Crashed short, National Airlines, Inc., B-727-235, N47MNA, Escambia Bay, Pensacola, Florida, May 8, 1978

Micro-summary: **This Boeing 727 crashed short while executing a surveillance radar approach.**

Event Date: **1978-05-08 at 2120 EDT**

Investigative Body: **National Transportation Safety Board (NTSB), USA**

Investigative Body's Web Site: **http://www.ntsb.gov/**

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NATIONAL TRANSPORTATION SAFETY BOARD

WASHINGTON, D.C. 20594

AIRCRAFT ACCIDENT REPORT

NATIONAL AIRLINES, INC.,
BOEING 727-235, N4744NA
ESCAMBIA BAY
PENSACOLA, FLORIDA

MAY 8, 1978

UNITED STATES GOVERNMENT

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Adopted: November 9, 1978

NATIONAL AIRLINES, INC.
B-727-235, N4744NA
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SYNOPSIS

About 2120 c.d.t., May 8, 1978, National Airlines Flight 193, a Boeing 727-235, crashed into Escambia Bay while executing a surveillance radar approach to runway 25 at Pensacola Regional Airport. The aircraft crashed about 3 nmi from the east end of runway 25 and came to rest in about 12 ft of water. There were 52 passengers and a crew of 6 on board; 3 passengers were drowned.

The reported surface weather at Pensacola was, measured ceiling--400 ft overcast; surface visibility--4 mi in fog and haze; surface wind--190° at 7 kn.

The National Transportation Safety Board determines that the probable cause of this accident was the flightcrew's unprofessionally conducted nonprecision instrument approach, in that the captain and the crew failed to monitor the descent rate and altitude, and the first officer failed to provide the captain with required altitude and approach performance callouts. The crew failed to check and utilize all instruments available for altitude awareness, turned off the ground proximity warning system, and failed to configure the aircraft properly and in a timely manner for the approach.

Contributing to the accident was the radar controller's failure to provide advance notice of the start-descent point which accelerated the pace of the crew's cockpit activities after the passage of the final approach fix.

1. FACTUAL INFORMATION

1.1 History of the Flight

On May 8, 1978, National Airlines, Inc., Flight 193 operated as a scheduled passenger flight between Miami and Pensacola, Florida, with en route stops at Melbourne and Tampa, Florida, New Orleans, Louisiana, and Mobile, Alabama.

About 2102 c.d.t. 1/, National 193 departed Mobile on an IFR flight plan to Pensacola; there were 52 passengers and a crew of 6 on board. The flight's cruising altitude was 7,000 ft 2/, and the captain was flying the aircraft. At 2109:20, National 193 established radio communications with the Pensacola radar controller, who told the flightcrew that they would be vectored for an airport surveillance radar (ASR) approach to "runway two five, wind one nine zero at eight, altimeter two niner niner four (29.94 inHg)." At 2109:33, at the flightcrew's request, the radar controller restated the type of approach and added, "Pensacola weather, measured ceiling four hundred overcast, visibility four (mi), fog, haze." The flightcrew acknowledged receipt of the transmission.

Shortly thereafter the flightcrew asked the radar controller if the ILS to runway 16 was in use and was told that it had been out of service for several months because of construction on runway 16.

At this point, National 193 was being vectored for the approach behind another Boeing 727, Eastern Flight 117; at 2111:14, the radar controller transmitted, "Eastern one seventeen, National one ninety-three, published minimum descent altitude (MDA) four eight zero (480 ft), missed approach point (is the) runway threshold." Eastern 117 acknowledged the message; National 193 did not. The cockpit voice recorder (CVR) transcript showed that Flight 193's flightcrew was reviewing the ASR approach to runway 25 when the message was broadcast. The transcript disclosed that the first officer briefed the captain correctly on the approach minimums and the missed approach procedure and that the captain acknowledged the briefing.

At 2113:39, the radar controller told National 193 that it was 11 nmi northwest of the airport and cleared it to descend and maintain 1,700 ft; the flight acknowledged the clearance. The controller then told them that a "Twin Beech" on an ASR approach, "broke out at four hundred and fifty feet indicated." Flight 193 answered "Thank you." The first officer said that 480 ft was the MDA, and that 450 ft was "illegal for that runway."

1/ All times herein are central daylight, based on the 24-hour clock.
2/ All altitudes herein are mean sea level unless otherwise specified.

At 2114:57 the first officer said that the aircraft was descending through 2,600 ft "for seventeen hundred (ft);" at 2115:07, the flight was vectored to 110°; and shortly thereafter the captain began to configure the aircraft for the approach. The descent and in-range checklists had been completed, and the flightcrew began its before-landing initial checklist.

At 2117:05, the controller told the flight that it was 6 nmi northeast of the airport and, at 2117:39, turned it to a heading of 160°. At 2118:25, National 193 was vectored to a heading of 220°. At 2118:31, the captain called for 15° flaps, and 5 sec later, the flight engineer said that the before-landing initial checklist was complete.

At 2119:01, National 193 received and acknowledged clearance to descend to 1,500 ft. At 2119:20, the radar controller told National 193 that it was "five and one-half miles from runway—continue to your minimum descent altitude." The flight acknowledged the clearance, and at 2119:29 the flaps were extended to 25°. At 2119:37, the controller turned the flight to 250°, and the flight acknowledged the transmission.

At 2119:54, the radar controller told National 193 that it was 4 nmi from the runway and that Eastern 117 had executed a missed approach. The flight replied, "Thank you."

At 2119:56, the landing gear warning horn sounded, and 4 sec later, as the aircraft rolled out on the final approach heading, the captain called for the landing gear and the landing final checklist.

At 2120:11, in response to the flight engineer's checklist challenge "landing gear and lever," the first officer responded, "Down, three green." The flight engineer stated, "Standing by on the final flaps." These remarks coincided with a transmission from the radar controller that the flight was on course and 3 1/2 nmi from the runway.

At 2120:15, the ground proximity warning system (GPWS) whooper sounded, and the "Pull up, pull up" voice warning began. The GPWS warning continued until 2120:24. During this 9-sec period only two remarks appeared on the CVR transcript--at 2120:19, the captain said "Did you (get) your thing", and at 2120:21, the first officer said, "Descent rate's keeping it up."

The flight engineer stated that he activated the inhibit switch of the GPWS and that he did this in response to what he believed was the captain's command to turn the system off.

At 2120:31, the first officer said, "... we're down to fifty feet." Two seconds later, the aircraft hit the water.

The aircraft crashed during the hours of darkness in Escambia Bay, about 3 nmi from the east end of runway 25 of the Pensacola Regional Airport. The coordinates of the accident site were 30° 29' 8" N, 87° 7' 3" W.

1.2 Injuries to Persons

Injuries	Crew	Passengers	Others
Fatal	0	3	0
Serious	2	9	0
Minor/None	4	40	0

1.3 Damage to Aircraft

The aircraft was damaged substantially.

1.4 Other Damage

None

1.5 Personnel Information

The six crewmembers on National 193 were qualified and certificated for the flight and had received the training required by current regulations. (See Appendix B.)

The flightcrew had been off duty for more than 24 hrs before reporting for this flight. On May 8, they had flown 3 hrs 2 min and had been on duty about 6 hrs when the aircraft crashed.

1.6 Aircraft Information

N4744, a Boeing 727-235, was certificated, maintained, and equipped in accordance with current regulations and procedures. (See Appendix C.) The flight log contained no outstanding discrepancies.

The aircraft's Maintenance Analysis Book at the company's Miami, Florida, maintenance base contained two maintenance alert cards concerning the engines. One card, dated May 7, 1978, stated that the No. 1 engine was "hard to get out of rev (reverse)...." The other card, dated May 8, 1978, stated that the flight engineer had reported that all three engines were slow "to spool up."

The aircraft weight and balance sheet for departure from Mobile showed that the aircraft had 23,506 lbs of jet fuel aboard at that time. The estimated landing weight at Pensacola was about 131,000 lbs. Based on that weight and the surface winds at the airport, the corrected V_{ref} speed for the approach was 124 kn indicated (KIAS).

1.7 Meteorological Information

The accident occurred under an overcast sky. The 2200 National Weather Service (NWS) surface analysis showed a stationary front through southeastern Arkansas and central Florida.

The surface weather observations for the Pensacola Regional Airport were, in part, as follows:

> 2054, record special: Measured ceiling--400 ft overcast, surface visibility--4 miles, fog, haze, temperature--76° F., dewpoint--73° F., surface wind--190° at 7 kns, altimeter setting--29.92 inHg.

> 2140, special: Measured ceiling--300 ft overcast, surface visibility--3 miles, tower visibility--3 miles, surface wind--220° at 7 kns, altimeter setting--29.91 inHg., visibility lower northwest, aircraft mishap.

The flightcrew was provided the 2054 Pensacola observation before leaving Mobile.

The captain of Eastern 117, which had missed an ASR Approach to runway 25, said that his first officer was at the controls and "at MDA, about one mile from the threshold, lights were sighted forward and left of the aircraft; then some runway lights came into view forward and a little right." He told the first officer to remain at the MDA. He then lost all ground contact, called for the missed approach, and said that the lights at the approach end of the runway came into view "just under the nose of the aircraft after we started the missed approach."

1.8 Aids to Navigation

The ILS was not in service because runway 16/34 was closed for construction. The Brent LOM, located 4.4 nmi northwest of runway 16, and the Pickens nondirectional radio beacon, located 2.5 nmi southeast of the field, were in service. The FAA had issued this information in a Notice to Airmen (NOTAM) on January 6, 1978.

The radar in use at Pensacola was an ASR-8, BI-5 with ASR-4 indicators. The system does not provide altitude readout data to the controller. FAA inspection personnel certified that the radar system components were operating within prescribed parameters. The system is capable of providing ASR approaches to all runways.

The minimums for an ASR approach to runway 25 are as follows: MDA 480 ft (369 ft above ground level (a.g.l.)) and 1 mile visibility. The missed approach procedure calls for a "climb to 1,500 ft on runway heading within 15 NM." However, the Pensacola approach control issued the following missed approach clearance to National 193: "Fly runway heading, climb, and maintain two thousand (ft)."

1.9 Communications

There were no known communications malfunctions.

1.10 Aerodrome Information

Pensacola Regional Airport, elevation 121 ft, is located 3 mi northeast of the city of Pensacola. At the time of the accident runway 7/25 was the only usable runway.

Because of construction, runway 16/34 and its associated navaids and facilities were out of service. All data concerning this situation were published in a NOTAM dated January 6, 1978. On January 10, 1978, National Airlines issued NAL Flight Operations General Memorandum No 1-78 to all pilots. The bulletin stated in part:

> "1. PNS RUNWAY CLOSURE 16/34
>
> "Effective January 9, 1978, Runway 16/34 was scheduled to be closed for rebuilding of the runway. It will remain closed for an estimated 85 days. Check NOTAM for actual closure.
>
> "Runway 7/25 will be the only runway usable during the closure of 16/34. The only approved instrument approach to Runway 7/25 is a 'RADAR-1' (page 18-7 JEPCO).
>
> "ALL NAVAIDS on Runway 16/34 will be shut down with the exception of the Pickens locator and the Brent LOM. There is no VASI on Runway 25. Hopefully a VASI system will be installed on Runway 7 on or about February 15, 1978. Note carefully the obstructions on the approaches to either runway."

