

National Transportation Safety Board

Office of Aviation Safety

Washington, DC 20594



DCA22LA126

OPERATIONAL FACTORS/HUMAN PERFORMANCE

Group Chairs' Factual Report

November 9, 2022

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A. INCIDENT

Location: Tulsa, Oklahoma
Date: June 8, 2022
Time: 0415 central daylight time (CDT)¹
0915 universal time coordinated (UTC)
Airplane: Boeing 757-236; N949FD, FedEx² 1170

B. OPERATIONAL FACTORS/HUMAN PERFORMANCE GROUP

Group Co-Chair	Shawn Etcher National Transportation Safety Board Washington, D.C. 20594
Group Co-Chair	Sabrina Woods National Transportation Safety Board Washington, D.C. 20594
Group Member	Dajuan Sevillian National Transportation Safety Board Washington, D.C. 20594
Group Member	James Hobart Federal Aviation Administration (FAA) Louisville, KY 40223
Group Member	Todd Johnson FedEx Express Memphis, TN 38118
Group Member	John "Max" Clark Airline Pilots Association (ALPA) McLean, VA 22102

C. SUMMARY

On June 8, 2022, about 0415 local, FedEx flight 1170, a B757-236, N949FD, landed at Tulsa International Airport (TUL), Tulsa, Oklahoma. The flight was in contact

¹ All times within this report will be in CDT and at the time of the incident UTC time was CDT + 5 hours.

² Throughout the report FedEx Express and FedEx will be synonymous.

with air traffic control and prior to the landing were cleared for and acknowledged the clearance to land on runway 18L. However, radar data indicated that the flight lined up for and landed on runway 18R. After landing, the airplane taxied to the ramp. The two flight crew members were the only occupants on board and were uninjured. The flight was operating under Title 14 *Code of Federal Regulations* Part 121 as a cargo flight from Perot Field/Fort Worth Alliance Airport (AFW), Fort Worth, Texas to TUL.

D. FACTUAL INFORMATION

1.0 Operational Factors and Human Performance Group Activities

1.1 June 8, 2022

The Group Chairmen were notified of the incident and began collecting data to begin travel and the investigation. Request for pilot interviews, pilot records, flight information, and manuals were sent via email to the operator's party coordinator.

1.2 June 9, 2022

The Group Chairmen traveled to Memphis, Tennessee to conduct interviews with the incident flight crews the following day.

1.3 June 10, 2022

The group convened at the FedEx facility located in Memphis Tennessee. The group interviewed the incident first officer and then the incident captain.³

1.4 July 26, 2022

The group reconvened at the FedEx facility located in Memphis Tennessee and interviewed the fatigue risk management program manager and their human factors and training manager. The group had an opportunity to view a sleep room and discussed the reservation process with the program manager. Additionally, the group conducted a simulator session to document the flight deck indications that would have been available to the crew on the morning of the incident for both runway 18R and 18L.⁴

³ For further detail on the interviews reference Operational Factors/Human Performance – Attachment 1 – Flight Crew Interview Summaries and Statements.

⁴ For further detail on the simulator evaluation reference Operational Factors/Human Performance – Attachment 9 - Simulator Evaluation.

1.5 July 27, 2022

The group convened at the ALPA FedEx Master Executive Council's office located in Memphis Tennessee to discuss the ALPA fatigue risk management software program.

2.0 History of Flight

According to crew statements and trip pairing documentation, the incident flight crew began the day's pairing in Ontario, California. Their report time was 1850 Pacific daylight time (2050 CDT). Their first flight of the evening was from Ontario International Airport (ONT), Ontario, California to AFW. The flight arrived at AFW about 0030 CDT.

After postflight procedures each crewmember procured a crew rest room. According to the first officer, he was able to get about 30 minutes of rest prior to preparing for the next flight, which was the incident flight. The captain reported that he attempted to obtain rest, however, he *"couldn't get to sleep."* However, the captain added that he would not have flown fatigued, and he did not feel tired on the incident flight.

The crew reconvened in the preflight briefing room, where they checked NOTAMs⁵ and the weather. Then they proceeded to the airplane where they conducted preflight checks.

About 0330, the flight pushed back from the parking position, taxied out to the runway, and departed AFW for the less than one-hour flight to TUL. The captain was the pilot flying and the first officer was the pilot monitoring. The flight climbed to an enroute altitude of FL310⁶ and the departure, enroute, and descent phases of flight were uneventful.

The first officer stated that at the start of the descent he obtained the current TUL weather and performance data for the landing. He then proceeded to set up the frequencies for the ILS⁷. Additionally, they created a waypoint about 30 miles from the airport as they wanted to be at 11,000 ft at that point. The captain briefed the anticipated visual approach, backed up by the ILS, and landing to runway 18L, which

⁵ Notice to Air Missions.

⁶ A level of constant atmospheric pressure related to a reference datum of 29.92 inches of mercury, stated in three digits that represent hundreds of feet. Source Aeronautical Information Manual "Pilot/Controller Glossary." FL310 is the height above mean sea level (msl) at standard atmospheric pressure measured in hundreds of feet (i.e., FL310 is about 31,000 feet msl).

⁷ Instrument landing system.

included the frequency for the ILS, the Vref⁸ speed of 123 kts, and the approach lights for runway 18L. He also briefed that they would not use the autobrakes, as he wanted to “roll long” as the parking location was at the south end of runway 18L.

The flight was transferred from the FAA Air Route Traffic Control Center to the FAA TUL approach controller about 10,000 ft and were issued a heading of 360°, which routed the flight west of the airport. According to the flight crew the flight was in instrument meteorological conditions at the time. The flight was given a further descent and then exited the base of the clouds. The first officer reported that when the flight exited the clouds, he could not see the runway but did visually acquire the TUL airport beacon and said it “*looked like a normal downwind.*” The captain reported that after exiting the clouds he could see the lights for runway 8/26 and that they were “normal.” Additionally, the captain reported that he had flown into TUL about two weeks prior.

The flight crew extended the centerline for runway 18L in their FMS⁹, which displayed the extended centerline on their navigational display in the cockpit. Additionally, the first officer identified that the frequency for the ILS 18L was correct and, when the captain requested, extended the flaps to one.

The approach controller asked, and the crew verified that they had the airport in sight and the flight was cleared for the visual approach to runway 18L and cleared to land runway 18L. The captain commanded the autopilot to start the turn to the right and the first officer set 2,400 ft into the altitude preselector, as that was the altitude for the final approach fix as published on the ILS 18L approach chart. During the turn to final, the captain stated he disengaged the autopilot, the flight crew extending the flaps to 5 and subsequently configured the airplane for landing which included flaps 30 and then conducted the before landing checklist.

According to the first officer, while on final approach, the aircraft appeared low visually and he brought that to the captain’s attention. He further explained that the glideslope appeared to be “normal” however, the PAPI¹⁰ lights indicated they were below the runway’s glidepath. Additionally, he stated that the deviation bar on his HSI¹¹ was deflected to the left; however, during the incident flight he did not bring that to the captain’s awareness.¹² The captain adjusted the descent rate of the airplane to place the airplane on the visual glideslope as indicated by the PAPI.

⁸ Reference landing speed, which is an airspeed used for final approach, which adjust the normal approach speed for winds and gusty conditions. Vref is 1.3 times the stall speed in the landing configuration. Source: FAA [Airplane Flying Handbook \(FAA-H-8083-3B\) Chapter 12](#)

⁹ Flight Management System.

¹⁰ Precision Approach Path Indicator.

¹¹ Horizontal Situation Indicator.

¹² Source: Operational Factors/Human Performance Attachment 1: “Crew Interview Summaries,” pg. 3.
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According to the captain, the airplane was equipped with a HUD¹³ which was in front of him and in use during the approach. He stated that initially the HUD was showing “*slightly off to the left.*” However, he transitioned visually to what the PAPI lights were indicating for his vertical alignment with the runway and was more focused on that.

The flight touched down on runway 18R and the RAAS¹⁴ subsequently announced there was 3,000 ft of runway remaining. The captain stated during a post incident interview, that he applied the brakes and “*came on them harder initially because he was confused.*” After slowing the airplane, the captain further reported to the first officer “*yep, we landed on the wrong side.*” The controller told the flight to taxi to the end of the runway and to the ramp. However, the crew informed the controller that they had landed on runway 18R and were then issued revised taxi instructions to the ramp.

3.0 Crew

The incident flight crew consisted of a captain and first officer. During the interview with the captain, he stated that he had flown into TUL “*at least a hundred times*”¹⁵ and the most recent was about two weeks prior to the incident. The first officer stated during his interview that it was his second time operating into TUL since his employment began with FedEx. Both crewmembers stated that this pairing was the first time they had flown with each other.

3.1 Captain

The captain was 57-years-old and held an Airline Transport Pilot certificate with a rating for airplane single engine land and multiengine land, and type ratings on the A-310¹⁶, B-707¹⁷, B-720, B-757¹⁸, B-767 which included limitations of B-757, B-767, A-310 Circling approach – VMC Only, and English Proficient. He held an FAA first-class medical certificate dated January 27, 2022, with limitation of must wear corrective

¹³ Heads-Up Display.

¹⁴ Runway Awareness and Advisory System.

¹⁵ Source: Operational Factors/Human Performance – Attachment 1 Crew Interview Summaries and Statements, pg. 3.

¹⁶ Airbus SAS, A300 Model B4-601, A300 Model B4-603, A300 Model B4-620, A300 Model B4-605R, A300 Model B4-622R, A300 Model B4605R Variant F, A300 Model B4-622, A310 Model 204, A310 Model 221, A310 Model 222, A310 Model 203, A310 Model 322, A310 Model 324, A321XLR Model 30, A310 Model 325. Source: FAA Order 8900.1, Figure 5-88, dated July 15, 2019.

