United Parcel Service

NTSB Accident Investigation File: DCA13MA133

Party Submission

Investigation of Accident Involving UPS Flight 1354

May 1, 2014

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ACRONYMS AND ABBREVIATIONS

ACARS	Aircraft Communications, Addressing and Reporting System
AFDS	Autopilot and Flight Director System
AGL	Above Ground Level
ALT HLD	Altitude Hold
AQP	Advance Qualifications Program
ARTCC	Air Route Traffic Control Center
ASAP	Aviation Safety Action Program
ATC	Air Traffic Control
ATIS	Automatic Terminal Information Service
ATP	Airline Transport Pilot
CBA	Collective Bargaining Agreement
CDT	Central Daylight Time
CFIT	Controlled Flight into Terrain
CFR	Code of Federal Regulations
CRM	Crew Resource Management
CVR	Cockpit Voice Recorder
DA	Decision Altitude
EDW	Early Duty Window
EGPWS	Enhanced Ground Proximity Warning System
FAA	Federal Aviation Administration
FAF	Final Approach Fix
FDR	Flight Data Recorder
FE	Flight Engineer
FO	First Officer
FPM	Feet Per Minute
FSAG	Fatigue Safety Action Group
FWG	Fatigue Working Group
FL	Flight Level
FMA	Flight Mode Annunciator
FMS	Flight Management System
FOM	Flight Operations Manual
FOQA	Flight Operational Quality Assurance
FSTF	Flight Safety Task Force
HDG/SEL	Heading Select
IAF	Initial Approach Fix
ICAO	International Civil Aviation Organization
IFR	Instrument Flight Rules
ILS	Instrument Landing System
IMC	Instrument Meteorological Conditions
IROs	International Relief Officers
LOC	Localizer
LVL/CH	Level Change (as in Flight Level Change)
MCP	Mode Control Panel
MDA	Minimum Descent Altitude

METAR	Meteorological Aerodrome Report
MVFR	Marginal Visual Flight Rules
NA	Not Authorized
NAV	Navigation
ND	Navigation Display
NDR	National Driver Registry
NTSB	National Transportation Safety Board
NWS	National Weather Service
PF	Pilot Flying
PIC	Pilot-In-Command
PM	Pilot Monitoring
PRIA	Pilot Records Improvement Act
SA	Situational Awareness
SAB	Scheduling Advisory Board
SIC	Second in Command
SM	Statute Miles
SMS	Safety Management System
SPECI	Special Observation
TAF	Terminal Aerodrome Forecast
TEM	Threat and Error Management
TSO	Technical Standard Order
V/L	VOR Localizer
VFR	Visual Flight Rules
VMC	Visual Meteorological Conditions
VOR	VHF Omnidirectional Radio Range
V/S	Vertical Speed
WOCL	Window of Circadian Low

1. ACCIDENT.

Operator:	United Parcel Service (UPS)
Registration:	N155UP
Type:	Airbus A300-600
Flight:	UPS #1354
Location:	Birmingham, Alabama
Date:	August 14, 2013

2. PARTY SUBMISSON GROUP MEMBERS.

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3. EXECUTIVE SUMMARY.

On August, 14, 2013, at about 0447 central daylight time (CDT), UPS flight 1354 (UPS1354), an Airbus A300-600, N155UP, crashed short of runway 18 while on approach to Birmingham-Shuttlesworth International Airport (KBHM), Birmingham, Alabama. The two flight crew members were fatally injured and the aircraft was destroyed. The cargo flight was operating under 14 Code of Federal Regulations (CFR), Part 121 and originated from Louisville International-Standiford Field Airport (KSDF), Louisville, Kentucky. At the time of the accident, the Captain was the Pilot Flying (PF) and the First Officer (FO) was the Pilot Monitoring (PM).

4. BACKGROUND.

4.1 Airline.

UPS Airlines is one of the world's leading cargo carriers, connecting customers in 220 countries and territories through the world's largest logistics network. UPS operates a fleet of 237 jets, which it supplements with approximately 300 vendor aircraft, to fly nearly 2,000 daily flight legs into 800 airports around the world. Since UPS Airlines was founded in 1988, the airline has flown more than 3 million flights and 7 million hours, with strong safety and on-time performance records.

4.2 Flight Qualified Managers.

UPS Airlines Flight Operations features a dedicated team of flight-qualified management personnel. Flight-qualified managers are highly experienced pilots who are Captain qualified on UPS aircraft and are also career professionals experienced in managing an airline. This structure allows for dedicated subject matter experts who provide leadership in the areas of safety, training, flight standards, regulatory compliance and other key functions.

The UPS model has been validated by the strong safety and performance records our airline has compiled in over two decades of operation.

5. FACTUAL INFORMATION.

5.1 History of Flight.

The accident crew, Captain and FO began the duty day at Chicago-Rockford International Airport (KRFD) on August 13, 2013. Their initial flight departed KRFD at 2134 (all times local) and arrived at General Downing - Peoria International Airport (KPIA) at 2209. The following flight departed KPIA at 2255 and arrived in KSDF at 2357. The crew had 3 hours and 58 minutes in KSDF while waiting for the 0349 scheduled departure for UPS1354 on August 14, 2013. According to records, both crew members checked into individual crew rest facilities located in the flight operations facility during their break in KSDF.[1]

The van driver who picked the crew up and drove them to N155UP for UPS1354 characterized their mood as nothing out of the ordinary. At 0319, the crew received a pre-departure clearance for a routing cleared as filed, with an expected initial climb to 5,000 feet,[2] a transponder code of 4016 and a routing of direct BWG (Bowling Green, Kentucky), direct EWO (New Hope, Kentucky), direct BNA (Nashville, Tennessee), direct RQZ (Rocket - Huntsville, Alabama), and then direct to KBHM. Hartsfield - Jackson Atlanta International Airport (KATL) was the filed alternate for the flight per 14 CFR § 121.619. The pre-flight portion of the flight, equipment and avionics tests, and checklists leading to engine start and taxi were all normal.

The load supervisor for UPS1354 in KSDF briefly met and spoke with the crew. He characterized the Captain's mood as nothing out of the ordinary. Taxi and takeoff were consistent with UPS procedures and unremarkable.

At 0402, UPS1354 departed KSDF and was cleared to climb to 10,000 feet. At 0406, UPS1354 contacted Indianapolis ARTCC[3] and was given a climb clearance to 23,000 feet and cleared direct to KBHM. According to downloaded Flight Management System (FMS) data, the crew programmed the FMS to fly direct to KBHM.

At 0412, UPS1354 sent an ACARS in-range[4] downlink message that included the text message "call hotel van"[5] with an estimated arrival time of 0451 and no reported issues. At 0413, UPS1354 contacted Memphis ARTCC as they climbed to their final cruising altitude of 28,000 feet, and at 0427, they were level at 28,000 feet. According to Cockpit Voice Recorder (CVR) data, prior to the top of descent, the crew received the current Automatic

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[1] For additional information on the crew's activities, see the Human Performance Group Chairman's Factual Report.

[2] Altitudes are mean sea level (MSL) unless otherwise noted.

[3] Air Route Traffic Control Centers (ARTCC) are established primarily to provide air traffic service to aircraft operating on IFR flight plans within controlled airspace, and principally during the en route phase of flight. Source AIM Section 4-1-1.

[4] According to the UPS FOM, Section 07.01.01.02.07 "In-Range Report," an in-range report will be made to the Company approximately 20 minutes before landing.

[5] To view ACARS in-range message, see Operations Group Chairman's Factual Report Attachment 12 – ACARS Data.

Terminal Information Service (ATIS) information Papa (P)[6] for KBHM, and the Captain who was serving as the PF planned and briefed the localizer (LOC18) 18 non-precision Profile approach at KBHM.[7]

Approximately 19 minutes later, at 0432, UPS1354 began its descent from 28,000 to 24,000 feet. UPS1354 was further cleared to descend to 11,000 feet at the pilot's discretion.

At 0441, while flying level at 11,000 feet, UPS1354 checked in with KBHM Approach Control advising that they had ATIS information Papa (P) and requested a lower altitude. The KBHM Approach Controller issued a descent clearance to 3,000 feet, and said, "runway six is still closed, do you want the localizer one eight?"[8] UPS1354 responded with, "Yes sir, the localizer one eight will work."

A LabCorp pilot, flying a PA31 Piper Navajo with the call sign of "Skylab 301" (airplane registration N3589X) landed at approximately 0417 (about 30 minutes prior to the accident) on runway 18 using the LOC 18 approach. The LabCorp pilot, who was familiar with KBHM, told NTSB staff he remembered being in visual weather conditions "most of the time" while on the approach, and that he could see the airport from about 6 miles out and on the approach at 2,300 feet. He did not report any problems with the localizer approach.[9]

At 0442, ATC instructed UPS1354 to "turn ten degrees right, join the localizer, maintain three thousand." About one minute later, while UPS1354 was about 11 miles from the BASKN[10] final approach fix (FAF) on the localizer, ATC transmitted, "UPS thirteen fifty four heavy, one-one miles from BASKN, maintain two thousand five hundred till established on localizer, cleared localizer one eight approach," and UPS1354 acknowledged the clearance.

At 0445 UPS1354 contacted the KBHM Tower Controller, was given a landing clearance for runway 18 with calm winds. The landing clearance was acknowledged by UPS1354. Radar data and flight data recorder (FDR) information indicated that UPS1354 intercepted and

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[6] For detailed information on ATIS information Papa (P), see Section 7.0 "Meteorological Information" of Operations Group Chairman's Factual Report.

[7]For additional information see Ops Factor Attachment 7 – AOM Approach Briefing Guides.

[8] For additional ATC information, see ATC Group Chairman's Factual Report.

[9] In addition, NTSB Staff received statements from a Southwest Airlines flight crew who landed on runway 18 from a visual approach at 2100 CDT on August 13, 2013. Both pilots stated there was nothing unusual about their approach to runway 18.

[10] BASKN was the final approach fix (FAF) and identified on the KBHM LOC18 approach chart as 6.0 miles DME (distance measuring equipment) on the localizer. The BASKN intersection was 4.7 miles from the end of runway 18. The minimum crossing altitude for BASKN depicted on the 11-2 Jeppesen KBHM LOC 18 approach was 2,300 feet.

tracked the localizer to runway 18, and subsequently crossed the BASKN intersection at an altitude of approximately 2,500 feet, and then began a vertical speed descent from 2,500 feet after passing BASKN. FDR data further indicated that the downward vertical speed increased to about 1500 feet per minute (FPM) along the approach inside the FAF, and UPS1354 descended through the minimum descent altitude (MDA) of 1,200 feet at a downward vertical speed of approximately 1,500 FPM.

At about 0447, FDR data indicated that the crew received an Enhanced Ground Proximity Warning System (EGPWS)[11] aural "sink rate" alert at a recorded radio altitude of 235 feet while descending at a recorded value of 1,536 FPM. About 7 seconds after the "sink rate" alert, the aircraft struck trees and impacted terrain approximately 1.2 miles from the end of the runway, and portions of the aircraft came to rest approximately 3/4 of a mile from the end of runway 18. A "too low terrain" EGPWS aural alert was annunciated just prior to the end of the FDR recording. The aircraft was destroyed by impact with the terrain and post-crash fire. Both flight crewmembers' injuries were fatal.

5.2 Personnel Information.

5.2.1 The Captain (PF).

The Captain was 58 years old and resided in Matthews, North Carolina. His date of hire with UPS was October 29, 1990, and he was based in KSDF as an A300 Captain. He began his career at UPS as a B727 Flight Engineer (FE), transitioning to B727 FO in August 1994. He attempted to upgrade to captain on the B757 in July 2000 and September 2002, voluntarily withdrawing from training on both occasions and returning to the position of a B727 FO both times.[12] In April 2004, he transitioned to FO on the A300, and upgraded to Captain on the A300 in June 2009.

Prior to joining UPS, the Captain was a U.S. Marine Corps pilot. Following his honorable discharge from the Marine Corps, the Captain was employed by Trans World Airlines (TWA) as a FE on the B727 in 1989. Previously he was a SD360 FO for CCAir in Charlotte, North Carolina from October 1987 to November 1989, and a flight instructor for Tar Heel Aviation from June 1987 to October 1987.

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[11] Enhanced Ground Proximity Warning System. For more information, see Systems Group Chairman's Factual Report.

[12] The UPS training department did not retain the training records for the Captain's two B757 attempts not completed due to his voluntary withdrawal from training. For additional information, see Ops Factor Attachment 4 – Crew Records.

The Captain held an Airline Transport Pilot (ATP) certificate with type ratings on the A310[13] and SK-65 and a First Class Medical Certificate. He also held a Flight Engineer Certificate (Turbojet) and a Flight Instructor Certificate (Airplane Single Engine, Instrument Airplane).

The Captain was current and qualified under UPS and Federal Aviation Administration (FAA) requirements. A review of FAA records found no prior accident or enforcement actions and one incident.[14] A search of records at the National Driver Registry (NDR) found no history of driver's license revocation or suspension. UPS records reflect that the Captain had no recorded disciplinary actions.

5.2.2 The Captain's Pilot Certification Record.

FAA records of the Captain indicated the following:

Flight Engineer – Turbojet certificate issued January 11, 1989.
Notice of Disapproval for Flight Instructor certificate issued March 26, 1985 (Oral and Flight); Areas of reexamination: Complete Flight Test.

Flight Instructor –Airplane – Single Engine (expires April 30, 1987) certificate issued April 4, 1985.

Flight Instructor – Airplane – Single Engine – Instrument Airplane (expires May 31, 1989) certificate issued May 30, 1987.

Private Pilot – Airplane Single Engine Land certificate issued January 8, 1979.

Commercial Pilot – Rotorcraft Helicopter – Instrument Helicopter; Private Pilot Privileges – Airplane Single Engine Land certificate issued December 22, 1982.

Commercial Pilot – Rotorcraft Helicopter – Instrument Helicopter; Airplane Single Engine Land (Not valid for carriage of persons for hire in airplanes on cross-country flights of more than 50 nautical miles) certificate issued February 8, 1983.