The captain had a copy of this memorandum in his flight bag; the first officer did not.

Runway 7/25 is asphalt surfaced, and is 6,001 ft long and 150 ft wide. The runway has medium intensity runway lights, but has neither an approach light system nor runway end identifier lights (REIL). A visual approach slope indicator (VASI) light system serving runway 25 was commissioned on March 16, 1978, and a local NOTAM was issued on the same date announcing the availability of the system.

The company publishes a daily NOTAM summary which is posted on a bulletin board at crew scheduling. All flight personnel are required to read and familiarize themselves with the information on this board. The May 8, 1978, summary included information about closed runway 16/34 at Pensacola; however, it did not include the information that the ILS was out of service or that the VASI was available on runway 25.

The captain testified that he reviewed the summary. He said that he knew runway 16/34 was closed, but that he had forgotten it. He did not know that the runway 25 VASI was operational. The first officer stated that he was not aware that the VASI was available; he knew 16/34 was closed but had forgotten it, and therefore, he anticipated that the ILS would be available.

1.11 Flight Recorders

N4744 was equipped with a Sundstrand Data Control model F-542 flight data recorder (FDR), serial No. 1044. The recorder showed no outward evidence of damage. The foil recording medium was not damaged; all parameter and binary traces were present and active with no evidence of recorder malfunction or recording abnormalities. A readout was made of the final 7 min 22 sec of the recorded traces beginning at a point 35 sec before the start of descent from 7,000 ft. (See Appendix D.)

N4744 was equipped with a Sundstrand CVR, serial no. 2116. The recorder was removed from the aircraft and brought to the Safety Board's CVR laboratory where the last 10 minutes of the recorder tape were transcribed. The quality of the recording was excellent.

A plot of N4744's flightpath from about 7 sec before the flight was cleared to descend from 1,700 ft (2119:00) to the sound of impact on the CVR transcript (2120:33) was derived by integrating pertinent CVR data with the FDR's altitude trace. (See Appendix E.)

Examination of this plot disclosed that the altitude alert sounded 4 times during the descent--at 1,700 ft (2119:06), at 1,700 ft (2119:10), at 1,300 ft (2119:45), and at 700 ft (2120:08).

The descent rate was less than 1,000 fpm until the aircraft descended through 1,300 ft. The descent rate then increased to about 1,500 fpm. At 500 ft the rate increased to 2,000 fpm, and at 300 ft the rate began to decrease again to about 1,250 fpm. It remained at that value over the last 100 ft of the descent.

The GPWS activated about 500 ft (2020:15)—almost coincident with the maximum descent rate—and ceased about 250 ft (2020:24).

During the descent from 1,700 ft, the FDR readout showed that the indicated airspeed was maintained between 150 and 160 KIAS until the aircraft reached 600 ft; at 600 ft it started to decrease. When the recording traces terminated, the airspeed was 138 KIAS.

A plot of N4744's probable ground track was derived by integrating pertinent data from the aircraft's FDR and CVR, and from the radar D-log plot from the Jacksonville Air Route Traffic Control Center (ARTCC). (See Appendix F.)

1.12 Wreckage and Impact Information

The aircraft struck the bay with its landing gear down and its flaps extended to 25°; it came to rest in about 12 ft of water. Although the aircraft was damaged extensively by impact, the wings and empennage did not separate from the fuselage. The underside of the fuselage was buckled, compressed, and crushed.

The keel beam structure in the area of fuselage station (FS) 740 was displaced upward about 30 in., and the associated structure on each side of the beam was compressed upward.

The No. 2 engine assembly had separated from the aircraft, but its air duct remained in its normal position. The undersides of the Nos. 1 and 3 engine nacelle structures were crushed for their entire length.

The underside of the fuselage from FS 950E aft, including the two aft cargo doors and the aft airstair, had separated from the aircraft. The nose and main landing gears separated from the aircraft during impact.

The settings of cockpit instruments were documented before the aircraft was removed from the bay; the cockpit was partially filled with water. The following pertinent readings, settings and switch and control positions were noted:

Altitude alerter--2,000 ft, barometer 29.94 in.

Captain's Instrument Panel

Radio altimeter--MDA bug-380 ft, indicated altitude-0
Barometric altimeter--Altimeter setting-29.94 in. MDA bug-480 ft, indicated altitude-minus 920 ft
Airspeed indicator--Outside bugs-124 kn and 145 kn, inside bug-138 kn
Static source--Normal
Flight director--Heading mode

First Officer's Instrument Panel

Radio altimeter--MDA bug 375 ft, indicator - no setting, pointer was out of view
Barometric altimeter--Altimeter setting-29.94 in; MDA bug-480 ft, indicated altitude-315 ft
Airspeed indicator--Outside bugs-124 kn and 143 kn, inside bug-138 kn
Static source--Normal
Flight director--Heading mode

Center Console

Engine fire switches--All pulled
Landing gear lever--Down
Speed brake lever--Down and in detent
Flight directors--Both heading mode
Flap handle--25° detent
Stabilizer trim indicator--4° aircraft noseup

Upper Flight Engineer's Panel

Electrical panel--Normal configuration
Essential power selector--No. 3 generator

Lower Flight Engineer's Panel

GPWS inhibit switch--Guarded and armed - safety wire broken
GPWS circuit breakers--Both in
Altitude alerter circuit breaker--In

Several components were removed from the aircraft at Pensacola, and transported to Miami, Florida. On May 31, 1978, they were examined at National Airlines' and Barfield Instrument Corporation's facilities. These components were: The pilot's and first officer's altimeters, radio altimeters, and radio altimeter transmitters/receivers; the No. 1 air data computer; the altitude alert controller and computer; and the GPWS warning box. Except for the two radio altimeter/transmitters/receivers which could not be functionally tested because of internal contamination, the functional testing did not disclose any evidence of preimpact malfunctions.

When tested, the MDA lights in the radio altimeters operated normally. The light bulbs from the MDA annunciator were removed from the pilot's and first officer's flight director indicators and examined at the Safety Board's facilities in Washington, D.C. There was some distortion of the bulb filaments, but a positive conclusion as to whether the bulbs were illuminated at impact could not be reached.

1.13 Medical and Pathological Information

Post-mortem examination of the three dead passengers disclosed that in each case the cause of death was drowning. None of the bodies had sustained traumatic injuries. Analyses of blood and tissue samples taken from the three victims were negative for carbon monoxide, for basic, acidic, and neutral drugs, and for ethyl alcohol.

Two passengers in the coach section and two aft flight attendants suffered serious impact injuries. The two passengers suffered lower back fractures; one flight attendant received abdominal injuries; and the other attendant received a concussion and a separated shoulder. The other seven injuries were classified serious, because they were hospitalized for more than 48 hours.

The remaining 44 passengers and crewmembers either were not injured or suffered minor sprains, lacerations, contusions, and skin irritations from exposure to fuel in the water.

1.14 Fire

There was no evidence of fire.

1.15 Survival Aspects

The aircraft struck the water about 200 to 300 yds from a barge. The two-man crew said that the aircraft entered the water "like a seaplane landing" and stopped within about "one aircraft length (150 ft)." The water temperature was moderate, and the wind, wave, and current action was minimal.

The flight attendants and passengers were not warned before impact. The passengers were seated with seatbelts fastened, seatbacks upright, and trays stowed. Most passengers reported that they had been thrown forward or downward, or both; many said that they had struck the seatback in front of them; and several stated that their eyeglasses were not dislodged by the impact forces. Several passengers compared the impact forces to a "regular hard landing."

Except for damage to the aft portion of the fuselage, the cockpit flight deck and passengers compartment and its furnishings were largely intact.

The cockpit entry door separated inward but did not impede egress to the cabin. The left forward clothes closet in the passenger cabin became dislodged, shifted forward, and, according to the crew, delayed the opening of the forward passenger door. A floor access panel (about 33 in by 15 in) in the first-class cabin aisle between the forward passenger and galley door came loose on impact. The forward flight attendant and the first officer fell into this hole while helping passengers out of the aircraft.

All galleys remained secured. Except for several lightweight trim panels and a ceiling panel in the rear of the cabin, all overhead storage racks and ceiling panels remained secured.

The only passenger seat damage was at rows 26, 27, and 28 where the seats and seat rows had either canted, pivoted, or separated. No seatbelt failures were noted. Only three persons were known to have been seated in these rows--a passenger in seat 26D received a serious lower back fracture; a passenger in seat 26E received only minor injuries, and a flight attendant in seat 27D suffered serious abdominal injuries.

The cabin floor aft of row 26 and to the right of the aft galley was either destroyed or missing. The aft entry door on the rear pressure bulkhead was off its hinges and damaged extensively, and the unoccupied flight attendant's jumpseat mounted on this door was damaged badly.

The aircraft was not equipped with, nor was it required to be equipped with, liferafts and approved flotation-type seat cushions. Twenty-four passengers and the crew believed that the seat cushions were flotation devices. Fourteen passengers tried to use them for flotation, and several survivors indicated that the cushions came apart and were not buoyant.

Since, by regulation, the Mobile to Pensacola portion of the flight was not an extended overwater flight, the passenger briefing did not include the location and use of water survival equipment. Therefore, many passengers were not aware of the location of the life vests, how to don them, how to use them, and the location and use of the life vest's emergency lights. Those passengers who knew or were told that the life vests were stowed in compartments beneath the seats had difficulty extracting them. Rising water in the cabin compounded the problems of locating and removing the vests from the underseat compartments.

The aircraft's emergency lights operated immediately after impact, and at least one unit was removed and used as a flashlight. In addition, the senior flight attendant used the portable emergency megaphone to direct the passenger evacuation.

The aircraft began to fill with water immediately after impact. Water and fuel--from either ruptured fuel lines or tanks--entered the cabin through the damaged after sections of the fuselage, and the aircraft began to sink tail first. By the time the flightcrew exited the cockpit the water in the forward cabin was about 1 ft deep and rising.

N4744 was equipped with four door-mounted inflatable emergency evacuation slides, however, only one--the aft emergency door slide--was automatically inflatable. None of these slides were inflated.

The crew opened the forward passenger and galley doors. The evacuation slide pack on the forward door was partially submerged and the crewmembers could not find the inflation handle. However, because of the debris and the hole in the aisle, this door was not used during the initial stages of the evacuation. When the flight engineer opened the forward galley door, its evacuation slide pack was partially submerged. The engineer saw the barge approaching and elected not to try to find the inflation handle and inflate the slide. Rather, he returned to the cabin to expedite passenger evacuation.

The aft emergency door was opened partially by a passenger who managed to exit through that door; however, he did not open it wide enough to initiate the slide's automatic inflation sequence. The left forward and right forward aft overwing exits were opened by passengers. About 33 of the 52 passengers left through the 3 overwing exits, 13 used the forward galley door, and 1 used the aft emergency door.

During and after the passenger evacuation, crewmembers entered and traversed the coach cabin—sometimes swimming underwater--to insure that the passengers were out of the aircraft and to obtain life vests for those passengers who had left the cabin without them. The crewmembers later swam out to distribute vests and to assist the passengers.

Several able-bodied passengers helped other passengers to leave the aircraft, to obtain and don life vests, or to stay afloat awaiting rescue.