¹⁷ The Boeing Company, 707-100 Long Body, 707-100B, Long Body, 707-100B Short Body, 707-200, 707-300, 707-300B, 707-300C, 707-400, 720 Series, 720B Series. Source: FAA Order 8900.1, Figure 5-88, dated July 15, 2019.

¹⁸ The Boeing Company, 757-200 Series, 757-200PF Series, 757-200CB Series, 757-300 Series, 767-200 Series, 767-300 Series, 767-300F Series, 767-400ER Series, 767-2C Series. Source: FAA Order 8900.1, Figure 5-88, dated July 15, 2019.

lenses. At the time of the incident, he was based at Memphis International Airport (MEM), Memphis, Tennessee.

3.1.1 Captain's Pilot Certification Records

FAA records indicated the following:

Commercial Pilot - Airplane Multiengine Land Limited to Center Thrust, Instrument Airplane certificate was issued August 12, 1988.

Commercial Pilot - Airplane Single- Engine Land, Multiengine Land limited to Center Thrust, Instrument Airplane certificate was issued February 5, 1989.

Commercial Pilot - Airplane Single-Engine and Multiengine Land, Instrument Airplane, B-707/720 certificate was issued January 12, 1996.

Airline Transport Pilot - Airplane Multiengine Land, B707, B720; Commercial Privileges Airplane Single-Engine Land certificate was issued December 2, 2006.

Airline Transport Pilot - Airplane Multiengine Land, B-707, B-720, B-757/767; Commercial Privileges Airplane Single-Engine Land; B-757/767 Circ. Apch - VMC¹⁹ Only certificate was issued August 27, 2007.

Airline Transport Pilot - Airplane Multiengine Land, A-310, B707, B720, B-757, B-767; Commercial Privileges Airplane Single-Engine Land; Limitations - English Proficient; A-310, B-757, B-767 Circ. Apch - VMC Only certificate was issued May 18, 2012.

3.1.2 Captain's Pilot Certificates and Ratings Held at Time of the Incident

AIRLINE TRANSPORT PILOT (issued May 18, 2012)

Airplane Multiengine Land

A-310, B-707, B-720, B-757, B-767

Commercial Privileges - Airplane Single-Engine Land

Limitations: English Proficient; A-310, B-757, B-767 Circ. Apch - VMC Only

MEDICAL CERTIFICATE FIRST CLASS (issued January 27, 2022)

Limitations: Must wear corrective lenses.

¹⁹ Visual Meteorological Conditions.
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3.1.3 Captain's Flight hours

The captain's approximate flight times were based on pilot interviews and FedEx Express provided records:

Previous 24 hours	7:19
Last 30 days	48:33
Last 60 days	72:06
Last 90 days	81:49
Total Hours B757 as Captain	789:56
Total Flight Experience	10,000 ²⁰

3.1.4 Captain's Training and Proficiency Check Completed

A summary of the captain's recent training events at FedEx Express was as follows:

Initial Qualification -B757	October 30, 2019
Most Recent Recurrent Pilot Continuous Maneuvers Training	January 24-25, 2022
Most Recent Continuous Line Operating Evaluation	April 23, 2021
Most Recent Line Check	February 5, 2022
Most Recent Fatigue Training ²¹	August 2019
Most Recent HUD Training	February 5, 2022
Most Recent EFVS ²² Training	February 5, 2022
Most Recent Recurrent Ground School	April 21, 2021
Most Recent Human Factors Training	April 21, 2021

3.1.5 Captain's Sleep Schedule

In the 72 hours preceding the incident, the captain obtained approximately 18 ½ hours of sleep according to his statements. His account starts the evening of June 5 therefore it is unknown at what time he awoke that morning. He obtained

²⁰ Source: Captain interview.

²¹ Fatigue training occurred as part of the Ground School Initial/Transition Learning Management System computer-based training curriculum during the captain's upgrade training.

²² Enhanced Flight Vision System.

approximately seven hours of sleep, followed by a six-hour period of wakefulness, a two-hour nap, another six-hour period of wakefulness, and a final four-and-a-half-hour period of rest prior to the 0225 crew show on June 7. Following that flight, he slept for approximately five hours. The captain did not have another period of rest before the incident flight. He was awake for approximately 15 hours and 30 minutes prior to the incident occurring.

3.1.6 Captain's 72-Hour History

On June 5, 2022, the captain reported he was in bed by 2300. His alarm was set for 0400 on June 6th so that he could deadhead from Will Rogers World Airport (OKC), Oklahoma City, Oklahoma to Indianapolis International Airport (IND) Indianapolis, Indiana to start the trip. He arrived at IND at approximately 1100 eastern daylight time (EDT). The captain took a nap, ate dinner, and took a walk. Cell phone records show there was activity between 1500 and 1900 EDT²³. He reported he went back to bed about 2000 EDT and woke about 0100 EDT for crew show time. The crew flew to ONT arriving at 0425 PDT and got to their hotel about 0545 PDT. The captain went to bed about 0700 PDT. Cell phone records indicate there was some activity about 0700 PDT. The captain said he slept until about 1230/1300 PDT. He then went for a walk, ate lunch, and came back for show time about 1848 PDT. There was cell phone activity from 1500 to 1700 PDT. The crew then flew from ONT to AFW, the flight taking about 2 and ½ hours. The captain stated he tried to take a nap but could not fall asleep. The crew show time for TUL was 0230 where, according to the captain, they briefed the flight, weather, NOTAMS and took off at about 0330. The crew flew to TUL landing at 0423.

3.2 First Officer

The first officer was 50-years-old and held an ATP certificate with a rating for multiengine land single-engine land, rotorcraft-helicopter, instrument helicopter, instrument powered-lift, powered-lift, and type ratings in the A-320²⁴, B-757, B-767, with limitations of English Proficient and A-320, B-757, B-767 CIRC. APCH. - VMC ONLY. He also held a flight instructor certificate with ratings for Airplane Single and Multiengine, Rotorcraft- Helicopter, Instrument Airplane and Helicopter, Instrument Powered-Lift, Powered-Lift; however, the certificate expired on July 31, 2017. He held an FAA first-class medical certificate dated May 24, 2022, with no medical restrictions. At the time of the incident, he was based at MEM.

²³ Mobile phone records obtained from the carrier were listed in UTC therefore adjustments had to be made to reflect each time zone in the 72-hour history.

²⁴ Airbus SAS, A-318 Series, A-319 Series, A-320 Series, A-321 Series. Source: FAA Order 8900.1, Figure 5-88, dated July 15, 2019.

3.2.1 First Officer's Pilot Certification Record

FAA records indicated the following:

Commercial Pilot - Airplane Single-Engine Land; Rotorcraft Helicopter; Instrument Airplane & Helicopter certificate was issued October 10, 1997.

Commercial Pilot - Airplane Single and Multiengine Land; Rotorcraft - Helicopter; Instrument Airplane and Helicopter certificate was issued March 11, 2000.

Flight Instructor - Rotorcraft Helicopter; Instrument Helicopter certificate was issued May 10, 2014.

Flight Instructor - Airplane Multiengine; Rotorcraft Helicopter; Instrument Helicopter certificate was issued May 10, 2014.

Airline Transport Pilot - Airplane Multiengine Land; Commercial Pilot Privileges: Airplane Single-Engine land; rotorcraft Helicopter; Instrument Helicopter; Limitations: English Proficient certificate was issued on July 13, 2014.

Airline Transport Pilot - Airplane Multiengine Land; Commercial Privileges: Airplane Single-Engine Land, Powered Lift, Rotorcraft - Helicopter, Instrument Helicopter; Limitations: English Proficient certificate was issued March 15, 2015.

Airline Transport Pilot - Airplane Multiengine Land; Commercial Privileges: Airplane Single-Engine Land, Rotorcraft - Helicopter, Instrument Helicopter Powered Lift, Powered Lift Instrument; Limitations: English Proficient certificate was issued July 6, 2015.

Flight Instructor - Airplane Multiengine, Powered Lift, Instrument Powered Lift, Rotorcraft Helicopter, Instrument Helicopter certificated was issued July 7, 2015.

Flight Instructor - Airplane Multiengine, Instrument Airplane, Powered Lift, Instrument Powered Lift, Rotorcraft Helicopter, Instrument Helicopter certificate was issued July 7, 2015.

Flight Instructor - Airplane Single and Multiengine, Instrument Airplane, Rotorcraft Helicopter, Instrument Helicopter, Powered Lift, Instrument Powered Lift certificate was issued July 8, 2015.

Airline Transport Pilot - Airplane Multiengine Land; A-320; Commercial Privileges: Airplane Single-Engine Land, Rotorcraft - Helicopter, Instrument Helicopter Powered Lift, Powered Lift Instrument; Limitations: English Proficient, A-320 Circ Apch - VMC Only certificate was issued December 17, 2019.

Airline Transport Pilot – Airplane Multiengine Land; A-320, B-757, B-767; Commercial Privileges: Airplane Single-Engine Land, Rotorcraft – Helicopter, Instrument Helicopter, Powered Lift, Powered Lift Instrument; Limitations: English Proficient, A-320, B-757, B-767 Circ Apch – VMC Only certificate was issued August 28, 2020.

3.2.2 First Officer’s Pilot Certificates and Ratings Held at the Time of the Incident

AIRLINE TRANSPORT PILOT (issued August 28, 2020)

Airplane Multiengine Land

A-320, B-757, B-767

Commercial Privileges – Airplane Single-Engine Land, Rotorcraft – Helicopter, Instrument Helicopter, Powered Lift, Powered Lift Instrument

Limitations: English Proficient; A-320, B-757, B-767 Circ. Apch – VMC Only

MEDICAL CERTIFICATE FIRST CLASS (issued May 24, 2022)

Limitations: None.

