



# National Transportation Safety Board Aviation Accident Final Report

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<b>Location:</b>	Houston, TX	<b>Accident Number:</b>	FTW98FA380
<b>Date &amp; Time:</b>	09/11/1998, 0624 CDT	<b>Registration:</b>	N316UP
<b>Aircraft:</b>	Boeing 767-34AF	<b>Aircraft Damage:</b>	Substantial
<b>Defining Event:</b>		<b>Injuries:</b>	2 None
<b>Flight Conducted Under:</b>	Part 121: Air Carrier - Non-scheduled		

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## Analysis

The night cargo flight was dispatched from the company's main hub into a known area of potentially severe weather, which was influenced by a stationary front and Tropical Storm "Frances." The terminal forecast provided by the operator to their flight crew was 2-days old. The flight crew was not properly briefed on the forecasted weather conditions for the destination airport, and were not provided with all of the adverse weather information and NOTAMS affecting their route of flight and their destination airport. The flight crew missed the first approach to runway 17R due to strong crosswinds. The flight was subsequently vectored for a Category 1 ILS approach to runway 35L. Level 4 to 5 convective activity with tops to 42,000 feet were present over the destination airport at the time of the mishap. The flight crew configured the airplane for an "autoland" approach with the auto-brakes set for maximum braking. A strong crosswind to a quartering tailwind prevailed during the flight's final approach and landing. The airplane touched down 17-feet left of the centerline of the 9,000-foot long ungrooved concrete runway, which was reported to be partly flooded due to its low crown. The auto-pilot was never disconnected by the flight crew and no attempt was made by the flight crew to abort the landing during the accident sequence. The tower had previously reported standing water at the intersection of runway 17R and taxiway Delta during the first approach. The investigation revealed that the runway condition check was conducted by driving a vehicle over the runway centerline for the full length of the runway. The investigation team was on the runway when another torrential rain shower moved across the airport. The team was able to observe a rapid manifestation of water pooling on the runway, mostly away from the centerline. The depth of the water pooling was measured to be at least 7- inches. The investigation team concluded that the issued "standing water" report failed to indicate the severity of the amount of water actually flooding the runway. Heavy rain showers, sometimes described as "torrential" prevailed throughout the area at the time of the accident. Another weather station, located 29 miles to the southeast, reported 7.64 inches of rain from the tropical storm. Witnesses reported the airplane produced a "heavy rooster tail of water" as soon as it touched down on runway 35L. Airport Rescue and Fire Fighting personnel that responded to the accident site, reported that despite the location of their fire house, approximately 1/4-mile across the ramp from the resting place of the airplane, the aircraft was not visible due to the heavy rain that prevailed at the time of the mishap. Some of the first

responders reported that "it was raining sideways" at the time of the mishap. Tire marks, similar to "steam cleaning" were found on the concrete surface of the runway, from the touchdown point to the point where the airplane exited the left side of the 150-foot wide runway, were consistent with the tires being in a state of hydroplaning. Nose wheel steering was found to be operational during the landing sequence. Main tire pressures were found to be within inflation limits (185 to 200 PSI). Two of the main tires (no. 3 and no. 7) were damaged and deflated during the accident sequence. One tire showed some discoloration (bluing). On-board avionics test equipment did not record any faults with the autoland system during the accident flight. Examination and bench testing of the eight brake assemblies did not reveal any anomalies. The eight wheel transducers were also tested by the manufacturer and were found to be within limits. The anti-skid/auto-brake control unit was also tested and found fully functional. Flight data recorder data, as well as tire prints made by the nose wheel tire on the runway revealed that the inter-connect between the rudder and the nose wheel assembly attempted to steer the aircraft toward the localizer course. All navigational aids associated with the instrument approach were reported as operating normal during the two approaches. There was sufficient fuel on board to proceed to the alternate airport.

## Probable Cause and Findings

The National Transportation Safety Board determines the probable cause(s) of this accident to be: The flight crew's decision to land with convective activity over the airport with a prevailing crosswind to a quartering tailwind, on an ungrooved, flooded runway, which resulted in hydroplaning and a loss of directional control. Factors contributing to the accident were: prevailing dark night conditions; severe weather conditions associated with a major tropical storm, such as convective activity, strong crosswinds, the quartering tailwind, and torrential rain. Also contributing to the accident were the operator's failure to provide the flight crew with up-to-date weather forecasts, in-flight weather advisories, and pertinent NOTAMS relating to the safe operation of the flight.

