flight 35.

1/ All times herein are eastern standard, based on the 24-hour clock, unless otherwise noted.
2/ All altitudes herein are mean sea level.

The 1351 surface weather observation at JFK was: measured ceiling, 2,700 feet overcast; visibility, 7 miles; temperature, 26°; dewpoint, 21°; wind, 050° at 14 knots; and altimeter, 30.59 inHg.

The captain completed his visual preflight inspection of the airplane and supervised its refueling with 2,120 pounds of jet A fuel. He then completed the cockpit checklist to engine start. The captain stated that he observed no discrepancies during the preflight inspection and that he did not see ice on any part of the airplane except for a narrow strip of ice along the entire length of the leading edges of both wings. The captain described the ice as a white line drawn on the leading edges of both wings, 1 to 1 1/2 inches wide and less than 1/16 inch deep. The strip did not cover the entire leading edge of any of the deicer boots. The captain stated further that, based on his experience and in his opinion, the amount of ice did not warrant deicing the wings before takeoff and the ice was not a hazard to the safe performance of the Fokker F-27. The F-27 engine air inlets are covered partially by the propeller nose cone. Consequently, the inside of the inlets are not visible from the ground and require the crewmember to use a ladder to inspect them properly. The captain did not use a ladder to inspect the engine inlet cowls. As the captain completed the preflight inspection, the first officer supervised the loading of baggage. The flight attendant supervised the boarding of the 21 passengers, which included a 3-month-old infant and a 2 1/2-year-old child. The loading and boarding were completed about 1420, and the engines were started immediately in order to recharge the pneumatic system, which the captain noticed was low during taxi at Groton.

The engine start was uneventful; Flight 35 departed the gate at 1430 and was cleared to runway 4L. The captain and first officer stated that no snow or slush was thrown back by the Boeing 727 they followed on taxi, and that they did not taxi through puddles of water or slush.

The flightcrew did not use, nor did company procedures require the use of, a challenge and response method to complete the before takeoff checklist. The captain said that he completed the items on the checklist up to and including "After Engine Start," and the first officer completed the other checks up to the "Before Take-Off" items. The flightcrew stated that the control locks were released, that the control surfaces were checked for freedom of movement, and that the fuel heat was on for more than the required 2 minutes "on" time. The first officer stated that she completed all the before takeoff checklist items as the airplane taxied onto the runway. The first officer was at the controls for the takeoff and was occupying the right seat; the captain was in the left seat.

At 1441:07 the local controller cleared Flight 35 into position on the runway, and at 1441:46, the flight was cleared to takeoff. The flightcrew said the takeoff roll was normal. At 1442:00 the captain stated, "Temps and pressures are within limits. . .," followed by the call "eighty knots" at 1442:08. At 1442:12, the captain said, "Vee one, vee R, vee two."

The flightcrew said that the rotation was normal. At 1442:19, when the airplane was 50 feet to 100 feet above the runway, the first officer called for the gear to be raised. Concurrent with the first officer's call, the captain observed that the left engine autofeather light had illuminated. The cockpit voice recorder transcript showed that, at 1442:19, the left engine RPM decreased concurrently with the first officer's command, "and gear up." The captain stated that he raised the landing gear immediately following the first officer's command. At 1442:20, he said, "Left engine, we just lost it." At 1442:22, the captain said, "Okay, keep her going."

The captain said that following the loss of power to the left engine, the airplane was under control and the airspeed was about 110 knots. He then confirmed that the left engine was not operating, and at 1442:26, he stated, "Okay, let's feather the left one, power lever back." At 1442:27, the cockpit voice recorder recorded the sound of decreasing right engine rpm's. The captain stated that the reference to "power lever back" was a momentary mental lapse since it was not the correct feathering procedure for the F-27 airplane. The movement of the power lever is the first step in the feathering procedure for the DHC-6 airplanes; the captain was also qualified to be captain on the DHC-6. He stated that as soon as he said "power lever back" he realized the error, and that he made no move to pull the left power lever back.

The captain stated that as he placed his hand on the high pressure fuel cock for the left engine, which was the correct F-27 feather procedure, power was lost on the right engine. He said that this occurred before he retarded the left engine high pressure fuel cock, and consequently, he did not move the left high pressure fuel cock.

At 1442:30, the local controller transmitted, "Pilgrim thirty-five, heavy smoke coming from the number — right engine." The local controller said he saw white smoke trailing from the No. 1 engine after rotation, followed by "heavier white smoke" "appearing behind the No. 2 engine. At 1442:28, the captain said, "Keep the (right) one going." (The captain later stated that he actually said, "Keep the airplane going," not the right engine.) At 1442:35, the captain transmitted that they were going to land. This transmission was followed at 1442:37 by a sound similar to landing gear actuation. The captain stated that as he reached for the landing gear handle, he saw the power levers and the right engine high pressure fuel cock "in the full forward position."

At 1442:44, the first sounds of impact were recorded; they lasted until 1442:55. The cockpit voice recorder ran until 1446:18, when the airplane's battery was turned off.

The airplane had landed on runway 4L with the landing gear unlocked and in transit to the down position. The airplane hit first about 6,000 feet from the threshold of the runway, and 60 feet to the right of the centerline. The airplane slid for about 600 feet on the runway before it went off the right side and into the snow. It slid on the snow another 600 feet before coming to a stop near the intersection of runway 4L and taxiway G. The captain recalled that both power levers were full forward and both high pressure fuel cocks were open when the airplane stopped.

The flight attendant, who had been seated in the jumpseat in the rear of the passenger cabin, stated that she could see the instrument panel in the cockpit because the door to the forward cabin was open and the curtain was pulled back. She saw a red propeller feather button light illuminate on the left side of the instrument panel, and "both pilots' hands were in use trying to restart the engine." She said the right engine lost power about 10 seconds after the left engine stopped. When the airplane struck the ground, she felt a severe pain in her back. As the airplane was sliding on the runway, she deliberately unfastened her seat belt, got out of her seat, and laid on the cabin floor in the aisle. She issued instructions to the passengers on how to evacuate the cabin as she lay incapacitated in the aisle.

After the airplane stopped, the captain exited the airplane through the forward cargo door and proceeded to the rear of the airplane. He found the main boarding door already open, and he reentered the cabin to assist the flight attendant. The captain and one passenger helped the flight attendant out of the airplane.

The first officer opened the right exit window when the airplane stopped and turned off the fuel boost pumps. She recalled seeing the captain close the high pressure fuel cocks. She got out of her seat and opened the cockpit to the passenger cabin. At the direction of the first officer and the flight attendant, most passengers evacuated the airplane through the forward cargo door; two exited through the left underwing emergency exits.

The captain stated that, he returned to the cockpit at the request of the crash/fire/rescue crew chief and shut off all switches, put both high pressure fuel cocks in the feather position, pulled the "tee" handles for both engines, and shut off the master switch. This was done to reduce the possibility of a ground fire.

The accident occurred during daylight hours at coordinates 40°38'29" north and 73°46'41" west.

1.2 Injuries to Persons

	Crew	Passengers	Other	Total
Fatal	0	0	0	0
Serious	1	0	0	1
Minor	1	13	0	14
None	1	8	0	9
Total	3	21	0	24

1.3 Damage to Aircraft

The airplane was damaged substantially.

1.4 Other Damage

None.

1.5 Personnel Information

The flightcrew and flight attendant were qualified for the flight in accordance with Federal Aviation Administration (FAA) and company procedures and had received the required training. (See appendix B.)

1.6 Aircraft Information

The airplane, a Fokker F27-100, was purchased by Pilgrim Airlines on July 20, 1982. Between July 20, 1982, and November 1, 1983, the airplane was refurbished and modified by Pilgrim to meet United States certification standards. The U.S. certification for commercial operations was granted by the FAA's Northeast Region on October 28, 1983. The airplane had been maintained in accordance with applicable Federal regulations, and its maximum allowable takeoff gross weight was 40,800 pounds. The actual takeoff gross weight at JFK was 33,849 pounds. The center of gravity was within the acceptable range. There was a total of 5,000 pounds of jet A fuel on board at the time of the accident.

The airplane was powered by two Rolls Royce Dart 514-7 turbopropeller engines. The 4-blade, hydraulically operated variable pitch propellers (Model (C) R.175/4-40/13E) were manufactured by Dowty-Rotol. A review of the inspection records for the airplane did not reveal any recurring maintenance deficiencies for the previous 30 days. (See appendix C.) Three logbook items from the previous flight were entered before Flight 35 departed JFK. The items were: (1) low pneumatic pressure, (2) a malfunction of the captain's attitude indicator, and (3) a drop in the right engine oil pressure gage. A circuit breaker was reset to correct the attitude indicator malfunction and a fuse was replaced shortly after departing Groton to correct the fault which caused the oil pressure drop.