3.2.3 First Officer’s Flight hours

The first officer’s approximate flight times were based on pilot interviews and FedEx Express provided records:

Previous 24 hours	7:19
Last 30 days	36:44
Last 60 days	69:26
Last 90 days	98:17
Total Hours B757 as FO	739:21
Total Flight Experience	4,500 ²⁵

3.2.4 First Officers Training and Proficiency Checks Completed

A summary of the first officer’s recent training events at FedEx Express was as follows:

Initial Qualification – 757	September 23, 2020
Most Recent Line Check	May 20, 2021
Most Recent Continuous Line Operating Evaluation	November 10, 2021

²⁵ Source: First Officer interview.

Most Recent Fatigue Training ²⁶	November 11, 2021
Most Recent HUD Training	March 20, 2021
Most Recent EFVS Training	March 20, 2021
Most Recent Recurrent Ground School	November 8, 2021
Most Recent Human Factors Training	November 8, 2021

3.2.5 First Officer's Sleep Schedule

In the 72 hours preceding the incident, the first officer obtained approximately 22½ hours of sleep according to his statements. His account starts the evening of June 5 therefore it is unknown at what time he awoke that morning. The longest period of rest was the evening of June 5 to the morning of June 6 where the first officer recorded approximately nine hours of sleep. This was followed by a period of wakefulness for approximately 12 hours. A four-hour nap followed and was prior to the 0225 crew show on June 7. After that flight, the first officer recorded another seven hours of sleep, interrupted by a lunch break. The next crew show was approximately three hours later. Following that flight, the first officer took a short, ½ hour nap before the last crew show at 0226 for the incident flight. He was awake for approximately 12 hours since his last prolonged period of rest, and three hours since his nap, prior to the incident occurring.

3.2.6 First Officer's 72-Hour History

The first officer lived in Colorado. On June 6, he awoke about 0600 mountain daylight time (MDT) and flew from Denver International Airport (DEN), Denver Colorado to IND about 1100 MDT. He arrived just before 1600 EDT. He took a rideshare to the hotel at approximately 1630 EDT, ate dinner, then retired to his room. Cell phone records indicate there was some activity between 1600 and 1800 EDT.²⁷ The first officer indicated he was in bed about 1900 EDT. He was awakened about 2300 EDT and could not go back to sleep. He stated that at approximately 0130 EDT, he got up to go through his routine and get ready for the flight. The crew had a 0225 EDT crew show for the flight and departed about 0355 EDT. They flew from IND to ONT, a 4hr 19 min flight. They landed in ONT at 0510 PDT. The first officer indicated that he ate breakfast, then went to bed until 1130 PDT. He got up, went for a walk until approximately 1400 PDT, and then took about a two-hour nap. Cell phone records indicate there was some activity around 1400 PDT and again at 1800 PDT. He was up at 1750 PDT for a show time at 1850 PDT. They arrived in AFW, and the first officer signed up for a sleep room, ate, and indicated he got about 20-30 minutes of sleep during the scheduled 2hr 44 min layover. The crew showtime for the flight to TUL was

²⁶ Fatigue training occurred during the Human Factors Ground School training. Additionally, the first officer received fatigue training in June 2020 as part of the new hire curriculum.

²⁷ Mobile phone records from the carrier were used to establish a 72-hour history.

approximately 0226. The crew briefed the flight and prepped for departure that occurred at approximately 0330.

3.3 Trip Pairing

The FedEx flight operations manager stated that the biomathematical software used to assess trip pairings assumed that a nap was to be taken in hub-turns lasting 2 ½ hours or more (see section 8.6 Fatigue Risk Management Program). This assumption was not conveyed to flight crews.

Figure 1 depicts the original pairing the crew was assigned at the start of their trip on June 6, 2022:

Trip 217 Version 009 (Caused by TRADEASSIGNMENT)																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																											
R	D	Flight	H	Date	Org-Dst	Eq	Dprt	Arrv	Blok	Turn	Duty	Dprt	Arrv	Blok	Turn	Duty	CFSR2JJTTT	8	T	I	Lg	Cls	Tail#	P	Brf	Dfb	Meals	F	A	P	Role	---	Layover---																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																										
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Figure 1: Original trip pairing.

Figure 2 depicts the modified pairing the crew was given following the incident flight:

Trip Recap

Trip 3103 MEM 57 06JUN22

Shows in 0 days 0:00 hours

Block 7:49 Pay 17:20

R	D	Flight	H	Date	Org-Dst	Eq	Dprt	Arrv	Blok	Turn	Lyovr	Duty	Dprt	Arrv	Blok	Turn	Lyovr	Duty	Meals
DL1648	X	06Jun22	MEM-ATL	1100	1215	115	150						1100	1215	115	150			
DL1554	X	06Jun22	ATL-IND	1405	1534	129	1621	1451	604	1405	1534	129	1621	1451	604				
GT		06JUN22																	
HOTEL		06JUN22																	
GT		07JUN22																	
1701		07Jun22	IND-ONT	0755	1210	415	1458	1328	545	0806	1225	419	1443	1313	600	BM			
GT		07JUN22																	
HOTEL		07JUN22																	
GT		08JUN22																	
1116		08Jun22	ONT-AFW	0308	0546	238	244						0250	0526	236	257			DM
1170		08Jun22	AFW-TUL	0830	0926	56							748	0823	0922	59			744
--- TOTAL SCHEDULED ---										--- TOTAL ACTUAL ---									
Away	Blok	DH	Dty	Min	Trip	Totl	Pay	Away	Blok	DH	Dty	Min	Trip	Totl	Pay				
4756	749						1720	4752	754						1720				

Figure 2. Post-incident trip pairing.

4.0 Airplane



Figure 3. Incident Airplane (Source: FlightRadar 24).

The airplane was a B757-236, Serial No. 25060 and was manufactured in 1991. It was powered by two Rolls-Royce RB211-535E4 engines, each capable of producing 42,540 pounds of thrust. The airplane was purchased by and registered to FedEx on October 21, 2010. Prior to that, it was registered to British Airways PLC in the United Kingdom.

The airplane was equipped with an EFIS²⁸, FMS²⁹, and HUD³⁰. The captain stated he had the HUD in use until he was on the visual approach to the runway. He never stowed the HUD, but he was able to “look through it” to the runway to see the PAPIs and focus on the runway.

4.1 Weight and Balance

Weight and balance information was taken from the dispatch flight release. Limitations are indicated in **bold** type. All weights below are in pounds (lbs.).

	Weight ³¹
Basic Operating Weight	121,212
Fuel	25,800
Cargo	33,700

²⁸ Electronic Flight Instrument System.

²⁹ Flight Management System.

³⁰ Heads-Up Display.

³¹ Weight is based on lbs.

Zero Fuel Weight	154,912
Maximum Zero Fuel Weight	184,000
Ramp Weight	180,712
Maximum Taxi Weight	231,000
Taxi fuel	600
Takeoff Gross Weight	180,112
Maximum Takeoff Weight	230,000
Enroute Fuel Burn	5,960
Projected Landing Weight	174,152
Maximum Landing Weight	198,000
Takeoff C.G. ³²	31.2

5.0 Airport Information

Tulsa International Airport was located about 5 miles northeast of Tulsa, Oklahoma, had a field elevation of 677.5 ft msl. The airport was owned by the City of Tulsa and was serviced by an FAA Air Traffic Control Tower (ATCT) that was in operation 24-hours a day. The ATCT was in operation at the time of the incident. Approach radar services were provided by Tulsa Approach control.

At the time of the incident, TUL, had three paved runway surfaces designated as 18L/36R, 18R/36L, and 8/26. The intended landing runway 18L was 10,000 ft long and 150 ft wide, with precision instrument markings. It had high-intensity edge lights, centerline lights, a 4-light PAPI on the left side of the runway, and MALSR³³ approach lights. The actual landing runway 18R was 6,101 ft long and 150 ft wide with precision instrument markings and a 600-foot displaced threshold. It had high-intensity edge lights, a 4-light PAPI located on the left side of the runway, and runway end identifier lights.

A NOTAM for TUL showed for runway 18R/36L the following:

*KTUL APT 2021112D544V1 11/062 15NOV21 1829Z - PERM
TUL RWY 18R/36L CHANGED TO 6101FT X 100FT
2111151829-PERM*

³² C.G. range was 9.8 to 37.2

³³ Medium Intensity Approach Light System with Runway Alignment Indicator Lights.
OPERATIONAL FACTORS/HUMAN PERFORMANCE
GROUP CHAIRS' FACTUAL REPORT