The aircraft sank to the bottom of the Bay with the top of the fuselage awash and the water in the forward cabin at about the level of the forward galley counter. Once the captain determined the aircraft would not sink farther, he directed some passengers to return to the cabin and placed the severely injured persons on top of the fuselage to await rescue.

The barge captain maneuvered his vessel toward the left side of the fuselage and began picking up passengers. Most of the passengers were picked up by the barge's crew within 30 min of impact.

The bodies of the three drowned passengers were found outside the cabin, two were near the aft fuselage.

1.16 Tests and Research

A performance analysis of N4744's final 2 min of flight was conducted to determine aircraft configuration, engine thrust levels, and pitch angles during the final descent to impact.

The analysis showed that the final descent from 1,700 ft was begun with the landing gear retracted and the flaps extended to 15°. The descent was begun with a thrust reduction to 25 percent of takeoff rated thrust. (All thrust settings are expressed as a percentage of takeoff rated thrust.) Twenty-five percent was maintained until about 1,400 ft when the flaps were extended to 25°. Over the next 21 sec of the descent, the thrust was reduced, and it reached 12.5 percent at 1,250 ft. Thrust was maintained at 12.5 percent for about 8 to 9 sec and then reduced to flight idle. At 940 ft, when the landing gear was extended, the thrust had been retarded to flight idle, and it remained at that setting throughout the final 35 sec of the flight.

The history of the aircraft pitch attitudes showed that the aircraft descended from 1,700 ft to 1,500 ft at a pitch attitude of about 3° noseup. Shortly after leaving 1,500 ft the flaps were extended to 25°, and from that point down to 1,300 ft the pitch attitude decreased to about 0". Between 1,300 ft and about 1,250 ft the aircraft's nose was lowered to a pitch attitude of about 3° nosedown, and this attitude was maintained from 1,250 ft down to about 500 ft. At 500 ft, almost simultaneous with the GPWS warning, the pitch attitude decreased to 4° nosedown and remained there until about 2 sec before the GPWS warning stopped. At this time the aircraft's nose was raised, and over the last 10 sec of the flight, the pitch attitude was increased, reaching about 0.5° noseup at impact. The GPWS warning began about 18 sec before impact and ended about 9 sec before impact.

The airspeed remained fairly constant between 150 and 160 KIAS from the start of descent until the landing gear was extended at 156 KIAS. From gear extension until impact, the airspeed decreased at a fairly constant rate and reached 137 KIAS at impact.

The aircraft's descent recovery time and capability were computed using an entry airspeed of 145 kns equivalent airspeed (KEAS) and descent rates of 1,600 fpm and 2,000 fpm. Thrust was not used to initiate the go-around, and the load factor resulting from the applied stick forces during the go-around ranged from 1.2 times the force of gravity (1.2 G) to the onset of the stickshaker at 1.62 G. Timing was begun when column force was first applied and ended with a zero descent rate. Altitude loss during the maneuver was also measured.

When stick forces were applied and a load factor of 1.62 G produced, level flight from both the 1,600 fpm and 2,000 fpm descent rates would have been attained in about 4.2 sec; however, the altitude losses would have been about 78 ft and 86 ft, respectively. At 1.2 G, level flight would have been attained in about 6.4 sec; however, the altitude losses would have been about 128 ft and 158 ft, respectively.

The performance parameters of other aircraft systems also were examined. Extension of the wing flaps or landing gear, or retarding engine thrust will cause the aircraft to pitch down. The captain said he knew of these characteristics. Since the recommended procedures for flying the aircraft call for the pilot to trim out excessive stick forces, noseup stabilizer trim would be required to counteract the pitching moments generated by these changes during the descent. The last sounds of stabilizer trim actuation were recorded at 1,250 ft, or about 16 sec after the flaps were extended to 25°.

According to the manufacturer, the wing trailing edge flaps will move from 0° to 4.5° in 16 sec and from 4.5° to 30° in 8.6 sec. The flaps will extend from 15° to 25° in 3.4 sec.

According to National Airlines, the microswitches which activate the landing gear warning horn are positioned on the thrust lever races about 3/4 in. above the flight idle stop or slightly above the flight idle engine rpm (57 percent N_2). Retarding any one or all three thrust levers to this point on the race with the landing gear retracted will cause the landing gear warning horn to sound.

National Airlines also estimated that 25 percent of takeoff rated thrust corresponds to about 1.4 EPR; 12.5 percent corresponds to about 1.2 EPR.

1.17 Other Information

1.17.1 ATC Procedures

The prescribed ASR procedures for the Pensacola Pegional Airport are contained in FAA Form 8260-4, Radar-Standard Instrument Approach Procedure (SIAP), dated October 20, 1977. The form contains the minimums for the approaches and states that the final approach fixes are 5 nmi from the thresholds of all runways, that the minimum descent altitude at the fixes is 1,500 ft, and that the descent to the MDA begins at the final approach fix (FAF).

Air traffic controllers are required to follow the procedures contained in Air Traffic Control Handbook 7110.65A. The pertinent handbook procedures cited below are based on the existing weather at Pensacola at the time of the accident.

The approach gate is defined in the ATC Handbook's Pilot/Controller Glossary as "The point on the final approach course which is 1 mile from the final approach fix on the side away from the airport or 5 miles from the landing threshold, whichever is farther from the landing threshold...." Based on this definition, the approach gate for runway 25 was 6 mi from its threshold.

Paragraph 790 requires the controller to vector arriving aircraft to intercept the final approach course...

> "c. At least 2 miles outside the approach gate...and...
>
> * * * *
>
> "e. At an altitude which will allow descent in accordance with the published procedure, for a nonprecision approach."

Based on this paragraph, the intercept point on the final approach course to runway 25 is 8 mi from its threshold.

Paragraph 1190 requires the controller to provide recommended altitudes on final approach only if this service is requested by the pilot. The flightcrew of National 193 did not request this service.

Paragraph 1192 requires the controller to issue "advance notice of where descent will begin and issue the straight-in MDA prior to issuing final descent for the approaches." It also includes the following recommended phraseology for accomplishing this: "Prepare to descend in (number of miles) mile/s."

According to paragraph 1195 the controller can discontinue an ASR approach when...

> "... (2) In your opinion, continuation of a safe approach to the MAP is questionable."

According to the evidence, the flight was about 5 nmi from the runway before the controller issued the turn to the final approach heading. The controller stated that he knew the turn to final was within 8 nmi from the runway, and that it was not as far out as he would have liked. However, he never questioned the safety of the approach and elected to continue the approach.

The controller also furnished National 193 with six position reports; the first two were based on the aircraft's distance from the airport, and the last four on its distance from the runway.

The controller said that he knew he was required to give the pilot advance notice of the descent point. Since the flight was already descending and since he had issued clearance to descend to the MDA before the aircraft reached the descent point, he "felt that would not apply; he was already in a descent."

The Pensacola tower training officer testified that in IFR weather he would instruct trainees to turn an aircraft on the final approach course at least 2 miles outside the approach gate. However, he stated that if he was working the aircraft and misjudged the distance and turned it "inside the 8 miles, and ... felt everything else was satisfactory, then (he) would have continued the approach."

The captain and first officer of National 193 commented on their impressions of the approach and the manner in which they were vectored toward the final approach course.

The first officer testified that the entire crew was busy after they descended from 1,700 ft, "but not to the point where it was of great concern to me." However, he also noted that "the checklist was delayed because we were not aware that we were at the final approach fix, until we received clearance down to our minimum descent altitude;" and further, "we were definitely not in the configuration over the final approach fix that we had desired."

The first officer believed that the approach was "normal" until the flight was vectored to 250°. He said that had he been flying the aircraft he would have, at that point, considered a missed approach. However, he "...felt at that time, as I feel now, that a missed approach at that point was not appropriate."

The captain stated that he expected the controller to vector him to intercept the final approach course and give him a warning of the final approach fix so that, he "...could have the aircraft in the landing configuration at the time (he) arrived over the final fix."

He said he did not receive the information he needed; in particular he did not receive the distance to the final approach fix or the descent point, although he knew that it was 5 nmi from the runway. He said that if he had received this distance information the aircraft would have been stablized, there would have been "much less to do after passing the final approach fix", and "more attention (would have been) directed to flying and less at accomplishing other functions." The captain testified that he felt a little rushed, but "... didn't feel rushed enough to execute a go-around at that point." In response to the question, "At any time did you think the approach should be abandoned or refused?" he answered "If I had thought so, I would have gone around."

The flight engineer testified that after they were cleared to the MDA he had "a slight feeling of rush." He said that the controller gave them a turn about the same time they were cleared to the MDA, and he "...felt like we were a little bit rushed due to where we were at in the checklist and everything, but I didn't think it was that serious."

1.17.2 Ground Proximity Warning System

National Airlines Flight Operations B-727 Bulletin No. 8-76, dated September 27, 1976, contained a description of the GPWS, its operation, and the company's policies concerning its use.

The system is operable when electrical power is on the aircraft and the essential bus is powered. Large, undimmable red pullup-lights located on the lower right-hand corner of the captain's and first officer's instrument panels provide a visual warning; aural warning is provided by a speaker located in the cockpit ceiling. The GPWS inhibit switch, which deactivates the system, is located on the flight engineer's lower panel. The switch is safety wired in the armed position. If the system is inhibited and the switch is then returned to the armed position, there is a 4-sec delay before the system will resume normal operation.

Although the GPWS has five warning modes, only two were pertinent to this accident, and they functioned as follows:

Mode 1 - Excessive descent rate below 2,500 ft above the ground. Mode 1 does not depend on aircraft configuration and functions all the time. The warning is triggered by a descent rate of 1,700 fpm at 700 ft a.g.l. The descent rate decreases linearly to about 1,400 fpm at 0 ft a.g.l.

Mode 4 - Nonlanding configuration below 500 ft a.g.l. With the gear down and flaps set at 25°, a mode-4 warning will be triggered at 500 ft a.g.l. at a sink rate of about 1,420 fpm.

Modes 1 and 4 will activate a visual alert--flashing red pull up lights--and an aural alert--"whoop-whoop"--followed by a verbal command--"pull up-pull up". The warnings are continuous until the condition is corrected.

If a GPWS warning is sounded on descent, the company bulletin provides the following guidance to the flightcrew:

"It is not intended that a missed approach be conducted in each case involving a GPWS warning. The GPWS alert is a warning that the crew must immediately focus their attention on terrain proximity and make a determination as to whether the warning is valid. If there is any doubt as to the validity of the warning, positive action to alter the flightpath to stop the warning should be initiated immediately. This action is particularly appropriate under the following conditions:

(a) While maneuvering for an approach at night or in instrument conditions.

(b) When established on an approach where vertical guidance is unreliable...."

The captain testified that, when the GPWS warning sounded, he looked at his altimeter and instantaneous vertical speed indicator (IVSI) and "...misread the altimeter. I had 1,500 instead of 5 (500 ft), and my rate of descent was in the vicinity of 2,000 (fpm)."

The first officer testified that, when the GPWS activated, he thought the aircraft was still above 1,000 ft. He said that he "noticed an excessive descent rate," identified that as the cause of the alarm, and brought this to the captain's attention. He thought that the captain had acknowledged the information; he saw the captain initiate back pressure on the yoke; he felt the aircraft respond; and "at that point the ground proximity warning system ceased."