A Safety Board investigator and two FAA inspectors examined the airplane less than 1 hour after the accident. They observed a band of ice on the leading edges of both wings and on the horizontal and vertical stabilizers which measured 1/2 inch thick and 1 1/2 to 2 inches wide. The ice covered the entire length of the right wing leading edge, and three quarters of the leading edge of the left wing. The ice was described as "rime ice" 3/ by one FAA inspector, and "clear ice" 4/ by the other. The Safety Board investigator who was at the scene shortly after the accident described the ice on the wings as a mixture of clear and rime ice. Additionally, there was a 1/2-inch buildup of ice on the captain's windshield wiper post.

The Pilgrim Airlines chief pilot observed the airplane about 4 hours after the accident. He stated that there was a narrow strip of clear, smooth ice along the length of the leading edge of both wings. He said the ice was 1 to 1 1/2 inches wide inboard of the landing lights, tapered to 1/2 inch at the wingtips, and was 1/8 inch thick inboard near the landing lights. Ice was not evident on the inlet cowlings of either engine.

1.7 Meteorological Information

On the day of the accident, southern New England and southeastern New York were under the influence of a ridge of high pressure ahead of a large low pressure area centered over northern Indiana. Conditions along the path of the flight from Groton to JFK International Airport and in the vicinity of JFK International Airport were characterized by overcast skies, moderate northwesterly winds, and areas of moderate snow and snow showers.

The following are the surface observations at Groton when N148PM departed and at Kennedy Airport when N148PM arrived and departed.

Groton:

1245: type—surface aviation; ceiling—estimated 2,500 feet overcast; visibility--7 miles; weather--none; temperature--17° F; dewpoint—missing; wind—030°, 15 knots; altimeter--30.74 inches.

3/ Rime icing (or rime ice) is a white or milky and opaque granular deposit of ice formed by the rapid freezing of super-cooled water drops as they impinge upon an exposed aircraft surface; formation involves slow accretion and is favored by small drop size, and a high degree of super-cooling and rapid dissipation of latent heat of fusion, i.e., one particle freezes before the next one strikes; white appearance is the result of numerous, relatively large air pockets. Rime ice weighs less than clear ice, but may seriously distort airfoil shape and therefore diminish aerodynamic efficiency.

4/ Clear icing (or clear ice) generally is in the form of a layer or mass of ice which is relatively transparent because of its homogeneous structure and small number and size of air spaces (synonymous with glaze, particularly with respect to aircraft icing).

JFK:

1351; type—surface aviation; ceiling—measured 2,700 feet overcast; visibility--7 miles; weather—none; temperature—26° F; dewpoint—21° F; wind—050°, 14 knots; altimeter—30.59 inches.

1444: type—local; ceiling—measured 1,900 feet overcast; visibility 7 miles; wind—040°, 14 knots; temperature--26° F; altimeter--30.60 inches; remarks--aircraft mishap.

1451: type—surface aviation; ceiling—measured 1,900 feet overcast; visibility—7 miles; weather--none; temperature—26° F; dewpoint--20° F; wind--040°, 13 knots; altimeter—30.60 inches.

Icing conditions existed during the flight from Groton to New York. Cloud bases were generally between 2,000 and 2,500 feet with tops between 5,300 and 5,500 feet. A possibility of encountering partially melted snow or light freezing rain existed near the base of the clouds along the route of flight. Light to moderate rime ice could have formed within the clouds and light to severe mixed icing could have formed within and below the clouds.

Pilots reported encountering varying degrees of ice formations in and around the New York area from 1200 to 1400. The area weather forecast called for icing conditions along the route from Groton to New York. The captain of Flight 35 stated after the accident that light icing conditions were encountered near Deer Park, New York, at 4,000 feet. He further stated that the ice melted away in the course of the airplane's descent to 3,000 feet although the wing deicers and engine heat were not used during the flight. In an interview after the accident, the captain stated that the airplane was in instrument meteorological conditions (IMC) for 3 to 4 minutes during the inbound flight and no precipitation was encountered. The light ice he saw cleared up right away and the small accumulation that formed on the windshield just slid off. He observed no more ice after the airplane descended below 3,000 feet; the remainder of the inbound approach was flown clear of the clouds.

1.8 Aids to Navigation

Not applicable.

1.9 Communications

There were no reported communications difficulties.

1.10 Aerodrome Information

John F. Kennedy International Airport is operated by the New York and New Jersey Port Authority, with air traffic control services provided by FAA. Firefighting and crash rescue services are provided by the Port Authority. Runway 4L is 11,352 feet long and 150 feet wide, and is 12 feet above mean sea level.

1.11 Flight Recorders

A Collins cockpit voice recorder (CVR), SN 3989, was removed from N148PM and brought to the National Transportation Safety Board's Audio Laboratory. It was undamaged. The recording was unusual in its operation in that "hot" microphones 5/ were used at all times, resulting in a recording of flight crew conversation of excellent fidelity and with no noise interference. The entire recording was reviewed, and investigators determined that only that portion which dealt with the takeoff and impact needed to be transcribed. The CVR also was used to determine if the flightcrew used the checklist and to document crew activities during taxi and takeoff.

The airplane was equipped with Fairchild flight data recorder (FDR), SN 5830. Examination of the flight recorder disclosed no evidence of damage. However, when the readout which was made by the Safety Board was correlated to the transcript of the CVR, there appeared to be a disparity, or misalignment, between the FDR's airspeed and altitude traces. For instance, when the "80-knot" callout was made, the airspeed trace from the FDR indicated about 68 knots.

Thereafter, the flight recorder was examined at the Safety Board's laboratory, but no mechanical reason was found for the misalignment between the two traces. The vertical "g" trace, the heading trace, and the microphone keying traces were in alignment.

1.12 Wreckage and Impact Information

The underside of the fuselage was damaged from the nose gear to the tailskid. Buckling was found at fuselage stations (FS) 51, 97, 122, 229, 695, and 855. The leading edge of the center section of the left wing had a wrinkle which extended spanwise outward from wing station (WS) 40 to WS 100. The left engine nacelle was bent downward on the right lower side in the area of the landing gear. There was no visible damage to the nose gear or main landing gears. When the airplane was raised, the three gears extended fully and locked into place. There was no evidence of damage to the tires or wheel assemblies.

The aileron, elevator, and rudder controls were jammed and could not be moved. The ailerons were full left and the elevator and rudder were in a neutral position. The lower part of the fuselage was pushed upward preventing movement of the controls. No failures or separations were observed in any flight control system component or cable.

The elevator trim was found 3/4 units noseup. The left and right engine high pressure cocks were in the aft position (closed), and the thrust levers were in the full forward position (open).

Both engines remained attached to the airplane, and the propellers remained attached to the engines. About 2 inches of the tips of two blades were missing from the left propeller which had been ground down during contact with the runway. The 83° angle of the blades of the left propeller corresponded to the feathered position. The tips of all four blades of the right propeller assembly curled rearward in a uniform manner and had turned in the hub toward the feathered position. The propeller of each engine could be turned freely by hand, with the respective turbines also turning.

5/ Hot microphone means that the CVR recorded transmissions made by both pilots through their respective microphones, as well as through the cockpit area microphone.

The fuel and oil filters were serviceable. A continuous supply of fuel was available to the high pressure fuel pumps at the fuel filter inlets of both engines when individual boost pumps were selected to "on", with airplane electrical power available. Also, when both engines were motored, a continuous supply of fuel was available at the fuel nozzle manifolds. All four electrically driven fuel boost pumps produced 10 to 12 psi of fuel pressure as indicated on the individual gauges in the cockpit.

When fuel heat was selected, the differential pressure switch for both systems illuminated the respective fuel heat warning lights in the cockpit, indicating that the fuel pressure at the manifold fuel filter outlet averaged about 3 psi below the flow meter inlet pressure. The fuel inlet pressure was zero during functional tests. The tests indicated that the differential pressure switch functioned correctly.

The engine cowl heat systems were checked for electrical continuity up to the connector at the cowl bulkhead. The electrical timers functioned correctly and electrical power was available to the connector.

An autofeather check was performed on both engines using the airplane's electrical (battery) power; the left and right systems functioned properly. The opposite system was "locked out" when each autofeather check was performed. Both propeller assemblies were cycled to and from the feathered position by the respective feather pump. Each engine propeller-below-lock, autofeather, and the cockpit feather pump indicator lights illuminated at the appropriate time.

One combustion chamber was removed from each engine and examined along with the turbine guidevanes and the first-stage turbine blades. No abnormal conditions were observed. All tests showed that all fuel system components were intact and capable of supplying fuel to the engines.