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[13] According to FAA Order 8900.1, Figure 5-88 "Pilot Certification Aircraft Type Designations – Airplane," the A-300-600R and A-310 are common type ratings.

[14] On August 20, 2010, the captain was involved in an incident where the A300 (UPS Flight #1286, Aircraft Registration N163UP) he operated as PIC departed a taxiway after landing in KCLT. The incident was accepted into the ASAP program, and according to the FAA records, remediation was accomplished by the UPS A300 Chief Pilot.

Commercial Pilot – Airplane – Single Engine Land; Rotorcraft Helicopter; Instrument – Helicopter and Airplane certificate issued July 22, 1983.

Commercial Pilot – Airplane – Single Engine Land; Rotorcraft Helicopter, SK-65; Instrument – Helicopter and Airplane certificate issued August 11, 1986.

Commercial Pilot – Airplane – Single and Multiengine Land; Rotorcraft Helicopter, SK-65; Instrument – Helicopter and Airplane certificate issued March 21, 1987.

Airline Transport Pilot – Airplane Multiengine Land; Commercial Privileges – Airplane Single Engine Land; Rotorcraft Helicopter, SK-65; Instrument – Helicopter certificate issued September 7, 1989.

Airline Transport Pilot – Airplane Multiengine Land – A310 (A310 SIC Privileges only; A310 Circ. Apch – VMC Only); Commercial Privileges – Airplane Single Engine Land; Rotorcraft Helicopter, SK-65; Instrument – Helicopter certificate issued May 9, 2006.

Airline Transport Pilot – Airplane Multiengine Land – A310 (A310 Circ. Apch – VMC Only) ; Commercial Privileges – Airplane Single Engine Land; Rotorcraft Helicopter, SK-65; Instrument – Helicopter (English Proficient) certificate issued June 2, 2009.

5.2.3 The Captain's Certificates and Ratings Held at Time of the Accident.

Airline Transport Pilot (issued June 2, 2009)
Airplane Multi-Engine Land
A310 (A310 CIRC. APCH – VMC ONLY)
Commercial Privileges Airplane Single Engine Land; Rotorcraft – Helicopter, SK-65, Instrument
Helicopter – English Proficient
Flight Engineer (issued February 12, 2009) Turbojet
Medical Certificate – First Class (issued April 16, 2013) Limitations: Must have available glasses for near vision.

5.2.4 The Captain's Training and Proficiency Checks Completed.

Date of Hire (UPS)	October 29, 1990
Date Transitioned to A300 (FO)	April 7, 2004
Date Upgraded to Captain on A300	June 2, 2009
Date of Initial Type Rating on A300 (SIC)	May 9, 2006
Date of Most Recent Proficiency Check (CQ)	June 26, 2013
Date of Most Recent Proficiency Training	June 26, 2013
Date of Most Recent PIC Line Check	March 21, 2013

5.2.5 The Captain's Flight Times.

The Captain's UPS flight times were as follows:[15]

Total pilot flying time	6,406
Total Pilot-In-Command (PIC) time	1,516
Total A300 time	3,265
Total A300 PIC time	1,516
Total flying time last 24 hours	3
Total flying time last 30 days	41
Total flying time last 60 days	72
Total flying time last 180 days	138
Total flying time last 12 months	407

5.2.6 The First Officer (PM).

The FO was 37 years old, and resided in Lynchburg, Tennessee. Her date of hire with UPS was November 16, 2006, and she was based in KSDF as an A300 FO. She began her career at UPS as a B727 FE. She transitioned to a B757 FO on October 30, 2007, followed by a transition to a B747 FO on June 29, 2009 and transferring to the Anchorage (ANC) base. On June 7, 2012 she transitioned to FO on the A300 based in KSDF.

Prior to UPS the FO was a pilot for Volaer in Smyrna, Tennessee from May 6, 2006. She was also employed twice as a pilot for Fraction Air in Nashville, Tennessee, once from November 1, 2004 to May 1, 2006, and then from January 1, 2003 to October 1, 2004. The FO also listed employment with ExpressJet in Houston, Texas from October 1, 2004 to November 15, 2004.

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[15] A review of the Captain's employment records did not list flight times at his previous employers or the military. On April 16, 2013, the captain listed "8,600 hours" as his total time for his First Class Medical application. Times listed here are UPS flight times only, and derived from UPS flight records and NTSB Form 6120.

The FO held an ATP certificate with type ratings on the A310 SIC, B747-4, B757, B767, BE400, HS125, and MU300 and a First Class Medical Certificate. The FO also held a FE Certificate (Turbojet).

The FO was current and qualified under UPS and FAA requirements. A review of FAA records and Pilot Records Improvement Act (PRIA)[16] records on file with UPS found no prior accident, incident or enforcement actions. A search of records at the National Driver Registry (NDR) found no history of driver's license revocation or suspension. UPS reported the FO had no recorded disciplinary actions.

5.2.7 The First Officer's Pilot Certification Record.

FAA records of the first officer indicated the following:

Flight Engineer – Turbojet certificate issued January 22, 2007.

Private Pilot – Airplane Single Engine Land certificate issued March 17, 1995.

Private Pilot – Airplane Single Engine Land; Instrument Airplane certificate issued May 27, 1999.

Commercial Pilot – Airplane Single Engine Land; Instrument Airplane certificate issued June 6, 2000.

Commercial Pilot – Airplane Single and Multiengine Land (Airplane Multiengine VFR Only).Commercial Pilot – Airplane Multiengine Land; Instrument Airplane certificate issued September 21, 2000.

Airline Transport Pilot – Airplane Multiengine Land – BE-400, MU-300; Commercial Privileges – Airplane Single Engine Land certificate issued March 6, 2004.

Airline Transport Pilot – Airplane Multiengine Land – BE-400, MU-300, HS-125; Commercial Privileges – Airplane Single Engine Land certificate issued February 27, 2006.

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[16] Pilot Records Improvement Act of 1996. PRIA requires that a hiring air carrier under 14 CFR. parts 121 and 135, or a hiring air operator under 14 CFR part 125, request, receive, and evaluate certain information concerning a pilot/applicant's training, experience, qualification, and safety background, before allowing that individual to begin service as a pilot with their company.

Airline Transport Pilot – Airplane Multiengine Land – B757, B767, BE-400, MU-300, HS-125 (B757, B767 Circ. Apch. – VMC Only); Commercial Privileges – Airplane Single Engine Land certificate issued November 30, 2007.

Airline Transport Pilot – Airplane Multiengine Land – B747-4, B757, B767, BE-400, MU-300, HS-125 (B747-4, B757, B767 Circ. Apch. – VMC Only); Commercial Privileges – Airplane Single Engine Land (English Proficient) certificate issued June 29, 2009.

Airline Transport Pilot – Airplane Multiengine Land – A310, B747-4, B757, B767, BE-400, MU-300, HS-125 (A310 B747-4, B757, B767 Circ. Apch. – VMC Only; A310 SIC Privileges Only); Commercial Privileges – Airplane Single Engine Land (English Proficient) certificate issued June 7, 2012.

5.2.8 The First Officer's Certificates and Ratings Held at Time of the Accident.

Airline Transport Pilot (issued June 7, 2012)
Airplane Multiengine Land
A310, B747-4, B757, B767, BE400, MU300, HS125 (A310 B747-4, B757, B767 CIRC
APCH – VMC Only; A310 SIC Privileges Only);
Commercial Privileges – Airplane Single Engine Land – English Proficient
Flight Engineer (issued November 2, 2009) Turbojet
Medical Certificate – First Class (issued January 7, 2013) Limitations: None

5.2.9 The First Officer's Training and Proficiency Checks Completed.

Date of Hire (UPS)	November 16, 2006
Date Transitioned to A300 (FO)	June 7, 2012
Date of Initial Type Rating on A300 (SIC)	June 7, 2012
Date of Most Recent Proficiency Check (CQ)	June 26, 2013
Date of Most Recent Proficiency Training	June 26, 2013

5.2.10 The First Officer's Flight Times.

The FO's UPS flight times were as follows:

Total pilot flying time	4,721
Total Pilot-In-Command (PIC) time	1,764
Total A300 time	403
Total flying time last 24 hours	3
Total flying time last 30 days	31
Total flying time last 60 days	54
Total flying time last 180 days	132
Total flying time last 12 months	335

5.3 Aircraft Information.

Registration N155UP, Serial # 0841

Type: Airbus 300-600F4-622R

Minimum Crew: two (pilot, co-pilot)

The aircraft was operated and in compliance with 14 CFR, Part 121 and was in airworthy condition.

5.4 Meteorological Information.

The Meteorological Group Chairman's Factual report listed the following general flight category and raw observations surrounding the accident flight[17]:

Forecast:

TAF AMD KBHM 140647Z 1407/1506 VRB03KT P6SM BKN004

FM141300 VRB04KT P6SM SCT009 BKN015

FM141500 01007KT P6SM FEW050 SCT250=

TAF KBHM 140533Z 1406/1506 VRB03KT P6SM BKN004 TEMPO 1406/1408 SCT005 BKN025

FM141300 VRB04KT P6SM SCT009 BKN015

FM141500 01007KT P6SM FEW050 SCT250=

[17] Meteorological Group Chairman's Factual Report 550535

Observations:

MVFR SPECI KBHM 140712Z 00000KT 9SM SCT006 BKN016 23/22 A2997 RMK AO2=

MVFR SPECI KBHM 140734Z 00000KT 10SM BKN010 BKN016 23/22 A2996 RMK AO2=

IFR METAR KBHM 140753Z 00000KT 9SM OVC008 23/22 A2996 RMK AO2 CIG 007V011 SLP137 T02330217=

MVFR/IFR SPECI KBHM 140848Z 33003KT 10SM OVC010 23/22 A2997 RMK AO2 CIG 006V013=

MVFR/IFR METAR KBHM 140853Z 00000KT 10SM BKN010 OVC075 23/22 A2997 RMK AO2 CIG 006V013 SLP138 T02330217 52000=

VFR SPECI KBHM 140904Z 00000KT 10SM SCT010 BKN075 23/22 A2996 RMK AO2=

Accident 0947Z

VFR METAR KBHM 140953Z 34004KT 10SM FEW011 BKN035 OVC075 23/22 A2997 RMK AO2 SLP141 T02330222=

The flight departure papers included the two Special Observations (SPECI) for KBHM at 0712Z and 0734Z. Neither of these observations included significant remarks. The crew requested ACARS weather enroute and received the weather based upon the 0853Z observation. The remarks portion of the METAR (Meteorological Aerodrome Report) was omitted from the ATIS broadcast, including the remark *CIG 006V013* which is, “ceiling 600 feet variable 1,300 feet”.

The SPECI that was taken at 0904Z was never reported on ATIS.

Shortly after the accident, the 0953Z observations reported:

> *Wind 340° at 4 knots, visibility unrestricted at 10 miles, a few clouds at 1,100 feet, ceiling broken at 3,500 feet, overcast at 7,500 feet, temperature 23° C, dew point temperature 22° C, altimeter 29.97 inches of Hg. Remarks: automated observation system, sea level pressure 1014.1-hPa, temperature 23.3° C, dew point 22.2° C.*

Civil twilight did not begin until 0947Z, so a human observer would likely not have been able to see lower clouds in the vicinity of the airport.

The following information was taken from the Meteorology Group Chairman's Factual Report:

> The PF of FedEx flight 1488, a Boeing 757 that landed immediately after the accident at 0508 CDT provided a statement. He stated that his flight, which landed after the

accident, had encountered a solid layer of clouds on descent from 20,000 feet and did not break out of the clouds until 300 feet AGL on the Instrument Landing System (ILS) approach to runway 06. That pilot also lived in the Birmingham area and had been flying in the area for the last 35 years in all makes and models of aircraft and was very familiar with the local area.

The National Weather Service (NWS) Terminal Aerodrome Forecast (TAF) for KBHM was issued by the NWS Weather Forecast Office in Birmingham at 0033 CDT on August 14, 2013 and valid for a 24-hour period. The forecast for KBHM from 0100 through 0800 CDT expected a variable wind at 3 knots, visibility unrestricted at better than 6 miles, ceiling broken at 400 feet AGL, with a temporary period between 0100 and 0300 CDT of scattered clouds at 500 feet, and ceiling broken at 2,500 feet. MVFR conditions were forecasted after 0800 CDT through 1000 CDT, with VFR conditions after 1000 CDT through the day.

5.5 A300 Non-Precision Approach Automation.

The A300 Autopilot and Flight Director System (AFDS) provides automated vertical and lateral guidance for the aircraft. The Mode Control Panel (MCP) and Flight Mode Annunciator (FMA) provide AFDS control and feedback to the pilot. The AFDS also interfaces with the FMS for lateral and vertical navigation.

5.5.1 Mode Control Panel.

The MCP (Figure 1) is the primary pilot interface with this system and allows the pilot to select the lateral and vertical guidance modes of operation. During an arrival, if an ILS approach is not available, the lateral modes available are HDG/SEL, NAV and V/L. HDG/SEL mode directs a turn to the heading selected on the MCP. NAV mode is used to intercept and track courses generated by the FMS. The V/L mode is used to intercept and track a selected VOR or LOC course.

The vertical modes available without an ILS approach available are ALT HLD, LVL/CH, PROFILE, and V/S. ALT HLD mode directs the AFDS to maintain either the MCP selected altitude or the altitude existing at the time the ALT HLD button is selected. LVL/CH mode directs the AFDS to either climb or descend to the MCP selected altitude. PROFILE mode is used to intercept and track a vertical path generated by the FMS. V/S mode simply directs a climb or descent at the rate selected on the MCP.

