NATIONAL TRANSPORTATION SAFETY BOARD
Office of Aviation Safety
Washington, D.C. 20594

December 17, 2006

Group Chairman's Factual Report

OPERATIONAL FACTORS

DCA06MA064

A. ACCIDENT

Operator:	Comair, Inc. dba Comair Airlines dba Delta Connection
Location:	Blue Grass Airport, Lexington, Kentucky
Date:	August 27, 2006
Time:	0607 eastern daylight time[1]
Airplane:	Bombardier CL-600-2B19 (CRJ-100), Registration Number: N431CA, Serial # 7472

B. OPERATIONS/ HUMAN PERFORMANCE GROUP

Captain B. David Tew - Chairman Operational Factors Division (AS-30) National Transportation Safety Board 490 L'Enfant Plaza East, SW Washington, DC 20594-2000	Dr. Evan Byrne - Member Human Performance Division – (AS-50) National Transportation Safety Board 490 L'Enfant Plaza East, SW Washington, DC 20594-2000
Captain Brian Schimp CRJ Fleet Manager Comair, Inc. 77 Comair Blvd. Erlanger, KY 41018	Ms. Ellen Tom Aviation Safety Inspector Federal Aviation Administration Cincinnati FSDO Cincinnati, Ohio 45226
Captain Louis A. Johnson Human Factors Comair, Inc. 77 Comair Blvd. Erlanger, KY 41018	Captain Shawn Pruchnicki Air Line Pilot Association, International 535 Herndon Parkway Herndon, VA 21072

[1] All times are eastern daylight time (edt) based on a 24-hour clock, unless otherwise noted. Actual time of accident is approximate, determined by the Flight Data Recorder (FDR) and Air Traffic Control (ATC) transcripts.

Captain Jacques Nadeau
CRJ[2] Customer Liaison Pilot
Bombardier Aerospace
13100 Henri-Fabre Blvd.
Mirabel
Quebec, Canada J7N 3C6

C. SUMMARY

On August 27, 2006, about 0607 eastern daylight time, Comair flight 5191, a Bombardier CL-600-2B19 (CRJ-100), N431CA, crashed during takeoff from Blue Grass Airport, Lexington, Kentucky (LEX). The airplane, which had been cleared for runway 22, taxied onto runway 26 instead and ran off the end of runway 26. Of the 47 passengers and 3 crewmembers on board the airplane, 49 were killed, and 1 received serious injuries. The airplane was destroyed by impact forces and postcrash fire. The flight was operating under the provisions of 14 *Code of Federal Regulations* Part 121 and was en route to Hartsfield-Jackson Atlanta International Airport, Atlanta, Georgia (ATL).

D. DETAILS OF THE INVESTIGATION

The Operations/ Human Performance Groups worked as a combined team throughout the investigation.

The NTSB investigators on the Operations/ Human Performance Group traveled to the accident site on Sunday, August 27, 2006 where they inspected the accident site and gathered flight documents from the wreckage. The Group gathered duplicates of all flight documents that were given to the accident crew.

On August 28 and 29, 2006, the group conducted interviews with Comair ground personnel who handled the accident airplane on the morning of the accident. A daylight examination of LEX and the associated signage, taxiways, and runways was performed. A night taxi was performed in a Comair CRJ to provide the group with a visual examination of the LEX airport and its associated signage, taxiways and runways from a CRJ cockpit during similar conditions that were present when the accident airplane departed.

On August 29, the group traveled to Comair Headquarters in Erlanger, Kentucky. From August 29 to September 3, various activities were conducted during this field phase of the investigation[3]. Company records were reviewed, including training and personnel records. The group gathered and reviewed flight and training manuals. The group gathered information for the 72-hour history of the

[2] CRJ – Canadair Regional Jet
[3] See attachment 1 – Interview Summaries

accident pilots. Interviews were conducted with three check captains, four line captains [one line captain was also a ground school instructor], and four first officers (F/O). The pilots interviewed included pilots who had given training, checkrides, and line checks to the accident pilots. The pilots interviewed also included pilots who had recently flown with the accident pilots. An additional three interviews included interviews with the crew of an American Eagle flight and the captain of a Skywest flight that departed LEX just prior to the accident flight. Interviews were also conducted with the Comair Director of Safety and the Federal Aviation (FAA) principal operations inspector (POI) for Comair. The group observed a simulator demonstration of two Comair line pilots performing normal operations during a simulated departure in real time from LEX. This field phase of the investigation was concluded on September 3, 2006.