A "hydroglo" test was made by Allied New York Services, Inc., about midnight on January 13, 1934, on fuel samples taken from the airplane fuel systems and from Allied Fuel Truck No. 704 which was used to refuel the airplane at JFK. The tests were negative for contaminants and water. Fuel samples were taken from the left and right wing fuel tanks and filters. The fuel was free of water and contaminants and was the proper type for use in the Dart 514-7 engine.

1.13 Medical and Pathological Information

Minor injuries were sustained by the captain and 13 passengers during the impact and while the airplane slid along the ground; their injuries consisted of minor contusions, muscular strains, and cervical-sacral strains. The flight attendant needed assistance to evacuate the airplane. The first officer and eight passengers, including an infant and a 2 1/2-year old boy, were not injured. The infant's mother held the child in her arms during the impact and ground slid. She had no difficulty holding the infant securely. The 2 1/2 year old boy was belted securely in his seat.

The captain, the flight attendant, and some passengers were transported to Jamaica Hospital. Examination and x-rays of the captain and passengers disclosed no serious injuries, and they were released. The flight attendant was later diagnosed as having sustained a compression fracture of the third Thorasic (T_3) vertebra.

1.14 Fire

There was no fire.

1.15 Survival Aspects

Emergency Response.--At 1443, the local controller in the air traffic control tower notified both JFK crash/fire/rescue (CFR) stations of the accident using the airport crash alarm system. A total of five fire trucks with two firefighters per vehicle responded from the two fire stations. The quick response truck arrived at the airplane 1 minute 10 seconds after the alarm was received. The second crash truck arrived 10 seconds later, and all vehicles were at the airplane within 2 minutes 50 seconds after the accident. All passengers and crew had evacuated the airplane by the time the first quick response vehicle arrived at the airplane.

Immediately after the arrival of CFR vehicles, the CFR crew chief conferred with the captain. Since electrical power still remained on the airplane, the CFR crew chief asked the captain to return to the cockpit to turn it off. The crew chief also advised the captain to "make it quick." The captain entered the airplane alone, turned off electrical power, and reexited the airplane.

The JFK medical office also was notified at 1443 and placed on standby with three mobile emergency hospital units. Their standby status was cancelled when it was apparent that the occupants had suffered minor injuries. Medical personnel then proceeded to the operations building where all the passengers and one crewmember were medically evaluated.

New York City police and fire units were alerted routinely by the control tower at 1443 and responded immediately. All mutual aid vehicles were held at the operations building gate in accordance with the JFK emergency plan. Emergency vehicles were not escorted farther because mutual aid assistance was not required.

Evacuation.--All of the airplane's occupants, except for the 3-month-old infant who was held by its mother during the impact and ground slide, were wearing their seatbelts. The three crewmembers were also wearing their shoulder harnesses. Although no alert was given, the flight attendant and passengers were aware of an impending impact because of the loss of power from the right engine. Some passengers attempted to brace themselves according to a position shown on the passenger safety information card--head resting on arms braced on the seatback in front. However, the seatbacks folded over when the passengers leaned on them, thereby providing no support for the recommended brace position. The passengers then assumed a variety of brace positions in the short time available before the airplane struck the runway. The impact caused passengers to be thrown forward and down into seats in front of them. Some hit the seatbacks ahead of them. All passengers were thrown forward in their seats, but all were retained by their lap belts. No passenger seat failed. One passenger recalled seeing the cabin floor flex upward in an "undulating" manner at impact. He also described the longitudinal deceleration after impact as a "hard braking maneuver." The 1,200-foot ground slide was described as not severe. The passengers described the impact as very hard and a jolt.

The captain stated that his seat collapsed and slid forward at impact and he felt pain in his back; he extricated himself from the seat and opened the forward cargo door. The door was "stiff" in its track, and he had to exert more than normal force to open the door which he found difficult to do because of his back pain. He exited the

airplane through the door opening because passengers behind him were attempting to egress through that exit. The captain then proceeded to the rear main door which he found open. He reentered the cabin in order to assist the flight attendant; he found the flight attendant and one passenger in the rear cabin. The captain and the passenger assisted the flight attendant from the airplane.

The first officer opened her cockpit window exit before the airplane slid to a stop. After the airplane came to rest, she left her seat and proceeded to the galley area and cleared away an ice bucket and other debris from the cargo door area. A few passengers remained in the cabin, and the first officer directed them to exit through the left underwing emergency exit.

The cabin overhead bins contained no carry-on baggage or hard items. The articles of clothing in the bins spilled out during the impact and slide down the runway. No one in the cabin was injured by the article, since only cloth items were in the overhead bins.

The flight attendant experienced a sharp back pain when the airplane contacted the runway. She believed the she had sustained a spinal fracture so she unfastened her seatbelt and shoulder harness, left her seat, and lay on the cabin floor while the airplane was sliding to a stop. The flight attendant (while lying on the floor near the last row of passenger seats) shouted instructions to the passengers to open the exits and to evacuate the airplane.

The evacuation was orderly and was completed in less than 70 seconds. The captain, first officer, and 18 passengers exited through the cargo door exit, two passengers exited through the left emergency exit, and the flight attendant, assisted by the captain and one passenger, exited through the main cabin door. Except for the flight attendant, the 3-month-old infant, and the 2 1/2-year-old child, no other occupants required assistance exiting the airplane. When everyone had evacuated the airplane, a count was taken of the passengers. A discrepancy was found in the total number of passengers, so the first officer reentered the airplane to insure that everyone was out. As she again exited the airplane, the fire trucks began to arrive.

Interior Damage.--The cargo door, a designated emergency exit, was opened by the captain with difficulty. Investigation showed that the door could be opened partially until it jammed about 35 inches from its fully closed position. The left and right door tracks were bent and the rear edge of the door was bowed outward as a result of impact.

The cockpit observer jumpseat had separated from its attachments and had come to rest in the aisle which led to the cargo door. The forward and rearward cargo restraint poles had come free of their ceiling attachments.

The galley, which was located in the cargo compartment, came free of its attachments, although it remained essentially in its normal location, and some of its contents spilled into the aisle. The forward cabin separator, which was located between the cargo compartment and the passenger cabin, separated from its attachments but it remained essentially in its normal position. A small picnic-type cooler containing ice cubes was stowed on the floor between the galley and the cabin separator because it would not fit inside the galley. At impact, the cooler came free and ice cubes spilled into the floor and mingled with galley debris, causing at least one passenger to slip and fall when he was walking to the cargo door.

The door in the forward cabin separator was held open for takeoff with a rubber strap fastened to the rear cargo restraint pole. At impact, the door came off its hinges and fell partially inside the cargo compartment and partially inside the passenger cabin.

A passenger attempted to remove the left cabin emergency exit door at seat 8-A. Despite having read the instructions about the door and listening to the verbal instructions of the flight attendant, he could not remove the exit door. The 8-A seatback had fallen forward and prevented pulling the emergency exit into the airplane; the passenger eventually was able to lift the emergency exit over the seatback and remove it, and he and another passenger, exited through the hatch. The Safety Board's investigation showed that seat 8-A's seatback could be folded forward with a very slight amount of pressure applied to its rear side because the seatback attachments had little friction because of wear. Seats are usually designed with a feature that allows seatbacks to move forward when a force of about 35 pounds is applied.

The investigation also disclosed that pulling emergency exists into the airplane was further restricted by the rearward angle of the seatback in front and the armrest of seat 8-A. Similar difficulties were encountered during the removal of the emergency exit on the opposite side of the cabin at seat 8-D.

In the rear cabin, the commode and its fairing had broken free and blocked the floor level emergency exit which was located inside the lavatory. The Safety Board's investigation showed that before the accident possibly only one of the two latches which locked the commode to the floor was secured and that only one of the four fasteners which held the fairing in place was engaged. A picnic jug which contained coffee was stowed in the lavatory during takeoff, and at impact coffee spilled onto the floor next to the emergency exit.

1.16 Tests and Research

1.16.1 Engine Test Results

The Safety Board examined the left and right engines on February 8, 1984, and tested them in the Rolls Royce test cell. Before the engines were installed in the test cell, the engine oil was removed and strained through a 100-micron strainer and no foreign particles were found. The propeller shaft "runout" on both engines was within prescribed limits. The first-stage impeller vanes were examined using a borescope and no damage was noted. Both engines produced shaft horsepower within acceptable performance limits. The engine torque pressure switches were tested and both functioned normally.