The captain said that since he believed he was at 1,500 ft when the GPWS warning began, he did not make any drastic corrections, because he "...wanted to make it as smooth as possible." He just "eased the yoke back and I think I used a little cruise trim 3/ ...." He did not add power. He said, "When I started shallowing the descent, the warning went off and I thought the problem had been solved."

The captain testified that when the GPWS warning began he made a determination as to terrain proximity. He stated, "I looked for terrain. There was none to see." He said he could have used his radio altimeter but he did not do so, "because I was mentally above a thousand (ft) and I don't normally use it on this type of approach until after I have passed a thousand."

The flightcrew stated that the loudness of the aural warning made verbal communications between crewmembers difficult. Although the remark, "Did you (get) your thing," was recorded on the CVR, the captain did not recall making the remark and the first officer did not recall hearing it. A similar GPWS on another National Airlines Boeing 727 was measured for loudness; it produced a level of about 100 dB. According to acoustical experts, this noise level would impede normal verbal communication.

The flight engineer thought he saw 700 ft on the altimeter when the GPWS activated. He heard the remark, "Did you (get) your thing," and believed it was the captain talking; however, because of the noise of the GPWS warning, he was not positive of the exact words or who the captain was addressing. He testified that he then asked if the captain wanted the GPWS shut off; however, the CVR transcript does not corroborate this statement. He said he heard the first officer say that the descent rate was "keeping it up" and replied, "I am disconnecting this. Okay, just a second." He identified the words, "Okay, just a second," at 2120:25 on the CVR transcript as the latter part of his statement informing the pilots that he was turning the GPWS system off.

The flight engineer broke the safety wire and turned off the GPWS. The flight engineer later returned the switch to the armed position. He thought that the system would reactivate if the aircraft was still being operated "within the alarm parameters of any mode of the system." The GPWS alarm did not sound again.

1.17.3 Altimetry

Three aircraft systems concerned with the reporting or monitoring of altitude were the altitude alert, barometric altimeter, and radio altimeter systems.

3/ The stabilizer trim is positioned by activating either the switches on the pilot's and first officer's control wheel (rapid rate) or the cruise trim switch on the control pedestal (slow rate).

The altitude alert system controls are located on top of, and in the center of, the glareshield. The system is programmed by inserting the proper altimeter setting and target altitude. Once programmed, the altitude alert system will provide visual and aural warnings to the crew as the aircraft either climbs or descends toward or beyond the selected altitude. During a descent the altitude alert system will provide the following warnings: About 800 ft above the selected altitude the system's yellow warning light will illuminate and remain on unless the pilot presses the light to cancel it. If the light is not canceled, it remains lit until the aircraft descends to 200 to 250 ft above the selected altitude. At that time the light goes out and a 2-sec tone signal begins.

About 200 to 250 ft below the selected altitude, the 2-sec tone signal begins again. Simultaneous with the tone, the yellow warning light begins to flash and cannot be canceled. The light sequence can be stopped either by climbing back to the selected altitude or by reprogramming the alert system.

National Airlines' B-727 procedures do not recommend that the flightcrew insert the MDA into the altitude alert system. They recommend that the flightcrew, upon initiating the final descent from the initial approach altitude to the MDA, insert the missed approach procedure's initial leveloff altitude into the altitude alert system.

The first officer testified that, in response to the ATC altitude clearances, he inserted 1,700 ft and then 1,500 ft into the altitude alert system. When the flight was cleared to the MDA, he acknowledged the clearance and then set the altitude alert system to 2,000 ft. He did not hear, and could not account for, the alert at 700 ft.

The captain testified that he saw the first officer set the altitude alert system to 1,700 ft and 1,500 ft. He said that the MDA was not set in the altitude alert system and that the first officer set 2,000 ft in the system after they descended below 1,500 ft. The captain also stated that he did not hear the audio alerts at 1,300 ft and 700 ft.

The captain's and first officer's instrument panels were equipped with Kollsman P/NA-41869-10.21 drum-pointer type barometric altimeters. (See figure 1.) This altimeter has a range from +50,000 ft to -1,500 ft. Hundreds of feet are indicated by a radial pointer, and thousands of feet are indicated on a rotating drum visible through a slot on the face of the instrument. A white crosshatch is painted on the left side of the drum adjacent to the numbers from +1,000 ft to -1,500 ft to increase the conspicuity of the lower altitude values.

The captain and first officer testified that they misread their barometeric altimeters during the latter stages of the descent after they were cleared to descend from 1,700 ft.

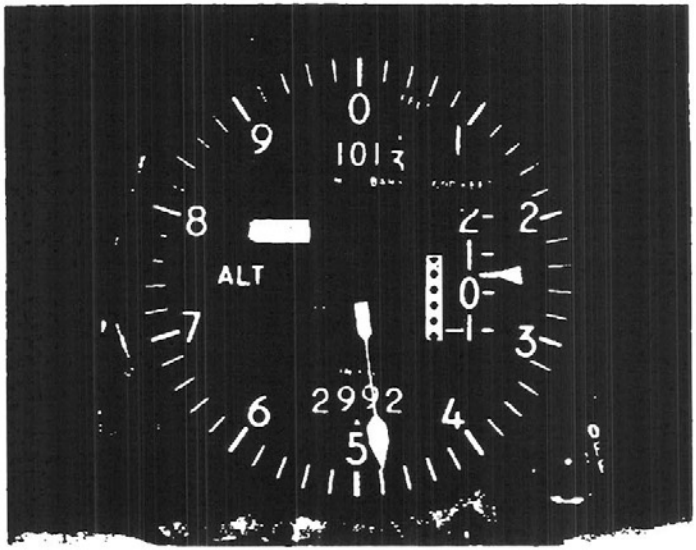

Figure 1. Kollsman Drum Pointer Altimeter

The captain said that he misread his altimeter at 500 ft and believed he saw 1,500 ft. He stated that "When that figure got on my mind as I ran my scan after that, I was seeing 400 and 300 and they were 14 and 13 in my mind. I was looking at the needle instead of looking at the 1,000-foot marker in it. I didn't actually look at the thousand-foot pointer at that time. I just glanced down at the hundred-foot pointer."

The first officer stated that after being cleared to the MDA he reset the altitude alert system and shifted his vision outside the cockpit to seek ground cues. He sighted a red light which he was unable to identify. His attention, was directed outside the aircraft until the GPWS alert began. After the alert was silenced, he "referenced (his) altimeter—in preparation for ... one-thousand-foot call. That was when (he) noticed 1,100 feet." He said his procedure for reading the altimeter is to read the pointer first. "That is the most obvious, because the hand is pointing to a number." Next his eyes go to the window, and he notes the thousand that is associated with the previously observed hundred foot, and in his mind computes what the altitude is.

The first officer stated that, "each pilot has a built-in time clock, so to speak, where you are in a habit of doing certain things--selecting flaps, whatever, and looking back at your instruments. According to the first officer, a certain amount of altitude on a normal descent will have gone by. He believed that because the aircraft had attained a higher descent rate than normal, a rate which he was "not aware of at the time." He stated, "When I looked back referencing my instruments expecting to see 1,000 ft, in my own internal time clock, that was where I expected that we would be, approximately 1,000 ft. That was confirmed when I saw the '1'. I initially read that as 1,100 ft because that is what I expected to see."

The first officer said that he failed to make the required altitude callouts, because he was never aware of the fact that the aircraft was below 1,000 ft until just before impact. According to the CVR, the only altitude callout he made was at 50 ft.

The captain alluded to a similar sensing of time passage during the descent. In response to a question regarding what may have lead to misreading his altimeter he answered, "...normally when you start to descend, you don't expect to go through this great an altitude this quickly, and at the completion of these things you just normally expect to be at a higher altitude than we were...."

The radio altimeter system provides the flightcrew with the aircraft's height above the terrain. The captain's and first officer's radio altimeters, located to the right and next to their attitude indicators, provide absolute altitude data from 2,500 ft a.g.l. to the surface. The evidence disclosed that both were set to the proper MDA for the approach, and therefore, the MDA warning lights on their flight directors and above their radio altimeters should have illuminated when the aircraft descended below the MDA. However, these lights are smaller than the GPWS warning lights.

The captain and first officer could not state whether the MDA lights were illuminated; they could only say that they could not recall observing these lights. They said that they did not recall ever looking at their radio altimeters. They said that the radio altimeter is a backup instrument until the aircraft is below 1,000 ft; and that there is no need to include it in their monitoring scan until the aircraft was below 1,000 ft. Since, in their minds, they never reached that altitude, they did not expand their scan pattern to include the instrument.

1.17.4 Altimetry and Instrument Display Studies

The research literature concerning the readability of various types of altimeters has been summarized in an FAA study completed in 1972.4/ The literature on the drum pointer altimeter suggests that, in

4/ Altimetry Display Studies. Report No. FAA-RD-72-46, May 1972.

terms of speed of reading and number of errors made, it is far superior to the old-style, three-pointer altimeter--a display using a large pointer to indicate hundreds of feet; an intermediate pointer to indicate thousands of feet; and a small pointer to indicate tens of thousands of feet. However, it is generally inferior to the digital counter-pointer or counter-drum pointer displays, which in addition to a pointer present a complete digital altitude readout to the pilot.

The FAA report also included literature concerning studies of pilot eye scanning behavior during the approach and landing phase of flight operations. The percentage of time spent on each instrument and the eye-scanning pattern between instruments were plotted for a manual ILS configuration and a flight director ILS configuration. During the approach in the manual ILS configuration, the pilot devoted 35 percent of his scan time to the attitude indicator, 55 percent to his horizontal situation indicator and glide slope deviation indicator, 3 percent to his airspeed indicator, 3 percent to his altimeter, and 1 percent to his IVSI.

In the flight director mode, the pilot devoted 74 percent of his scan time to his flight director attitude indicator, 10 percent to his horizontal situation indicator and glide slope deviation indicator, 6 percent to his airspeed indicator, 5 percent to his altimeter, and 2 percent to his IVSI.

These scan pattern figures are confirmed generally in a later study conducted by Amos A. Spady, Jr., of the NASA Langley Research Center, Hampton, Virginia 5/.

1.17.5 Flight Director

N4744 was equipped with a Collins FD 109 Flight Director System. This system provides a three-dimensional display of lateral and vertical steering commands and a realistic presentation of aircraft attitude on a single instrument, the flight director indicator (FDI). Steering commands for the selected function are presented to the pilot by V-shaped command bars which, when in use, are superimposed over the attitude indicator of the FDI. In order to satisfy the steering command, the pilot maneuvers his aircraft to fly the fixed delta-shaped aircraft symbol into the command bars.

With the flight director system in heading mode, lateral steering inputs can be inserted into the system by rotating the heading control knob and setting the heading marker on the horizontal situation indicator (HSI) to the new heading. The command bars will command the turn to the desired heading.

5/ Airlines Pilot Scanning Behavior During Approaches and Landings In a Boeing 737 Simulator, October 20, 1977.

The command bars also can be used for vertical guidance when heading mode is selected. The pilot can use either of two methods to select his desired pitch reference. He can place the command bars to the desired pitch reference by rotating the pitch control knob; or if the aircraft is being flown at a pitch attitude that he wants to maintain, he can press the synchronize button on the pitch control knob. In the latter case, the flight director system will drive the command bars to a position which will command the existing pitch attitude. In either case the command bars will remain in the selected position until the pilot resets them.