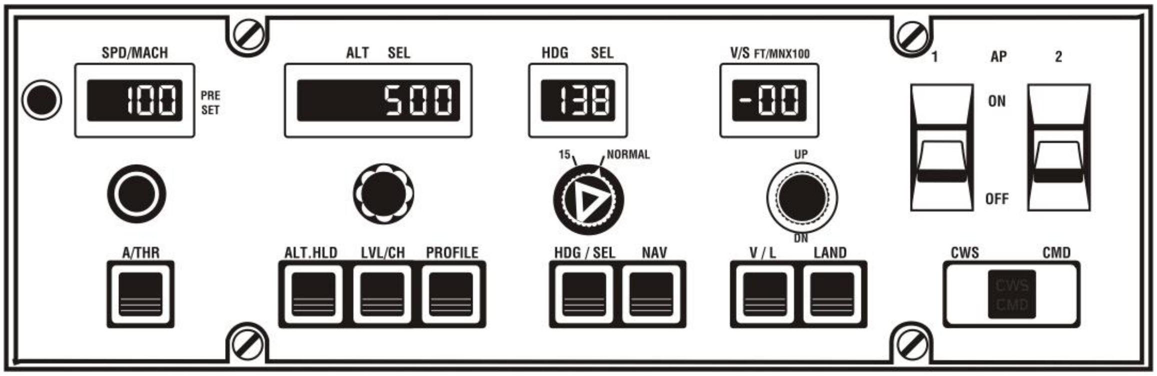


Figure 1

5.5.2 Flight Management System.

The accuracy of both NAV and PROFILE modes depends on the proper configuration of the FMS. Prior to flight, the FMS is programmed with a series of fixes associated with the planned route of flight and generates a course for each leg. As the flight progresses and the aircraft passes over each fix, the FMS flight plan automatically sequences so that the next course becomes the active course and the next fix becomes the "To" waypoint. The AFDS will only provide guidance to the active course. When the flight is vectored off the active course to intercept another course, the pilot must manually sequence the FMS flight plan to establish the desired course. Similarly, PROFILE mode will only provide guidance to the vertical path for the active course.

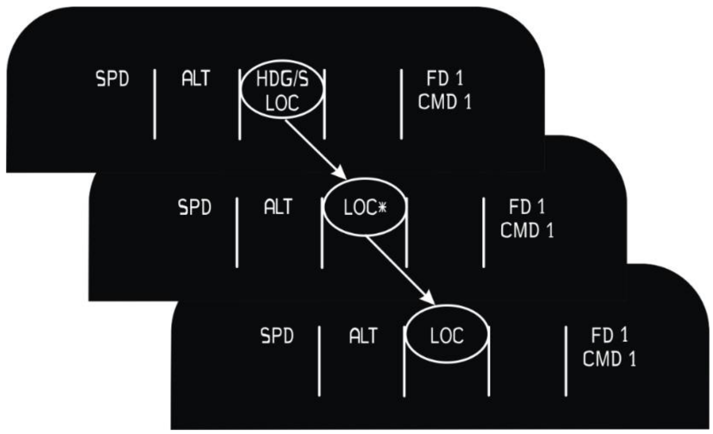
For a non-precision approach, the FMS has the capability to compute a final approach vertical path to a barometric decision altitude (DA). This path is called a V-NAV path. While the FMS normally does not operate in a V-NAV type mode, the V-NAV will be available if an approach has been loaded from the FMS database and the FMS Final Approach mode has been activated. This is commonly referred to as "Activating Final." For lateral and vertical guidance to be available for the approach, the FMS course must be sequenced to the final approach course and the Final Approach mode must be activated.

5.5.3 Flight Mode Annunciator.

While the MCP selects the mode, the FMA (Figure 2) indicates the engagement/armed status of the AFDS. The FMA is the upper portion of the primary flight display (PFD) and is divided into four or five columns based on the current mode of operation. Each column indicates the status for its respective mode. The FMA is color coded to indicate the mode status (manual, armed, captured, or engaged). Flight crew selections on the MCP may not directly relate to the current engaged status on the FMA.

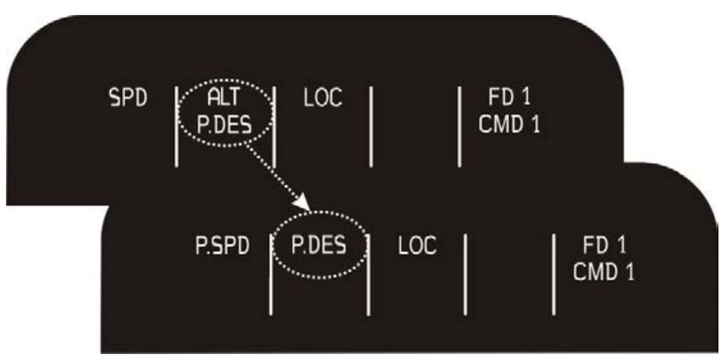
For example: when a crew is being vectored for a localizer approach with HDG/SEL selected on the MCP, the FMA will display the active lateral mode as HDG/S (shown in green). When cleared to intercept the localizer, the crew will select V/L on the MCP. On the FMA this will be depicted by a blue LOC below the green HDG/S indicating that HDG/S is active and LOC is armed. As the aircraft captures the localizer the blue LOC changes to a green LOC* and moves to the top row replacing HDG/S indicating the localizer is being captured. Once the AFDS begins to track the localizer the * disappears. Now LOC is the engaged lateral mode (track).

Figure 2



Similarly, the FMA indicates the status of the vertical mode selections. When on the localizer and at the final approach fix altitude, the MCP will show ALT HLD selected and the FMA will display the active vertical mode as ALT in green. (Figure 3) When PROFILE is selected on the MCP, P.DES will be displayed in blue below the green ALT, indicating that a descent on the V-NAV path has been armed. As the aircraft approaches the V-NAV path, P.DES will begin to flash. When the V-NAV path is intercepted, P.DES will turn green and replace the green ALT, indicating the new active vertical mode. In this way the FMA indicates the actual engagement status for all modes of the AFDS.

Figure 3



When the V-NAV path is used to fly a non-precision approach, because the selected vertical mode is PROFILE, it is known as a Profile Approach. If the V-NAV path is not available, for whatever reason, the vertical path must be manually controlled by setting and adjusting the descent rate using the V/S mode on the MCP. This type of approach is called a Vertical Speed Approach. Because there is no vertical guidance, the pilot must select an appropriate vertical speed and constantly evaluate the need to adjust the descent rate. UPS pilots are encouraged to establish a descent rate that will provide a constant descent to minimums. Whereas the V-NAV path is designed to clear any intermediate altitude restrictions and arrive at minimums in a position to land, in V/S the pilot must modify the descent rate to insure compliance with the restrictions as well as arriving at minimums with sufficient time to be in a position to land.

5.6 UPS Non-Precision Approach Briefing Guide.

UPS crews are trained annually in the execution of non-precision approaches. These approaches are not typically flown during line operations and therefore are emphasis items during training. It is typical for crews to see 2-3 non-precision approaches during each year's annual training. As these approaches are flown infrequently, a briefing guide is provided to mitigate risks associated with flying this type of approach. (Figures 4 and 5) The briefing guide is used as an aid in preparing the aircraft and the crew for these approaches. The A300 AOM also contains complete non-precision approach procedures (AOM Chapter 4) and is available for crew reference. UPS Flight Operational Quality Assurance (FOQA) and Advance Qualifications Program (AQP) data has shown that although these approaches are infrequent, they do not produce an inordinate number or rate of reportable events.

Figure 4 Profile Approach Briefing Guide

04.22.01.09 PROFILE APPROACH BRIEFING GUIDE

PROFILE APPROACH SUMMARY TABLE

TYPE OF APPROACH	APPROACH CHART TITLE	RETRIEVE FROM DATABASE AS	RAW DATA	AFDS ROLL MODE	VNI
RNAV (GPS)	RNAV (GPS) RWY XXX RNAV (GPS) "__" RWY XXX	GPS XXX or RNV XXX	NO	NAV	NAV
RNAV (RNP)	RNAV (RNP) RWY XXX	NOT AUTHORIZED			
GPS	GPS RWY XXX	GPS XXX	NO	NAV	NAV
GPS OVERLAY	VOR or GPS RWY XXX VOR DME or GPS RWY XXX	VOR XXX	NO	NAV	NAV
VOR	VOR RWY XXX VOR DME RWY XXX	VOR XXX	YES (PM ARC/ROSE)	NAV	PF-NAV PM-VOR
LOC	LOC RWY XXX LOC DME RWY XXX ILS or LOC RWY XXX ILS or LOC DME RWY XXX	LOC XXX or ILS XXX	YES(PFD)	LOC	ILS
ILS (GS OUT)	ILS RWY XXX ILS DME RWY XXX	ILS XXX	YES(PFD)	LOC	ILS

1. Review PROFILE APPROACH SUMMARY table for approach set-up.
   - Check GPS PRIMARY and GPS PREDICTIVE for GPS approaches.
   - Verify PROG page RNP value (CLR any crew-entered RNP).
   - Verify ECAM FM/GPS POS DISAGREE message not displayed and FMC indicates High Accuracy.
   - Verify approach temperature restrictions. (Profile approaches are prohibited -15°C or below or charted temperature if more restrictive.)
   - VNAV path must be depicted on the approach chart.
   - ILS G/S OTS approaches, the VNAV path is the same as the ILS glideslope.
   - Verify VNAV path clears all step down fixes in the final approach segment.
2. Determine DA or D-DA and set altimeter bugs.
   - A Barometric DA may be utilized on the following approaches:
     - RNAV (GPS) approaches with published LNAV/VNAV minima.
     - ILS (GS out) or approaches titled ILS or LOC RWY XXX, or ILS or LOC DME RWY XXX.
3. Load approach in FMC and accomplish the following:
   - Enter DA/D-DA on APPROACH page.
   - Verify database Vertical Path Angle agrees with approach chart within .1 degrees.
   - Adjust V_{APP} on Approach page if necessary.
4. Accomplish Approach Briefing.
5. Activate FINAL APPROACH.
6. Select PROFILE and verify P.DES armed. (On ILS G/S OTS approaches or LOC approaches, where the VNAV path crosses the FAF below the FAF minimum altitude, start a 1000 FPM descent at the FAF and immediately select PROFILE to capture path from above.)

Figure 5 Vertical Speed Approach Briefing Guide

04.22.01.10 VERTICAL SPEED APPROACH BRIEFING GUIDE

VERTICAL SPEED APPROACH SUMMARY TABLE

TYPE OF APPROACH	APPROACH CHART TITLE	RETRIEVE FROM DATABASE AS	RAW DATA	AFDS ROLL MODE	VNI
RNAV (GPS)	RNAV (GPS) RWY XXX RNAV (GPS) "__" RWY XXX	GPS XXX or RNV XXX	NO	NAV	ILS
GPS	GPS RWY XXX	GPS XXX	NO	NAV	ILS
GPS OVERLAY	VOR or GPS RWY XXX VOR DME or GPS RWY XXX	VOR XXX	NO	NAV	ILS
VOR	VOR RWY XXX VOR DME RWY XXX	VOR XXX	YES (PM ARC/RO-SE)	NAV	PF-NAV PM-VOR
LOC	LOC RWY XXX LOC DME RWY XXX ILS or LOC RWY XXX ILS or LOC DME RWY XXX	LOC XXX ILS XXX	YES (PFD)	LOC	ILS
ILS (GS OUT)	ILS RWY XXX ILS DME RWY XXX	ILS XXX	YES (PFD)	LOC	ILS
LDA	LDA RWY XXX LDA DME RWY XXX	N/A	YES (PFD/RMI)	LOC	ILS
LDA WITH GLIDESLOPE	LDA RWY XXX LDA DME RWY XXX	N/A	YES (PFD/RMI)	LAND	ILS
LOC BC	LOC (BACK CRS) RWY XXX LOC (BACK CRS) DME RWY XXX				
NDB	NDB RWY XXX NDB or GPS RWY XXX	NOT AUTHORIZED			
VOR DME RNAV	VOR DME RNAV RWY XXX VOR DME RNAV or GPS RWY XXX				
RNAV (RNP)	RNAV (RNP) RWY XXX				

1. Review approach requirements.
   - Review Vertical Speed Approach Summary Table.
   - GPS and RNAV GPS approaches - verify GPS PRIMARY and GPS PREDICTIVE. Verify ECAM FM/GPS POS DISAGREE message not displayed and FMC indicates High Accuracy.
   - Verify PROG page RNP value (CLR any crew-entered RNP).
2. Determine MDA and set altimeter bugs.
3. Accomplish approach briefing to include:
   - Rate of descent to be used during the final approach segment.
   - VDP computation and identification.
4. Use V/S to descend to MDA.
5. Do not descend below MDA until reaching computed VDP and required visual references are established.

5.7 UPS Sterile Cockpit Policy.

The following is an excerpt from the UPS Flight Operations Manual (FOM):

STERILE COCKPIT DURING CRITICAL PHASES OF FLIGHT[18]

Critical phases of flight - All ground operations involving pushback, taxi, takeoff and landing, and all other inflight operations below 18,000′ (25,000′ in Central or South America), except cruise flight.

During critical phases of flight, all cockpit occupants will refrain from any conduct that is not required for the safe operation of the aircraft. It is essential that cockpit occupants maintain a vigilant traffic watch and cockpit distractions are eliminated to the greatest extent possible. The Captain is responsible for maintaining a cockpit environment that prevents distractions and interference with the proper conduct of crewmember duties.

Specific activities prohibited during critical phases of flight:

- Conversation, verbal exchanges and conduct not pertinent to the safe operation of the flight
- Radio calls for non-safety purposes (e.g., departure reports when ACARS is inoperative)
- Eating meals (operating crewmembers)
- Completing paperwork unrelated to the safe operation of flight (e.g., making logbook entries)
- Reading publications not pertinent to the safe conduct of the flight (operating crewmembers)
- Using portable electronic devices or mobile phones

  NOTE: If needed, operating crewmembers may use a mobile phone to facilitate communications with Flight Control, prior to takeoff, when the aircraft is stationary (not taxiing). Mobile phones must be OFF for takeoff.

[18] FOM 02.02.06.05

5.8 UPS Fatigue Risk Management Plan.

NTSB Docket No. SA-538, Exhibit No. 14-E (attachment 1).