The left engine vibration tests, oil consumption rate, oil pressure, and rundown times were all within prescribed limits. During the test run, the left engine produced 1,535 shaft horsepower at 575° centigrade. Takeoff rpm was 14,600, which is 100 rpm over maximum for takeoff. The right engine vibration tests were calibrated at 1.6 inches per second at 12,000 rpm; 1.5 inches per second is an acceptable rate. All other tests were within acceptable limits. The right engine produced 1,535 shaft horsepower at 594° centigrade, the maximum temperature is 590° centigrade.

1.16.2 Propeller Examination Test

The Safety Board examined both propellers. The pitch change mechanisms of the propeller assemblies were cycled hydraulically on a test stand from coarse pitch to fine pitch and from fine pitch back to coarse pitch. 6/ During the cycling, the flight fine pitch locking mechanisms functioned correctly. The internal leak rate of the left and right assemblies was 2 and 12 imperial pints (Imp. Pts) per hour, respectively. The acceptable limited is 40 Imp. Pts./Hr. The fine pitch latching times were less than 1.5 seconds for both left and right assemblies. Neither assembly had external oil leaks while on the stand.

The four blades from the right propeller were removed from the hub. The torque required to "break away" the retaining nuts for each blade was 12,000 to 13,000-foot- pounds, exceeding the 12,000-pound minimum.

The bearing was removed from the blade that had received the most bending damage. There were no imprints made on the race by the roller-type bearings that would show approximate blade angle when the blade contacted the runway. The propeller control units (PCU) from both engines were tested functionally on March 8 and 9, 1984, and each performed satisfactorily.

1.16.3 Airplane Electrical System

On April 23 and 24, 1984, the Safety Board tested the propeller electrical systems. Electrical wiring diagrams were provided by the Fokker Aircraft Company. Both engines were removed from the airframe before the tests.

A 24-volt battery was installed in the airplane to provide an electrical source. The following systems and electrical components in the propeller circuits were tested on both engines: isolation relays, throttle switches, HPC switches, autocourser circuit relays, feather contractor relays feathering switches, indicator/warning lights, feather pump circuit and relays, and engine lockout functions.

A test, consisting of jumping the two terminals at the cannon plug connector which controlled the electrical circuit for the low pressure torque switch, was run for each engine. The application of voltage to the connector terminals simulated the closing of the low-pressure torque switch and would start the autofeathering systems. The electrical circuits for both engine's low-pressure torque systems operated according to specifications. Both alternators were functionally checked and no deficiencies were noted.

1.16.4 Audio Spectral Diagram

An audio spectral analysis was performed using the CVR tape and a diagram was prepared to assist in identifying sound the frequencies and signatures of the engines and propellers. The audio spectral diagram began when the engines stabilized at takeoff rpm and continued until the airplane struck the runway. The diagram base time started at 1442:20 and was divided into segments of "seconds." To obtain local time, the elapsed time was added to 1442:20.

6/ Coarse pitch and fine pitch are European terms for low pitch and high pitch respectively.

The sound of the cycling of the left engine's feathering pump was identified by a Fokker factory representative. The sound patterns were identified as left engine and right engine, respectively, from cockpit conversation recorded on the CVR. The frequency associated with stabilized takeoff rpm was more noticeable on the left engine.

At the base time plus 0.8 second, the left engine rpm decreased rapidly. At the base time plus 1 second, a frequency identified as coming from the feathering pump began to cycle. The sound frequency from the CVR tape for the left engine was equivalent to 87 percent engine rpm at takeoff. At base time plus 9.2 seconds, the rpm on the right engine began to decrease rapidly. A correlation was made between the CVR spectral diagram and the CVR tape recording which recorded the captain saying, "Okay let's feather the left one, power lever back." This command was followed by the captain's statement, "Keep the [right] one going." Thirteen seconds later, the airplane struck the runway. At the same instant that the captain said, "Okay let's feather the left one, power lever back," the audio spectral diagram showed a loss of power on the right engine.

The Safety Board conducted flight tests in an F-27 airplane to produce a CVR tape which was used as a comparison audio spectral diagram. The audio traces of certain events were compared to audio traces of the Flight 35 CVR audio spectral diagram. One test involved moving the HP cock to the "off" position until a flame out was noted, and then returning the HP cock to the "on" position. The off-on movement of the HP cock was initiated to simulate an engine failure caused by the mistaken movement of the HP cock. The audio traces produced in the test could not be specifically identified with audio traces on the audio spectial diagram from Flight 35. However, during the flight test the test flight airplane recorded a more rapid rpm decay than Flight 35, and the rpm of Flight 35 reached a lower value than noted with the test flight airplane.

1.17 Additional Information

1.17.1 Past History of Unwanted Autofeathering

The Fokker Aircraft manufacturer was asked to provide any information of previous unwanted autofeathering of the Dowty-Rotol propeller. The following data were provided:

Year	Carrier	Circumstances
1963	Phillippine Airlines	LH prop autofeathered during T/O when reducing rpm to 13,800. When rpm was restored above 14,000, prop returned to normal. Cause: two crossed wires in LH fine pitch relay.
1964	Air Nippon Airlines	RH prop feathered during T/O at 12,000 rpm. Same failure occurred during subsequent test run at 11,500 rpm. Cause: torque pressure switch bridge retaining pin not properly locked.
1978	Phillips	RH prop auto-feathered during T/O run. Cause: short circuit in HP cock switch.

The electrical circuits involved in these incidents were tested on N148PM and found to be in a normal operating condition.

Safety Board investigators examined FAA Service Difficulty Reports (SDR) from February 22, 1979, to January 6, 1984, for the F-27 Rolls Royce Dart 514-7 engine to determine if SDRs had been submitted on engine conditions and/or malfunctions of systems which activated the autofeather systems. Two instances were reported: On January 29, 1981, a No. 2 engine propeller autofeathered during takeoff because the oil cooler had ruptured resulting in a loss of oil pressure and torque and autofeather system activation. On December 23, 1981, a No. 2 engine propeller autofeathered during climb when the high pressure (HP) fuel filter became clogged, resulting in a power loss and activation of the autofeather system. In both cases, the autofeather system functioned according to system design.

1.17.2 Propeller Operation

The propellers on the Rolls Royce Dart 514-7 turbopropeller engines are controlled by the propeller control unit (PCU) and a feathering pump. The Dowty-Rotol installation is a three-oil line system, with the center line used to coarsen propeller blade pitch. The PCU maintains engine speed at 14,500 rpm.

To feather the propeller, the governor valve of the propeller control unit opens to direct oil to the coarse side of the main operating piston in the propeller. The unit can be feathered manually by moving the high pressure cock to the feather position, which mechanically opens the governor valve. The feathering pump must be operated by the feathering pump button until feathering is complete.

The autofeathering circuit will operate only if, on a "failed" engine, torque low pressure drops below 50 psi, the high pressure cock control level is open, and the rpm control lever is set in advance (forward) of the 12,500 rpm position. Also, the high pressure cock control lever on the other engine must be forward of the feather position when the torque pressure switch senses low pressure coming from the propeller reduction gear case. The propeller governor valves allow oil pressure to start the propeller blades toward feather and at the same time start the propeller feathering pump motor.

1.17.3 Engine Anti-ice/De-ice System and the Use of Continuous Ignition

The airplane was equipped with electrical systems designed to remove or prevent the formation of ice on the engine air intakes, propeller spinners, the leading edges of the propeller blades, and windshields. The power for the heating elements of these systems comes from the engine-driven alternators.

Electrical heater elements are fitted around both the main air intake and oil cooler air intake of each engine and may be energized when required. Both anti-icing and de-icing techniques are employed by using continuously heated and intermittently heated elements. A continuously heated anti-icing element prevents ice from forming on the leading edge of the intake. Behind the leading edge, ice is allowed to form and is dislodged by the cyclic heating of the de-icer elements immediately behind the anti-icing elements and on the inner and outer surfaces of the intakes. To ensure that this ice breaks away easily, the de-icing element is divided into segments by continuously heated strips which extend rearward from the anti-icing element.

During the period when de-icing heat is off, a thin layer of ice can form which acts as an insulator. When heating is resumed, heat is mor effective than on an uncovered surface, and the inner layer of ice adhering to the surface is melted or dispersed easily.

To prevent ice formation inside the air intakes caused by water droplets running back and refreezing, an additional intermittently heated element, using a lower intensity current, is situated farther back on the inner wall of the intake. Similar elements are fitted in the spinners of each propeller and also are molded into overshoes on the leading edges of the blades. The switches, indicators, and warning lights required for the control of each power unit de-icing system are located on the overhead de-icing panel and are as follows:

1. 3-position (ON, OFF and TEST) control switch.
2. 2-position (SLOW and FAST) cyclic timer selector switch.
3. 2-position (ENGINE and TOTAL) ammeter selector switch.
4. Ammeter.
5. Blue cycling indicator light of the press-to-test type.