## Findings

Occurrence #1: IN FLIGHT ENCOUNTER WITH WEATHER

Phase of Operation: APPROACH - FAF/OUTER MARKER TO THRESHOLD (IFR)

### Findings

1. (F) LIGHT CONDITION - DARK NIGHT
2. (F) DISPATCH PROCEDURES - INADEQUATE - DISPATCHER
3. (F) WEATHER CONDITION - THUNDERSTORM
4. (F) WEATHER CONDITION - CROSSWIND
5. (F) WEATHER CONDITION - TAILWIND
6. (F) WEATHER CONDITION - RAIN
7. MISSED APPROACH - PERFORMED - FLIGHTCREW

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Occurrence #2: LOSS OF CONTROL - ON GROUND/WATER

Phase of Operation: LANDING - ROLL

### Findings

8. (F) AIRPORT FACILITIES,RUNWAY/LANDING AREA CONDITION - INACCURATE
9. (F) AIRPORT FACILITIES,RUNWAY/LANDING AREA CONDITION - WATER
10. (F) AIRPORT FACILITIES,RUNWAY/LANDING AREA CONDITION - OTHER
11. (F) AIRCRAFT PERFORMANCE,HYDROPLANING CONDITION
12. (C) WEATHER EVALUATION - MISJUDGED - FLIGHTCREW
13. (C) DIRECTIONAL CONTROL - NOT MAINTAINED - FLIGHTCREW

## Factual Information

### HISTORY OF FLIGHT

On September 11, 1998, at 0624 central daylight time, a twin-engine Boeing 767-34AF airplane, N316UP, operating as UPS Flight 774, was substantially damaged following a loss of control during the landing roll at the Ellington Field Airport near Houston, Texas. The two-airline transport rated pilots were not injured. The airplane was owned and operated by United Parcel Service (UPS) Co., of Louisville, Kentucky, under 14 Code of Federal Regulations Part 121. Dark night instrument meteorological conditions prevailed for the cargo flight for which an instrument flight rules (IFR) flight plan was filed. The flight was dispatched from the UPS main hub in Louisville, Kentucky, at 0357, for the scheduled one hour and fifty minute flight to Ellington Field. The flight was scheduled to arrive at Ellington Field at 0554.

The captain was the "flying pilot" during the accident flight. The first instrument landing system (ILS) approach to runway 17R was missed at 0551, due to the prevailing high crosswind conditions at the airport. After performing a missed approach, the flight was vectored around weather for a second approach to the same runway. During the vectoring sequence, the controller suggested the ILS approach for runway 35L to avoid thunderstorms transiting near the final approach course for runway 17R. The crew accepted the suggestion and the airplane was subsequently vectored for the Category 1 ILS approach to runway 35L.

The crew stated that all three autopilot systems were functioning, and the airplane was configured for an "autoland" Cat I approach and landing to runway 35L, with the auto-brakes set for maximum braking (setting number 4). The ILS 3-degree glide slope was intercepted and captured at a radar altitude of 2,300 feet. The captain reported that he was closely monitoring the flight controls and instruments during the approach and landing sequence. Both crew members concurred that the approach was stabilized and uneventful, and visual contact was made with the runway environment as the airplane descended through 1,000 feet MSL. The flight data recorder (FDR) revealed that above 500 feet radar altitude, the autoland system established a nose right crab angle of 11 to 12 degrees.

The winds issued by the tower to flight 774 while on short final were from 090 degrees at 15 knots, gusting to 23 knots. The flight crew acknowledged that no windshear alerts were received during the two approaches.

The crew reported that the touchdown was normal. FDR data revealed that the airplane touched down on the right main gear with a 3-degree bank into the right crosswind. The captain stated that the airplane touched down slightly left of centerline. FDR data revealed that the nose landing gear touched down 17 feet to the left of the centerline. Tire tracks on the runway revealed that the airplane remained downwind of the runway centerline after touchdown. FDR data revealed that rudder deflection during the initial landing rollout moved from 0.3 degrees right to 25 degrees right (maximum deflection) within about 9 seconds.