5.9 UPS Safety Culture.

UPS *Airlines is committed to the safety and security of our employees, our customers, and the communities in which we serve. We are committed to be a world leader in safety and service. We rely on the professionalism, sound judgment and safe work practices of our employees to fulfill our safety objectives.*

From the UPS Policy Book, p. 27: "We Value Health, Wellness, and Safety."

> The health, wellness, and safety of our people and the public are of utmost importance to us. We train our people to avoid injury to themselves and others in all aspects of their work. We do not tolerate unsafe work practices.
>
> We give recognition to employees for health, wellness, and safety accomplishments. We provide programs that help promote the health and wellness of employees and their families, and the safety of our operations.
>
> We are committed to fostering the most effective safe practices in our work. By meeting our high safety standards and goals, we contribute to the well-being of our people, company, and the communities we serve.
>
> In the journey to continuously improve our aviation safety performance and operational efficiencies, we are committed to implementing and maintaining the safety practices outlined in the FAA's Safety Management System (SMS). The foundation of our safety management system is designed on the fundamentals of United States and International safety practices and standards. Inherent in the voluntary implementation of SMS is:
>
> - Our commitment to manage safety risk.
> - Our commitment to comply with regulatory requirements.
> - Our commitment to encourage employees to report safety concerns confidentially and without reprisal for reporting through our Aviation Safety Action Program (ASAP), Hazard, and Event reporting systems.

- Our commitment to provide management guidance for setting and reviewing safety objectives, as well as reviewing our safety policies and practices regularly to ensure relevance.
- Our commitment to provide visible, consistent support of our safety policies and practices from all levels of management.

In addition, it is the responsibility of all employees to perform their duties in accordance with the safety and compliance standards set forth by the company and regulatory agencies. It is essential that every employee understand that compliance with company and technical manuals, reporting safety concerns, and adherence to safe work practices is a core expectation.

UPS Airlines has a history of highly collaborative Safety programs with the IPA. These programs include:

- The Aviation Safety Action Program (ASAP) is a voluntary safety program approved by the FAA that allows airlines to identify safety issues and implement proactive corrective measures. UPS and the IPA have jointly agreed to participate in this program under the terms of FAA Advisory Circular 120-66B and a Memorandum of Understanding between UPS and the IPA regarding the execution of the ASAP program.

- Flight Operations Quality Assurance (FOQA) is an FAA approved voluntary aviation safety program, established at UPS in 2001 for the routine collection and analysis of digital flight data generated during line operations. In a joint and cooperative effort with the IPA, UPS was the first U.S. freight airline to establish a FOQA program, and all aircraft are configured with quick access recorders for routine and frequent downloads. The primary purpose of our FOQA program is to provide more information about, and greater insight into, the total flight operations environment to reveal and correct root causes of identified problems. The information provided by FOQA is used to improve safety margins, reduce operational costs and significantly enhance training effectiveness, operational procedures, maintenance and engineering procedures, and air traffic control procedures. FOQA derived information is unique in that it provides objective event identification and trending on an aggregate level with sample rates not available through other methods.

- The Crew Resource Management (CRM) Advisory Board is a joint committee which meets monthly to review and develop CRM content for inclusion in UPS CRM training programs.

- The Advance Qualifications Program (AQP) Advisory Group jointly develops and revises the training programs and courses involving crew members and conducts training footprint reviews. It also addresses suggested changes related to standards for training and crew member performance.

- The Fatigue Working Group (FWG) is a joint group established to meet monthly for two specific purposes: to review fatigue events where initially a crew member has been found responsible for the fatigue event, and provide an avenue for the IPA to request a risk analysis for specific flights and pairings by the Fatigue Safety Action Group (FSAG). The FWG provides the IPA an avenue to bring matters before the FSAG.

- The Scheduling Advisory Board (SAB) is a joint board that meets monthly with the purpose of discussing pairings that have been constructed by crew scheduling. The IPA is provided a preliminary copy of bid packages before they are published for crew members, and can bring concerns about any pairing or other scheduling component. The SAB can and does request changes to specific schedules before publication.

- The Flight Safety Task Force (FSTF) is a joint UPS/IPA working group focused on examining in-flight fire safety enhancements and mitigation strategies.

5.10 UPS Crew Resource Management and Threat and Error Management Training.

UPS has a robust CRM and Threat and Error Management (TEM) training program. The program is collaboratively developed and taught by UPS and IPA instructors. CRM and TEM training starts at the beginning of employment and is integrated into training throughout a UPS pilot's career with the airline.

The UPS FOM provides the following guidance to UPS pilots:

> UPS has a diverse work force with many different facets such as gender, cultural or ethnic differences, and racial differences. Additionally, international flying adds another dimension to this diversity with International Civil Aviation Organization (ICAO) standards and language barriers.
>
> The Captain sets the tone and establishes a level of adherence to UPS policies and procedures, and encourages crew participation. The more specific and standard we are in our briefings, the less chance there will be a misunderstanding or deviation from expectations. These briefings should also incorporate International Relief Officers (IROs) and jumpseaters who actually may have valuable input and could assist in certain situations. The Flight Control Dispatcher is a

good resource. Remember, there is almost always someone who has an answer to a particular problem.[19]

Crewmembers are ultimately responsible for the safe conduct of the flight. Implementation of CRM at UPS empowers crewmembers to exercise their judgment and skills to avoid undesired consequences. Essentially, every detail consistent with cockpit function requirements shall be duly assigned and accepted as an individual's responsibility prior to the commencement of a flight operation. These requirements are described in detail in our various operation manuals (i.e., FOM, AOM and OpSpecs) specific to each fleet. As crewmembers, you are expected to know and understand all of these available resources, as well as how to engage the external resources so often talked about in the various CRM training events you have experienced throughout your career. Along with the crewmembers, the Flight Control Dispatcher, who does your flight planning and flight monitoring, should be considered a critical part of the team.[20]

Under the umbrella of Risk Management, CRM and TEM have become an integral safety component of operations at UPS. We will continue to train and educate our crewmembers on the importance and use of these tools. Risk Management has and will continue to be a key component to ensure that UPS maintains the safest and most profitable operation possible.[21]

5.11 UPS Flight Crew Alertness Guide.

NTSB Docket No. SA-538, Exhibit No. 14-F (attachment 2).

6. ANALYSIS AND FINDINGS.

6.1 Fitness for Duty.

6.1.1 Part 117.

The flight crew schedule for UPS1354 was built IAW 14 CFR. Part 121 rules and the current UPS/IPA Collective Bargaining Agreement (CBA). The CBA is more restrictive than Part

[19] UPS FOM Vol 1, 05.01.01.06
[20] UPS FOM Vol 1, 05.01.01.02
[21] UPS FOM Vol 1, 05.05.01.01

121, and the CBA reflects agreed-upon rules that address UPS's operations which occur predominantly at night. These CBA rules have been fashioned and agreed to by UPS and the IPA specifically to enhance the safety of UPS flight operations. Accordingly, the CBA contains restrictive scheduling rules for operating within the Window of Circadian Low (WOCL). (The WOCL as defined in the CBA is termed the "Early Duty Window" (EDW).) The schedule for UPS1354 fully complied with both Part 121 and the CBA.

During the NTSB investigative hearing, some questions were raised regarding 14 CFR Part 117. At the time of the UPS1354 accident, Part 117 had not been promulgated by the FAA. The FAA issued Part 117 four and a half months later (January 1, 2014). Even as eventually promulgated by the FAA, Part 117 was not applied to cargo operators. UPS fully supports the exclusion of cargo operators from the scope of Part 117. We firmly believe there are more effective methods of achieving a higher level of safety, and that the applicability of Part 117 to the scheduling surrounding this accident would have had no influence on these events.

A comparison of UPS EDW scheduling practices applicable at the time of the accident to Part 117 rules is contained in Chart 1.[22]

Chart 1

	Part 121 Subpart Q	UPS EDW Operations	Part 117	Accident Crew Schedule
Duty Time	N/A	11 hours	11 hours	8:11
Flight hours	8 hours	8 hours	8 hours	2:29
Rest Requirement	9 hours	10.5 hours	10 hours	14:28
Consecutive Nights	N/A	N/A	3 nights	2 nights

As the information in Chart 1 indicates, UPS EDW operations limitations meet or exceed both Part 121 Subpart Q and Part 117 limitations except for consecutive nights permitted to be flown.

Even comparing the accident crew's projected schedules for the accident week to Part 117 rules, the PF's five consecutive nights of scheduled operations would have been in compliance, because each night provided the opportunity for two hours of prospective rest.

[22] Chart 1 is derived from the Human Performance Group Chairman's Factual Report Exhibit 14A.

The prospective rest must be scheduled and obtained each night in a suitable rest facility[23]. The PM, having operated a flight segment from KSAT to KSDF on the first night, without a two hour scheduled prospective rest in a suitable facility, would have been limited to only three nights of operation. Regardless, the accident flight occurred on night 2 of the pairing. Therefore, UPS respectfully submits that Part 117 rules would have had no influence on the events leading up to the accident, and the facts of this accident do not support a finding related to the possible benefit of Part 117 to cargo operations being flown primarily at night.

Proposed Finding: 14 CFR Part 117 regulatory requirements were not raised by the facts surrounding this accident.

Proposed Finding: 14 CFR Part 117 regulatory requirements, even had they been in place, would not have influenced the outcome of this accident.

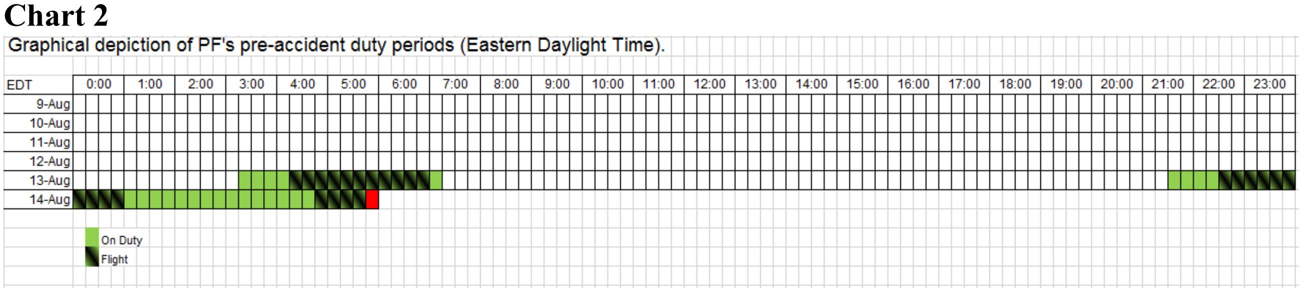
6.1.2 Joint Responsibility for Fitness.

UPS adheres to the FAA-approved Fatigue Risk Management Plan (FRMP) requirements underpinning its Joint Responsibility for Fitness for Duty. UPS is responsible for publishing operating schedules that are safe and that provide the regulatory-prescribed opportunities for adequate and consistent recuperative rest. Under UPS's own standards, the crew rest opportunities are designed to be even more generous than those mandated by regulation.

UPS pilots are responsible for effectively utilizing the rest opportunities provided them so that, for each flight segment assigned, a flight crew member is Fit for Duty.

The PF's operating schedule and rest opportunities are depicted in Chart 2.[24] As is represented, the PF's schedule provided a 14+ hour opportunity for rest during the layover in KRFD on August 13, 2013.

Chart 2

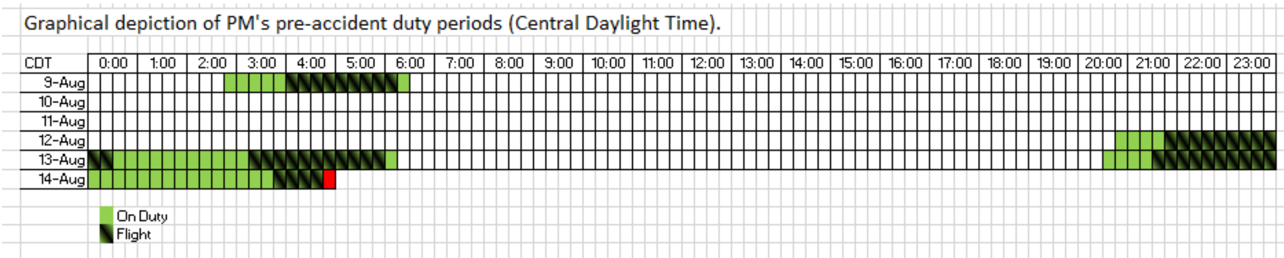


[23] Provided at the Aircrew Service Center in Louisville.

[24] The flight crew information in Chart 2 was drawn from the actual flight schedules.

The PM's operating schedule and rest opportunity is depicted in Chart 3.[25] As is represented, the PM’s known schedule provided a 60+ hour layover opportunity for rest during the layover in KSAT beginning August 9, 2013, and a 14+ hour opportunity for rest during the layover in KRFD on August 13, 2013.

Chart 3



Proposed Finding: The Captain/PF had adequate rest opportunities for the intended schedule.

Proposed Finding: The FO/PM had adequate rest opportunities for the intended schedule.

[25] The flight crew information in Chart 3 was drawn from the actual flight schedules.

Chart 4[26] provides the PF's graphical data of pre-accident (both known and Personal Electronic Device (PED)) activities during the same period. To the extent the PED analysis can reliably correlate PED activity to non-sleep activity, as the PED Factual Report represents, it appears the PF managed his sleep opportunities well and showed no signs of chronic or acute fatigue. The only decrement to alertness would be the normal circadian issues associated with operating in the WOCL during the approach into KBHM. UPS mitigates the effects of operating in the WOCL by maintaining high levels of cockpit standardized procedures, redundant call-outs, fatigue management guidance and training, and written professional expectations.