1.17.6 National Airlines Operational Procedures

The recommended procedures for operating the Boeing 727 are contained in the company's "B-727 Flight Manual." The flight manual's Flight Patterns and Maneuvers section presents pictorially the recommended procedures for flying instrument approaches and accompanies the presentation with text.

The procedures for the "VOR-LOC-ADF-ASR MDA Approaches" recommend that the crew plan a 30° flap landing and complete the before-landing initial checklist before starting to configure the aircraft for landing. Flaps are to be extended to 15° and the 15° flaps maneuvering speed is to be established before intercepting the final approach course. The illustration shows the aircraft established on the final approach course outside of the FAF. After the final approach course is intercepted, the flaps should be extended to 25° and the 25° flap maneuvering speed should be attained. The landing gear is to be extended before reaching the FAF and landing flaps (30°) should be extended at the fix or start-descent point. (See Appendix G.)

An 800 to 1,000 fpm rate of descent should be established at the FAF or final descent point, and thrust should be adjusted to maintain an airspeed within 5 KIAS of the corrected V_{ref}. The maximum descent rate is 1,000 fpm. According to a company check airman, if a target EPR of about 1.4 is established at the beginning of the descent as the flaps and gear are lowered, the aircraft will decelerate to a descent rate and airspeed that is close to these parameters. The captain stated that he was trying to hold about 140 to 145 KIAS on the descent to the MDA.

The flight manual cautions the pilot, "Under normal conditions the gear handle should not be operated while the flaps are in transit." The purpose of this restriction is to insure that maximum hydraulic system pressure is available to the nose gear lock operating mechanism when the gear handle is operated.

According to the airplane flight manual, the pilot-not-flying is required to call out the following:

"1,000 ft - (SPEED) and (SINK RATE),
200 ft above (MDA),
100 ft above,
MDA,
Runway in sight or Missed Approach Point"

He is also required to call out any excessive deviations from the desired sink rate and target indicated airspeeds.

The airplane flight manual does not assign the flight engineer any specific altitude awareness tasks. He is directed to monitor his panel; "however, especially in the lower altitude portion of an instrument approach, he will assist the pilots in monitoring and cross checking the forward panel calling any abnormal conditions to the captain's attention."

The text describing the nonprecision approach contains the following:

> "ASR - Verify the MDA. The Controller provides navigational guidance in azimuth only. The Pilot is furnished headings to align the airplane with the extended centerline of the landing runway. The Pilot will be advised when to start descent, but elevation guidance is not available. In addition, the Pilot will be advised of his distance from the runway and, upon request, the Controller will give recommended altitudes each mile before reaching the published MDA. Navigational guidance is provided until the airplane reaches the Missed Approach point or a point one mile from the approach end of the runway."

The airplane flight manual also advises the pilots, "IF AT ANY TIME during the approach the aircraft alignment, altitude, speed, sink rate, or any other factor gets out of bounds to the point that excessive maneuvering is necessary to achieve the proper re-alignment, a MISSED APPROACH shall be commenced."

The flight manual states that the use of the flight director on an MDA-type approach is optional and recommends "that the Flight Director not be used for the descent portion of the ADF or ASR Approaches, due to the work load added by manual control and the confusion that results."

The captain testified that he used his flight director during the approach. He said he used the command bars for pitch attitude reference while they were in level flight at 1,700 ft, and he estimated that they were referencing an aircraft pitch attitude of "two or three degrees noseup probably." After being cleared out of 1,700 ft, he said that he only used the flight director system for heading reference, and that he did not make any further pitch adjustments to the command bars.

1.17.7 The Tugboat and Barge

The tugboat and barge which assisted in the rescue operation had been proceeding on a northerly heading that was almost perpendicular to the extended centerline of runway 25. The tug was pushing the barge. Both vessels were slightly north of the runway extended centerline when the aircraft passed astern of them and crashed. The impact site was about 200 to 300 yards to the left and aft of the vessels position.

The tug was about 30 ft long and 8 ft wide, and the barge was about 70 ft long and 30 ft wide. The tug had a white masthead light, red running lights on the port side, and green running lights on the starboard side. The navigation lights were "low intensity." Although there was a portable "Q-beam" high-intensity spotlight about 5 in. in diameter aboard the tug, it was not turned on until after the plane hit the water.

The barge also was equipped with standard red (port side) and green (starboard side) running lights mounted on its forward end. In addition, the barge was equipped with a flashing amber light mounted on the forward end at the midbeam position. The barge lights were portable low-intensity lights powered by dry cell batteries.

Based on the relative position of the aircraft and the boats during the accident sequence, the starboard sides of the vessels would have been facing National 193 until it passed astern of them.

The first officer and flight engineer stated that they saw a red light in front of the aircraft during the final descent. The first officer saw the light after the aircraft "left the 1,700 to 1,500-ft region." He thought it was in the vicinity of the airport, and he continued to watch it in the hopes of identifying the runway environment. It was a single red light, and he did not believe it to be one of the VASI lights. Neither man could identify the light when shown photographs of the airport area taken at night from a helicopter positioned along the final approach course.

2. ANALYSIS AND CONCLUSIONS

2.1 Analysis

The pilots were certificated properly and were qualified for the flight. There was no evidence that medical or psychological problems affected their performances.

The controllers in the Pensacola tower were certificated properly and were qualified to handle the flight.

The aircraft was certificated, equipped, and maintained in accordance with regulations and approved procedures. Except for the report that the engines were "slow to spool up," there was no evidence of a failure or a malfunction of the aircraft's structure, flight controls, powerplants, or systems. Since the accident cannot be attributed to a failure of any engine to respond to a request for thrust, the reported engine difficulties cannot be considered contributory. Although tests did not prove that the MDA lights were illuminated at impact, they did disclose that the system was capable of normal operation before the crash.

The evidence disclosed some confusion on the part of the crew as to what instrument approaches were available for their use at Pensacola. After that was resolved, there was further confusion concerning some of the procedures involved in the ASR approach. Since the company had provided their flightcrews with material describing the facilities available at Pensacola and since they knew that an ASR approach would have to be flown, their lack of knowledge can only be attributed to inadequate preflight preparation.

The evidence showed that the radar controller did not adhere to procedures contained in FAA Handbook 7110.65A which were designed to aid the flightcrew in the proper pacing of their cockpit duties during the ASR approach. One procedure required the controller to position the aircraft on the final approach course at least 8 nmi from the runway. The evidence disclosed that the controller gave National 193 its vector to the final approach course about 5 nmi from the runway, and that the flight completed the turn about 6 sec after they were told they were 4 nmi from the runway.

Since the ASR approach is not based on a navaid which provides a portrayal of position data on the aircraft's navigational instruments, the pilot must depend on the controller for this information. Based on this information, he should be cognizant of his aircraft's position relative to the airport at all times. He is particularly dependent on the controller to supply him with precise position information concerning his distance from the final approach descent point, so that he can configure his aircraft for the approach in a timely manner. Although the controller did provide National 193 with position information relative to the airport and runway on several occasions, he did not provide its flightcrew with the "advance notice of where descent will begin," as required in paragraph 1192 of the Handbook. The radar controller contended that this notice was no longer required, since he had cleared the aircraft to descend to the MDA before it reached the FAF. The provisions of the paragraph however refute his contention. The intent of paragraph 1192 is to insure that the controller affords the pilot preparation time to configure his aircraft for the impending final descent. Clearing National 193 to descend to the MDA 1/2 mile before the descent point did not comply with either the intent or recommended phraseology of the paragraph.

The controller said that he had misjudged the aircraft's distance and turned it to final inside the recommended distance. However, he knew that the aircraft was in a "descent configuration," that he had cleared it to the initial approach altitude about 6 nmi from the runway, that he had cleared it to the MDA outside of 5 nmi from the runway, and that it was intercepting the final approach course about 4.5 nmi from the runway. Since the controller had received no information from the pilot to indicate he was having difficulties, there was no reason for him to terminate the approach.

Because the controller did not position National 193 on the final approach course outside the approach gate, he had created a situation that would make it impossible for the captain to configure his aircraft in the manner specified in the flight manual. In order to place his aircraft in the desired configuration at the FAF, he would have to lower the flaps to 25° and extend the landing gear either as he was approaching the fix or on the intercept turns to the final approach course.

At 2117:05, while on a 110° heading, a heading which was within 40° of what would constitute a downwind leg to runway 25, the captain was told that his aircraft was 6 nmi northeast of the field; 34 sec later he was turned to a heading of 160°. He should have recognized that this heading approximated a base leg to runway 25, and that it would keep his aircraft within 6 nmi to 8 nmi of the field until he was turned to the final approach course and fix. Since the captain knew that the FAF and the start-descent point were 5 nmi from the runway, he should have recognized that the intercept turn or turns from the 160° heading to the final approach course would place his aircraft on that course at, or possibly inside, the FAF. Thus, he should have known that he would have to be ready to extend the flaps to 25° and lower the landing gear either on this leg or on the turn to intercept the final approach course. The evidence showed that he either did not recognize what was happening, or he was unable to make these adjustments to the recommended procedures.

At 2118:25, National 193 was turned to 220°. Although this was an intercept heading to the final approach course, the captain did nothing to further configure his aircraft. At 2119:04, they were cleared to 1,500 ft; at 2119:20, they were cleared to the MDA; and at 2119:29, the captain requested "twenty-five flaps." The landing gear was not extended until 2120:00, 4 sec after the landing gear warning horn sounded. When the gear was extended, the aircraft was completing its turn to the final approach course and was descending through about 940 ft.

The captain testified that he failed to extend the landing gear immediately after lowering the flaps to 25°, because he wanted to avoid placing a simultaneous demand on the hydraulic system while the flaps were in transit. However, the flaps would have reached 25° in 3 to 4 sec; he did not call for the gear for another 27 sec. Based on the vectors and clearances given to the flight, especially the clearance to MDA, the captain should have realized that his aircraft was at, or about to pass, the FAF. The evidence indicated that he was reluctant to lower the gear until he was established on the final approach heading.

Because of this delay, the landing flaps were not extended. Both of these delays increased the captain's workload during the descent and contributed to producing the major causal area of the accident--a lack of altitude awareness. The delay in extending the landing gear and the resultant delay in beginning the before-landing final checklist also contributed in part to the first officer's failure to provide the captain with some of his required altitude callouts.

Except for monitoring, crosschecking, and calling abnormal conditions to the captain's attention "in the lower altitude portions of an instrument approach," no specific altitude awareness responsibilities were assigned to the flight engineer. The evidence showed that he was busy with his assigned checklist duties after the aircraft descended through 1,000 ft. The captain called for "gear down" at 940 ft and for the before-landing final checklist 1 to 2 sec later. Since the first four items on the checklist were accomplished by the flight engineer and since he challenged the first officer with the fifth item, "landing gear and lever," 10 sec later, he obviously was involved in accomplishing the checklist. The GPWS alert sounded about 3 sec after the first officer responded to the "landing gear and lever" checklist challenge.

With regard to the first officer, the evidence disclosed that either he did not look at his altimeter or he did not perceive what he saw until the aircraft was at 100 ft. At this point, the aircraft was descending at 20 fps. Although he claimed he thought the altimeter read 1,100 ft, he was able to resolve the error quickly since he made a 50-ft callout.