On September 25, 2006, the group gathered at LEX to conduct a taxi in a Comair CRJ airplane during similar conditions as the accident flight. During this taxi, extensive pictures were taken for documentation.

Documentation of the group's taxi observations on August 28, 2006 and the photo tests conducted on September 25 & 26 will be contained in an addendum to the Human Performance Group Chairman's Factual Report.

1.0 HISTORY OF FLIGHT

The Human Performance factual describes the crew actions prior to check-in at LEX on the morning of August 27, 2006.

The accident crew was observed reporting for duty about 0515. The accident crew was scheduled for a departure time of 0600.

Upon arrival in the Comair operations area at LEX, the accident pilots gathered their departure paperwork or Flight Release, which contained weather information, a flight plan, and associated airplane information. The crew then proceeded toward the ramp area where there were three Comair CRJ airplanes parked. The crew initially boarded the wrong airplane and powered up that airplane using the auxiliary power unit (APU). Ramp personnel noticed that they were on the wrong airplane and entered the airplane and advised the crew. At about 0520-0525, the accident crew checked their paperwork, gathered their bags, and proceeded to the correct airplane.

About 0540, the crew gave a signal to the ramp agent to begin boarding the airplane. The airplane was pushed back from its parking spot about 0600. The engines were started and the first officer called for a taxi clearance from the air traffic control (ATC) tower controller. The taxi clearance was to taxi to runway 22. This clearance allowed the crew to taxi all the way to runway 22 without stopping at any intersecting runways. At 0600, it was still before sunrise and night conditions existed. There was no rain during the taxi and takeoff and the visibility was reported at 8 miles. Floodlights at the terminal building illuminated the ramp area and taxiway lights were illuminated on taxiway A. The runway lights on runway 22 were illuminated and on

step 3[4]. Runway 26 lights were not illuminated and the runway was NOTAM'd closed except during daytime operations.

The accident flight began to taxi about 0602. The captain taxied the airplane while the F/O prepared the cockpit for departure and performed his required checklists. The airplane was taxied to a position that was the hold short point for runway 26 and stopped at about 0604:33. The airplane remained at that hold short point for approximately 46 seconds while the F/O completed his Before Takeoff checklist items. The F/O then called for a takeoff clearance and the air traffic controller cleared the flight for takeoff. Neither the F/O nor the tower controller stated the runway during request for and the clearance for takeoff. The captain taxied onto runway 26 and aligned the airplane for takeoff. The final checklist items were completed as the captain taxied into position and then the captain transferred control of the airplane to the F/O.

About 0606, the F/O pushed the engine power levers toward the takeoff power setting and asked the captain to adjust the engine power for takeoff. The F/O was the pilot flying (PF) as the airplane began the takeoff roll. The airplane exited the runway while still in contact with the ground. Shortly thereafter, the airplane crossed a berm past the runway end and became airborne, contacted trees and crashed into the ground.

2.0 FLIGHT CREW INFORMATION

Both crewmembers were current and qualified under Comair Airlines and FAA requirements.

2.1 Captain Jeffrey Adam Clay

Date of hire with Comair Airlines, Inc.: November 29, 1999

FAA records of Captain Clay indicated that:

Private Pilot - Airplane Single Engine Land certificate was issued on September 14, 1997.
Private Pilot - Airplane Single Engine Land – Instrument Airplane certificate was issued on November 23. 1997.
Private Pilot - Airplane Single and Multi-Engine Land – Instrument Airplane certificate was issued on January 29, 1998.
Commercial Pilot – Airplane Multi-Engine Land – Instrument Airplane – Airplane Single Engine Land certificate was issued on February 27, 1998.
Flight Instructor- Airplane Single Engine certificate was originally issued on June 4, 1998.
Flight Instructor- Airplane Single Engine - Instruments certificate was originally issued on July 22, 1991.
Flight Instructor – Airplane Single and Multi Engine – Instruments was originally issued on August 24, 1998.