The F-27 operations manual states under "Delayed Activation, Power Plant Deicing" that, if icing conditions are encountered before the system is switched on, there is a possibility of flame extinction after the system starts working. Also the Rolls Royce engine manual under the section "Late Selection of Power Unit Ice Protection System," contains the following statement, "Should icing conditions be encountered before the system is switched on, there is a possibility of flame extinction shortly after the system starts operating; this is due to comparatively large pieces of ice breaking off and passing into the engine, resulting in a high concentration of water in the combustion chamber."

The flight manual calls for the use of powerplant de-icing as follows: "The power plant deicing systems must be activated before entering icing conditions. To insure this, activate de-icing systems whenever the temperature is below +10° C, unless it is certain that no ice conditions will be encountered." The flight manual also notes under the "use of ignition" that if the de-ice system is turned on after entering the icing conditions, "then turn on both ignition switches." The manual also states, "since continuous use will effect the service life of ignitors, record such use of ignition." The operations flight manual does not require or recommend the use of continuous ignition for takeoff or landing.

1.17.4 Past History of Dart Engines

In 1960, the Civil Aeronautics Board investigated an accident that involved Dart 500 series engines and in-flight engine icing during the flight of Capital Airlines Flight 20 of January 18, 1960, near Charles City, Virginia. 7/ In its report of that accident, the Board noted that the heating elements of the engine ice protection system are designed to melt off ice in small pieces, which normally have no noticeable effect on the operation when they enter the engine. The report states, "However, if ice is allowed to build up to a considerable thickness before being removed, large pieces of ice enter the engine. The resultant high concentration of water may cause a partial or complete flame out. Tests conducted during the development of similar Dart engines disclosed that the

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7/ Civil Aeronautics Board Aircraft Accident Reports, Vol. 7, 1959-1963 Case No. 475. (Capital Airlines, Inc. Vickers-Armstrong Viscount, N7462 near Charles City, Virginia, January 18, 1960, September 15, 1961.

engines would flame out from ingestion of from 3.5 to 4 pounds of airframe ice, which is equivalent to the release of between a 1/4 and 1/2 inch thickness of ice from the inside part of the nose cowling."

The 1960 report continues: "The anti-icing system should be turned on well in advance of anticipated icing conditions in order to allow the inlet duct to warm up enough to prevent excessive ice from forming. If ice has been allowed to accumulate and the system is armed late, heating underneath the ice formation is quite rapid since the ice acts as an insulator. If ice has formed and the ice-protection system is turned on, sufficient heating occurs in approximately 30 seconds and de-icing will result. Under these circumstances, there is a good possibility that the entire ice accumulation around the inlet duct circumference will slip off and go through the engine en mass. The release of a large amount of ice from the inside part of the nose cowling, due to the late arming of the engine ice protection system, would have been sufficient to flame out any of the engines."

1.17.5 Pilgrim Airlines Procedures

Flightcrew.--The Pilgrim Airline's F-27 crewmember training program was approved initially by the FAA's Westfield, Massachusetts, General Aviation District Office (GADO) on January 4, 1980, and again on March 20, 1981. The ground training program was accomplished at the Pilgrim Airlines headquarters at Groton, Connecticut, and primarily consisted of classroom lectures. Simulator training was accomplished at the facilities of another airline under the supervision of the Pilgrim Airlines/FAA-designated check airmen. The ground training for pilot-in-command initial transition and upgrading consisted of 100 hours of classroom lectures. Recurrent ground training consisted of 20 hours of classroom lectures. When the FAA approved the flightcrew training program in 1980 and 1981, Pilgrim had two pilot instructors who were designated to conduct the ground and flight training program.

A new pilot training manual was approved by the FAA on February 14, 1984, which clearly defined the company policy to require flightcrews to complete checklist items by "read and response method." In addition, the manual included clear instructions for procedures to be followed in the event that autofeather of propeller occurs during takeoff.

Flight Attendant.--The Pilgrim Airlines flight attendant manual contained no name or title of a Pilgrim official on the "Approved" line on the manual's title page. The manual pages were not numbered. It was not possible to determine if the manual was complete without a comparison with the master manual. No instructions were given to flight attendants, in the event of an accident, to remain seated with their restraints fastened until the airplane's motion stopped. The manual contained no procedures to assure that food and beverage service items were stowed inside approved compartments before takeoff and landing. The manual contained the following instructions with regard to the use of seatbelts for infants and children:

5.0 FLIGHT ATTENDANT SAFETY PROCEDURES

A. SEAT BELTS

3. Children occupying seats alone must use seat belt or be held by an adult. [seated in his own seat]

H. BOARDING

1. Passenger Seating Regulations - Assist passengers in finding their seats. Except for the following special cases:

b. A child under two years of age may be held by an accompanying passenger. Do not place a seat belt around the child, only around the fare paying passenger.

A child two or over must occupany a seat. Place the seat belt around the child in the normal manner."

With regard to maintaining the airplane's center of gravity, the flight attendant manual contained instructions to block certain passenger seats as a function of various minimum and maximum cargo and baggage compartment weights and for when water methanol was carried. No instructions/procedures were given for how a flight attendant would learn of the weights of cargo and baggage or know which passenger seats to block; moreover, the manual did not require that cabin seating be coordinated with the captain before departure.

1.17.6 FAA Surveillance of Pilgrim Airlines

The FAA GADO at Westfield, Massachusetts, maintains the Pilgrim Airlines operating certificate. The GADO was staffed with five operations safety inspectors and a unit supervisor in the year before the accident. The GADO was responsible for four 14 CFR Part 121 certificates and an average of 62 14 CFR Part 135 certificates during the same time period. Each inspector was assigned about 12 14 CFR Part 135 operators, and 4 of the inspectors were assigned to 14 CFR Part 121 operators. The GADO supervisor stated that each inspector averaged about 34 Part 135 flight checks per month, but had conducted no Part 121 flight checks of Pilgrim Airlines pilots. There was one FAA F-27-qualified inspector at the GADO. During the year before the accident, the operations inspectors performed 28 ramp inspections and 5 surveillance visits at Pilgrim Airlines. However, the operations inspectors had not observed Pilgrim Airlines flight or ground training.

The Westfield GADO was assigned five or six airworthiness safety inspectors and a unit chief during the year before the accident. Since two airworthiness inspectors were trainees, the four remaining inspectors were responsible for 28 certificates each, and a total of 114 repair station certificates. Eighteen ramp and surveillance inspections were conducted of Pilgrim Airlines.

During the period January 1, 1983, through January 13, 1984, 23 line checks, 41 proficiency checks, and 6 type-rating checkrides had been conducted by FAA-designated Pilgrim Airline pilots. None of these activities was conducted or observed by FAA inspectors nor was there a requirement to observe these activities. There was no record that FAA inspectors observed Pilgrim Airlines pilot or flight attendant training.

The captain of Flight 35 received three line checks between August 19, 1982, and December 8, 1983; none were conducted by the FAA. The captain received four proficiency checks from September 23, 1982, to December 8, 1983, none of which was observed by the FAA. The first officer on Flight 35 received ground training in the F-27 airplane on September 1, 1983, which consisted of 60 classroom hours. She successfully completed her first officer's flightcheck on October 26, 1983. The flight check was conducted by a company check airman.

1.17.7 Pilgrim Airline Accident/Incident History

The Safety Board accident files indicates that between 1977 and 1984 Pilgrim Airlines airplanes have been involved in three accidents (including the subject accident) and one incident. However, all the accidents/incidents have occurred since February 1, 1982. The incident and the first two accidents involved Pilgrim Airlines airplanes operating under 14 CFR 135, while the January 13, 1984, accident flight was conducted under 14 CFR 121. One accident involved an inflight fire which started in the windshield washer/de-ice system. The second accident occurred when a Pilgrim Airlines airplane landed short of the intended runway due to weather related factors. The incident involved a collision with a ground power cart as the airplane taxied. One accident resulted in a fatality to a passenger, two accidents resulted in serious injuries, and the incident involved no injuries to passengers or crew.

The Safety Board attributed flightcrew error as the probable cause of one accident and the incident. The probable cause of the other two accidents was weather and inadequate system design/maintenance, respectively.

1.18 New Investigative Techniques

None.

2. ANALYSIS

2.1 General

The flightcrew was certificated properly and qualified for the flight. There was no evidence of any preexisting medical or psychological condition that might have affected the flightcrew's performance. The airplane was properly equipped, maintained, and loaded in accordance with existing FAA regulations and company procedures. There was no evidence of any maintenance discrepancies that would have affected the flight.