The captain further stated that he engaged the thrust reversers as soon as the nose gear was on the ground; however, there was "no feel of deceleration" from either the brakes or the reversers.

The flight crew did not initiate any attempt to abort the landing. Despite the windshield wipers operating at the "high" setting, both crewmembers concurred that the forward visibility deteriorated drastically on short approach and during the landing roll (the operator did not

maintain the optional cockpit windshield hydrophobic coating treatment available from the aircraft manufacturer).

The flight crew reported that the airplane's autoland system continued to attempt to correct the ground track of the airplane towards the localizer course (centerline of the runway) during the landing roll. The FDR data revealed that the flight crew did not disconnect the auto-pilot during the accident sequence. FDR information revealed that the airplane touched down at a ground speed of 149 knots (144 calibrated). The reference speed (Vref) for the approach was calculated at 143 knots IAS.

Several witnesses on the ground observed the landing of the airplane. Most witnesses concurred that the airplane produced "a heavy rooster tail of water" as soon as it touched down on the runway. The flight crew of a Miami Air Flight aircraft, which was operating under the call sign "Brisbane 290," was on the ground awaiting a clearance, and reported to the tower that "the landing airplane [UPS 774] looks like he just fish-tailed sideways off-the-runway." The same flight crew alerted the tower that the airplane "had gone dark" and was on the side of the runway.

The investigation revealed four major shortcomings in the UPS Pre-Departure weather briefing packages: published runway advisories were not relayed; runway or field conditions were not current; the RAMTAF terminal forecast for the destination airport was not current; and only certain adverse weather advisories were provided to the flight crew.

#### OTHER DAMAGE

The taxiway marker for taxiway Bravo was destroyed by impact with the right wing of the airplane. Seven runway lights and three taxiway lights were either sheared or knocked down by the airplane during the accident sequence. Runway 35L/17R remained closed until the airplane was recovered to the airport ramp, approximately 3 days after the accident.

#### PERSONNEL INFORMATION

The 41-year old captain was issued an airline transport pilot certificate on June 24, 1994. He had been employed with UPS Airlines since March 21, 1988. He was upgraded to captain on July 6, 1994. Prior to his captain assignment, he functioned as a first officer in the Boeing 767. The captain had accumulated a total of 5,600 hours, of which 3,200 hours were in the Boeing 757/767. His last proficiency check was completed 14 days prior to the accident, on August 28, 1998. His last medical examination was completed on June 16, 1998, and he was issued an FAA first class medical certificate without any waivers or limitations. The captain had flown a total of 11 hours in the preceding 30 days, 47 hours in the preceding 90 days, and 360 hours in the preceding 12 months. Prior to joining UPS, the captain was an officer with the United States Air Force, where he had accumulated around 600 hours in the KC-135 and 1,300 hours in the Cessna T-37.

The first officer, age 53, held an airline transport pilot certificate, issued by the FAA with an airplane multiengine land rating and type ratings in the Boeings 707 and 720. The first officer was hired by UPS Airlines on March 21, 1988, as a flight engineer on the DC-8 aircraft. The first officer had accumulated a total of 5,950 flight hours, of which 2,270 were in the Boeing 757/767 aircraft. His last FAA first class medical certificate was issued on January 5, 1998, with a limitation for wearing eyeglasses to correct a near vision condition. The first officer completed his last proficiency check in the Boeing 757/767 on August 28, 1998. He had flown 99 hours in the preceding 90 days, 37 hours in the preceding 30 days, with 482 hours in the

preceding 12 months. Prior to joining UPS, the first officer was also an officer in the United States Air Force, where he flew KC-135 tankers.

Both crewmembers had completed the required cockpit resource management (CRM) training from the operator. The investigation revealed that the operator did not address a hydroplaning scenario in any of their syllabi for crew training.

The flight crew was not properly briefed on forecasted weather conditions for their destination and were not provided with all the adverse weather information affecting the route of flight. The flight crew failed to recognize that their terminal forecast or RAMTAF was two days old, nor did they contact UPS flight dispatch for any updated conditions. The flight crew made several attempts to obtain updated weather watch information through the on-board ACARS; however, they used the improper station identifiers and were not able to obtain any weather updates.