[4] The LEX runway lights had 5 steps of intensity with step being the lowest and step 5 being the highest.

Air Transport Pilot – Airplane Single and Multi-Engine Land- with CL-65 rating – Commercial Pilot Privileges certificate was issued on January 14, 2004.

Pilot certificates and ratings held by Captain Clay at time of the accident:

FLIGHT INSTRUCTOR (issued August 24, 1998)
AIRPLANE SINGLE AND MULTI ENGINE
INSTRUMENT AIRPLANE
VALID ONLY WHEN ACCOMPANIED BY PILOT CERTIFICATE

AIRLINE TRANSPORT PILOT (issued January 14, 2004)
AIRPLANE MULTIENGINE LAND
CL-65
COMMERCIAL PRIVILEGES
AIRPLANE SINGLE ENGINE LAND
Limitations:
ATP CIRCLING APPROACH – VMC ONLY
CL-65 CIRCLING APPROACH – VMC ONLY

Training and Proficiency Checks:

Comair Airlines Initial New Hire training completed on December 4, 1999
Initial Type Rating CL -65: January 14, 2004
Upgraded to captain on CL -65 on January 30, 2004
Last recurrent training: July 31, 2006
Last recurrent ground training: November 16, 2005
Last Line Operational Evaluation: July 31, 2006
Last AQP[5] Maneuver Validation: July 30, 2006
Comair Airlines last Proficiency check on CL -65 on November 14, 2004
Last Line Check: May 12, 2006

Flight Times: based on Comair Airlines employment records

Total pilot flying time	4,710 hours
Total Pilot-In-Command (PIC) time	1,567 hours
Total CL-65 flying time	3,082 hours
Total CL-65 PIC time	1,567 hours
Total flying time last 24 hours	3 hours, 53 minutes
Total flying time last 7 days	8 hours, 13 minutes
Total flying time last 30 days	55 hours, 58 minutes
Total flying time last 60 days	105 hours, 16 minutes
Total flying time last 90 days	158 hours, 53 minutes
Total flying time last 12 months	570 hours, 49 minutes

[5] AQP –Advanced Qualification Program. See attachment 2 – AQP as defined in the FAA Inspectors Handbook 8400.10, Volume 3, page 3-413.

A review of FAA records found no prior accident, incident or enforcement actions.

Comair records indicated that, including the accident flight, Captain Clay had flown to LEX seven times since September 2004. Three of the arrivals occurred during night conditions. Three of the departures, including the accident flight, occurred during night conditions. Prior to the accident, Captain Clay's last flights into and out of LEX occurred on June 16/17, 2006. The last flights were a daytime arrival and a nighttime departure.

2.2 First Officer James Michael Polehinke

Date of hire with Comair Airlines, Inc.: March 06, 2002

FAA records of F/O Polehinke indicated that:

Private Pilot - Airplane Single Engine Land certificate was issued on January 4, 1996.
Private Pilot - Airplane Single Engine Land - Instruments certificate was issued on April 26, 1996.
Commercial Pilot – Airplane Single Engine Land - Instruments certificate was issued on June 10, 1996.
Commercial Pilot – Airplane Single and Multi-Engine Land - Instruments certificate was issued on June 26, 1996.
Airline Transport Pilot – Airplane Multi-Engine Land – Commercial Pilot Privileges – Airplane Single Engine Land certificate was issued on January 27, 2000.
A type rating on the BE-1900 was added on November 13, 2000. A type rating on the CL-65 was added on November 3, 2005 with second-in-command (SIC) privileges only.
Flight Instructor – Airplane Single Engine Land certificate was issued on November 20, 1996.