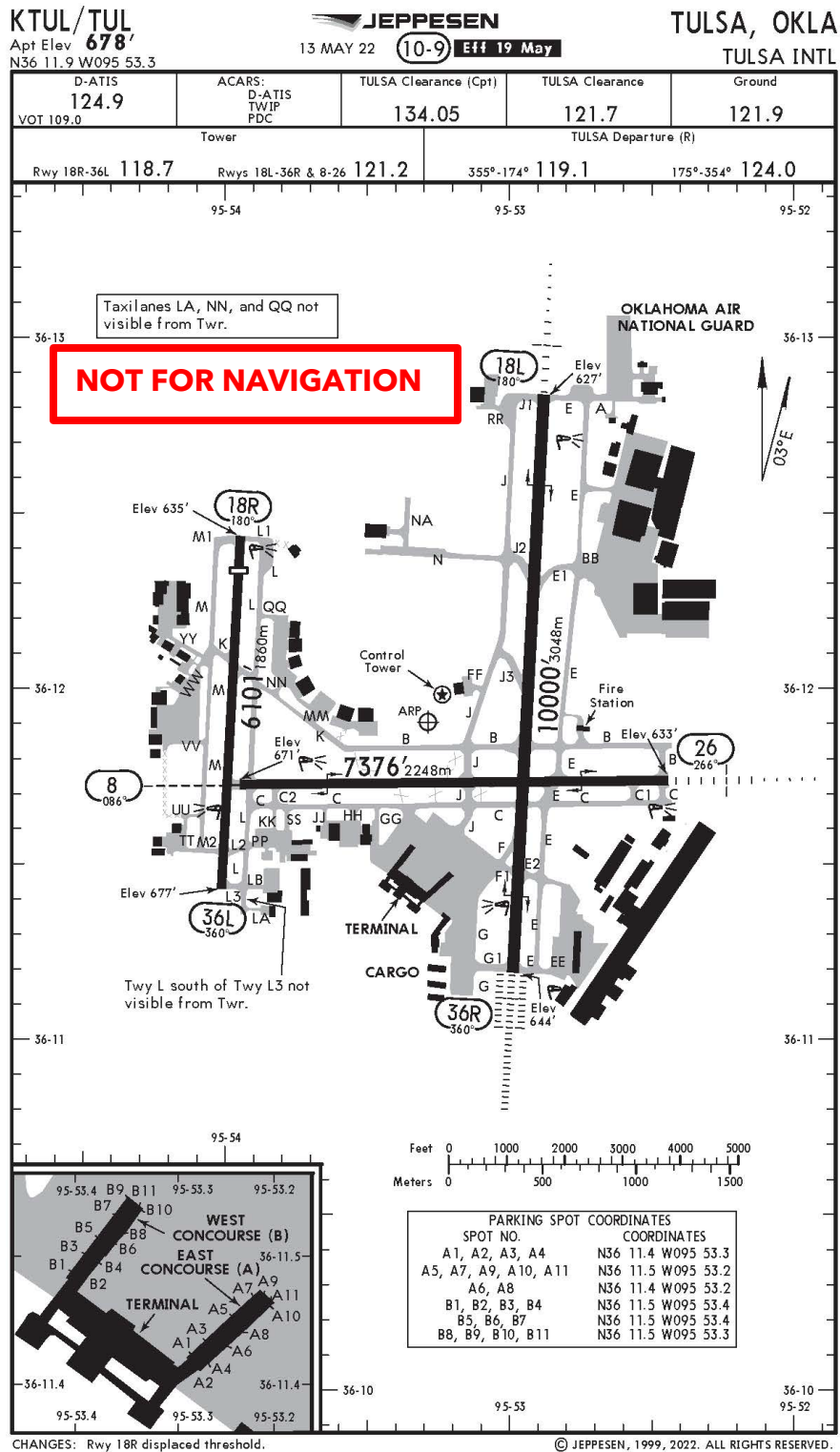


Figure 4. Tulsa International Airport 10-9 Airport Diagram
(Source: Jeppesen)

5.1 TUL Airport Information Chart

KTUL/TUL

JEPPESSEN
13 MAY 22 **10-9A** Eff 19 May

TULSA, OKLA

TULSA INTL

GENERAL						
CAUTION: 4000' blacktop track 1.5 NM east Rwy 26, do not mistake for rwy.						
Irregular wind pattern approach end Runway 18R.						
Low-level wind shear alert system.						
Terminal Doppler Weather Radar.						
Noise abatement all rwys: Climb to 3000' as soon as possible after takeoff.						
Rwy 18R and 36R right traffic.						
ADDITIONAL RUNWAY INFORMATION						
RWY				USABLE LENGTHS		
				LANDING BEYOND		
				Threshold	Glide Slope	TAKE-OFF
						WIDTH
8	HIRL REIL ① PAPI-L (angle 3.00°)	grooved				150'
26	HIRL MALSR ②③ PAPI-L	grooved				46m
① PAPI unusable beyond 8° both sides of centerline.						
② Angle 3.00°.						
③ PAPI unusable beyond 7° right and 9° left of centerline.						
18L	HIRL CL MALSR PAPI-L (angle 2.75°)	RVR		8944' 2726m		150'
④ 36R	HIRL CL ALSF-II TDZ ⑤ PAPI-L	RVR		9090' 2771m		46m
④ Grooved.						
⑤ Angle 3.00°.						
18R	HIRL REIL PAPI-L (angle 2.75°)	grooved	⑥ 5501' 1677m	5426' 1654m		150'
36L	HIRL REIL PAPI-L (angle 3.00°)	grooved	⑥			46m
⑥ LDA 5101' 1555m						
TAKE-OFF & OBSTACLE DEPARTURE PROCEDURE						
Rwys 18L, 36R						
2 operating RVRs are required All operating RVRs are controlling		Adequate Vis Ref		STD		
CL & HIRL						1 & 2 Eng
TDZ RVR 5						
Mid RVR 5						
Rollout RVR 5						
Rwys 8, 18R, 26, 36L						
Adequate Vis Ref		STD				
		3 & 4 Eng		1 & 2 Eng		
1/4		1/2		1		
OBSTACLE DP						
Rwy 26- Climb on a heading between 292° clockwise to 086° from departure end of runway, or minimum climb of 222'/NM to 2900' for headings 087° through 291°.						
(For TAKEOFF OBSTACLE NOTES see 10-9A1)						
FOR FILING AS ALTERNATE						
ILS Rwy 18L ILS Rwy 18R ILS Rwy 36R		RNAV (GPS) Rwy 26		LOC Rwy 18L LOC Rwy 18R LOC Rwy 36R RNAV (GPS) Rwy 8 RNAV (GPS) Rwy 18L RNAV (GPS) Rwy 18R RNAV (GPS) Rwy 36L RNAV (GPS) Rwy 36R VOR DME Rwy 8 VOR Rwy 26 RADAR-1		
A	600-2	800-2	800-2			
B						
C			900-2½			
D			900-2¾			
CHANGES: Rwy 18R/36L usable lghs, Rwy 26 REIL, notes, ILS Rwy 18R alt mms.						
© JEPPESEN, 1999, 2022. ALL RIGHTS RESERVED						

CHANGES: Rwy 18R/36L usable lgths, Rwy 26 REIL, notes, ILS Rwy 18R alt mms. © JEPPESSEN, 1999, 2022. ALL RIGHTS RESERVED.

Figure 5. Tulsa International 10-9A (Source: Jeppesen)

5.2 ILS 18L Approach Chart

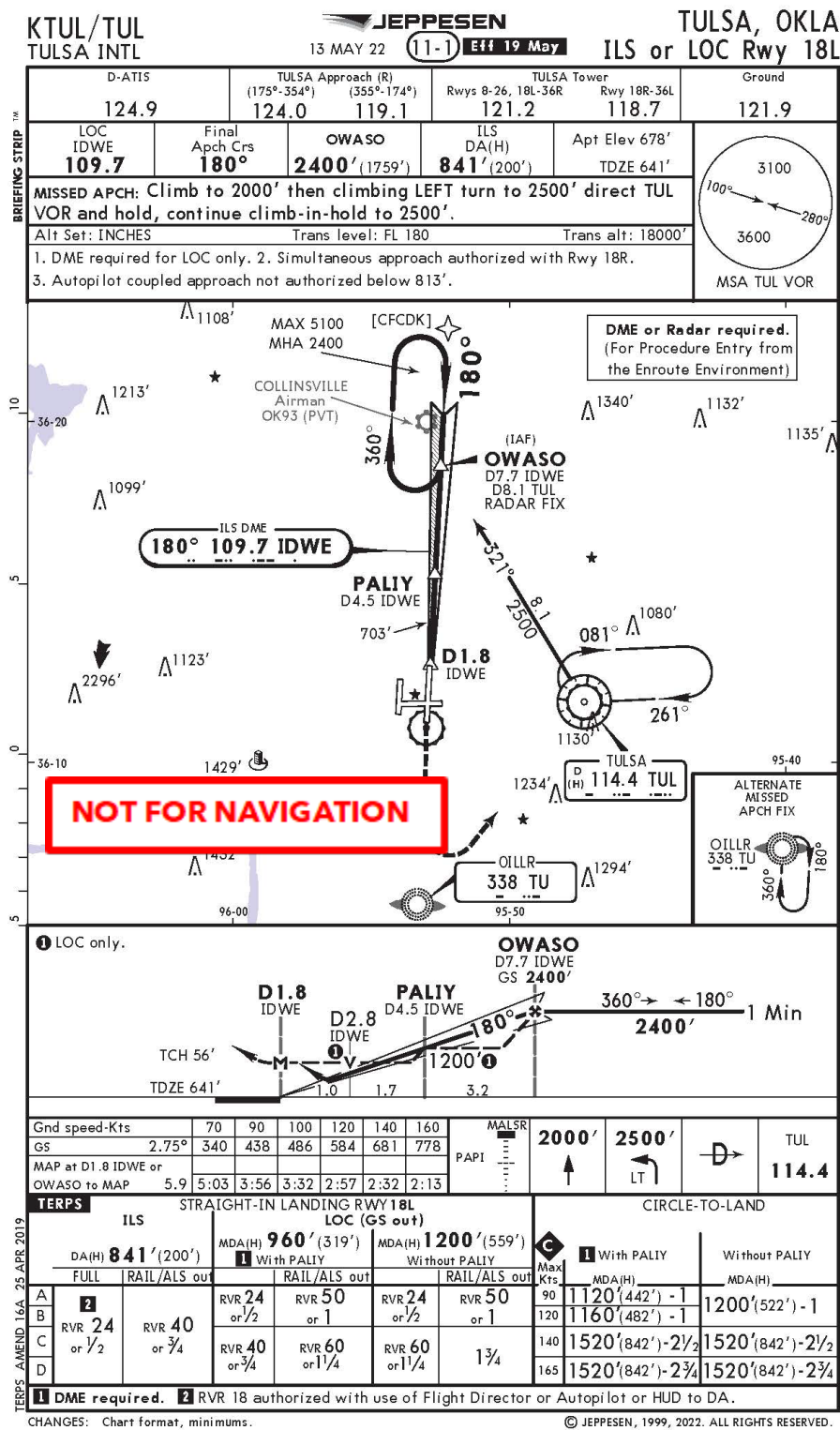


Figure 6. Tulsa International ILS 18L 11-1 Approach Plate (Source: Jeppesen)

5.3 Approach Lighting

According to the Aeronautical Information Manual Pilot/Controller Glossary, the PAPI provides vertical approach slope guidance to landing aircraft. PAPIs consist of a single row of either two or four lights, normally installed on the left side of the runway, and have an effective visual range of about 5 miles during the day and up to 20 miles at night. PAPIs radiate a directional pattern of high intensity red and white focused light beams which indicated that the pilot is "on path" if the pilot sees an equal number of white lights and red lights, with white to the left of the red; "above path" if the pilot sees more white than red lights; and "below path" if the pilot sees more red than white lights.