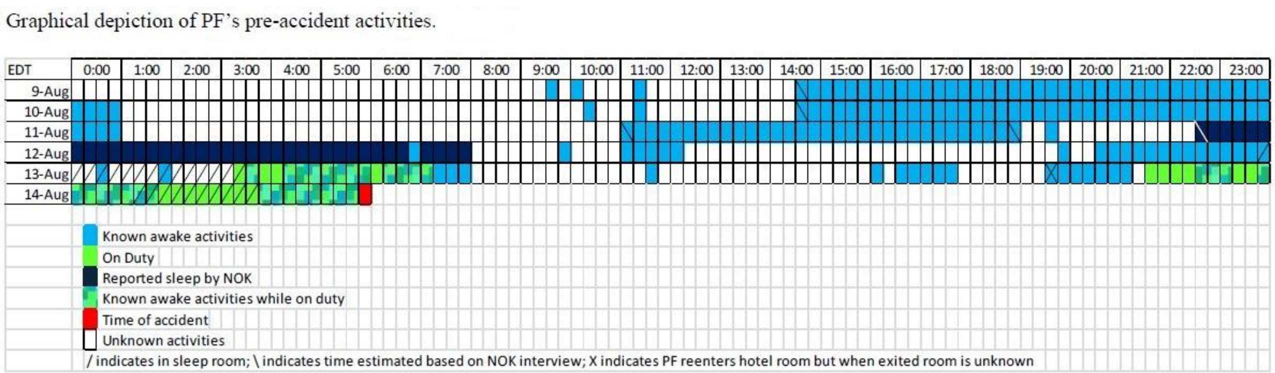


Chart 4

Chart 5[27] provides PM's graphical data of pre-accident (both known and PED) activities during the same period. Again, to the extent the PED analysis can reliably correlate PED activity to non-sleep activity, it appears the PM had an opportunity for extensive periods of un-interrupted rest during the 36-hour period prior to the KBHM accident. The PM is quoted, however, as saying in the CVR transcript that while she slept in KRFD, she was still tired. The feeling of sleep pressure she experienced appears to support the findings in the PED Factual Report that such loss of sleep resulted from personal activities during the 60+ hour layover in KSAT. While the PED report indicates that fatigue may have had an impact on the PM's performance, UPS believes that the behavioral markers throughout the flight were not of the type that would indicate to the Captain/PF that there was a fitness for duty concern with the FO/PM.

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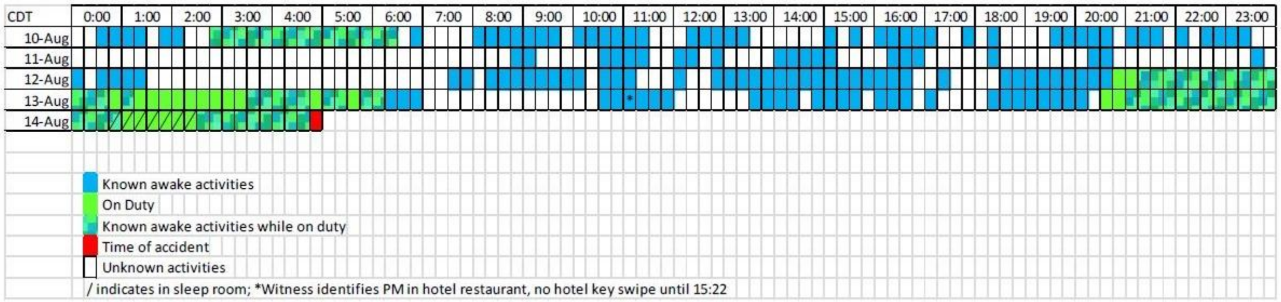
[26] The flight crew information in Chart 4 was documented by the NTSB through interviews, company records, hotel records, and PED records.

[27] The flight crew information in Chart 5 was documented by the NTSB through interviews, company records, hotel records, and PED records.

Chart 5

Graphical depiction of PM's pre-accident activities.



Proposed Finding: The Captain/PF took full advantage of his sleep opportunities.

Proposed Finding: The FO/PM did not take full advantage of her sleep opportunities.

Effective utilization of rest opportunities is crucial for safe flight operations, especially on the "back side of the clock," or what would be nighttime for a person on a typical schedule. In this particular schedule, both crew members utilized a private, separate sleep room in the KSDF gateway the morning of August 14, 2013. UPS also investigated the KRFD crew hotel for any reported incidents of interrupted crew rest and no incidents were reported during the period reviewed.

Proposed Finding: UPS provided each pilot adequate crew rest opportunities prior to the accident flight.

Furthermore, flight crew always have the ability and are expected to call not fit for duty due to fatigue when crucial rest is not obtained and safety of flight is in question. UPS has a non-punitive fatigue call policy. Non-punitive means a crew member can report not fit for duty due to fatigue, and even elect to use a sick day for self-induced fatigue, with no job-related consequences. Each fatigue call is also treated as a separate safety occurrence and is investigated fully. This schedule, as planned and as operated, was not a fatigue threat to aviation safety when utilizing proper rest opportunities. With proper rest, UPS standardized operating procedures, redundant call-outs, and compliance with written professional expectations, operating in the WOCL should not have posed inordinate or unacceptable risk.

Proposed Finding: UPS has a non-punitive fatigue policy that permitted either pilot to call in fatigued if they had elected to do so.

6.1.3 Fatigue Not the Predominant Influence.

The errors made by the accident crew do not support fatigue as a finding but more likely point to other issues. The following performance markers are often used to evaluate the presence of fatigue:

- Slowed Response Time.
- Reduced Vigilance/Monitoring.
- Poor Decision-Making.
- Fixation on Tasks.
- Poor Risk Assessment.
- Slow to Change Plans.

A review of the accident crew's schedules shows that both pilots had multiple days off prior to the accident pairing. The PF had 8 days off. (The first 3 days of the scheduled pairing was removed due to the PF's use of sick days.) The PM flew the pairing as scheduled and had 6 days off prior to the first flight of the pairing followed by a 62 hour layover. NTSB interviews with those who interacted with the crew indicated that no signs of chronic fatigue were exhibited by either crewmember.

In the case of UPS1354, it is UPS's opinion that the performance markers present in the accident scenario are indicative of a flight crew experiencing a loss of situational awareness and task saturation rather than fatigue. In fact, the following behavioral markers highlight the crew's unimpaired level of alertness:

- No missed ATC calls.
- Thorough use of the Non-Precision Approach Briefing Guide and proper briefing of the planned approach.
- Recognition of the potential to be held high by ATC and an awareness that they were high.
- Descent to 11,000 feet and subsequent reduction in airspeed in preparation for the next descent clearance.
- Early extension of Landing Gear by PF and descent at or near VFE to ensure descent to intermediate approach segment altitudes.
- Jovial attitude and conversation during descent.
- PM makes SOP compliant responses to PF's calls for configuration changes ("Speed Checks, Flaps___").
- PM notes COLIG is approaching and comments that there is 8 miles between COLIG and BASKN (indicating that distance exists to allow descent and slow down).
- PM and PF quickly note FMA changes and LOC movement.
- PF calls "Activation of Final" at appropriate time.

- PF max-performs the aircraft (slat and flap extension at or near VFE).
- PF selects PROFILE at the appropriate time.
- PF makes SOP-required calls outside the FAF (Flaps 40 – Landing Checklist – Set Missed Approach Altitude).
- PM performs configuration changes and completes Landing Checklist (pausing – indicates listening to ATC discuss with another aircraft runway 6/24 availability – missing only setting the missed approach altitude).
- PF recognizes that Profile did not engage and selects V/S.
- Upon completion of Landing Checklist, PM quickly notes that Profile not engaged and comments to PF.
- PF confirms approach to be flown in V/S and notes that they are high on the approach.
- PM traps Missed Approach Altitude not set and corrects error.
- PM appears to calculate and confirm that the aircraft was in fact high on approach (even though VDEV indicator indicated low).
- PF notes that step down fix exists.
- PF correctly notes DME of step down fix and correct crossing altitude.
- PF responded quickly to EGPWS Sink Rate Alert.

Although the PED Factual report does point to a possible sleep debt in the case of the PM, an objective analysis of the performance and behavioral markers evidenced above indicates a level of engagement that is indicative of a crew that was alert and fully engaged in the flight. In fact, the errors made were more indicative of a task saturated crew rather than ones attributed to fatigue.

Proposed Finding: Performance markers in the aggregate indicate that the crew was alert and engaged during the accident flight.

Proposed Finding: Performance markers present in the accident scenario are indicative of a flight crew experiencing a loss of situational awareness and task saturation rather than fatigue.

6.2 EGPWS.

Some discussion and analysis was performed by the NTSB regarding the model of EGPWS software installed on the accident aircraft. UPS1354 had EGPWS software (version -212) installed and operational, which fully complied with all requirements of the current FAA Technical Standard Order (TSO) for EGPWS installations. In the accident sequence, the accident flight received a Mode 1 "Sink Rate" EGPWS alert. The aircraft entered the curve for this alert and after a short delay built into the system, i.e. persistence time, the alert occurred at 250 feet AGL. The Mode 1 “Pull Up” envelope was not penetrated. The crew adjusted the descent rate but shortly thereafter struck the first trees. Newer versions of this software do not alter the Mode 1 curve and these alerts are not modified.

From the Aircraft Performance Factual Report:

The EGPWS “too low terrain” warning on the CVR came 1 second after the “first sound of impact,” and so was not able to alert the crew in time to avoid descending into the trees. An updated version of the EGPWS software (version -218) would have provided the “too low terrain” 6.5 seconds earlier than that provided by the software version installed on the accident aircraft (version -212).

During the investigation, the NTSB performed simulator tests intended to determine whether an earlier alert (available on version -218) would have been timely enough for the crew to have taken action to avoid the accident. Considering three different responses to the EGPWS “too low terrain” alert, and assuming real-world performance can be and was accurately duplicated in the simulator, the results of the simulator tests are as follows:

1. Vertical speed was changed from a 1,500 feet/min descent to a 500 feet/min climb.

   The first tree could not have been cleared simply by changing the selected vertical speed from a 1,500 feet/min. descent to a 500 feet/min. climb. This action would have to be initiated 0.7 seconds *before* the “too low terrain” alert provided by the EGPWS -218 software.

2. A normal go-around was performed.

   An automated normal go-around maneuver, initiated by activating the TOGA switches within 0.6 seconds of the “too low terrain” alert provided by the EGPWS -218 software would have cleared the first tree. However, it is not likely with normal latency of reaction time that this would have been accomplished.

3. A Controlled Flight into Terrain (CFIT) recovery maneuver was performed.

   A CFIT recovery maneuver, initiated within 2.4 seconds of the “too low terrain” alert provided by the EGPWS -218 software, would have cleared the first tree.

However, in the case of test 3 above, the CFIT maneuver would not have been the required response to a “too low terrain” alert under UPS procedures which are based upon Honeywell and Airbus manuals. EGPWS alerts are separated into two categories: “Caution Alerts” and

"Warning Alerts". "Warning Alerts" are the only alerts that require an immediate CFIT recovery maneuver. "Caution Alerts" occur for a variety of reasons and the required responses vary depending on the situation. "Too low terrain" is a "Caution Alert". This is not intended to say that a CFIT recovery would not be appropriate anytime a pilot or crew determines that there is a risk of flight into terrain, perhaps because of recognition there has been a loss of situational awareness. On the contrary, UPS policies emphasize a CFIT maneuver is appropriate under any circumstance where there is the potential for imminent contact with terrain.

Although the current version of the EGPWS software (version -212) met all FAA requirements, the additional enhancements of the newer version may provide enhanced safety. In this instance, UPS does not believe the updated software would have been sufficient to prevent this accident, but a review of the EGPWS TSO requirements deserves consideration as a possible safety enhancement.

Proposed Finding: The EGPWS software update alone would not have added sufficient warning time to permit the crew to avoid the accident under these circumstances.

6.3 Weather Analysis.

During the flight preparation phase, the crew reviews all relevant flight planning data which includes dispatch legality based upon forecast weather. Legality for dispatch is based upon visibility only (except in specific cases)[28]. In the case of UPS1354, the flight was legally dispatched with forecast weather of 400 feet broken and visibility greater than 6 statute miles (SM). KBHM was a legal destination IAW FAR 121.651, but due to the 400-foot ceiling, the flight was issued a legal alternate of Atlanta Hartsfield International Airport (KATL).

Prior to departure the following meteorological information was available from the NWS:

Forecast:

TAF AMD KBHM 140647Z 1407/1506 VRB03KT P6SM BKN004
FM141300 VRB04KT P6SM SCT009 BKN015
FM141500 01007KT P6SM FEW050 SCT250=

TAF KBHM 140533Z 1406/1506 VRB03KT P6SM BKN004 TEMPO 1406/1408 SCT005 BKN025
FM141300 VRB04KT P6SM SCT009 BKN015
FM141500 01007KT P6SM FEW050 SCT250=

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Observations:

MVFR SPECI KBHM 140712Z 00000KT 9SM SCT006 BKN016 23/22 A2997 RMK AO2=
MVFR SPECI KBHM 140734Z 00000KT 10SM BKN010 BKN016 23/22 A2996 RMK AO2=

During the course of the investigation NTSB identified that the flight departure papers did not include remarks with the METAR reports. NTSB investigators have discussed whether METAR remarks should have been part of the flight departure paperwork. In the case of UPS1354, the remarks that were omitted were "*RMK AO2=*" on both observations. Since these specific remarks indicate only that the report was generated from an automated observation, they were not significant.

Proposed Finding: The flight dispatch system used by UPS did not provide METAR remarks to the crew, however the excluded remarks "*AO2*" held no significance.

Enroute, the UPS crews are required to update the arrival weather with the most current reported information by accessing digital ATIS. If digital ATIS is not available, a crew will often access the ACARS METAR feature to acquire an update for weather at the destination.

Digital ATIS was not available at KBHM, so at 0904Z UPS1354 requested the weather via ACARS and received the 0853Z METAR without the appended remarks:

> *0853Z Wind Calm, 10 SM, 1000 BKN, 7500 OVC, 23/22 29.97.*

If the remarks of this METAR had been included, the crew would have had the following additional information: *ceiling 600 variable 1300*. This would have represented improving conditions from the forecast of a 400-foot ceiling contained in the flight departure paperwork.

Proposed Finding: The flight dispatch system, via ACARS, provided ICAO formatted weather which did not include remarks.