#### AIRCRAFT INFORMATION

The 1997 transport category airplane was manufactured by Boeing Aircraft under serial number 27744, and delivered to UPS as N316UP on May 30, 1997, as a Boeing 767-34AF "Freightliner". At the time of the accident, the airplane had accumulated a total of 2,810 hours and 1,170 cycles.

According to the manufacturer, the certified autoland crosswind limits are: 25 knot headwind; 25 knot crosswind, and 15 knots tailwind. The corresponding limitations in the operator's AFM are: 25 knot headwind; 10 knot tailwind; and 25 knot crosswind.

The airplane was equipped with two General Electric CF6-80C2B turbofan engines. The left engine (s/n 704417) had accumulated a total of 2,065 hours and 1,356 cycles since new. The right engine (s/n 704398) had accumulated 1,864 hours and 1,320 cycles since new.

The airplane was last serviced with fuel at Louisville, Kentucky, where 6,663 gallons of jet fuel was added. The airplane was reported to have approximately 28,000 pounds of fuel on board at the time of the accident.

The maximum aircraft ramp weight was 409,000 pounds (408,000 pounds maximum takeoff weight). The maximum aircraft landing weight was 326,000 pounds. The airplane's weight at the time of departure from Louisville was 346,300 pounds, and the landing weight at the time of accident was 317,400 pounds. The airplane was found to be within weight and balance limits at the time of the accident. The cargo and palletized containers within the airplane were found properly secured and restrained.

#### METEOROLOGICAL INFORMATION

A review of the dispatch information provided to the flight crew by the operator revealed that the crew was not provided with current forecasted weather for their destination prior to departure from Louisville. The weather in south Texas was influenced by Tropical Storm "Frances." There were three National Weather Service (NWS) in-flight weather advisories in effect at the time of the accident: SIGMET [significant meteorological information] 25C and AIRMETs TANGO 2 and SIERRA 1. Convective SIGMET 25C was issued for an area of severe thunderstorms with tops observed above 45,000 feet. The storms posed a threat of tornadoes, hail to 1-inch in diameter, and wind gusts to 50 knots. Severe or greater turbulence was possible in these storms. Convective SIGMET 25C was not provided to the flight crew.

The National Weather Service (NWS) had issued AIRMET TANGO 2 which was current over the area at the time of the accident. The advisory was in four parts warning of occasional moderate turbulence below 12,000 feet, moderate turbulence between 25,000 and 35,000 feet, sustained surface winds greater than 30 knots, and low level windshear potential associated with Tropical Storm "Frances," with conditions continuing beyond 0900. AIRMET SIERRA 1 was current for IFR conditions with occasional ceilings below 1,000 feet and visibility below 3 statute miles in moderate rain and mist. Conditions were expected to spread slowly northwestward and continue beyond 0900 through 1500. Neither of the two AIRMETs were provided to the crew prior to their departure from Louisville.

The NWS National Tropical Prediction Center had tropical storm warnings in effect for the area, with the potential for strong gusty winds, heavy rain, flash flooding, and isolated tornadoes. This information was NOT provided to the flight crew. The NWS Storm Prediction Center had issued severe watch 824 current over the accident site, which warned of the potential for tornadoes and severe thunderstorms with wind gusts to 70 knots, dangerous lightning, and a few cumulonimbus with cloud tops to 50,000 feet. This weather information was not provided to the flight crew.

The main synoptic features on the National Weather Service (NWS) Surface Analysis chart at 0700 on September 11, 1998, depicted Tropical Storm "Frances" and a stationary front extending over the Houston area. The two weather systems interacted, with the frontal boundary drawing the tropical system into it and provided a converging zone that influenced clouds, rainfall, and the ultimate movement of the tropical storm. Tropical Storm "Frances" brought significant tropical moisture in the form of heavy rain and strong winds.

A review of the station models over southeast Texas and Louisiana near the time of the accident indicated overcast skies, a well-defined cyclonic wind pattern circulating into the tropical storm, and precipitation varying from light to heavy.