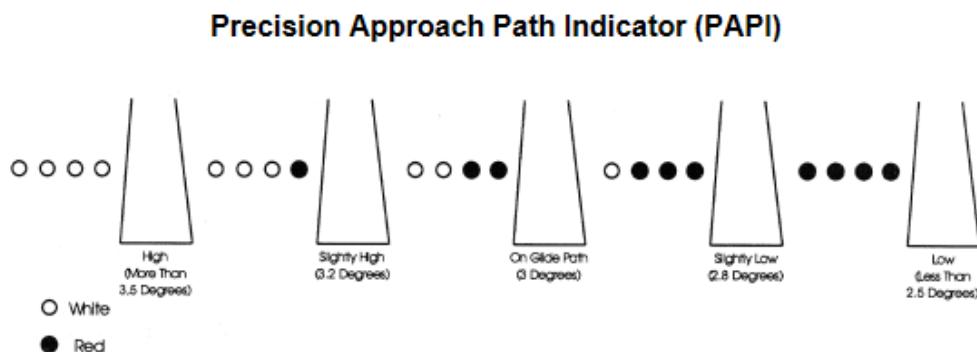


Figure 7: Precision Approach Path Indicator³⁴

6.0 Meteorological Information

The most recent recorded weather, prior to the incident, was the TUL METAR, which recorded the following:

*METAR KTUL 080853Z 04006KT 10SM FEW043 BKN055 BKN070 BKN250
23/22 A2986 RMK AO2 SLP104 T02330217 51002=*

7.0 Operator

FedEx began operations in 1973³⁵. They conducted cargo operations and had a CFR Part 121 certificate that was issued on March 7, 1972. According to the FAA website³⁶, FedEx conducted both domestic and flag (passenger/cargo) operations, had 491 airplanes, and of those aircraft 112 were B-757. The FAA Certificate Management Office that oversaw FedEx was in Memphis, Tennessee.

³⁴ Aeronautical Information Manual Chapter 2 Figure 2-1-5

³⁵ Source: [Our History | FedEx](#)

³⁶ Source: [Federal Aviation Administration - Airline Certificate Information - Detail View \(faa.gov\)](#).

FedEx had an ASAP³⁷ and FOQA³⁸ program. The crew stated they filed an ASAP report for this event.

8.0 Manual Excerpts

8.1 Runway Awareness Advisory System (RAAS)

FedEx Express' 757 Aircraft Systems Manual, "Warning Systems" provided, in part, the following information on RAAS:

RAAS is a software enhancement hosted within the EGPWS unit to provide aural advisories to assist flight crew awareness of airplane position during ground operations, approach to landing, and go-around. The airports in the RAAS airport database include details for every runway on the airport.

The following RAAS characteristics must be considered:

- *RAAS voice annunciations are based upon RAAS database runway details NOT the runway intended or planned.*
- *The voice annunciations do NOT take into account airplane performance factors such as airplane weight, wind, runway condition, slope, air temperature, or airport altitude.*
- *Voice annunciations do not ensure that a runway is inappropriate for takeoff or landing nor does the absence of voice annunciations ensure that a runway is appropriate for takeoff or landing.*
 - *Advisories do not ensure that the aircraft will land on the identified runway nor imply that the aircraft can or cannot be safely landed, stopped, or taken off, from a runway. They also do not ensure that the aircraft will, or can be, stopped before hold lines, the runway edges or the runway end.*
 - *The absence of advisories does not necessarily imply that the aircraft is approaching a surface other than a runway.*

³⁷ Aviation Safety Action Program.

³⁸ Flight Operations Quality Assurance.

- *Flight crew is responsible to use other means available to ensure correct runway selection and the performance calculations are accurate for the conditions.*
- *The design of RAAS does not include knowledge of ATC clearance or flight crew intent, and therefore factors such as clearance misunderstandings, incorrect or inappropriate clearances cannot necessarily be mitigated by use of RAAS.*

Voice Annunciations During Approach, Landing, Go-Around, and RTO on RAAS Airports

Voice Annunciation	Description
APPROACHING (RUNWAY IDENTIFIER)	Sounds once each time the airplane: • Approaches within approximately 3 nautical miles of a runway threshold, and • Is within 20 degrees of the runway heading, and • Is within approximately 200 feet plus one runway width of the runway extended centerline, and • Is between 750 feet and 300 feet AFE. ⊖ Note: The voice annunciation is delayed and sounds at 450 feet altitude if the voice annunciation would have sounded when the airplane was between 550 feet and 450 feet above field elevation. If the criteria above are not satisfied before the aircraft descends below 300 feet AFE, the advisory is canceled.
APPROACHING RUNWAYS	Sounds once each time the description is met while approaching two runways that meet the APPROACHING RUNWAY criteria.
APPROACHING (RUNWAY IDENTIFIER) (LENGTH) AVAILABLE	Sounds once (with insufficient runway available for landing) each time the airplane: • Approaches within approximately 3 nautical miles of a runway threshold with the available distance for landing being less than 5000 feet, and • Is within 20 degrees of the runway heading, and • Is within approximately 200 feet plus one runway width of the runway extended centerline, and • Is between 450 feet and 300 feet AFE. ⊖ Note: The voice annunciation is delayed and sounds at 450 feet altitude if the voice annunciation would have sounded when the airplane was between 550 feet and 450 feet above field elevation. If the criteria above are not satisfied before the aircraft descends below 300 feet AFE, the advisory is canceled.

The following four routine advisories are intended to enhance aircraft position awareness and reduce the risk of a runway incursion:

Approaching Runway (on ground)

On Runway (on ground)

Approaching Runway (in air)

Distance Remaining (landing and rollout advisory) ...

Approaching Runway - In the Air Advisory

This advisory provides the crew with awareness of which runway the aircraft is lined-up with on approach. RAAS-equipped aircraft provide the flight crew with an aural advisory when the aircraft is airborne and approaching a runway. The aural message consists of the word "APPROACHING" followed by the runway identifier. If more than one runway meets the qualifying conditions defined below, then the message "APPROACHING RUNWAYS" is generated. This advisory is suppressed between 550 and 450 ft. above runway elevation to allow normal 500 ft. altitude callouts and/or crew procedures without conflict. If the advisory is triggered while the aircraft is between 550 and 450 feet Above Field Elevation (AFE), the advisory is suppressed until the aircraft descends below 450 feet AFE, where the message will be annunciated. The Approaching Runway advisory is enabled when:

- Aircraft is between 750 feet and 300 feet AFE and*
- Aircraft is within approximately 3 nautical miles of the runway and*
- Aircraft track is aligned with the runway within ± 20 degrees and*
- Aircraft position is within approximately 200 feet, plus runway width, of the runway centerline.*

If the criteria above are not satisfied before the aircraft descends below 300 feet AFE, the advisory is canceled.

Distance Remaining - Landing and Rollout Advisory

This advisory enhances crew awareness of the aircraft along track position relative to the runway end. These advisories are generated at whole thousand-foot intervals, except that the last possible advisory occurs at 500 feet. The Distance Remaining advisory is generated when the following conditions are met:

- Aircraft is on the ground (or within 100 feet of the ground,) over the last half of the runway and 3,000 feet (or less) of runway remaining.*
- Aircraft ground speed is above 40 knots.*

If the crew elects to go around after the Distance Remaining advisories are triggered, the advisories continue to be annunciated at the appropriate distance along the runway.

The Distance Remaining advisories are inhibited once the aircraft climbs above 100 feet radio altitude or aircraft climb rate is greater than 450 fpm.

8.1.1 Applicable Non-Routine Advisories

RAAS had five non-routine advisories available which were to provide enhanced safety in specific situations that would not necessarily be encountered during routine aircraft operations. Four of the advisories were available when the airplane was on the ground. One of the advisories was specifically for when the airplane was in the air. The FedEx Express 757 Aircraft Systems Manual, "Warning Systems" provided the following information on "Approaching Short Runway Advisory - In Air" non-routine RAAS advisory:

This advisory provides the crew with awareness of which runway the aircraft is lined-up with, and that the available runway length for landing is less than the defined nominal landing runway length. The aural message consists of the words "APPROACHING" followed by the runway identifier, the distance available, and the word AVAILABLE. This advisory occurs once for each runway alignment. This advisory is generated when the following conditions are met:

- Aircraft is between 750 feet and 300 feet AFE and*
- Aircraft is within approximately 3 nautical miles of the runway and*
- Aircraft track is aligned with the runway within ± 20 degrees and*
- Aircraft position is within approximately 200 feet, plus runway width, of the runway centerline and*
- Aligned runway is shorter than a nominal runway length of 5000 feet.*

If the criteria above are not satisfied before the aircraft descends below 300 feet AFE, the advisory is canceled.