The most current ATIS is used to determine the legality for an approach. Once in range of KBHM, the PM checked the VHF ATIS broadcast, which stated:

> *Birmingham Airport Information Papa 0853 Zulu observation, wind calm, visibility 10, sky condition, ceiling 1,000 broken 7,500 overcast, temperature 23, dew point 22, altimeter 29.97.*

ATIS "Papa" was based upon the 0853Z observation and did not include the remarks of "ceiling 600 variable 1,300 feet." The remarks were not included in the ATIS[29] broadcast and therefore the crew was unaware of their existence or that the weather might be worse than reported.

In a statement to the NTSB, the PF of FedEx flight 1488, a Boeing 757 that landed immediately after the accident at 1008Z, stated that he had encountered a solid layer of clouds on descent from 20,000 feet and did not break out of the clouds until 300 feet AGL for the ILS approach to runway 06. The Aircraft Performance Study, using security camera footage, determined the actual cloud base for the accident aircraft was approximately 250 feet above the airport elevation, which was only 50 feet above the trees that were struck by the aircraft.

Based on ATIS "Papa", the crew of UPS1354 would have formed a mental model that the ceiling was 1,000 foot broken with 10 SM visibility below the clouds. The crew would have anticipated breaking out of the clouds well above minimums, in night VMC conditions.

If the crew had known the actual weather, they would have anticipated an Instrument Meteorological Conditions (IMC) night instrument approach, potentially to approach minimums, thereby allowing them to formulate a more accurate expectation. A more accurate mental model of the anticipated weather would have prompted the crew to anticipate an approach to minimums and the likelihood of a go-around.

The difference between the official weather report and the actual weather conditions at the approach end of the runway points to a need for the FAA to ensure that weather reporting systems at airports are more accurate. For example, if ATIS had been updated using the latest SPECI report (per FAA guidance), the discrepancy between the official reported ceiling and the actual ceiling in the approach corridor would have been even more pronounced and misleading, because it reported scattered clouds at 1,000 feet, ceiling broken at 7,500 feet, with no appended remarks.

Regardless of any weather information received enroute, the most current ATIS received prior to commencing an approach is used to determine the legality for the approach and would have reset any mental model formed by the crew. In the case of UPS1354, ATIS "Papa" overrode forecasted weather, METAR updates, and indicated improving conditions.

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[29] According to FAA Order 7110.65U, three types of remarks are required in ATIS weather reports: lightning, cumulonimbus, and towering cumulus clouds. The Order does say that "pertinent remarks" should be included, but there is no guidance as to which remarks would be considered pertinent. This means that remarks of a variable ceiling are not required and may be excluded from ATIS reports at the discretion of tower personnel.

UPS believes the crew expected to break out of clouds and observe the runway well above the MDA.

The following is a summary of the NWS weather observations from the Meteorological Factual Report:

0753Z Ceiling 800 Overcast, remarks 700 variable 1,100

0848Z Ceiling 1,000 Overcast, remarks 600 variable 1,300

0853Z Ceiling 1,000 Broken, remarks 600 variable 1,300

0904Z 1,000 Scattered, Ceiling 7,500 Broken, no remarks

0947Z Accident

0953Z 1,100 Few, Ceiling 3,500 Broken, no remarks

The observations at KBHM before and after the accident showed generally improving conditions with ceilings no lower than 800 feet. The actual ceiling at the approach end of runway 18 was 250 feet. This information misrepresented actual weather, and those elements provided to the crew likely caused the crew to form inaccurate expectations as to when they would break out of clouds on the approach.

Proposed Finding: Inaccurate weather information for the destination airport at the time of the accident likely contributed to an inaccurate mental model and expectations the crew had for the approach.

Proposed Finding: Proper ATIS updates and inclusion of the most current weather information would have provided weather information even more removed from the actual weather the crew encountered on the approach.

Proposed Finding: Airport weather observation tools were inadequate to identify variable weather at the approach end of the runway and thereby alert the crew to unexpected low ceilings.

6.4 Arrival.

During the cruise portion of the flight, the PF displayed excellent situational awareness and CRM by discussing with the PM that ATC often delayed the descent into KBHM.

The PF thoroughly briefed a localizer approach to runway 18 (LOC18) using the Profile Approach Briefing Guide. The briefing showed a high level of attention to detail and procedural professionalism. Although this approach was available and legal to execute, one technical error not trapped by the crew was that the minimums listed on the Jeppesen approach chart were mistakenly listed as NA (Not Authorized) at night. The NA was removed in 2012; however, Jeppesen neglected to make the change on the published approach chart. Had this error been trapped by the crew, the GPS approach to runway 18 was available as an alternative approach.

The flight was given a discretionary descent to FL240 followed by a clearance to 11,000 feet MSL[30]. Passing FL180, the approach checklist was completed and a sterile cockpit was required in accordance with UPS procedures.[31] Although the crew was permitted to descend to 11,000 feet, they were vectored on a straight-in arrival and approach to runway 18, and there was no additional distance for the flight to accomplish a normal descent profile. Arriving at 11,000 feet, the PM expressed concern about their altitude and asked if the PF would like lower. When the PM asked ATC for a continued descent, the flight was first changed to Approach Control and was then cleared to 3,000 feet. In conjunction with the descent clearance, the flight was given a ten degree right turn to join the localizer for runway 18. Chart 6 depicts a comparison of a normal descent path compared to the mishap aircraft profile. On a normal descent arrival, a flight would depart 10,000 feet at 30 NM from the airport, but due to a late ATC clearance and the use of a runway 18, UPS 1354 departed 10,000 feet at 20 NM. This necessitated a significantly higher descent rate and afforded much less time and distance to arrive in position for the approach.

Proposed Finding: ATC issued descent clearance well beyond the normal descent profile path.

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[30] FDR Factual 4.4.1

[31] FOM Vol. 2, 02.02.06.05

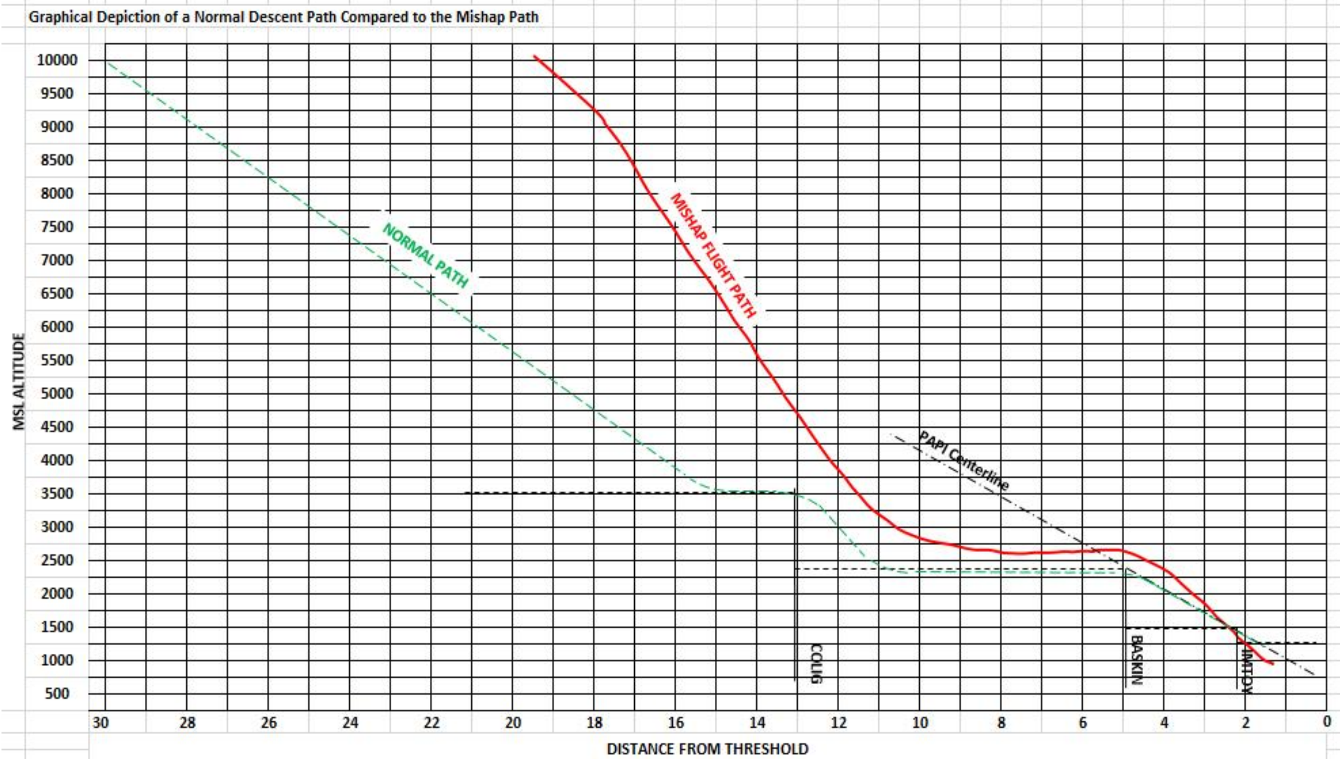


Chart 6

From CVR data obtained during the investigation, it appears the crew correctly determined that they were well above a normal descent path. (*Crew comments during the latter stages of the approach indicate this perception continued even after they passed through the normal approach path below 1000 feet AFE.*) The crew's correct analysis that they were high on the descent possibly became the primary focus for the PF as he concentrated on maneuvering the aircraft to meet the parameters for commencing the approach. The high workload generated by the late ATC descent required the PF to place his focus on energy management to the point of being unable to trap errors effectively. In short, the PF became task saturated at a critical phase of the flight.

Proposed Finding: High workload associated with energy management and descent planning in a critical phase of flight led to task saturation.

At 15.2 NM from the threshold, the flight was approximately 3,000 feet higher than a normal descent profile. At this point when the flight was given the ten degree right turn to join the localizer for runway 18, the FMS flight plan should have been sequenced to a waypoint on the approach. Sequencing the approach would have provided the following to the crew:

(Sequencing the approach refers to making the next point in the FMS the active waypoint for navigational purposes.)

- Only the final approach course would be displayed on the Navigation Display (ND), thereby giving the crew an accurate visual picture and distance to key points on the approach as well as lateral displacement from the final approach course.

- Accurate Vertical Path information would have been provided. The path information displayed to the accident crew was erroneous since the active waypoint in the FMS was KBHM.

By sequencing the FMS, the crew would have been set up for the pre-briefed LOC18 approach and would have had accurate vertical path (Profile) information. This guidance would have dramatically improved their situational awareness while they managed the late descent and rapidly approaching FAF. The absence of this information would have further fostered the feeling of time compression on the part of the crew and prevented the crew from "getting ahead" of the aircraft, further introducing confusion. If the vertical path (Profile) had been available, the autopilot would have been able to follow the FMS-generated glide path down to the DA and the autopilot would have also automatically disengaged at 50 feet below minimums, further alerting the crew of their position.

Proposed Finding: The crew did not properly sequence the FMS causing the aircraft to not have a viable vertical navigation path.

As stated previously, the high level of focus required by the crew for the descent may have resulted in the failure to trap the FMS sequencing error. Because the flight was 10,000 feet and only 20 NM from the airfield, this required the PF to focus on precise energy management. As a result the PF used early landing gear extension and speed brake modulation (extension and retraction), and, eventually, as he slowed the aircraft, he precisely called for flap extension just below the maximum flap extension speeds for each flap setting. This technique required a great amount of concentration and focus to ensure the flaps limiting speeds were not exceeded and energy was properly managed. During the descent, the PM also displayed active CRM engagement by correctly responding to flap changes in accordance with standard operating procedures: "Speed Checks, Flaps __".

Further analysis shows that at the time FMS sequencing should have occurred, a non-pertinent conversation took place between the PF and PM not in compliance with UPS Sterile

Cockpit Procedures.[32] This conversation may have further diminished the crew's ability to trap the FMS sequencing error.

Proposed Finding: The flight crew's non-pertinent conversation during the descent and approach phase, inconsistent with UPS Sterile Cockpit requirements, likely distracted the crew from higher priority tasks.

The PF had properly assessed the need for additional drag to make the steep descent required to be in a position to accomplish the approach. However, the focus required to accomplish the descent combined with the distraction of a non-pertinent conversation allowed the FMS sequencing error to remain un-trapped.

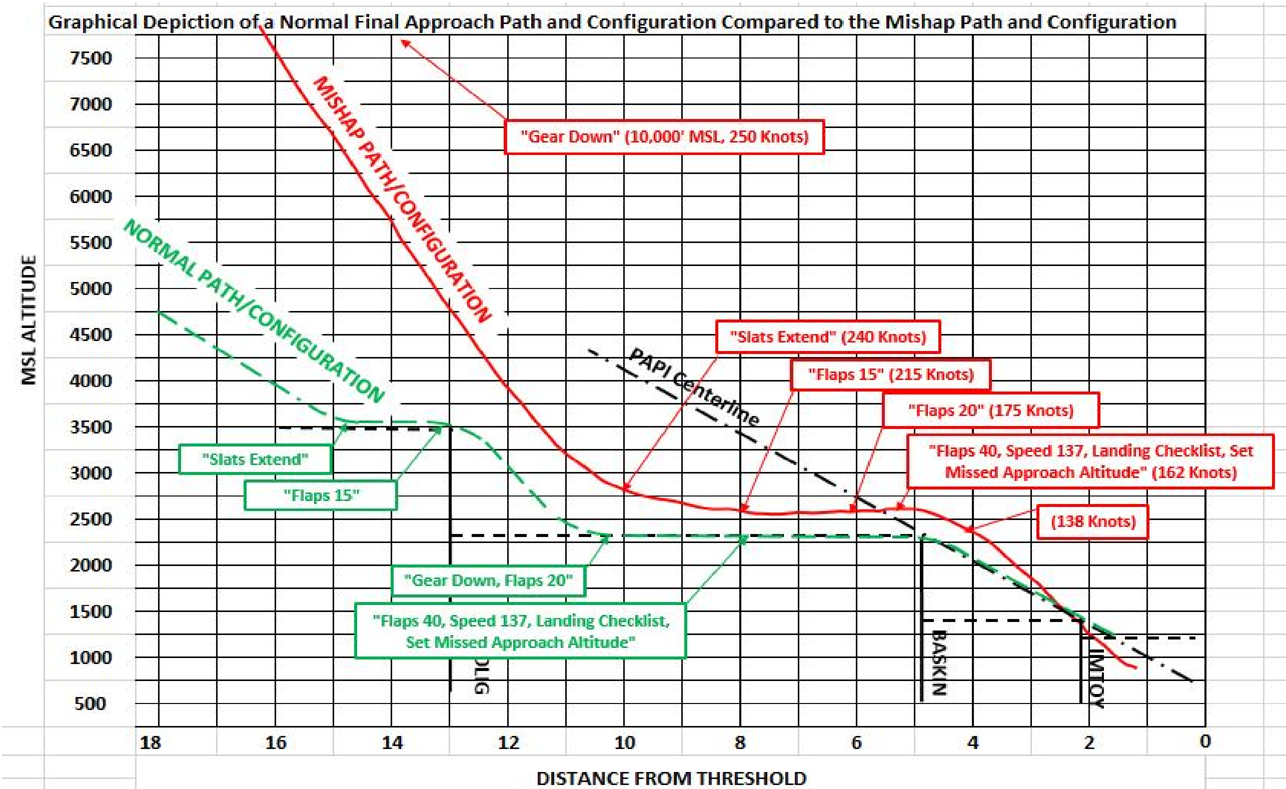
Proposed Finding: Task saturation associated with the delayed descent prevented the PF from trapping the sequencing error.