The evidence also indicated that, except for resetting the altitude alerter and extending the landing gear, the first officer's attention was directed outside the cockpit until he was required to respond to the flight engineer's checklist challenge, "landing gear and lever."

Since the controls of the altitude alerter are located on top of the instrument panel's glare shield, its use requires that the crew-member's attention be directed away from the flight instruments while he is manipulating the controls. According to the first officer and captain, the alerter was reset to the new missed approach altitude of 2,000 ft after the aircraft left 1,300 ft. A full 2-sec altitude alert sounded as the aircraft passed through 700 ft, the height which would approximate the upper aural warning altitude had the system been set to the MDA. Since the first officer and captain denied that it was set to the MDA, it is possible that the signal was spurious; its cause could not be determined by the evidence.

The first officer's duties also require him to seek ground cues during the descent. Around 1,500 ft, he saw a red light outside the aircraft and spent some time trying to determine if it was part of the airport environment. The origin of this light was never determined. The location of the tug and barge in front of the flight during its descent suggested that their lights may have furnished the source of the red light. However, the lights on the vessels were low intensity, and the red running lights on the port sides would have been hidden from the flightcrew's view. Regardless of the source of the light, the first officer's preoccupation with it caused him to omit several required callouts. He did not call out a descent rate and an airspeed which exceeded the recommended parameters, and he did not make the required altitude callout at 1,000 ft.

The first officer stated that he did not make the 1,000-ft callout, because he never got to 1,000 ft mentally. His explanation for this failure was the upset of his "inner time clock" which was based on a normal descent rate.

The first positive indications that the first officer had returned his attention inside the cockpit was when he extended the landing gear and 11 sec later, when he responded to the flight engineer's checklist challenge concerning the condition of the landing gear. The first officer did not recall any altimeter or IVSI readings during this 11-sec interval. He probably had either redirected his attention outside the aircraft or was monitoring the landing gear warning and position lights to insure the proper operation of the gear during the extension cycle. During this time the aircraft descended through 680 ft, and he did not provide the captain with the required "200 ft above MDA" call.

Three seconds after the first officer responded to the checklist challenge the GPWS warning began. In the interim that the GPWS warning persisted the intracockpit conversation that surmounted the aural warning disclosed that the captain's and first officer's attention was directed immediately to their IVSI's and the 2,000-fpm descent rate; their attention was not directed to their altimeters. Neither man noted that the MDA had been reached and passed.

While the first officer's failure to provide the captain with altitude awareness assistance during the upper portions of the approach can be attributed to his permitting himself to be distracted by outside visual cues, the evidence showed that another source of distraction from about 1,000 ft down to the activation of the GPWS was the workload imposed upon him by the extension of the landing gear and the associated checklist-monitoring tasks involved. Under normal circumstances these tasks should have been completed before the start of the descent to MDA, not upon leaving 1,000 ft.

A review of the captain's activities from 1,700 ft to the activation of the GPWS disclosed that during the early part of the descent—from 1,700 ft to about 1,300 ft--he had established a stable approach path. The average rate of descent was about 600 to 800 fpm; there was a slight increase in airspeed from 154 to 160 KIAS; the thrust was stabilized at 25 percent of takeoff rated thrust; and, except for a momentary pitch down as the flaps were extended to 25°, the pitch attitude decreased slowly from 3° noseup to 2° noseup. Had the landing gear been extended and flaps lowered to 30°, the aircraft would have probably achieved the desired parameters for the approach. However, the landing gear was not extended for another 25 to 30 sec, and the flaps remained at 25°. Because of this nonstandard approach configuration, the captain experienced added difficulties in his attempts to attain his desired descent rate and airspeed during the approach.

Contrary to the flight manual's recommendations, the captain continued to use his flight director during the approach, but only for heading guidance. Since he made no changes to the pitch reference position of the command bars during the approach, the bars would have remained positioned throughout the descent as they were when the captain was flying level at 1,700 ft--commanding an aircraft noseup pitch of about 2° to 3°. At 1,300 ft, when the captain began the turn to 250°, he also increased the rate of descent to 1,000 fpm. He decreased thrust, lowered the aircraft's nose, changed the pitch attitude to about 3° nosedown, and maintained that pitch attitude until the GPWS warning began. As a result of these changes, the horizon reference line of the flight director attitude indicator was now positioned about 3° above the stationary airplane symbol and about 2° to 3° below the command bars. When he set his heading marker to 250° for turn guidance, the command bars would have tilted to the right to request a right turn. Therefore, during the turn and descent, the captain was interpolating the information from this presentation to steer his aircraft and to maintain the 2° to 3° nosedown pitch attitude.

During the descent down to 500 ft, the captain could not recall observing any altitude readings; any airspeed reading other than that his desired speed on the approach was 140 to 145 KIAS; or any IVSI reading in excess of 1,000 fpm. The eye scanning studies note that during a flight director approach, 74 percent of the pilot's scan time is devoted to the flight director attitude indicator. These results were obtained while using the flight director in its optimum manner--flying the delta-shaped aircraft symbol into the command bars. In this instance, the manner in which the captain was using his flight director attitude indicator required him to interpolate the portrayal and probably caused him to devote a higher percentage of his eye scan time to the flight director indicator and a much lower percentage to the other flight instruments.

Since the pitch attitude remained constant, the increase in descent rate was the result of the thrust reduction and the extension of the landing gear. According to the captain, the increase in the descent rate was the cumulative result of thrust reduction and aircraft reconfiguration. However, the captain's handling of the thrust suggests that he did observe the airspeed indicator at some time during the descent. He had established an attitude which initially produced the desired rate of descent; however, he still kept retarding thrust until it reached 12.5 percent of takeoff rated thrust. At this point, the airspeed was about 10 to 15 KIAS over his stated desired target speed, and it appears that the thrust reduction was an attempt to reduce that speed while maintaining the pitch attitude which had produced the 1,000-fpm descent rate. Since he did not alter the pitch attitude, the lower thrust settings reduced the airspeed and increased the descent rate. This trend continued as thrust was reduced toward the flight-idle range where it remained until impact. Thus, the flight approached the MDA with thrust at flight idle and with a descent rate that was at or above 1,600 fpm.

The evidence concerning this phase of the flight disclosed that the demands of trying to establish a stabilized approach and of trying to insure that the MDA was reached in sufficient time and at a safe airspeed may have contributed to a breakdown in the captain's instrument scan pattern. This breakdown was similar to that noted on one of his flight checks. Based on his testimony and other evidence, the captain evidently fixed his attention on his flight director indicator and either excluded the altimeter and IVSI from his scan, or placed them at the outer perimeter of his attention span where he did not perceive their readings. Of paramount importance to this phase of the flight were the first officer's required altitude awareness callouts to the captain, which he failed to make.

The captain also testified that he experienced the same sense of pace that misled the first officer. He stated that since he was not aware of any rate of descent in excess of 1,000 fpm, he did not expect to go through "this great an altitude this quickly." Thus, when the GPWS activated he expected to be higher, and when he saw 500 ft on his altimeter, he believed it read 1,500 ft. The evidence showed that the captain was well aware of his altitude at 1,700 ft; he knew he was cleared to descend to 1,500 ft; he knew he was cleared to the MDA; he watched the first officer reset the altitude alerter after receiving this clearance, and he set up a 1,000-fpm descent rate sometime after that. The Board cannot determine how, under these circumstances, the captain could have read 500 ft and interpreted it to be 1,500 ft, an altitude he know he had left almost 1 min earlier.

The captain also said that he misread his altimeter two more times after he made the first error. Since the captain knew he was descending toward the MDA and he could hear the ground proximity warning, the Board does not believe it reasonable that he would repeat the first error two more times. However, while the warning was in progress the captain recalled the IVSI reading correctly. He recalled his control inputs, the manner in which they were made, and the results that these inputs had on the descent rate. Based upon the foregoing, the Board concludes that the captain focused his attention on the IVSI and either did not look at his altimeter or did not perceive its reading.

The Safety Board believes that the GPWS warning may have prevented the pilots from seeing the MDA lights. Although the evidence disclosed that the MDA warning light system was operational and that the proper MDA value had been inserted into the radio altimeter, neither pilot saw these lights illuminate. The evidence is conclusive that the activation of the GPWS warning directed both pilot's attention to the GPWS pullup lights, which are much brighter than the MDA lights, and to their IVSI's. As a result neither pilot saw the last automatic warning that might have alerted him to his altitude.

Because of the altitude at which the GPWS warning began, it is impossible to determine if mode 1 or mode 4 caused the system to activate. Regardless of the mode, once the aircraft descended below 500 ft the mode 4 system would have sustained the alarm until the flight engineer inhibited the system.

The flight engineer believed he had been instructed to turn the system off; the CVR transcript substantiates his belief. After the GPWS was turned off the flight engineer reset the switch. However, he must have reset it within 4 sec of impact, since the system did not have time to recycle.

Once the GPWS had sounded, the captain concurred with the first officer's analysis that it was the excessive descent rate which caused the warning. He eased back on the control column, saw the descent rate lessen, and heard the alarm cease. However, the alarm ceased because the system had been inhibited, not because of the change in the descent rate. The captain erroneously concluded that the problem was solved. The rate of descent had shallowed to 1,600 fpm when the warning was silenced, and the captain continued to descend without checking his altimeter. In this case, his failure to check his altimeter was vital to the safety of the flight since the performance analysis disclosed that for 4 sec to 6 sec after the warning was silenced the captain could have arrested the descent and avoided the crash. Based on these data, had a go-around been initiated while the 9-sec warning was in progress, the crash also could have been prevented.

Since the sky was dark and the aircraft was being flown in instrument meteorological conditions on an approach which afforded the pilot no vertical guidance, a prudent captain would have initiated a missed approach at the onset of the warning rather than try to determine the validity of the warning. The procedures in the company flight manual stated that under these conditions positive action to alter the flightpath would be "particularly appropriate." Merely easing the nose of the aircraft up to reduce the descent rate without adding thrust cannot be classified as such positive action. The facts that the aircraft entered the warning regime in a 3° nosedown attitude, at a 2,000-fpm descent rate, and with all engines at or near flight idle should have constituted added grounds to the captain to positively alter the flightpath.

The GPWS procedures also required that the pilots "focus their attention on terrain proximity" to determine the validity of the warning. The beginning of the GPWS alert constituted, if not an emergency, certainly an abnormal situation and should have made them check every available altimeter system to fix the aircraft's position relative to the terrain. The pilots knew they were at an altitude where the radio altimeters were operative; they knew that the approach was being made over water; and they knew that there were no terrain features present that would have made the radio altimeter readout suspect. Under the circumstances, the Safety Board concluded that an experienced flightcrew should have checked their radio altimeters since the altimeters would have provided them with an immediate readout of absolute altitude.

In summary, the Safety Board concludes that the ATC procedures affected the conduct of the approach, and, therefore, contributed to the chain of events which led to the accident. Although the controller had placed the aircraft in a position from which the approach could have been completed safely, he also had placed it in a position where the captain had to alter the timing of his checklist procedures in order to configure his aircraft more rapidly than usual. While the controller's handling of the flight did not place the aircraft in a dangerous position, his nonstandard procedures made the approach more difficult for the crew to accomplish.