8.1.2 RAAS System Constraints and Alert Priorities

The FedEx Express 757 Aircraft Systems Manual provided the following RAAS alert priorities and system constraints information:

Alert Priorities

The RAAS aural advisories have the lowest priority of all Enhanced or Basic Ground Proximity alerts.

System Constraints

Caution: *Runway location data may have errors inherent in the source data. Such errors can delay an advisory, or may cause unwanted advisories.*

- *The RAAS aural advisories have the lowest priority of all Enhanced or Basic Ground Proximity alerts. Other EGPWS aural alerts and warnings may preempt RAAS advisories.*
- *RAAS may become unavailable at any time due to loss of accuracy of GPS signals. There is no cockpit annunciation to indicate the status of RAAS while airborne.*
- *The design of RAAS does not include knowledge of ATC clearance or flight crew intent, and therefore factors such as clearance misunderstandings, incorrect or inappropriate clearances cannot necessarily be mitigated by use of RAAS.*
- *RAAS In-Air Approaching Runway advisories do not ensure that the aircraft will land on the identified runway.*

8.2 Arrival and Approach Briefing

The FedEx Flight Operations Manual pg. 6-5, dated February 17, 2022, provided, in part, the following guidance:

Planning

Crewmembers must review applicable destination NOTAMs, applicable Airport Info (10- 9x20-9x), FedEx Parking (10-10x/20-20x) and Airport Qualification (19-0x) pages to prepare for arrival. Obtain destination Arrival ATIS as early as possible with the goal of completing arrival planning and briefing prior to commencement of the initial descent.

When destination weather requires an Instrument Approach, the preferred order of approaches for any given runway is:

- *PA (ILS)*
- *APV³⁹*
- *NPA⁴⁰*

³⁹ Approach with Vertical Guidance.

⁴⁰ Nonprecision Approach

If the airport is conducting instrument approaches to more than one runway and it is not known which will be assigned, it is desirable to plan for and brief the most likely approach and at least one alternate.

When destination weather permits a Visual Approach, the PF should build, brief and select an instrument approach procedure as a backup (when available). Priority must be given to an instrument approach with vertical guidance to the runway in use. Reference the applicable Glideslope, VPATH or VGSI during the approach.

Refer to the QRH Approach Procedure Review to assess approach procedure requirements or limitations, and review approach procedure guidelines, techniques and callouts.

After the PF has selected an approach procedure, each crewmember must review the arrival and approach procedures prior to the briefing.

NOTES

Both crewmembers must independently verify that the FMS is programmed properly and will provide lateral, vertical, and speed commands consistent with the arrival, approach, and missed approach profiles and restrictions. For the initial part of the brief, the PF should brief items from the published procedure (page number, notes, etc.) and then continue to brief the actual arrival and approach procedure referencing the FMS while the PM confirms the arrival and approach procedure is correct using the appropriate chart...

Briefing - General

The PF will give an Arrival Briefing to include expected descent and approach procedures. Arrival and approach briefings should be "brief and to the point" Long briefings are counterproductive to crewmember retention and understanding; however, the Captain may choose to increase the detail of the briefing with consideration of the weather and crew experience.

Brief only items that are unique to the planned arrival or approach, or affect the safe/legal operation of the aircraft under the prevailing conditions.

The goals of the brief are to:

- Enhance communications, promote effective teamwork and ensure effective situational awareness of the crew.*
- Identify and brief significant known threats to safety from top of descent through approach and landing, and crew strategies to reduce the potential for error.*

- Brief any non-standard procedures to be used during descent and approach.

Briefing -Arrival

The PF briefs the arrival including the following, only as appropriate or applicable:

- Arrival chart title and page number.
- Arrival procedure routing with Altitude and Airspeed restrictions.
- Notes and Remarks.
- Transition level when other than FL180.
- Terrain/CFiT risks and EGPWS use.
- Airport Info, FedEx Parking and Airport Qualification pages.
- Any special procedures or crew duties (special altimetry procedures, customs, agriculture, etc.)

Briefing - Approach

The PF briefs the approach including the following, only as appropriate or applicable.

- Review applicable approach requirements, limitations, guidelines, techniques and callouts.
- IAP chart title, runway and page number.
- Approach frequency/identifier and final approach course.
- Final approach fix crossing altitude.
- VDA Milestones (CDFA) or intermediate minimum crossing altitudes (step-down fix)

Note

Any deviations from the briefed descent profile must be brought to the attention of the PF by the PM. The PF must acknowledge the deviation and where required, take corrective action.

- Approach minimums (visual, AH, DH, DA, DDA or MDA) and weather required
- 100 feet Baro-height above TDZE (Non-Precision or CAT I ILS)
- VDP (if depicted).
- Approach light configuration.
- VGSI side (VASI, PAPI, etc.)
- Missed approach procedure(s) for the approach to be flown.

Note

For a visual approach, unless specific missed approach procedures are supplied via chart and or ATC, expect to initially fly runway heading and climb to an altitude at or above 1,500 feet AFE. Upon executing a missed approach from a visual, the PM should contact ATC as soon as practical to clarify ATC desires.

- Any published Climb Gradient requirement.
- Notes and Remarks.
- Noise abatement requirements.
- Wind and/or gust additives.
- Flap settings (for aircraft with multiple possible settings).
- MCP/FCP/FMS intended use of Lateral, Vertical, and Speed modes.
- Intended use of autobrakes and autospoilers.
- Landing distance, runway length, and planned turnoff.
- Any special procedures, crew duties, or NOTAMs
- If weather is near CAT I minimums, the Captain should brief use of the EFVS, if available and qualified, to continue a domestic CAT I approach below minimums to 100 feet above TDZE. The Captain will also brief use of OpSpec C048 to start a domestic CAT I approach if the weather conditions may require its use
- Any airplane systems malfunctions or deferrals/restrictions that may affect the approach or landing.

NOTE

During last-minute runway/approach changes or during abnormal operations, the PM may build and brief the approach. If time does not allow for re-brief and verification of proper FMC/cockpit setup, the flight crew should ask for extended vectors or holding until briefing/setup can be accomplished.

8.3 Landing Runway Requirements

The FedEx Flight Operations Manual pg. 6-7, dated February 17, 2022, provided the following guidance:

Prior to landing, flight crews must determine landing performance using the Airplane Performance Software (APS) or QRH landing data as appropriate. The following criteria must be considered:

- Runway to be used,
- Meteorological conditions,
- Runway conditions in terms of the Runway Condition Code (RwyCC); runway surface condition, e.g., dry, wet, snow type and depth, ice and slush; or the braking action reported or expected, e.g., good, medium, or poor. Unless the runway is completely dry, it should be considered wet or contaminated (RwyCC 1-5). For example, in the U.S., runway FICON NOTAMs do not include RwyCC numbers when coverage does not exceed 25% of the runway surface, but any water or frozen contaminant should be included, e.g., 10% WET. In all such cases, use of RwyCC 1-5 is at the Captain's discretion based on

consideration of the available and suitable reports; refer to "8.03 Adverse Weather Ground Conditions".

- *Airplane weight and configuration, and*
- *Planned use of airplane ground deceleration devices, e.g., thrust reverser operative or inoperative.*
- *Published MAP Climb capability.*

The Captain shall ensure an approach is not continued below 1,000 ft. above airport elevation unless he is satisfied that, with the runway surface condition information available, a safe landing can be made.

According to the captain's interview summary he *"used no autobrakes"* as he wanted to *"rollout long."*⁴¹ He further provided that after the RAAS announced 3,000 feet remaining he applied the brakes and *"came on them harder initially"* because he *"was confused."*

8.4 Head-Up Display

According to the flight's ACARS messaging system, a downlink was submitted on June 8, 2022 at 0424:07 that reported HUD and EFVS usage. The report listed *"HUD Used on Approach: Y."*⁴²

Figure 8 shows the HUD display from the operator's panel in a FedEx B-757 simulator. The depiction was consistent with that shown on the captain's HUD in the simulator. The image in figure 8 was taken while the simulator was in right turn from base to final for runway 18R. The identifier IDWE located in the lower left side of the display is associated with the identifier for the runway 18L localizer. The course deviation indicator for the localizer is on the left side of the horizontal situation indicator at the bottom of the display.

⁴¹ Source: Attachment 1 – Crew Interview Summaries pg. 6.

⁴² Source: Attachment 3 - Incident Flight ACARS.