6.5 Approach to FAF.

As the aircraft continued its descent on the approach, the PM verbally noted that COLIG, the initial approach fix (IAF), was approaching quickly and stated, "at least there is 8 miles between COLIG and BASKN (FAF)." This indicates that the PM was focused on the late descent and tight arrival and was mentally computing whether the flight could complete the descent in time to begin the approach. At this point the flight was well above a normal descent path. A normal path would have allowed the flight to descend, slow and configure correctly, arriving on altitude and airspeed in a position to safely commence the approach. Chart 7 is a graphical depiction of a normal final approach path and configuration compared to the mishap path and configuration.

[32] FOM Vol. 2, 02.02.06.05

Chart 7



At 11 miles from BASKN or 16 miles from the runway threshold, see Chart 7, the crew was cleared for the LOC18 and instructed to descend to 2,500 feet MSL. The PF was aggressively descending but due to their proximity to the field, the flight remained high and fast. The PF recognized that Final Approach Mode had not been activated and called for the PM to "activate final". (*This is required in addition to sequencing the FMS flight plan for VNAV path engagement and further demonstrated a level of situational awareness by the PF.*)

While the crew was able to legally descend to 2,300 feet (FAF altitude) once established on the localizer, the flight only descended to the originally assigned altitude of 2,500 feet. It is possible that the crew overlooked the available 200-foot descent due to the hurried descent or they anticipated intercepting the V-NAV path at 2,500 feet. Had the FMS been properly sequenced, the Profile mode would have provided descent guidance from either 2,500 feet or 2,300 feet to minimums.

Even though the PF stopped his descent at 2,500 feet MSL, he still was not able to decelerate to reach the final approach speed of 137 knots until the flight passed the final approach fix. At 3 miles prior to the FAF the aircraft was just reaching 2,500 feet and slowing through 215 knots when the PF called for "Flaps 15." If on a normal non-precision approach as described in the UPS pilot training guide, at 3 miles from the FAF the aircraft should have been at the

FAF altitude (2,300 feet) and 160 knots with the landing gear extended and flaps set at 20 degrees. The mishap aircraft had the gear extended, only the slats extended, and was 200 feet high and 55 knots fast for the approach. Despite employing many good techniques for an expedited descent, the flight still arrived at the FAF 200 feet high and 7 knots fast. (Ref: Chart 7)

Proposed Finding: Despite using aggressive descent techniques, the flight arrived at the FAF 200 feet high and 7 knots fast.

While still engaged in managing the consequences of the late descent, the PF became aware of another challenge as the flight approached the FAF. Vertical guidance for final approach was not available as evidenced by the Profile (P.DES) not capturing. As addressed previously, this was the result of an improperly sequenced FMS. There were numerous subtle secondary indications of the sequencing error; however, the primary indicator was the FMA, and it appeared normal (P.DES armed to capture) until the FAF.

Prior to intercepting the vertical path, the FMA vertical mode should have shown that the aircraft was in altitude hold with a profile descent armed indicated by a green "ALT" and a cyan "P.DES." Even though the FMS was not sequenced properly, the FMA correctly displayed the green "ALT" and cyan "P.DES" that the crew expected to see. If the FMS had been sequenced properly, as the aircraft approached the vertical path (approximately at BASKN or sooner since the flight was 200 feet high), the "P.DES" would have flashed and then turned Green when captured. Because of the sequencing error, P.DES did not capture (P.DES did not flash and remained cyan, never turning green) and the aircraft did not start the descent.

It was not until the FAF that the PF recognized that there was a problem with the Profile descent. At this point the aircraft was in level flight and 200 feet above the desired vertical path. Analysis of the CVR transcripts revealed that the PF incorrectly attributed the failure to capture the Profile descent as a result of their height above the V-NAV path. The PF's comments further illustrate the ongoing focus on trying to descend to a normal path and the continuing sense that the flight was high.

After the PF recognized that P.DES had not captured, he selected vertical speed (V/S) on the MCP without communicating the change to the PM. It is possible the PF selected vertical speed (V/S) in an attempt to intercept the approach path from above or simply to descend to the VMC conditions that were broadcast as part of ATIS information Papa. Analysis of the CVR transcript shows that at the time the PF would have communicated the mode change from Profile to Vertical Speed, the PM was verbalizing the completion of the Landing Checklist and ATC was transmitting radio communications. After completing the Landing Checklist, the PM recognized that Vertical Speed mode was selected rather than the pre-briefed Profile mode and confirmed with the PF that this was intentional and not an error.

The PF acknowledged the Vertical Speed mode and stated that ATC "kept us high" which possibly reveals that the PF thought that the late descent kept the Profile mode from capturing the V-NAV path. This statement also further reinforces that the PF was aware of his vertical position at this time.

Note*: V/S would have been a valid mode if it had been briefed prior to commencement.*

Proposed Finding: The PF selected a V/S mode approach even though it had not been briefed.

6.6 Approach from FAF.

When the profile mode did not engage, the PF made the decision to transition to a vertical speed approach. The PF initially selected 700 FPM for the descent rate, adjusted to 1,000 FPM and ultimately increased the rate to 1,500 FPM attempting to correct to a normal descent path. The 1,500 FPM rate of descent (approximately twice the normal descent rate) led to time compression, particularly in the vertical plane, as the approach continued. While this was occurring, P.DES was indicating "armed" (cyan) on the FMA. As stated earlier, it is possible the PF mistakenly believed the aircraft would capture the profile from above. It is also likely the crew expected to break out of the clouds at 1,000 feet AFE, as reported in the ATIS, and then stabilize the approach in visual conditions. In either case, the crew would have expected one of these triggering events to occur well above minimums.

We previously noted that, as UPS1354 arrived at the FAF, the PF recognized that P.DES had not captured. An analysis of the CVR transcript revealed he may have mistakenly believed Profile Mode did not capture because the flight was above the vertical path. The PM stated that (ATC) "Kept ya high. Could never get over to Profile, we didn't do it like that," indicating a shared mental model regarding the reason Profile had not captured. This unexpected situation, and failure to meet UPS stabilized approach criteria, should have been a trigger for either crewmember to call for a go-around.

Stabilized Approach Criteria [33]

The purpose of conducting a stabilized approach is to maintain a high degree of safety during the approach and landing process. In complying with stabilized approach criteria, the Captain must consider traffic and weather conditions, distance to the runway and the aircraft's energy profile. The objective is to plan the aircraft configuration process in a manner that results in arriving at 1000' Above Field Elevation (AFE) during the approach, in a stabilized condition. Under no circumstances will safety-of-flight be compromised. If at any time during the approach the Captain feels that the stabilized approach criteria cannot be achieved or maintained, a go-around must be initiated.

All approaches must be stabilized by 1000' AFE. An approach is considered stable when the following conditions are met:

- Aircraft is in the landing configuration and the landing checklist has been completed
- Airspeed is within +10 or -5 knots of computed final approach speed*
- Sink rate is 1000' per minute or less and stable**
- Aircraft is on a stable vertical path that will result in landing within the touchdown zone
- Engine thrust is stabilized at a level that results in target speed (as listed above)
- Aircraft is aligned with the lateral confines of the runway by 200' AFE

NOTE: *Airspeed must be within 5 knots of target by 500' AFE.

NOTE: **Vertical speed up to 1200' per minute may be acceptable under approach conditions that require higher airspeeds/ground speeds due to non-normal aircraft system configuration.

Proposed Finding: Both crew members may have believed the lack of vertical guidance was a result of being above the vertical path and not a sequencing error.

Although UPS training does not include how to execute an *un-briefed* approach mode change, nor does UPS training indicate this is an option, the PF decided to transition from Profile to Vertical Speed approach procedures possibly believing there was a low risk associated with this decision based on the anticipated VMC weather conditions. As a result the PF may have expected to intercept and capture the Profile Path or encounter VMC conditions momentarily which would have allowed a stabilized descent by 1,000 feet AGL to a night VMC approach and landing.

It is possible the PF had two incorrect mental models, a flawed perception of the anticipated weather for the approach and a misunderstanding about why Profile mode was not capturing. The compounding effect of these two incorrect mental models and a "continuation bias" would potentially make regaining situational awareness highly unlikely.

> "*For example, in at least nine accidents, crews appeared to have been influenced by planned continuation bias, which is a proclivity to continue a plan or habitual course of action past the point when changing conditions require altering the plan. The cognitive underpinnings of plan continuation bias are not clearly understood, but we suggest this bias results from*

[33] FOM Vol 2, 03.07.01.03

multiple interacting factors, including other types of bias. For example: expectancy and confirmation biases strongly influence individuals' mental models of their current situation. Especially when a flight starts out resembling the thousands of previous flights, pilots are slow to notice subtle cues indicating that the situation is not what is expected or has gradually drifted into a more threatening mode. Further, when looking for information to evaluate their situation, individuals tend to notice cues consistent with their current mental model more readily than cues that are inconsistent."

Wiener, E. (1988). *Human factors in aviation*. (2nd ed.). Waltham, Ma: Academic Press.

Proposed Finding: The PF exhibited "continuation bias" perhaps believing the aircraft would intercept the vertical path and soon encounter night VMC conditions.

The PF displayed a level of situational awareness regarding the differences in a V/S approach procedure by mentioning the step-down fix and altitude (3.3 DME at 1,380 feet MSL). This was a subtle difference in the procedure between Profile and V/S approaches. In Vertical Speed approaches, the pilot must control the aircraft's rate of descent to ensure compliance with all restrictions, while with Profile approaches, altitude restrictions are ensured by the FMS and the pilot would only monitor the descent path for compliance.

Although it appears from CVR data that the crew was trying to maintain their situational awareness in regards to their distance from the runway, comments made by the crew show their vertical situational awareness was still eroding. At this point the flight was still above 1,000 feet AFE and was descending at 1,500 FPM, twice the normal descent rate. The PF stated, "and we're like way high or higher" to which, the PM responded, "About a couple hundred feet, yeah". This conversation revealed that both pilots were engaged in mentally calculating some form of descent gradient. The flight's rate of descent accelerated the altitude loss and caused time compression for the approach, limiting the available time for the crew to regain their situational awareness. The final approach fix altitude was 2,300 feet MSL with an anticipated ceiling at 1,600 feet MSL (1,000 feet AFE). At a normal descent rate, the crew would have anticipated VMC conditions in approximately one minute. However, descending at 1,500 FPM the crew actually lost more altitude, and broke out of IMC conditions below minimums, in less than the one-minute time frame. As a result, UPS believes time compression exacerbated the loss of situational awareness.

Proposed Finding: Time compression caused by a higher than normal rate of descent contributed to the loss of situational awareness by both crew members.

At 1,000 feet AFE the PM made the correct 1,000 foot call and the PF acknowledged stating, "Decision altitude 1,200," however there was no reference by either crewmember to the 1,500 FPM rate of descent. At 1,000 feet, the vertical speed should have been reduced to not more than 1,000 FPM IAW **UPS Stabilized Approach** criteria and either pilot should have commanded a Go Around if unable to immediately decrease the rate of descent. UPS has a **No Fault Go-Around Policy** and there is no jeopardy to either crew member's employment status for calling for or performing a Go-Around.[34]

It is also possible that the crew's lack of response to the non-standard vertical speed may have been attributed to a false mental model that would have led them to anticipate encountering VMC conditions at or very near 1,000 feet AFE.

> *Operators can erroneously maintain as valid, representations that have already departed from a reasonable picture of the reality. In dynamic situations, one reason is that operators try to avoid the cost of revising their mental model as long as it allows them to stay more or less in control. In other words, they satisfice. Because mental models are constantly matched against the feedback from the process they control, they are fed with a constant stream of data. However, there exist situations where the feedback is discrepant from the operator's expectations. When this discrepancy provokes such a loss of control that required tasks cannot be run anymore, some costly revision of the mental model as well as diagnostic actions are needed (Rasmussen, 1993). This is a non-trivial task in dynamic situations such as piloting an aircraft in that some control is already lost and the crew is required to run, coordinate and share two processes at the same time. One is a rule-based control of the flight parameters: the plane must continue to fly. The other process is information gathering and integration. The potential work overload caused by this dual activity may explain why outdated (flawed) mental models are maintained even after the detection of some mismatches. Provided they can keep the system within safe boundaries, operators in critical situations sometimes opt to lose some situation awareness rather than spend time gathering data at the cost of a total loss of control.*
>
> *(Amalberti, 1996). (International Journal of Human-Computer Studies, 60, 2004, page 122-123, When Mental Models Go Wrong: co-occurrences in Dynamic Critical Systems, Denis Besnard, David Greathead and Gordon Baxter)*

The flight was in IMC conditions after the 1,000 foot call and, according to the mental model established by the crew based upon the current ATIS, the flight should have been in VMC

[34] FOM Vol 2, 02.10.02.02

conditions. The 1,000 foot call should have provided empirical data that actual weather was not as broadcast by ATIS. However, there was no cognitive connection between the 1,000 foot call and its contradiction of the actual conditions. As a result the crew was tasked with flying an approach that had been challenging from the beginning and reconciling weather conditions that did not fit the flawed mental model.