The examinations of the propeller autofeather and manual feather systems and propeller controls and electrical circuits for both engines disclosed no defects or intermittent electrical malfunctions. All of the autofeather and manual feather components were functionally tested and were found to operate normally. The wire-by-wire examination of the electrical systems involved in the control of the feather and autofeather systems revealed no loose terminal connections, shorted wires, or inoperative microswitches, relays, or warning lights.

2.2 The Accident

The investigation revealed that the weather conditions encountered by the airplane on the inbound flight to JFK were as predicted and were conducive to airframe icing. This fact was confirmed by reports from pilots who encountered icing between 500 and 6,000 feet, and by statements of the flightcrew of Flight 35. Significantly, the flightcrew stated that they had not used engine anti-ice during the inbound flight,

although they did encounter icing conditions which resulted in an accumulation of ice on the airplane. Pilgrim Airlines procedures state that anti-ice systems must be activated before entering icing conditions. The procedures specify temperature of +10° C as the temperature below which engine anti-ice must be used. Since the temperatures encountered by Flight 35 were always well below 10° C on the day of the accident, the flightcrew should have used engine anti-ice whenever icing conditions were anticipated and their failure to do so was contrary to company procedures.

During the 45 minutes that the airplane remained on the ground at JFK, no ice would have formed on the airframe because there was no precipitation. However, the continuous subfreezing temperatures on the ground at the JFK would have prevented ice which had accumulated during the inbound flight from melting. Consequently, any airframe or engine inlet ice which could have affected the airplane must have formed before the landing at JFK at 1346. The captain recalled that he did see traces of ice on the leading edges of the wings before takeoff, but did not see ice on the other parts of the airplane.

Ice could have developed in the engine inlets during the inbound flight to JFK and if undetected by the captain during the preflight inspection, the ice would remain in the inlets as Flight 35 started the takeoff from JFK. Furthermore, 1 hour after the accident, FAA and Safety Board personnel observed ice which was 1/2 inch thick and extended almost the full length of each wing leading edge. There was also a 1/2-inch buildup of ice on the captain's windshield wiper post after the accident.

The evidence that ice on the wings did exist before takeoff leads the Safety Board to conclude that there was also an accumulation of ice in the engine inlets, and that this ice was not noted during the captain's preflight inspection. Furthermore, it is likely that the buildup of ice in the engine inlets was equal to the 1/2-inch accumulation on the leading edges of the wings.

The flightcrew used the engine anti-ice system when the airplane taxied for takeoff at JFK. However, the heating elements of the system were not activated until weight was removed from the landing gear. Once the airplane was off the ground, electricity was supplied to the engine de-ice system. Thereafter, the application of heat to the inlet cowls would have been sufficient to start to melt and dislodge accumulated ice in less than 30 seconds.

The potential hazards of activating the engine anti-ice system after ice has accumulated are discussed in the F-27 operations manual and the Rolls Royce engine manual and should have been known to the flightcrew. The instructions clearly warn that "a possibility of flame extinction" exists shortly after the system starts operating if large pieces of ice break off and enter the engine.

In the absence of any mechanical or electrical problems to cause the losses of power the facts of the accident strongly indicate that the left engine power loss and autofeather resulted from an ingestion of ice from the engine inlet cowls. Any engine inlet cowl ice, would have become dislodged upon rotation through the normal operation of the engine anti-ice system. The loss of power to the left engine would have triggered an autofeather of the left propeller after the low torque was sensed. There was no indication on the CVR of any activity by the flightcrew that would account for the power loss of the left engine, and there was no reason for the flightcrew to change power settings when the left engine shut down. As a result, the Safety Board concludes that the power loss to the left engine resulted from an ingestion of ice from the engine inlet cowl.

The right engine continued to operate normally for 7 seconds after the power loss on the left engine at 1442:22. A power loss on the right engine was noted by the flightcrew and confirmed at 1442:29, by an audio spectral diagram of the CVR tape. The right engine power loss occurred precisely at the same time the captain announced the manual feather procedure for the left engine. A possible explanation for the power reduction on the right engine is that the captain mistakenly reduced power on the right engine rather than retarding the left engine high pressure cock. However, the captain denied taking any action which would have reduced power on the right engine, and there were no indications on the CVR of other flightcrew activity that would account for an inadvertent power loss on the right engine. Furthermore, the F-27 flight tests did not produce audio traces or physical evidence which indicated that the captain moved the right engine high pressure cock, leading to a power reduction on the right engine. Consequently the Safety Board believes that the loss of power on the right engine was not caused by actions of the flightcrew.

Therefore, the Safety Board believes that the explanation for the power loss of the right engine also is ice ingestion. Since the right engine had been exposed to the same conditions as the left engine, the power loss on the right logically can be attributed to the same factors that caused the left engine power loss. Therefore, the Safety Board concludes that the right engine experienced a power loss when ice was ingested into the engine after application of the engine anti-ice system. The right propeller did not autofeather because the autofeather system on the operating engine is locked out as soon as one engine is shut down and its propeller autofeathered.

The captain's visual inspection of the exterior of the airplane revealed ice on the leading edges of the wings. However, he stated that, in his opinion, the ice did not constitute a hazard to flight. The Safety Board believes that the captain's preflight inspection of the airplane was inadequate, since he failed to observe the substantial ice accumulation noted after the accident which in the absence of precipitation had to have been on the wing at the time of his inspection, and because he made no attempt to remove the ice. The effects on airplane performance of ice on the fuselage, wings, and control surfaces are well known. The observation of this condition should have prompted the captain to remove the ice and to inspect the airplane more thoroughly. The need for these actions should have been very evident to the captain since he knew he had not used engine anti-ice on the preceding flight, and since he knew he probably would encounter more icing conditions on takeoff. The consequences of ice ingestion were explained in the crew's flight manual. Additionally, 14 CFR 91.209 specifically prohibits a takeoff with snow or ice adhering to wings, stabilizers, or control surfaces, or with frost, snow, or ice on any propeller or powerplant installation. Finally, 14 CFR 121.629(b) requires the captain to deice an airplane before takeoff.

The use of engine anti-ice during takeoff was a company prescribed procedure for the flightcrew to employ in the prevailing meteorological conditions. However, because the flightcrew had not used engine anti-ice on the inbound trip to JFK, it was important that a very thorough examination of the engine inlet cowls be conducted before using the engine anti-ice system on takeoff to insure that no ice was present. Consequently, the Safety Board concludes that the flightcrew's failure to use engine anti-ice on the inbound flight to JFK, the captain's failure to conduct a thorough preflight inspection, and the flightcrew's decision to use engine anti-ice on takeoff from JFK led to the power losses which resulted in the accident. While company procedures allowed the use of anti-ice on takeoff, the consequences of doing so under these circumstances should have been well known to the flightcrew.

The Safety Board is concerned also that the flightcrew did not use continuous ignition during takeoff. Although it was not required by Pilgrim Airlines, continuous ignition was available and may have prevented the power loss on the right engine. This omission also indicates that the flightcrew did not given adequate consideration to all the circumstances surrounding the takeoff.

2.3 Pilgrim Airlines Training

Flightcrew Training.--Pilgrim Airlines conducts in-house crew training, and Pilgrim designates check pilots to conduct simulator training. The training manual used in the training of Pilgrim pilots requires flightcrews to carry out the manual feather drill within "2 minutes" after propeller autofeather. However the checklist which the crew used at the time of the accident stated under the section, Automatic Feathering, ". . . carry out a manual feather drill as soon as practical." The Safety Board believes that the training of the flightcrew in emergency procedures was deficient, in that conflicting information was taught regarding the procedure to be followed when a propeller autofeathers on takeoff. The operator's manual stating within "2 minutes" and the checklist stating "as soon as practical." Neither procedure took into consideration nor emphasized flying the airplane to a safe altitude before completing the manual feather procedure.

As a result of the accident, Pilgram Airlines has amended its flightcrew training program as follows: "If the propeller is feathered and there is no fire, take no further action until 400 feet AGL."

2.4 Federal Aviation Administration Surveillance

The FAA surveillance program of Pilgrim Airlines did not provide the level of surveillance appropriate to a 14 CFR Part 121 airline. All pilot flight checks were conducted by Pilgrim Airlines personnel, and no training surveillance was conducted. Therefore, the FAA exercised very little oversight to the operational elements of Pilgrim Airlines. The inadequacies and inconsistencies in the flight attendant manual and the post-accident revisions to the operations manual indicate that more stringent and more thorough surveillance was necessary. The workload of the FAA inspectors at the Westfield GADO did not appear to have limited their performance of appropriate Part 135 flightchecks. However, there was no record that any Part 121 flightchecks or training surveillance was conducted of Pilgrim flightcrew by FAA inspectors. Consequently, the failure to perform more surveillance on Pilgrim Airlines appears to have been a conscious election of priorities. While the Safety Board recognizes the value of using designated check airmen, the total delegation of a portion of an airline surveillance program is unacceptable, if for no other reason that the FAA cannot exercise a proper quality control of the performance of the company-designate check airmen. This accident investigation indicated that FAA GADO inspectors did not devote sufficient time to the actual conduct of surveillance of Pilgrim Airlines training or the activities of company-designated check airmen.