The weather observations at Ellington Field (EFD) and the surrounding Houston and Galveston area documented weather consistent with a tropical storm with strong gusting winds, varying precipitation rates and types, and variable cloud heights as the spiral bands impacted the area. A tornado watch was in effect for the Houston area, and a tornado was reported near downtown Houston 9 minutes before the accident at 0615.

The 0631 special observation from EFD, the conditions were easterly sustained wind at 18 knots gusting to 25 knots, visibility at 5 statute miles restricted in moderate rain and mist, a broken ceiling at 700 feet and an overcast layer at 1,600 feet. The pressure was reported at 29.54 inches of mercury. A few minutes prior to the accident, the wind was gusting upwards of 37 knots with heavy rain.

Heavy rain showers, sometimes described as "torrential," prevailed throughout the area at the time of the accident. The George Bush Intercontinental Airport (IAH), located 23 miles northwest of Ellington Field, reported 4.65 inches of rain in the 24-hours preceding the accident. The Houston Hobby Airport (HOU), located 6 miles north northwest of Ellington Field, reported 7.00 inches of rain in the 24-hours preceding the accident. Likewise, Galveston's Scholes Field (GLS), located 29-miles southeast of Ellington Field, reported 7.64 inches of rain during the same reporting period.

The GOES-8 satellite images provided documented significant convective activity associated with the tropical storm near Ellington Field. The enhanced satellite images indicated cloud

tops near 42,000 feet at 0615 and 0630 on September 11, 1998, in the immediate area of Ellington Field.

The accident occurred at 0624 CDT. According to the Naval Observatory, the beginning of civil twilight was at 0640 CDT. There was no illumination from the moon under the overcast sky conditions prevailing at the time of the accident.

Airport Rescue and Fire Fighting (ARFF) personnel who responded to the accident site, reported that, despite the location of their fire station, approximately 1/4 mile across the ramp from the resting place of the Boeing 767, the airplane was not visible from their fire station due to the heavy rain that prevailed at the time of the mishap. Some of the ARFF personnel reported that at the time of the accident "it was raining sideways."

Flight dispatch last contacted the flight (via ACARS) about an hour and fifteen minutes prior to the accident. They provided the runway in use, as well as information that the airport was in a "broad weather area with some thunderstorm activity." Dispatch added that the thunderstorm activity was moving northwest at 25 knots, and no pilot reports were available. Flight dispatch had selected the Dallas Fort Worth International Airport (DFW) as the designated alternate airport for the flight. The investigation revealed that the weather at the DFW Airport was clear of the "weather watch area" and was not significantly affected by Tropical Storm "Frances." There was sufficient fuel aboard to proceed to the alternate airport (the flight to the alternate airport required 9,000 pounds of fuel).

#### AIDS TO NAVIGATION

The tower operator from Ellington Field Airport reported that all of the navigational aids associated with the ILS approach to runway 35L were operating normally at the time of the accident. Runway 35 ILS was described as a Category I analog ILS. The instrument approach was not "flight tested" following the mishap. Additionally, the tower operator reported that no obstructions were present in the ILS critical area at the time of the accident.

#### AERODROME INFORMATION

Ellington Field (EFD) is located 15 miles southeast of the Houston Hobby Airport, in Harris County. The airport is owned and operated by the City of Houston. The airport has a 24-hour non-FAA contract control tower operated by the Air National Guard (ANG). The airport has published ILS approaches to runways 35L/17R. Runway 35L is 9,000 feet long and 150 feet wide. The surface of the concrete runway is not grooved. The runway is marked for precision approaches. Runway markings were found to be in good conditions. Rubber deposits on runway 35L/17R were minimal. The runway was not equipped with centerline lighting. The runway is equipped with a 4-light PAPI visual slope indicator on the left side of the runway. The magnetic heading for runway 35L is 354 degrees and the elevation at the approach end of runway 35L is 28.8 feet. According to a previous runway assessment made by NASA, following a similar occurrence involving a NASA T-38 aircraft, the runway was found to have a "low crown" (less than 1% slope).