Figure 8. HUD display on simulator operator panel. (Source: NTSB)

8.4.1 HUD/EFVS Proficiency

The FedEx Express Flight Operations Manual, Chapter 2 "General Policies" provided the following guidance on the HUD and EFVS proficiency and usage requirements:

The HUD/EFVS system is an advanced flight information display that provides safety enhancements and increased situational awareness across the spectrum of FedEx flight operations, but especially in the takeoff and approach-to-landing phases. In order to fully utilize all the features and benefits of the technology, it is incumbent upon Captains to develop and maintain a high-level of proficiency with both the HUD and the incorporated EFVS. To facilitate the maintenance of proficiency and take full advantage of safety enhancements, Captains must deploy and use the HUD (when equipped and operable) as the primary reference for all phases of flight below 10,000 feet AGL when operating as the:

- PF: 50-percent of legs minimum
- PM: 100-percent of legs

The HUD (when equipped and operable) must be used at all times when conducting the following operations:

- Takeoff or approach with windshear reported in the vicinity of the airport.
- EFVS operation.
- CAT II ILS approach (EFVS use optional).
- CAT III ILS approach (EFVS use optional).
- HUD Takeoff Guidance required < RVR 500ft/150m (EFVS use optional).
- Low-visibility taxi ≤ RVR 1200 (EFVS use optional)

8.5 Visual Approach

The FedEx Express, 757/767 Flight Training Manual, dated November 12, 2020 provided, in part, the following graphic depiction and guidance for conducting a visual approach:

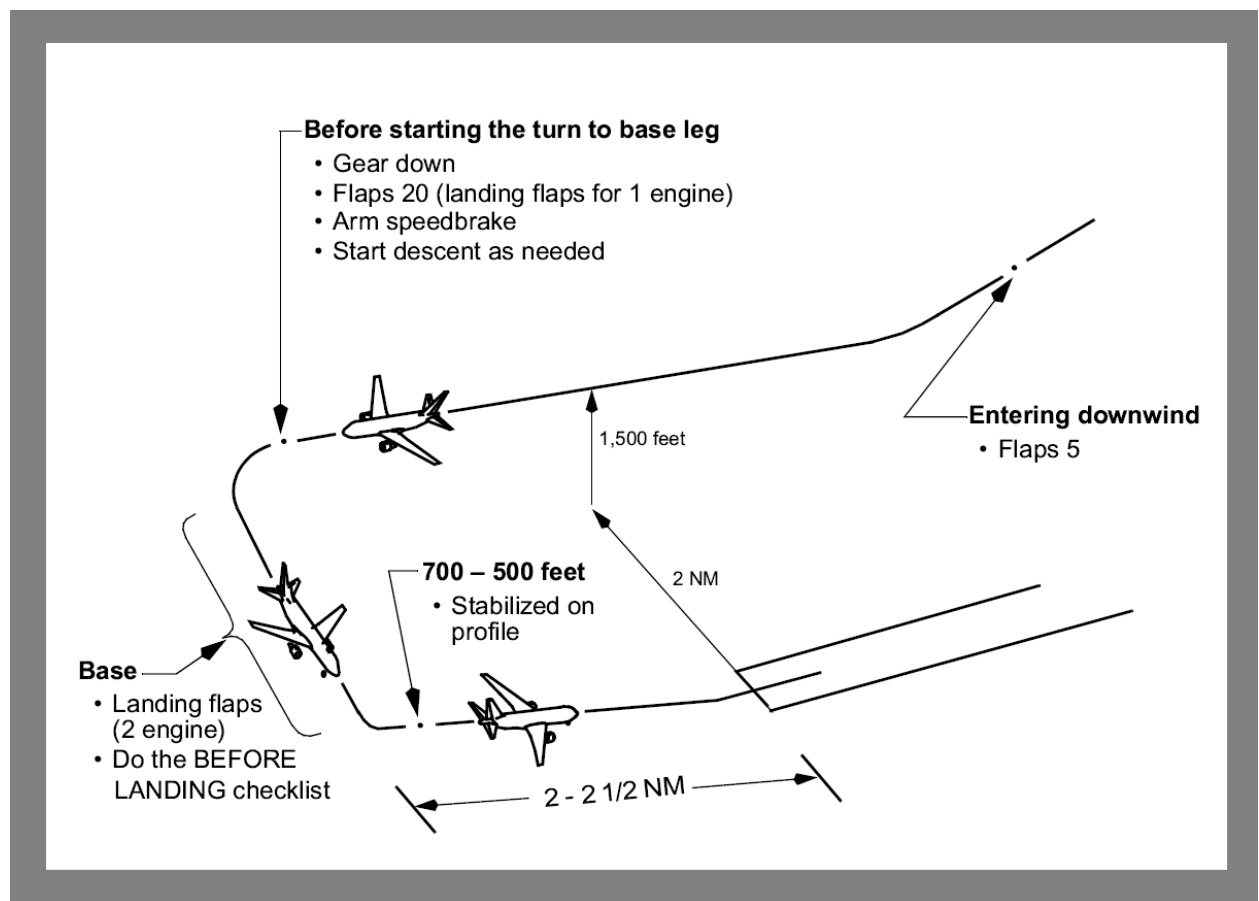


Figure 9. Visual approach pictorial depiction. (Source: FedEx Express Flight Training Manual)

The recommended landing approach path is approximately 2 ½° to 3°. Once the final approach is established, the airplane configuration remains fixed and only

small adjustments to the glide path, approach speed, and trim are necessary. This results in the same approach profile under all conditions...

Downwind and Base Leg

Fly at an altitude of 1,500 feet above the runway elevation and enter downwind with flaps 5 at flaps 5 maneuver speed. Maintain a track parallel to the landing runway approximately 2 NM abeam.

Before starting the turn to base leg, extend the landing gear, select flaps 20, arm speedbrake and slow to flaps 20 maneuver speed or approach speed plus wind additive in landing at flaps 20. If the approach pattern must be extended, delay lowering gear and selecting flaps 20 until approaching the normal visual approach profile. Turning base leg, adjust thrust as required while descending at approximately 600-700 fpm.

Extend landing flaps before turning final. Allow the speed to decrease to the proper final approach speed and trim the airplane. Do the BEFORE LANDING checklist. When established in the landing configuration, maneuvering to final approach may be accomplished at final approach speed (V_{REF} plus wind additive).

Final Approach

Roll out of the turn to final on the extended runway centerline and maintain the appropriate approach speed. An altitude of approximately 300 feet AFE for each NM from the runway provides a normal approach profile. Attempt to keep thrust changes small to avoid large trim changes. With the airplane in trim and at target airspeed, pitch attitude should approximate the normal approach body attitude. At speeds above approach speed, pitch attitude is less. At speeds below approach speed, pitch attitude is higher. Slower speed reduces aft body clearance at touchdown. Stabilize the airplane on the selected approach airspeed with an approximate rate of descent between 700 and 900 feet per minute on the desired glide path, in trim. Stabilize on the profile by 500 feet above touchdown...

8.5.1 Simulator Session

The Operational Factors/Human Performance group conducted a simulator evaluation in one of the operator's B757 simulator, see attachment 9 for detailed information on the evaluation.

During the evaluation, the simulator was placed on a right downwind leg west of the airport for an approach to runway 18R and 18L. The simulator navigation was programed in accordance with the operator's policies and procedures provided for an

ILS to runway 18L. During the visual approach to runway 18R the PFD (see figure 10 below) and HUD, as seen in section 8.4 of this report, indicated that the aircraft was to the right of course and below the glideslope.



Figure 10. Simulator PFD as viewed approaching runway 18R.

Several approaches were made to runway 18R and 18L. In these approaches the RAAS annunciated approaching the runway the airplane was aligned with, irrespective of the ILS frequency that was selected. One item that was noted during the approach to runway 18R was the EGPWS "glideslope" audible warning was annunciated approximately 13 times. During the crew interviews there was no indication that they received the aural alert. On approaches to 18R the flight mode annunciator indicated the glideslope was captured but the localizer (LOC) was still illuminated in the armed (white) mode indicating it had not captured.

8.6 Fatigue Risk Management Program (FRMP)

According to the FedEx flight operations manager, their FRMP was focused on predictive, proactive, and reactive risk modeling and it was done in collaboration with ALPA. FedEx fatigue software used the Karolinska Sleepiness Scale (KSS)⁴³ on a 1-9 scaled rating. ALPA used both the KSS, and the Psychomotor Vigilance Test⁴⁴ (PVT) and the resulting scores were compared. Potential pairings were reviewed at least 6 weeks prior to schedule. A KSS score of 7 or higher typically indicated the pairing needed further review and was a high risk. When a high risk KSS pairing was noted, it was discussed by the Fatigue Event Review Committee (FERC) which then worked with scheduling to resolve the issue with the pairing. The incident flight score was a KSS of 6.39 and a PVT of 9, and these scores incorporated the assumption that the crew would nap during their hub-turns⁴⁵. FedEx did not publish KSS pairing scores and they did not provide the scores or the napping assumption associated with the pairings to the crew.

Crews were provided accommodations at many of their hubs. A crew member could reserve a crew rest room from within the FedEx shared server. Rooms were temperature and light controlled, and a wake-up call was provided on request.

If a crew member felt he or she was too fatigued to proceed with a flight, he or she could make a call to the duty officer who would take one of three mitigative paths: 1) that leg of the pairing would slip to allow the opportunity for more rest; 2) another crew member could be dispatched to take the flight instead; or 3) the flight would be cancelled. If a crew member called in fatigued, it resulted in a mandatory fatigue report and a forfeiture of sick leave hours. A review would be conducted to determine if the crew member's lost hours would be returned to his or her sick bank. The FRMP manager said that they averaged 35-40 fatigue calls a month.

The FRMP was kept on file for two years, was approved by the Federal Aviation Administration, and went through an internal auditing process routinely.

8.7 Fatigue Risk Management - Training

The interim human factors and training manager at FedEx provided an overview of the company's fatigue training. Crew members received a training manual that included a section dedicated to fatigue. The section discussed conditions that produce fatigue, the effects of fatigue, identified how fatigue might manifest, and provided

⁴³ The Karolinska Sleepiness Scale is a 9-point scale that measures subjective level of sleepiness at a particular time of the day. A score of 1 is extremely alert while a score of 9 is extremely sleeping-fighting sleep.

⁴⁴ The Psychomotor Vigilance Test objectively assesses fatigue-related changes in alertness associated with sleep loss, extended wakefulness, circadian misalignment, and time on task.

⁴⁵ FedEx FRMP assumed the crew start each pairing fit for duty and that each crew member will take a 54-minute nap during a hub-turn (2 ½ to 3-hour turn).

mitigation techniques for combatting fatigue. The course used a combination of power point, case study and a training manual to facilitate training. Crew members received fatigue training at their new-hire indoctrination, at alternating 18- and 36-month training cycles, and during upgrade training.