The Safety Board is concerned that FAA GADO inspectors who conduct surveillance of Part 121 airlines may not apply the same standards of surveillance as FAA inspectors assigned to Flight Standards District Offices (FSDO). GADO workloads are by definition general aviation oriented. Consequently, GADO inspectors may not examine Part 121 airline activities from the same perspective as FSDO inspectors.

2.5 Survivability

The accident was survivable: the impact forces transmitted through the restraint system were well within the limits of human tolerance and there was no intrusion of structure into occupied spaces. In addition, except for the multiple failures of the captain's seat, no seats were damaged, no restraint systems failed and, there was no fire. All passengers were wearing seatbelts at impact, except for the infant who was held by its mother, and the three crewmembers were restrained by their four-point restraint systems. As soon as the right engine lost power, and despite the lack of a warning from the flightcrew, the flight attendant and passengers recognized the possibility of a crash and passengers and prepared for the impact.

The evacuation was conducted under hospitable circumstances: there was no smoke or fire; ambient daylight provided more than adequate illumination inside the cabin; there was no disruption to passenger seats; there was no panic or disruptive behavior among crew or passengers; the pilots and passengers suffered no debilitating injuries which prevented their unassisted escape from the airplane; the captain and the first officer provided leadership in the evacuation of the passengers; the flight attendant shouted instructions to passengers while she lay on the rear cabin floor; and, except for the infant and the 2 1/2-year-old child, all the passengers were able-bodied and were able to effect their own escape.

Had the circumstances of this accident involved any or all of the possible factors--fire, multiple impacts, or fuselage breakup--several problems which did develop would have been compounded and would have affected the survival of persons on board Flight 35 adversely. Specifically, the problems which existed in the accident were: emergency exits could not be removed expeditiously; the rear emergency exit was blocked by the commode and its fairing which broke free at impact; passengers could not maintain one of the brace positions depicted on the safety card; oversized galley beverage service items were not secured for takeoff; the flight attendant left her seat before the airplane came to rest; and the cockpit jumpseat and the cargo restraints were loose inside the forward cargo compartment. Some of these circumstances are uncontrollable, such as the blocking of the rear emergency exit by the commode, and the failure of the cockpit jumpseat and the cargo restraints. However, the problems with the brace position and the failure to secure galley beverage service items could have been eliminated by better planning and anticipation by the airline. Specifically, the stowage of oversize food and ice cube containers continues to be a problem in spite of the requirements of 14 CFR 121.576, which requires retention of these items. The Safety Board refers the FAA to Safety Recommendations A-72-60 and A-72-63, and the FAA's study and report on this issue entitled "A survey of Air Carrier Cabin Safety," issued December 1976, which detail similar problems. Additionally, closer FAA inspection of the cabin procedures should have surfaced many of these deficiencies and prompted corrective measures.

The Safety Board continues to be concerned about the lack of adequate passenger restraints for infants and small children in aircraft. The 3-month-old baby was held in a parent's arms during takeoff. Studies by the Insurance Institute for Highway and the University of Michigan's Highway Safety Research Institute have shown that an adult typically cannot restrain infants and small children adequately from crash forces even in relatively low-speed impacts. In an aircraft, an adult may not even be able to restrain an infant or child from flying upward or about the cabin during severe turbulence. If the adult is unrestrained or only loosely restrained, or if the adult lap belt fails to perform adequately, serious injuries or death could be incurred by a lap-held infant or child.

In 1978, the Safety Board recommended that the FAA take action to provide for the effective protection of infants and small children in aircraft. In 1983, the Safety Board recommended that any infant or child restraint device approved by the NHTSA for use in motor vehicles be approved by the FAA for use in aircraft use. On August 30, 1984, the NHTSA issued a final rule on performance test standards for infant and child restraint devices to be certified for use in aircraft. These standards permit any device meeting the test standards for motor vehicle and one additional inversion test to be certified also for aviation use. Forty-two currently available models have been tested by the Department of Transportation and have been shown to meet all test standards.

The Safety Board is encouraged by the adoption of this final rule and by the positive developments to provide adequate child restraint systems for small children and infants in aircraft. There still remains the need for uniform acceptance by the airlines of the use of approved child and infant restraint system on commercial aircraft. The Safety Board continues to urge the FAA and the airlines to allow (and for that matter to encourage) parents to provide and use individual approved infant and child restraint devices on aircraft.

The flight attendant manual contained confusing and incomplete, as well as extraneous information on the loading of passengers and baggage. Additionally, the manual was unclear with reference to the use of seatbelts for children. These deficiencies reflect inadequate enforcement and surveillance on the part of the FAA inspectors who were assigned to Pilgrim Airlines, as well as a lax attitude by the company to review and improve the manual.

The CFR response was timely--the first vehicle arrived 1 minute 10 seconds after notification, by which time everyone had already evacuated the aircraft. The captain had neglected to shut off electrical power before he left the cockpit. After the arrival of the first CFR truck, the captain conferred with the CFR crew chief who requested the captain to enter the airplane and secure the electrical system. He entered the airplane alone and turned off the electrical system.

The judgment exercised by the CFR crew chief in requesting the captain to reenter the airplane to shut down the electrical power is a matter of concern. If it was believed that a risk existed because the electrical power was a potential ignition source for a fire, it was unwise to expose the captain to the potential hazard inside the airplane. A better choice would have been to have a firefighter with a charged hand line and self-contained breathing apparatus (SCBA) accompany the captain into the airplane.

3. CONCLUSIONS

3.1 Findings

1. The crew was properly certified and qualified for the flight.
2. The airplane was properly equipped and maintained.
3. The engines, airplane, systems, and components operated properly.
4. Flight 35 encountered icing conditions inbound to JFK.
5. The flightcrew observed the buildup of ice on the airframe during the inbound flight to JFK. However, the engine de-ice/anti-ice system was not used during the flight though required by company flight manual procedures.

6. The captain noted ice on the leading edges of both wings during the preflight walk-around inspection before takeoff from JFK.

7. Engine anti-ice was turned on for takeoff but the system did not activate until weight was taken off the landing gear.

8. The captain did not detect any impending malfunction, such as loss of engine rpm, torque pressure, or fuel flow to either engine during the takeoff roll and initial climb.

9. The airplane was accelerating and had a positive rate of climb when the left engine experienced a power loss and the left propeller autofeathered.

10. Left propeller autofeathered most likely because ice, which had accumulated around the engine inlet, was loosened upon application of engine de-ice heat and ingested into the engine and causing a flameout.

11. The first officer had no difficulty maintaining a positive rate of climb and directional control with the right engine operating.

12. The right engine suffered a power loss most likely also because of ice ingestion.

13. Pilgrim Airlines training involved a different procedure for flightcrews to follow when a propeller autofeathers during takeoff than did the airline's flight manual. Neither procedure was an optional one.

14. The flight attendant manual had conflicting information with regard to the use of seatbelts for infants and children, and was unclear with regard to the duties and responsibilities for blocking of seats and weight restrictions for cargo/baggage.

15. The flight attendant manual contained no instructions to the flight attendant to remain seated with their restraints fastened until the airplane's movement had stopped and no instructions governing the proper stowage of oversize galley service items.

16. When some passengers attempted to assume one of the two brace positions depicted on the safety card, i.e., arms braced on the seatback in front and head resting on arms, the seatbacks folded over, and passengers had little time in which to assume alternate or brace positions before the airplane struck the runway.

17. Passengers' injuries resulted predominately from inertia forces on initial impact, which caused cervical-sacral strains and minor contusions when passengers struck adjacent seats.

18. The captain should not have been allowed to reenter the airplane alone to shutoff the electrical power, but should have been accompanied by a properly equipped firefighter with a charged handline.

19. Federal Aviation Administration surveillance of Pilgrim Airlines did not provide adequate monitoring of its operational programs.

3.2 Probable Cause

The National Transportation Safety Board determines that the probable cause of this accident was the flightcrew failure to use engine anti-ice on the inbound flight to JFK, the captain's failure to conduct a thorough preflight inspection, and the flightcrew's decision to use engine anti-ice on takeoff from JFK which lead to power losses on both engines.