An interview with the person (OPS24) tasked to determine the runway conditions at the airport revealed that OPS24 established radio contact with EFD ground controller at 1052:03, about one minute after UPS flight 774 had executed its missed approach to runway 17R, ready to conduct the daily runway check. Ground control approved his requested for the runway check

at 1052:07. At 1055:43, roughly 3 and a half minutes later OPS 24 calls "clear of one-seven right." A few second later the ground controller ask, "...is it wet our there?" and at 1055:57 OPS24 replies "..uh not bad on the runway, uh there's some minor flooding on the intersection of 17R and [taxiway] Delta and a little [flooding] on 17R and [taxiway] Echo, but that is about it."

The investigation revealed that the runway check conducted by OPS24 was conducted by driving an airport vehicle (Chevy Suburban) over the centerline of the runway being checked at about 35 mph. The runway condition report described by OPS 24 was not provided to the flight prior to their landing on 35R.

During the on-scene portion of the investigation, several of the parties were on runway 35R, beyond the intersection with taxiway Echo, when a very heavy rainstorm, also a remnant of Tropical Storm Frances, moved across the airport. From the protection of their vehicles, the parties were able to observe a very rapid manifestation of rainwater pooling on the runway away from the centerline of the runway. They were able to confirm that the most significant pooling was on the west side of the runway, apparently the lower side of the runway's crown. The water accumulation on the runway was "at a rate well in excess of the drain's capacity to remove the rainwater." After emerging from their vehicles, the parties were able to measure the depth of the clear pooling water to be at least 7-inches deep near the edge of the runway with measurably pooling to a point approximately 10-feet from the centerline of the runway. These observation were made during the daylight hours, and would have been much less noticeable during the hours of darkness.

The parties that observed the flooding concluded that a more accurate description of the flooding conditions would have probably be "runway flooding on runway 35L, left of centerline between taxiways Echo and Delta." Additionally, the local's controller initial report to the crew about "standing water" failed to indicate the severity of the amount of water actually flooding the active runway.

EFD airport remark for EFD notes "Runway 17R/35L has poor braking action when wet."

#### FLIGHT RECORDERS

The airplane was equipped with a cockpit voice recorder (CVR) and a digital flight data recorder (DFDR). Both recorders were functional and the data was extracted without difficulties.

#### WRECKAGE AND IMPACT INFORMATION

Tire tracks visible on the concrete surface of the runway indicated that after touchdown on the left side of the centerline, the aircraft gradually drifted to the left of centerline towards the west edge of the runway. The tire marks clearly visible on the concrete surface of the runway, which led to the aircraft resting place, gave the appearance of being "steam cleaned or sandblasted." Such scrubbing effect is indicative and consistent with hydroplaning during braking.

All three landing gears departed the left side of the runway. The airplane came to rest on the grass between the runway and its parallel taxiway on a measured magnetic heading of 292 degrees, approximately 1,489 feet from the point where the left main landing gear first

departed the hard surface area of the runway.

The right main landing gear strut fractured during the off-runway excursion and the dual tandem wheel truck penetrated the airframe. The right inboard flap, as well as portions of the wing leading edge slats (right wing), were also damaged. The right engine pylon was damaged and both engines sustained damage as result of foreign object ingestion.

The wing flaps were found fully extended (30 degrees) and the leading edge slats were found in the fully extended position. The spoilers were found in the retracted position. The rudder trim indicator was reading 0.3 degrees to the right of center. Documentation of the cockpit did not reveal any deviations from the settings associated with a normal engine shutdown.

#### MEDICAL AND TOXICOLOGICAL INFORMATION

The two crewmembers were taken to a local hospital for examination. While at the hospital, they were also tested for drugs and alcohol. Toxicological tests were negative for drugs and alcohol.

#### SURVIVAL ASPECTS

The control tower activated the crash alert system a 0625:41. Airport rescue and fire fighting (ARFF) equipment responded to the accident site within 2 minutes of the aircraft coming to rest near taxiway Delta.

ARFF personnel reported that the crew took about 10 minutes to exit the airplane. The captain experienced difficulties using the crew emergency escape system (harness). Both crewmembers reported difficulties donning the harness diaper. The airplane was not equipped with emergency slides. The FAA certified the Boeing 767 "Freightliner" with reels in lieu of emergency slides. Both pilots evacuated the airplane unassisted through the main cabin door on the left side of the airplane. The first officer utilized the harness assembly.