However, the accident would have been averted had the pilots performed to the established standards expected of airline cockpit crews. This report documents a lack of professionalism on the crew's part which contributed to their inability to recover from a procedural error on the part of the controller.

The accident was survivable for several reasons: (1) The traumatic injuries sustained by the passengers and crew indicated that the impact forces were not sufficient to produce fatal injuries; (2) since the water was not deep enough to totally submerge the aircraft, ample time was provided for evacuation, and the aircraft acted as a platform for those awaiting rescue; (3) the barge was immediately accessible to the passengers; (4) the air and water temperatures were moderate; and (5) the wind, wave, and current actions were minimal. In addition, the actions of the captain, his flightcrew, the cabin crew, and able-bodied passengers played a major role in insuring the survival of the passengers until they were rescued by the tugboat and barge.

The Safety Board commends the crew of the tug and barge for their actions during the rescue. The combined actions of both the aircraft and surface vessels' crews contributed immensely to minimizing the loss of lives in this accident.

3. CONCLUSIONS

3.1 Findings

1. The aircraft's crew and the controllers were certificated and qualified.

2. There were no aircraft systems or aircraft structures malfunctions.

3. The controller did not follow prescribed procedures; he did not vector the aircraft to intercept the final approach course 2 nmi outside the approach gate; and he did not provide the captain with advance notice of the final descent point. Therefore he contributed to the flight-crew's delay in extending flaps and beginning the before-landing final checklist.

4. The captain further delayed the configuration of his aircraft for the final descent, and he did not complete the process. The landing gear was extended at 940 ft; however, landing flaps (30°) were never extended.

5. The captain was unable to establish a stable descent profile after descending below 1,300 ft.

6. The captain and first officer did not monitor their IVSI's for an extended period before the activation of the GPWS.

7. The captain either misread or did not read his altimeters during the latter stages of the approach.

8. The first officer did not make any of the required altitude callouts during the final descent.

9. The flight engineer's inhibition of the GPWS coincided with the captain's raising the nose and reducing the descent rate. The pilots were misled into believing the problem was solved.

Probable Cause

The National Transportation Safety Board determines that the probable cause of this accident was the flightcrew's unprofessionally conducted nonprecision instrument approach, in that the captain and the crew failed to monitor the descent rate and altitude, and the first officer failed to provide the captain with required altitude and approach performance callouts. The crew failed to check and utilize all instruments available for altitude awareness, turned off the ground proximity warning system, and failed to configure the aircraft properly and in a timely manner for the approach.

Contributing to the accident was the radar controller's failure to provide advance notice of the start-descent point which accelerated the pace of the crew's cockpit activities after the passage of the final approach fix.

BY THE NATIONAL TRANSPORTATION SAFETY BOARD

/s/ JAMES B. KING
Chairman

/s/ ELWOOD T. DRIVER
Vice Chairman

/s/ FRANCIS H. McADAMS
Member

/s/ PHILIP A. HOGUE
Member

November 9, 1978

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APPENDIX A

INVESTIGATION AND DEPOSITIONS

1. Investigation

The National Transportation Safety Board was notified of the accident about 2140 on May 8, 1978. The Safety Board immediately dispatched an investigative team to the scene. Investigative groups were established for operations, air traffic control, witnesses, weather, human factors, structures, powerplants, systems, flight data recorder, maintenance records, and cockpit voice recorder.

Parties to the investigation were: The Federal Aviation Administration, National Airlines, Inc., Air Line Pilots Association, Professional Air Traffic Controllers Organization, Transport Workers Union, Pratt and Whitney Division of United Technologies Corporation, the Boeing Aircraft Company, and the Flight Engineers International Association.

2. Depositions

Deposition proceedings were held on June 29 and 30, 1978, in Washington, D.C. Testimony was taken from the following persons: the captain, first officer, and flight engineer of National 193; National Airline's Director of Boeing 727 Flight Standards; the approach controller; an ATC training officer; and two Federal Aviation Administration witnesses concerning airport construction and navaids.

APPENDIX B

PERSONNEL INFORMATION

Captain George T. Kunz

Captain Kunz, 55, was employed by National Airlines, Inc., November 12, 1956. He held Airline Transport Pilot Certificate No. 408979 with an aircraft multiengine land rating. He held type ratings for the Boeing 727 and Douglas DC-4, 6, 7, and 8 aircraft. His first-class medical certificate was issued November 10, 1977, with the limitation that he "shall possess correcting glasses for near vision while exercising the privileges of his airman's certificate." The captain testified that he was not wearing his glasses during the approach.

Captain Kunz was promoted to captain on the Boeing 727 aircraft on October 23, 1967. He passed his last proficiency check on October 31, 1977, and his last line check on November 5, 1977. He last completed recurrent training on May 3, 1978. The captain's most recent ASR approach check was given in the Boeing 727 simulator on April 22, 1977, and was satisfactory.

The review of the captain's training file disclosed one proficiency check upon which he experienced some difficulties. The check flight was given on January 9, 1976, when the company resumed service following the settlement of a flight attendant labor dispute. The captain had not been at the controls of a Boeing 727 for about 4 months. The check airman who gave the proficiency check stated, in part:

> "The flight took place in night VFR conditions and the air work maneuvers were accomplished first, with no particular problems. Three night requalification visual touch and go landings were satisfactorily completed at the Dade Collier Training Transitional Airport. The instrument hood was fixed in place, obscuring Capt. Kunz' forward vision. Since the training port has no radar, I provided simulated radar vectors to place the aircraft on an intercept angle to the final approach course. I am not sure which approach was attempted first, i.e. localizer only (glide slope out) or ADF approach. I am sure, though, that no simulated emergency or abnormal conditions were presented. During base leg to final, Capt. Kunz lost approximately 300 to 400 feet altitude and had to be reminded that we were well below our intended level. He did correct back to the intended altitude. However, on level off at MDA he again let the aircraft descend well below the desired altitude. I told Capt. Kunz to execute a missed approach. On our next approach it was very obvious that Capt. Kunz was having instrument scan problems (sometimes referred to as tunnel vision). He again demonstrated poor altitude control by going well below the desired pattern and MDA altitude. The hood was pulled and I had Capt. Kunz accomplish a VFR full stop landing."

The captain was given additional training and flew a recheck successfully. The company records disclosed that 188 captains had to complete a proficiency check before scheduled on a trip after the flight attendant strike ended; 14, including Capt. Kunz "required more than one flight to successfully complete the checks...."

Captain Kunz has flown 18,109 hrs, of which 5,358 were in the Boeing 727 aircraft. In the 30-day and 24-hour periods preceding the accident, he flew 79 and 0 hours, respectively.

First Officer Leonard G. Sanderson, Jr.

First Officer Sanderson, 31, was employed by National Airlines, Inc., December 20, 1976. He held Airline Transport Pilot Certificate No. 1972432 with commercial privileges and airplane single and multi-engine land ratings. His first-class medical certificate was issued December 2, 1977, with no limitations.

First Officer Sanderson initially qualified as a First Officer on Boeing 727 aircraft on January 24, 1977, and passed his last proficiency check on November 14, 1977. He last completed recurrent training on January 12, 1978.

First Officer Sanderson has flown 4,848 hours, of which 842 were in the Boeing 727. In the 30-day and 24-hour periods preceding the accident he flew 49 and 0 hours, respectively.

Except for ASR approaches given in the simulator during proficiency checks, neither pilot could recall having made an ASR approach in the aircraft recently.

Flight Engineer James K. Stockwell

Flight Engineer Stockwell, 47, was employed by National Airlines, Inc., June 2, 1969. He held the following certificates: Aircraft and Powerplant Mechanic Certificate No. 1237882; Flight Engineer Certificate No. 1726358 with reciprocating engine and turbojet engine ratings; and Commercial Pilot Certificate No. 1587778 with an instrument rating. His first-class medical certificate was issued October 23, 1977 with no limitations.

Flight Engineer Stockwell initially qualified as a flight engineer on Boeing 727 aircraft in August 20, 1969. He passed his last proficiency check on August 16, 1977, and his last line check on November 30, 1977. He last completed recurrent training on February 22, 1978.

Flight Engineer Stockwell has flown 9,486 hours as a flight engineer, of which 7,050 were in the Boeing 727. In the 30-day and 24-hour periods preceding the accident he flew 53 and 0 hours, respectively.

Flight Attendant Carol J. Crawford

Flight Attendant Crawford, 29, was employed by National Airlines, Inc., March 16, 1968. She was qualified for duty in the Boeing 727. Her total flight time in the Boeing 727 was about 5,000 hours.

Flight Attendant Crawford successfully completed her most recent recurrent training March 14, 1978. On March 28, 1977, she demonstrated her ability to operate the doors and exits of the Boeing 727 aircraft.

Flight Attendant Carl E. Greenwood

Flight Attendant Greenwood, 23, was employed by National Airlines, Inc., January 28, 1977. He was qualified for duty on the Boeing 727. His total flight time in the Boeing 727 was about 600 hours.

Flight Attendant Greenwood successfully completed his most recent recurrent training October 13, 1977. On January 15, 1977, he demonstrated his ability to operate the doors and exits of the Boeing 727 aircraft.

Flight Attendant Deborah W. Verplank

Flight Attendant Verplank, 28, was hired by National Airlines, Inc., August 26, 1970. She was qualified for duty in the Boeing 727. Her total flight time in the Boeing 727 was about 4,000 hours.

Flight Attendant Verplank successfully completed her most recent recurrent training April 17, 1978. On April 15, 1978, she demonstrated her ability to operate the doors and exits of the Boeing 727 aircraft.

APPENDIX C

AIRCRAFT INFORMATION

National Airlines, Inc., had operated N4744 continuously since its purchase from the Boeing Company on March 26, 1978, until the accident. The aircraft had been in service 26,720.2 hours.