8.7.1 Crew Fatigue Report

Figure 11 depicts the form used by crew members after reporting fatigue for a flight:

Crewmember Fatigue Reporting Form New

Event ID: 2040

Fatigue Information

Level of Fatigue at the time of event: Select option

96 Hours look back from Fatigue Event

UTC MEM View By: Hours Filter card Add Card List cards

Jun 13, 2022																								Jun 14, 2022																							
00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23
00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23

Narratives

Please provide a detailed narrative about the Fatigue Event and any Fatigue Countermeasures you may have employed. *

• A value is required for this field.

Please provide a narrative outlining suggestions for avoiding Fatigue events

Contributing Factors

☐ Pairing Revision
☐ Duty Length
☐ Rest Facilities
☐ Weather
☐ Mx
☐ Circadian Swap
☐ Extended Duty
☐ Late Departure

☐ Stand by
☐ Personal
☐ Nap Availability
☐ Multiple TZD
☐ Hotel

Other Contributing Factors:

Hotel Name (if any):

Mitigation Attempted

☐ Caffeine
☐ Hydration
☐ Exercise
☐ Nap
☐ None

Save Submit

Figure 11. Crewmember fatigue reporting form.

9.0 Additional Potential Incorrect Runway Line-Up

On June 23, the ATC Group and Human Performance Group Chairs traveled to TUL air traffic control tower (ATCT) for the purpose of interviewing the air traffic manager, the certified professional controller (CPC) on duty during the wrong surface incident, and an additional CPC who was not involved in the incident. When asked if any similar wrong surface occurrences have happened at Tulsa, the additional CPC mentioned that about a week prior to the FedEx incident, he noticed an American

Airlines flight lined up for runway 18R when they were cleared for 18L. He queried the crew and they replied that they were going to side-step to the assigned runway.

The Operations Group Chair requested crew statements from the American Airlines Flight 1446 crew. The pilots' Allied Pilot Association representative talked to the captain of the flight, who was the pilot flying, and reported the following:

He remembered the event well, the flight was "dropped off" from center to approach control to tower. They were on the right downwind for 18L. American never lands on runway 18R; however, the captain felt that the timing and the lighting were both a factor. He had electronic guidance up when he made the turn after being cleared for the visual on the downwind. The flight turned base to final about a 15-degree bank and was making a "wide" pattern. The runway lighting for runway 18R was brighter as he rolled out and was the first runway lights he saw. He "locked onto the lighting" about 8-9 miles out on final. Both crew members noticed that the electronic guidance was showing the course was off to the left. They then looked out to their left front and saw the lighting to the left side at the same time ATC mentioned it to them. When they lined up for runway 18L, they confirmed that the electronic guidance was showing them correct information.

The captain used to be an operations guy at an airport and that the lens on runway lights is directional so when looking at it from downwind you can see it; however, it appears the brightest when on glideslope. He didn't ask what step the lights were on to the controllers but felt that runway 18R lights "looked a lot brighter." He felt it was something they locked onto, they made the left turn to runway 18L and when on final to 18L, he looked over towards 18R and noticed that the lights were dimmer on the right side when they were established on 18L.

10.0 Federal Regulations

10.1 Title 14 CFR Part 117 Applicability

Title 14 CFR Part 117.1 provides the following information on what operations must comply with the flight and duty limitations and rest requirements: flightcrew members regulation:

Applicability.

- (a)** *This part prescribes flight and duty limitations and rest requirements for all flightcrew members and certificate holders conducting passenger operations under part 121 of this chapter.*
- (b)** *This part applies to all operations directed by part 121 certificate holders under part 91, other than subpart K, of this chapter if any segment is*

- conducted as a domestic passenger, flag passenger, or supplemental passenger operation.*
- (c)** *This part applies to all flightcrew members when participating in an operation under part 91, other than subpart K of this chapter, on behalf of the part 121 certificate holder if any flight segment is conducted as a domestic passenger, flag passenger, or supplemental passenger operation*
- (d)** *Notwithstanding paragraphs (a), (b) and (c) of this section, a certificate holder may conduct under part 117 its part 121 operations pursuant to 121.470, 121.480, or 121.500.*

10.2 Title 14 CFR Part 121 Subpart Q

14 CFR Part 121 Subpart Q "Flight Time Limitations and Rest Requirements: Domestic Operations" stated:

§ 121.470 Applicability.

This subpart prescribes flight time limitations and rest requirements for domestic all-cargo operations, except that:

- (a) Certificate holders conducting operations with airplanes having a passenger seat configuration of 30 seats or fewer, excluding each crewmember seat, and a payload capacity of 7,500 pounds or less, may comply with the applicable requirements of §§ 135.261 through 135.273 of this chapter.*
- (b) Certificate holders conducting scheduled operations entirely within the States of Alaska or Hawaii with airplanes having a passenger seat configuration of more than 30 seats, excluding each crewmember seat, or a payload capacity of more than 7,500 pounds, may comply with the requirements of this subpart or subpart R of this part for those operations.*
- (c) A certificate holder may apply the flightcrew member flight time and duty limitations and requirements of part 117 of this chapter. A certificate holder may choose to apply part 117 to its -*
- (1) Cargo operations conducted under contract to a U.S. government agency.*
- (2) All-cargo operations not conducted under contract to a U.S. Government agency,*
- (3) A certificate holder may elect to treat operations in paragraphs (c)(1) and (c)(2) of this section differently but, once having decided to conduct those operations under part 117, may not segregate those operations between this subpart and part 117.*

§ 121.471 Flight time limitations and rest requirements: All flight crewmembers.

- (a) No certificate holder conducting domestic operations may schedule any flight crewmember and no flight crewmember may accept an assignment for flight time in scheduled air transportation or in other commercial flying if that crewmember's total flight time in all commercial flying will exceed -
 - (1) 1,000 hours in any calendar year;
 - (2) 100 hours in any calendar month;
 - (3) 30 hours in any 7 consecutive days;
 - (4) 8 hours between required rest periods.
- (b) Except as provided in paragraph (c) of this section, no certificate holder conducting domestic operations may schedule a flight crewmember and no flight crewmember may accept an assignment for flight time during the 24 consecutive hours preceding the scheduled completion of any flight segment without a scheduled rest period during that 24 hours of at least the following:
 - (1) 9 consecutive hours of rest for less than 8 hours of scheduled flight time.
 - (2) 10 consecutive hours of rest for 8 or more but less than 9 hours of scheduled flight time.
 - (3) 11 consecutive hours of rest for 9 or more hours of scheduled flight time.
- (c) A certificate holder may schedule a flight crewmember for less than the rest required in paragraph (b) of this section or may reduce a scheduled rest under the following conditions:
 - (1) A rest required under paragraph (b)(1) of this section may be scheduled for or reduced to a minimum of 8 hours if the flight crewmember is given a rest period of at least 10 hours that must begin no later than 24 hours after the commencement of the reduced rest period.
 - (2) A rest required under paragraph (b)(2) of this section may be scheduled for or reduced to a minimum of 8 hours if the flight crewmember is given a rest period of at least 11 hours that must begin no later than 24 hours after the commencement of the reduced rest period.
 - (3) A rest required under paragraph (b)(3) of this section may be scheduled for or reduced to a minimum of 9 hours if the flight crewmember is given a rest period of at least 12 hours that must begin no later than 24 hours after the commencement of the reduced rest period.
 - (4) No certificate holder may assign, nor may any flight crewmember perform any flight time with the certificate holder unless the flight crewmember has had at least the minimum rest required under this paragraph.
- (d) Each certificate holder conducting domestic operations shall relieve each flight crewmember engaged in scheduled air transportation from all further duty for at least 24 consecutive hours during any 7 consecutive days.

- (e) *No certificate holder conducting domestic operations may assign any flight crewmember and no flight crewmember may accept assignment to any duty with the air carrier during any required rest period.*
- (f) *Time spent in transportation, not local in character, that a certificate holder requires of a flight crewmember and provides to transport the crewmember to an airport at which he is to serve on a flight as a crewmember, or from an airport at which he was relieved from duty to return to his home station, is not considered part of a rest period.*
- (g) *A flight crewmember is not considered to be scheduled for flight time in excess of flight time limitations if the flights to which he is assigned are scheduled and normally terminate within the limitations, but due to circumstances beyond the control of the certificate holder (such as adverse weather conditions), are not at the time of departure expected to reach their destination within the scheduled time.*

§ 121.473 Fatigue risk management system.

- (a) *No certificate holder may exceed any provision of this subpart unless approved by the FAA under a Fatigue Risk Management System.*
- (b) *The Fatigue Risk Management System must include:*
 - (1) *A fatigue risk management policy.*
 - (2) *An education and awareness training program.*
 - (3) *A fatigue reporting system.*
 - (4) *A system for monitoring flightcrew fatigue.*
 - (5) *An incident reporting process.*
 - (6) *A performance evaluation.*

11.0 Post Incident Safety Changes

Following the incident, the FedEx Fatigue Risk Management Group published a newsletter (see attachment 13) detailing the biomathematical software they use to determine trip pairings accounts for a nap on the hub turn. Crews were recommended to take advantage of those nap opportunities to help mitigate fatigue.

E. LIST OF ATTACHMENTS

Attachment 1: Flight Crew Interview Summaries
Attachment 2: Flight Crew Training Records [Excerpts]
Attachment 3: Incident Flight ACARS Records
Attachment 4: Incident Flight Weight and Balance
Attachment 5: Flight Operations Manual [Excerpts]
Attachment 6: Flight Crew Training Manual [Excerpts]

Attachment 7: FedEx Express B757 Quick Reference Handbook [Excerpts]
Attachment 8: FedEx Express B757 Aircraft System Manual [Excerpt]
Attachment 9: Simulator Evaluation
Attachment 10: Fatigue Event Review Committee Pairing Build Parameters
Attachment 11: Fatigue Risk Management Plan
Attachment 12: Interview Summaries with Fatigue Risk Management Personnel
Attachment 13: Fatigue Risk Management Group Newsletter (Post Incident)

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