#### TEST AND RESEARCH

Nose wheel steering was operational during the landing sequence. FDR data, as well as tire prints made by the nose wheel tire on the runway revealed that the inter-connect between the rudder and the nose wheel assembly attempted to steer the aircraft toward the localizer.

Main tire pressures were measured within the inflation limits (185 to 200 PSI). Two of the main tires (#3 and #7) were damaged and deflated during the accident sequence. One tire showed some discoloration (bluing). No evidence of reverted rubber skidding damage was found on any of the tires. According to the aircraft manufacturer in a letter dated January 29, 1999, to the NTSB IIC, hydroplaning speed is primarily a function of tire pressure. For a 767 with tires pressures between 180 and 200 psi, the hydroplaning speed is 116 to 122 knots. The tires will be prone to hydroplane at this speed if the water depth exceeds the tread design.

The FCC, FMC, and TMC did not record any faults in the autoland system during the last (accident) flight.

Examination and bench testing of the eight brake assemblies did not reveal any anomalies. The eight wheel transducers were also tested by the manufacturer and found to be within limits. The anti-skid/auto-brake control unit was also tested and found fully functional.

#### ADDITIONAL INFORMATION

United Parcel Service Airline Company (UPSCO), a wholly owned subsidiary of United Parcel Service of America Inc., is based in Louisville, Kentucky. UPS Airline began flight operations under 14 CFR Part 121 on January 18, 1988, operating a fleet of B-727s, DC-8s, B-747s and B-757s, totaling less than 100 aircraft. The UPS fleet doubled in size within its first 10 years without a major aircraft mishap. The airline safety director reports directly to the airline operations manager. The NTSB investigated 3 previous incidents/events (B-727 total loss of engine power during approach to ORD in 1996, and 2 low visibility approach events resulting in minor damage), all resulting in the airline taking proactive actions to prevent their reoccurrences.

The cargo aboard the airplane was released to the operator by the Investigator-in-Charge at 1530, on the date of the accident. The baggage and flight-related gear were removed from the cockpit by company personnel participating in the investigation and delivered to the flight crew's hotel. UPS ground personnel removed the cargo carried in the belly of the airplane during the evening of the accident. The palletized containers carried in the main cabin/cargo area were removed during the late evening hours of September 12, 1998.

A conditional release was issued to the operator at 1830 on September 12, 1998, to recover the wreckage to a secured area of the airport to facilitate further examination and eventual repairs.

The tail section of the airplane protruded approximately 35-feet into the runway area. Runway 35L/17R remained closed until the evening of September 13, 1998. A final wreckage release was granted on October 5, 1998. Repairs were made at the accident site and the airplane was returned to service 79 days after the mishap. The operator reported that the total cost to repair the airplane was \$20 million.

Tropical Storm "Frances" did an estimated 500 million dollars in property damage, and was responsible for one death in Texas related to the storm.

## Pilot Information

<b>Certificate:</b>	Airline Transport	<b>Age:</b>	40, Male
<b>Airplane Rating(s):</b>	Multi-engine Land	<b>Seat Occupied:</b>	Left
<b>Other Aircraft Rating(s):</b>	None	<b>Restraint Used:</b>	Seatbelt, Shoulder harness
<b>Instrument Rating(s):</b>	Airplane	<b>Second Pilot Present:</b>	Yes
<b>Instructor Rating(s):</b>	None	<b>Toxicology Performed:</b>	No
<b>Medical Certification:</b>	Class 1 Valid Medical--no waivers/lim.	<b>Last Medical Exam:</b>	06/16/1998
<b>Occupational Pilot:</b>	<b>Last Flight Review or Equivalent:</b>		
<b>Flight Time:</b>	5600 hours (Total, all aircraft), 3200 hours (Total, this make and model), 47 hours (Last 90 days, all aircraft), 11 hours (Last 30 days, all aircraft), 2 hours (Last 24 hours, all aircraft)		