4. RECOMMENDATIONS

As a result of its investigation, the National Transportation Safety Board recommends that the Federal Aviation Administration:

Issue instructions to air carrier Principal Maintenance Inspectors responsible for F-27 airplanes to examine underwing emergency exits for interference from adjacent passenger seats, and where interference is found, to direct air carriers to eliminate the interference within a specified time. (Class II, Priority Action) (A-84-128)

Issue instructions to air carrier Principal Maintenance Inspectors responsible for F-27 airplanes to require air carriers to install, within a specified time, an FAA-approved means to prevent the hinge pins from coming free of their hinges on the door between the forward cabin and the cargo compartment or to remove that door. (Class II, Priority Action) (A-84-129)

Issue instructions to air carrier Principal Operations Inspectors to review the passenger safety information cards of their respective carriers to assure that any depicted bracing position, utilizing the seatback for support, in fact can be used; and to require deletion of this bracing position from the safety information cards on those airplanes that are equipped with seats that have foldover seatbacks. (Class II, Priority Action) (A-84-130)

Issue instructions to the air carrier Principal Operations Inspector to require revision of the flight attendant manuals of Pilgrim Airlines to incorporate clear, concise, and unambiguous operating instructions, and to conform to accepted industry standards, and to require that the training program for crewmembers be consistent with the manuals. (Class II, Priority Action) (A-84-131)

Issue instructions to air carrier Principal Operations Inspectors to require that flight attendant training programs and manuals of air carriers address adequately the need to stow galley service items in approved compartments and to include, during their in-service inspections, increased surveillance of the proper pre-flight and pre-arrival stowage of galley service items. (Class II, Priority Action) (A-84-132)

Establish quality assurance procedures to ensure that air carrier operations and airworthiness inspections adequately address cabin safety issues, such as crew member training and manuals, storage of heavy items inside the cabin, storage of galley service items, and access to emergency exits. (Class II, Priority Action) (A-84-133)

BY THE NATIONAL TRANSPORTATION SAFETY BOARD

/s/ JIM BURNETT
Chairman

/s/ PATRICIA A. GOLDMAN
Vice Chairman

/s/ G. H. PATRICK BURSLEY
Member

October 16, 1984

APPENDIXES

APPENDIX A

INVESTIGATION AND HEARING

1. Investigation

The National Transportation Safety Board was notified of the accident about 1530 EST on Friday, January 13, 1984, and dispatched an investigation team to John F. Kennedy International Airport, Jamaica, New York. Investigative groups were formed for powerplants, structures, systems, survival factors, cockpit voice recorder, flight data recorder, weather, and operations.

Parties to the investigation were Pilgrim Airlines, Rolls-Royce, Dowty-Rotol, and the Federal Aviation Administration.

2. Public Hearing

A public hearing was not held; depositions were not taken.

APPENDIX B

PERSONNEL INFORMATION

Captain Willard F. Bushy

Captain Bushy, 32, holds Airline Transport Pilot Certificate No. 1956904, with airplane, multiengine land and Fokker F-27 ratings, and commercial privileges for airplane single engine land. He was hired by Pilgrim Airlines on March 5, 1979, as a DHC-6 first officer. He became a Fokker F-27 first officer on September 23, 1982, and was upgraded to F-27 captain on November 2, 1982. He also is a currently qualified captain on the DHC-6, and has flown the DHC-6 for Pilgrim Airlines as captain.

Captain Bushy had flown a total of 7,012 hours, of which 799 were in the F-27. He had flown 250 hours, 80 hours, and 3:5 hours respectively in the previous 90 days, 30 days, and 24 hours. He completed F-27 recurrent training on August 3, 1983, and a line check in the F-27 on December 8, 1983. His first class medical certificate was issued August 22, 1983 with no limitation.

First Officer Suzette N. Sturges

First Officer Sturges, 28, was hired as a DHC-6 first officer on November 21, 1982. She qualified as a Fokker F-27 first officer on December 26, 1983. She holds commercial certificate No. 47316450 with airplane single/multiengine land and instrument ratings. She had flown a total of 3,161 hours of which 197 hours were in the F-27. She had flown 278 hours, 83 hours, and 5 hours, respectively, in the previous 90 days, 30 days, and 24 hours, respectively.

Her first class medical certificate was issued November 14, 1983, with no limitations.

Flight Attendant Diane Turnbull

Flight Attendant Diane Turnbull age 22 completed her initial F-27 training on December 5, 1982. Her most recent recurrent emergency training was completed January 5, 1984.

APPENDIX C

AIRPLANE INFORMATION

Fokker F-27-100 N143PM

The airplane, manufacturer's serial number (SN) 10108, was manufactured in 1958 in Holland and purchased by Pilgrim Airlines July 20, 1982. The total airframe time was about 41,966 hours, and 40,300 landings had been made. The airplane had been maintained on an FAA-approved continuous maintenance program. The most recent maintenance check was completed January 7, 1984. All FAA Airworthiness Directives through 83-24 were completed.

Powerplants

	Left Engine S/N 10040	Right Engine S/N 6268
Total Time Since New (TTSN):	34,006 Hrs.	31,906 Hrs.
Total Time Since Overhaul (TTSO):	465.0 Hrs.	4,468.0 Hrs.

Propellers

		Left Engine S/N 175/58/140	Right Engine S/N DRG/12/61
Total Time Since New (TTSN):		19,191 Hrs.	20,550 Hrs.
Total Time Since Overhaul (TTSO):		465 Hrs.	2,185 Hrs.
Propeller Control Units (PCU): (Type CU-86E)		58/168	318/63
Blade Serial Nos.:	No. 1:	A-12702	A-104262
	No. 2:	A-124305	A-125502
	No. 3:	A-112716	A-104286
	No. 4	A-124304	A-125511

APPENDIX D

TRANSCRIPT OF COCKPIT VOICE RECORDER

CAM	Cockpit area microphone voice or sound source
RDO	Radio transmission from accident aircraft
-1	Voice identified as Captain
-2	Voice identified as First Officer
--?	Voice identified
UNK	Unknown
*	Unintelligible word
#	Nonpertinent word
%	Break in continuity
( )	Questionable text
(( ))	Editorial insertion
---	Pause

Note: Times are expressed in Greenwich Mean Time.

INTRA-COCKPIT

TIME & SOURCE	CONTENT
19:26:07	((Shortly following engine start, during taxi the copilot gave the pilot vee speeds and he answered "sixteen and a half, dry"))
19:28:59	((Pilgrim is cleared from the gate and taxis for the next twelve minutes))
CAM-1	* as much as we had at Groton, huh

AIR-GROUND COMMUNICATIONS

TIME & SOURCE	CONTENT
19:41:07 TWR	Pilgrim thirty five taxi into position and hold
19:41:09 RDO-1	Position and hold Pilgrim thirty five
USA 375	US Air three seventy five ready in sequence
TWR	Three seventy five roger
19:41:40 TWR	Pilgrim thirty five cleared for takeoff, fly heading zero six zero, your vector two twenty nine on course
19:41:46 RDO-1	Cleared for takeoff, and zero six zero for two twenty nine on course Pilgrim thirty five

INTRA-COCKPIT		AIR-GROUND COMMUNICATIONS	
TIME & SOURCE	CONTENT	TIME & SOURCE	CONTENT
		RDO	((Continuous radio transmissions to aircraft))
19:41:55 CAM-1	Okay, we have four lights out (fourteen five)		
19:42:00 CAM-1	Temps and pressures are within limits and ah, --- and * *		
19:42:09 CAM-1	Eighty knots		
19:42:12 CAM-1	Vee one, vee R, vee two		
19:42:19 CAM-2	And gear up		
19:42:19 CAM	((Sound of decreasing engine RPM))		
19:42:20 CAM-1	Left engine we just lost it		
19:42:22 CAM-1	Okay keep her going		
19:42:26 CAM-1	Okay, let's feather the left one, power lever back		
19:42:27 CAM	((Sound of decreasing RPM))		
19:42:28 CAM-1	Keep the (right) one going		

INTRA-COCKPIT

TIME & SOURCE	CONTENT
19:42:37 CAM	((Sound similar to gear lever actuation))
19:42:44 CAM	((Sound of impact))
19:42:55 CAM	((Sound of impact ceases))
19:43:09 CAM	((Sound of evacuation))
19:46:18 CAM	((Sound of electrical shutdown))

AIR-GROUND COMMUNICATIONS

TIME & SOURCE	CONTENT
19:42:30 TWR	Pilgrim thirty five heavy smoke coming from the number --- right engine
19:42:35 RDO-1	And the left one too we're going to land it
19:42:38 TWR	Okay, put the gear down please
TWR	Pilgrim three five the equipments on the way