Proposed Finding: A false mental model of the weather conditions contributed to accepting the risk associated with the high rate of descent.

If the hypothesis of a mental model based upon a 1,000 foot ceiling is what the crew had envisioned, they would have anticipated the following sequence of events:

- 1,000 feet AFE – 1000 foot call – (approaching VMC).
- Visual Ground Contact with the associated callouts from the PM.
- Runway in Sight call from the PF.
- 500 feet AFE – 500 foot call from the PM.
- Landing – Called from the PF.

In actuality, the flight was IMC and the crew appeared to feel they were still above the glide path. Because they did not break out into VMC conditions as anticipated, their SA was lost in the vertical plane. It should be noted that the PF was still maintaining some lateral situational awareness by calling "Two Miles." It is possible that the anticipation of encountering VMC at 1,000 feet had both crewmembers looking outside the cockpit for ground contact. This could possibly explain why neither crewmember had the flight instruments in their scan.

Proposed Finding: The crew did not adhere to UPS Stabilized Approach criteria below 1,000 feet AFE.

Proposed Finding: The crew did not execute a "no-fault" go-around in a timely manner as required by UPS Stabilized Approach criteria.

The crew subsequently missed and/or omitted the following critical SOP calls for this approach:[35]

- "Approaching Minimums" (1,300 feet MSL).
- "Minimums" (1,200 feet MSL).

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[35] A300 AOM, 04.06.01.09

- “500 feet “(500 feet AFE ~ 1,040 feet MSL).

Proposed Finding: The crew omitted required UPS standard callouts.

Based on actual weather conditions, adherence to these required callouts would have prompted the crew to level-off at the MDA, fly to the missed approach point and execute a missed approach.[36]

No pilot may operate an aircraft below the authorized MDA unless the aircraft is in a position to land and the runway environment is in sight.[37] The flight descended below the MDA without the runway in sight. At the MDA, there was no verbal communication between the PF and the PM that indicated the crew had the runway in sight. At 1,100 feet MSL (or 100 feet below minimums) the PM stated, “It wouldn’t happen to be actual.” To which the PF responded “Oh I know.” While the meaning of these statements is unclear, it is important to note they were made 100 feet below MDA and in actual IMC. The timing of this conversation further points to the effect of time compression (due to the 1,500 FPM rate of descent) and the continuing inaccurate mental model influencing the pilots at this point on the approach which led to a total loss of situational awareness. The CVR transcripts and the failure to comply with minimums indicate both crewmembers were preoccupied with actual IMC, possibly scanning for the runway, and not scanning their instruments.

Proposed Finding: The crew descended below MDA without the field in sight and with the aircraft not in position to safely land.

At the point on the approach where the flight should have reached the MDA if following a normal descent profile, the flight was actually 150 feet low (1,050 feet MSL), and neither crew member showed any signs of recognizing the situation.

According to a security camera at the airport which was incidentally covering the approach to runway 18, the aircraft approach or landing lights first became visible at a time corresponding to an altitude of 272 feet AGL (1,000 feet MSL), or 200 feet below the MDA.

At a Radar Altitude of 247 feet AGL (965 feet MSL), or 235 feet below the MDA, the crew received the EGPWS Sink Rate Alert, but still did not react in a manner consistent with any recognition that the aircraft was below MDA. One second later, the PF reacted to the alert and reduced the V/S to a 640 FPM descent.

At 152 feet AGL (900 feet MSL), or 300 feet below MDA:

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[36] FAR 121.651
[37] FAR 91.175

The PM stated, “There it is.”

The PF stated, “Oh, I got the runway out there 12 o’clock.”

At that point, the flight was 1.24 NM from the runway threshold and still descending.

The PM then responds, “Got the runway in sight, eh.”

The PF states, “Autopilots off.”

The PM states, “Alrighty.”

The Autopilot was then selected off at 96 feet AGL (859 feet MSL), and the descent rate was further adjusted to 448 FPM, still descending.

The aircraft struck the first tree at 832 feet MSL when the flight was 1.05 NM from the runway threshold. At that distance from the runway, the flight should have been at an altitude of at least 1,100 feet MSL based upon a proper glide path utilizing the PAPI.

One second after impacting the first tree the CVR recorded an EGPWS “too low terrain” warning to which the crew attempted to react, but the engines had sustained too much damage for effective recovery.

The PF stated, “Oh, did I hit something?”

The aircraft was still descending at 448 FPM when it impacted the surface terrain.

Analyzing the CVR transcripts from the point the aircraft became visible on the security camera, UPS concludes that the only logical explanation for the behaviors evidenced was that the crew believed they were breaking out above the MDA in VMC, although in actuality they were less than 300 feet AGL. This particular approach has been reported by other pilots as being a “Black Hole Approach” during night VMC, without any visible surface features, such as lights, from which to determine the aircraft's height in relation to the terrain. This is evidenced by the PF’s lack of urgency when responding to the first sink rate call, even though the flight was only 247 feet AGL.

This visual misperception, or optical illusion, was reinforced by the faulty mental model the aircrew had created for themselves by virtue of the expected weather and by the time compression generated by the flight’s high descent rate. As a result the crew may have believed the flight had broken out at or near the ATIS-predicted VMC conditions and at an altitude sufficient to complete the landing sequence. Because the crew expected to break out much earlier, their instrument cross check and callout discipline eroded[38]. This assessment is supported by an analysis of the actions of the crew when they first sighted the field and their subsequent responses. The responses were consistent with a crew encountering VMC conditions on a normal night approach, including the crew's response to the EGPWS Sink Rate Alert.

In summary, the errors made below 1,000 feet AFE appear to be the result of an incorrect shared mental model and degraded situational awareness by both crew members. When the crew did not break out of IMC when expected, and the crew was not alerted to the low altitude of the aircraft by proper instrument cross checks and callouts, they failed to properly arrest the descent rate and initiate a go around. By the time the crew called runway in sight, they were moments from striking the trees that effectively disabled the aircraft and made recovery impossible. The faulty mental model may have caused the crew to not fully realize their proximity to the terrain. Their expectation bias was that they would be above the MDA and hundreds of feet above the terrain when they first saw the runway environment. Consequently, the crew's continuation of the approach without arresting the descent rate was consistent with their misperception of the aircraft's state. The UPS FOM is very clear in stating, "If at any time during the approach the Captain feels that the stabilized approach criteria cannot be achieved or maintained, a go-around must be initiated." The crew's decision to continue the approach offers compelling evidence of a complete breakdown in the crew's situational awareness.

[38] The crew may have anticipated having enough time to accomplish the required callouts and achieve stabilized approach criteria.

7. POST-ACCIDENT SAFETY INITIATIVES AND ENHANCEMENTS.

UPS continuously evaluates procedures and processes to ensure current and potential risks are mitigated. Since the UPS1354 accident, the following actions have been implemented or further evaluated:

1. UPS Flight Training will continue its focus on the execution of non-precision approaches.
    - Additional scenarios are being incorporated into current non-precision approach training including: actual weather that is significantly different than anticipated and approaches where circumstances generate a need for the approach to be discontinued.

2. UPS Flight Operations will continue to emphasize Stabilized Approach Criteria and the No Fault Go-Around Policy:
    - UPS will emphasize the direct connection between Stabilized Approach Criteria and EGPWS Alerts.
    - UPS will emphasize in direct communications with aircrew the No Fault Go-Around Policy.

3. UPS Flight Operations will evaluate and modify required callouts to include specific reference(s) to Stabilized Approach Criteria.

4. UPS Flight Operations will evaluate changes to EGPWS Alert responses in all fleet AOM's.

5. UPS Flight Training will continue training emphasis on aircraft automation management and proper FMA indications.

6. UPS Flight Training conducted industry benchmarking for Pilot Monitoring.
    - UPS Flight Training will continue to actively participate in Industry-Wide Human Factors Workshops, enhance UPS procedures, and incorporate best practices.

7. UPS Flight Operations implemented a technology solution that allows crews to receive METARS remarks when requested via ACARS.

8. UPS Flight Operations is implementing a technical modification to the flight dispatch system that will include METARS remarks in the flight departure papers.

9. UPS is evaluating an upgrade to the EGPWS software.

10. UPS is evaluating the implementation of a LOSA (Line Operation Safety Audit) program to assist in risk assessment.

8. CONCLUSIONS AND RECOMMENDATIONS.

8.1 Proposed Findings.

1. 14 CFR Part 117 regulatory requirements were not raised by the facts surrounding this accident.
2. 14 CFR Part 117 regulatory requirements, even had they been in place, would not have influenced the outcome of this accident.
3. The Captain/PF had adequate rest opportunities for the intended schedule.
4. The FO/PM had adequate rest opportunities for the intended schedule.
5. The Captain/PF took advantage of his sleep opportunities.
6. The FO/PM did not take advantage of her sleep opportunities.
7. UPS provided each pilot adequate crew rest opportunities prior to the accident flight.
8. UPS has a non-punitive fatigue policy that permitted either pilot to call in fatigued if they had elected to do so.
9. Performance markers in the aggregate indicate that the crew was alert and engaged during the accident flight.
10. Performance markers present in the accident scenario are indicative of a flight crew experiencing a loss of situational awareness and task saturation rather than fatigue.
11. The EGPWS software update alone would not have added sufficient warning time to permit the crew to avoid the accident under these circumstances.
12. The flight dispatch system used by UPS did not provide METAR remarks to the crew, however the excluded remarks "*A O2*" held no significance.
13. The flight dispatch system, via ACARS, provided ICAO formatted weather which did not include remarks.
14. Inaccurate weather information for the destination airport at the time of the accident likely contributed to an inaccurate mental model and expectations the crew had for the approach.
15. Proper ATIS updates and inclusion of the most current weather information would have provided weather information even more removed from the actual weather the crew encountered on the approach.
16. Airport weather observation tools were inadequate to identify variable weather at the approach end of the runway and thereby alert the crew to unexpected low ceilings.
17. ATC issued descent clearance well beyond the normal descent profile path.
18. High workload associated with energy management and descent planning in a critical phase of flight led to task saturation.
19. The crew did not properly sequence the FMS causing the aircraft to not have a viable vertical navigation path.

20. The flight crew’s non-pertinent conversation during the descent and approach phase, inconsistent with UPS Sterile Cockpit requirements, likely distracted the crew from higher priority tasks.
21. Task saturation associated with the delayed descent prevented the PF from trapping the sequencing error.
22. Despite using aggressive descent techniques, the flight arrived at the FAF 200’ high and 7 knots fast.
23. The PF selected a V/S mode approach even though it had not been briefed.
24. Both crew members may have believed the lack of vertical guidance was a result of being above the vertical path and not a sequencing error.
25. The PF exhibited “continuation bias “perhaps believing the aircraft would intercept the vertical path and soon encounter night VMC conditions.
26. Time compression caused by a higher than normal rate of descent contributed to the loss of situational awareness by both crew members.
27. A false mental model of the weather conditions contributed to accepting the risk associated with the high rate of descent.
28. The crew did not adhere to UPS Stabilized Approach criteria below 1,000 feet AFE.
29. The crew did not execute a “no-fault” go-around in a timely manner as required by UPS Stabilized Approach criteria.
30. The crew omitted required UPS standard callouts.
31. The crew descended below MDA without the field in sight and with the aircraft not in position to land safely.

8.2 Proposed Probable Cause.

The probable cause of the accident was the flight crew’s task saturation, loss of situational awareness, and non-adherence to UPS standard operating procedures which led to Controlled Flight into Terrain (CFIT).

8.3 Proposed Contributing Factors.

1. Inaccurate arrival ATIS information which allowed the crew to believe they would be landing in night VMC, and fostered a faulty mental model of the intended approach
2. A late ATC directed descent for the arriving flight which kept the aircraft high until late in the approach, not providing sufficient distance to allow the crew to stabilize by the final approach fix, thereby producing time compression, task saturation and distraction during a critical phase of flight.

3. Failure to properly sequence the FMS causing the aircraft to not have a viable vertical navigation path.
4. The flight crew's non-pertinent conversation during the descent and approach phase, inconsistent with UPS Sterile Cockpit requirements, likely distracting the crew from higher priority tasks.
5. The PF's decision to execute a "non-briefed" vertical speed approach when Profile did not capture.
6. The flight crew's non-adherence to UPS Stabilized Approach Criteria and incomplete evaluation of the state of the approach at 1,000 feet AFE.
7. Omission of required call outs on the approach, which deprived the crew of opportunities to trap errors.
8. Descent below MDA prior to having the runway in sight and the aircraft in a position to land safely.
9. Breakdown of critical Pilot Monitoring duties during latter portions of the approach phase.

8.4 Recommendations.

As a result of this accident UPS Airlines believes the NTSB should issue the following recommendations to the following:

1. FAA to review guidance requirements regarding which METAR remarks are required to be included in the ATIS information.
2. National Weather Service and FAA to evaluate quality of ceiling information provided by ASOS systems.
3. FAA to establish guidelines for maximum descent gradients for aircraft arrivals.
4. Industry Working Groups to develop enhanced guidance for PM duties and responsibilities.
5. FAA and manufacturers to evaluate current TSO standards for EGPWS to determine if new technology exists to enhance the current level of safety during approaches.
6. UPS to emphasize the facts of this case to its aircrews to enhance its FRMP.
7. UPS to emphasize the facts of this case to its aircrews to emphasize the importance of Pilot Monitoring duties.
8. UPS to emphasize the facts of this case to its aircrews to emphasize the importance of UPS's Stabilized Approach Criteria.