N4744 was equipped with 3 Pratt and Whitney Model JT8D-7B engines. Pertinent information pertaining to the engines is as follows:

	Engine No. 1	Engine No. 2	Engine No. 3
Serial No.	654797	654939	649246
Date Installed	3/21/78	8/26/77	10/15/77
Time Since New (hours)	19,678.9	20,539.6	26,432.6
Cycles Since New	21,555	21,100	26,808
Time Since Heavy Maintenance	5,386.9	2,312.8	1,891.8
Cycles Since Heavy Maintenance	5,143	1,857	1,491

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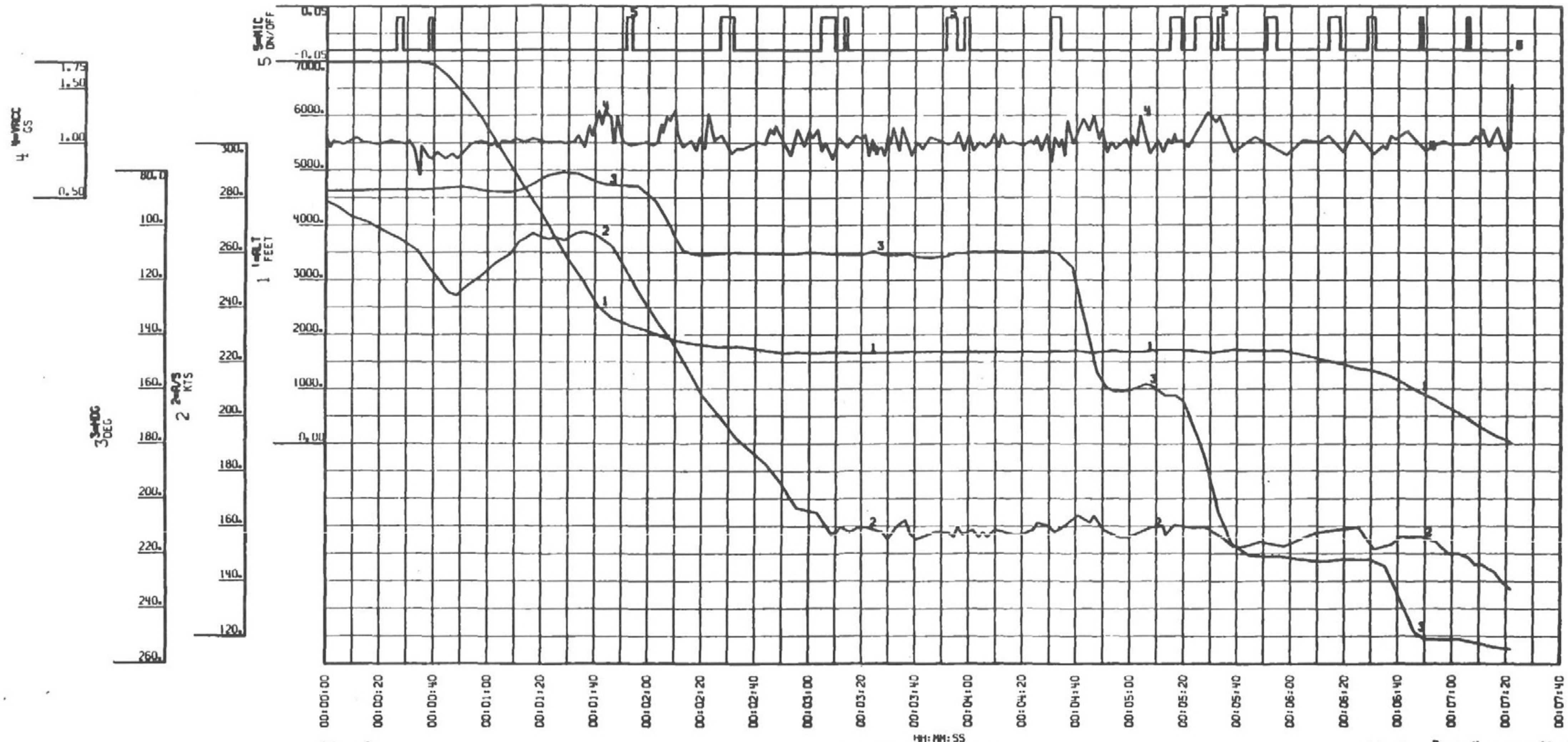
NATIONAL AIRLINES AT PENSACOLA, FL. MAY 8, 1978



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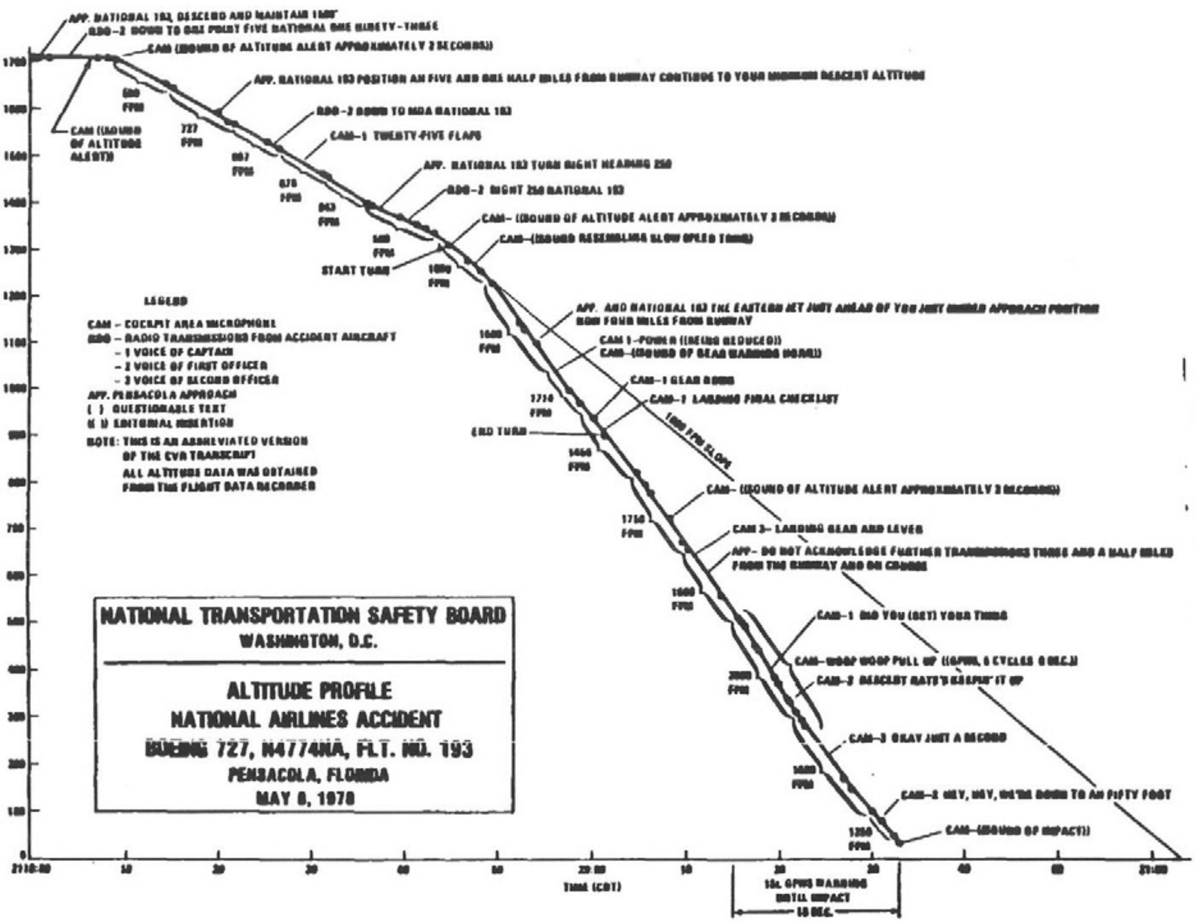
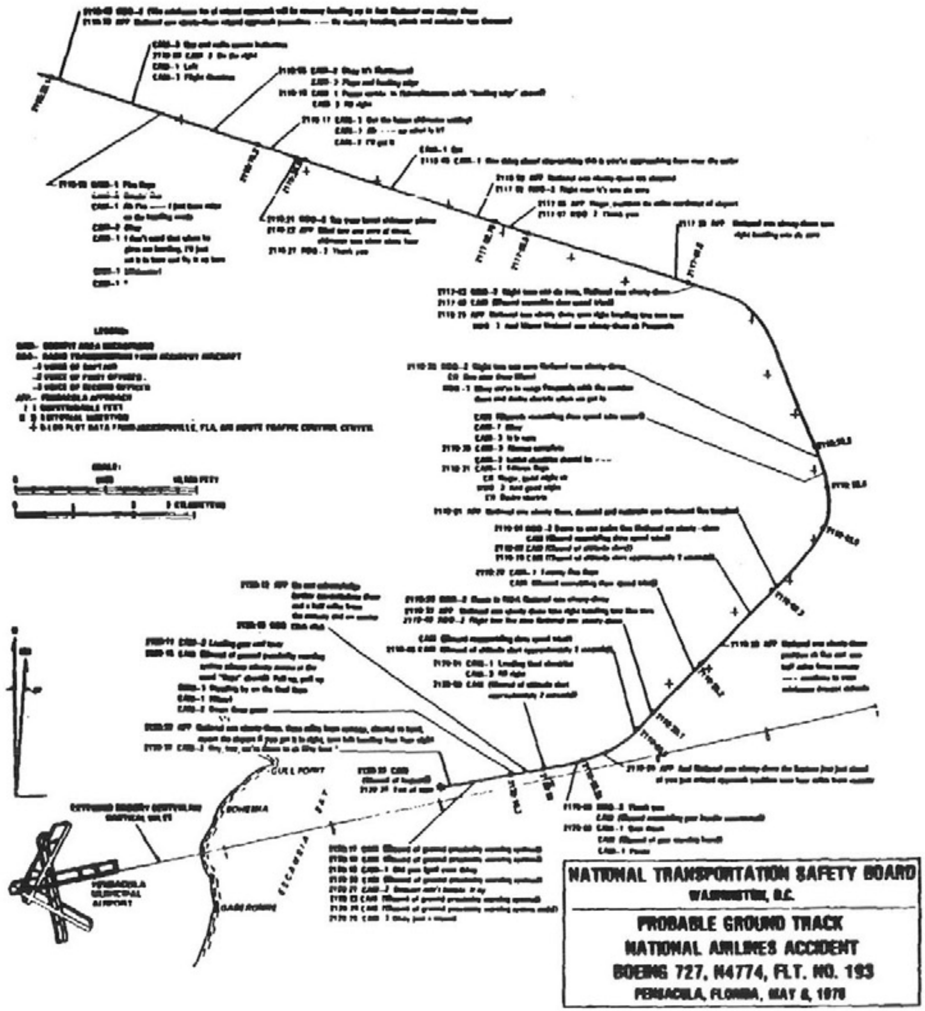
APPENDIX E


NATIONAL TRANSPORTATION SAFETY BOARD
WASHINGTON, D.C.
ALTITUDE PROFILE
NATIONAL AIRLINES ACCIDENT
BOEING 727, N4774NA, FLT. NO. 193
PENSACOLA, FLORIDA
MAY 8, 1978
LEGEND
CAM - COCKPIT AREA MICROPHONE
RDO - RADIO TRANSMISSIONS FROM ACCIDENT AIRCRAFT
-1 VOICE OF CAPTAIN
-2 VOICE OF FIRST OFFICER
-3 VOICE OF SECOND OFFICER
APP. PENSACOLA APPROACH
( ) QUESTIONABLE TEXT
(( )) EDITORIAL INSERTION
NOTE: THIS IS AN ABBREVIATED VERSION OF THE CVR TRANSCRIPT
ALL ALTITUDE DATA WAS OBTAINED FROM THE FLIGHT DATA RECORDER
ALTITUDE (MSL)
TIME (CDT)
CAM-1 TWENTY-FIVE FLAPS
START TURN
END TURN
1000 FPM SLOPE
CAM-1 GEAR DOWN
CAM-1 LANDING FINAL CHECKLIST
CAM-3 LANDING GEAR AND LEVER
CAM-3 OKAY JUST A SECOND
CAM-((SOUND OF IMPACT))
1250 FPM

APPENDIX F


GULL POINT
BOHEMIA
ESCAMBIA BAY
PENSACOLA MUNICIPAL AIRPORT
NATIONAL TRANSPORTATION SAFETY BOARD
WASHINGTON, D.C.
PROBABLE GROUND TRACK
NATIONAL AIRLINES ACCIDENT
BOEING 727, N4774, FLT. NO. 193
PENSACOLA, FLORIDA, MAY 8, 1978