## Aircraft and Owner/Operator Information

<b>Aircraft Manufacturer:</b>	Boeing	<b>Registration:</b>	N316UP
<b>Model/Series:</b>	767-34AF 767-34AF	<b>Aircraft Category:</b>	Airplane
<b>Year of Manufacture:</b>		<b>Amateur Built:</b>	No
<b>Airworthiness Certificate:</b>	Transport	<b>Serial Number:</b>	27744
<b>Landing Gear Type:</b>	Retractable - Tricycle	<b>Seats:</b>	6
<b>Date/Type of Last Inspection:</b>	08/23/1998, Continuous Airworthiness	<b>Certified Max Gross Wt.:</b>	408000 lbs
<b>Time Since Last Inspection:</b>		<b>Engines:</b>	2 Turbo Jet
<b>Airframe Total Time:</b>	2810 Hours	<b>Engine Manufacturer:</b>	General Electric
<b>ELT:</b>	Not installed	<b>Engine Model/Series:</b>	CF6-80C2B
<b>Registered Owner:</b>	United Parcel Service	<b>Rated Power:</b>	lbs
<b>Operator:</b>	United Parcel Service	<b>Air Carrier Operating Certificate:</b>	Flag carrier (121)
<b>Operator Does Business As:</b>	UPS Airline	<b>Operator Designator Code:</b>	IPXA

## Meteorological Information and Flight Plan

<b>Conditions at Accident Site:</b>	Instrument Conditions	<b>Condition of Light:</b>	Night
<b>Observation Facility, Elevation:</b>	EFD, 28 ft msl	<b>Observation Time:</b>	0631 CDT
<b>Distance from Accident Site:</b>	0 Nautical Miles	<b>Direction from Accident Site:</b>	0°
<b>Lowest Cloud Condition:</b>	Unknown	<b>Temperature/Dew Point:</b>	26° C / 26° C
<b>Lowest Ceiling:</b>	Broken / 700 ft agl	<b>Visibility</b>	4 Miles
<b>Wind Speed/Gusts, Direction:</b>	18 knots/ 25 knots, 100°	<b>Visibility (RVR):</b>	0 ft
<b>Altimeter Setting:</b>	29.54 inches Hg	<b>Visibility (RVV):</b>	0 Miles
<b>Precipitation and Obscuration:</b>			
<b>Departure Point:</b>	LOUISVILLE, KY (SDF)	<b>Type of Flight Plan Filed:</b>	IFR
<b>Destination:</b>	HOUSTON, TX (EFD)	<b>Type of Clearance:</b>	IFR
<b>Departure Time:</b>	0457 EDT	<b>Type of Airspace:</b>	Class C

## Airport Information

<b>Airport:</b>	Ellington Field (EFD)	<b>Runway Surface Type:</b>	Concrete
<b>Airport Elevation:</b>	34 ft	<b>Runway Surface Condition:</b>	Wet
<b>Runway Used:</b>	35L	<b>IFR Approach:</b>	ILS
<b>Runway Length/Width:</b>	9000 ft / 150 ft	<b>VFR Approach/Landing:</b>	None

## Wreckage and Impact Information

<b>Crew Injuries:</b>	2 None	<b>Aircraft Damage:</b>	Substantial
<b>Passenger Injuries:</b>	N/A	<b>Aircraft Fire:</b>	None
<b>Ground Injuries:</b>	N/A	<b>Aircraft Explosion:</b>	None
<b>Total Injuries:</b>	2 None	<b>Latitude, Longitude:</b>	29.607222, -95.158611

## Administrative Information

<b>Investigator In Charge (IIC):</b>	Hector R Casanova	<b>Adopted Date:</b>	02/26/2007
<b>Additional Participating Persons:</b>	Bruce L Haseltine; Federal Aviation Administration; Houston, TX John Hamilton; Boeing Aircraft; Seattle, WA E J Carlton Jr.; United Parcel Service; Louisville, KY Mike Brady; Independent Pilots Association; Louisville, KY		
<b>Publish Date:</b>			
<b>Investigation Docket:</b>	NTSB accident and incident dockets serve as permanent archival information for the NTSB's investigations. Dockets released prior to June 1, 2009 are publicly available from the NTSB's Record Management Division at <a href="mailto:pubinq@ntsb.gov">pubinq@ntsb.gov</a> , or at 800-877-6799. Dockets released after this date are available at <a href="http://dms.nts.gov/pubdms/">http://dms.nts.gov/pubdms/</a> .		

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