Pilot certificates and ratings held by F/O Polehinke at time of accident:

FLIGHT INSTRUCTOR (issued November 20, 1996)
AIRPLANE SINGLE ENGINE/ CFI
Limitations: VALID ONLY WHEN ACCOMPANIED BY PILOT CERTIFICATE

AIRLINE TRANSPORT PILOT (issued November 3, 2005)
AIRPLANE MULTIENGINE LAND
CL-65, BE-1900
COMMERCIAL PILOT PRIVILEGES
AIRPLANE SINGLE ENGINE LAND
CL-65 SIC PRIVILEGES ONLY
CL-65 CIRCLING APPROACH – VMC ONLY

Training and Proficiency Checks:
Comair Airlines Initial New Hire training completed on March 6, 2002
Initial SIC Type Rating CL-65, SIC Privileges only: November 3, 2005
Last recurrent ground training: April 4, 2006
Last Line Operational Evaluation: April 6, 2006
Last AQP Maneuver Validation: April 5, 2006
Comair Airlines last Proficiency check on CL-65 on April 6, 2006

F/O Polehinke received a NOTICE OF DISAPPROVAL on October 15, 1996 when he failed an oral examination and practical test for his FLIGHT INSTRUCTOR AIRPLANE SINGLE ENGINE certificate. He was unsatisfactory in the areas of airplane weight & balance, and navigation & flight planning. He was retested on November 20, 1996 and passed.

F/O Polehinke received a NOTICE OF DISAPPROVAL on January 26, 2000 when he failed a practical test for his Air Transport Pilot (ATP) certificate. He was unsatisfactory in the area of minimum flight control speeds. He was retested on January 27, 2000 and passed.

F/O Polehinke failed his Comair CRJ F/O Initial Proficiency Check on May 3, 2002. He was retested on May 10, 2002 and passed.

Flight Times: based on Comair Airlines employment records

Total pilot flying time	6,564 hours
Total PIC time	940 hours
Total CL-65 second-in-command (SIC) time	3,564 hours
Total time in CL-65	3,564hours
Total flying time last 24 hours	0:00
Total flying time last 7 days	17 hours, 40 minutes
Total flying time last 30 days	64 hours, 51 minutes
Total flying time last 60 days	156 hours, 06 minutes
Total flying time last 90 days	245 hours, 04 minutes
Total flying time last 12 months	876 hours, 02 minutes

A review of FAA records found no prior accident, incident or enforcement actions.

Comair records indicated that, including the accident flight, F/O Polehinke had flown to LEX eleven times since September 2004. Five of the arrivals occurred during night conditions. Two of the departures, including the accident flight, occurred during night conditions. Prior to the accident, F/O Polehinke's last flights into and out of LEX occurred on May 18/19, 2006. These flights were a night arrival and a daytime departure.

3.0 WEIGHT AND BALANCE

The following information was entered on the CRJ40/50 Load Manifest form that was completed by the accident crew. This form contained the following information:

	Weight
Basic Operating Weight	31,499 lbs.
Passenger Weight	8,648 lbs.
Baggage & Cargo	1,640 lbs.
Zero Fuel Weight	41,787 lbs.
Fuel	7,500 lbs.
Ramp Weight	49,287 lbs.
Taxi Fuel Burn	200 lbs.
Takeoff Weight	49,087 lbs.
Maximum Takeoff Weight Allowed	50,178 lbs.

The Operations Group used Comair Airlines manuals and load manifest to determine that the takeoff center of gravity (CG) was within the approved limits of the airplane for a takeoff from runway 22. Using information obtained from Bombardier Aerospace, investigators determined the airplane was too heavy for a takeoff from runway 26.

4.0 AERODROME INFORMATION

Using information from the Jeppesen chart 11-1, the following airport information was obtained. At the time of the accident, Blue Grass Airport elevation was 979 feet above mean sea level (MSL), and was located four miles west of the city of Lexington, Kentucky. The airport had two hard surface runways. Jeppesen data indicated runway 4/22 was grooved and was 7,003 feet long and 150 feet wide. Runway 8/26 and was 3,500 feet long and had paint lines indicating a 75-foot usable width. Runway 8/26 was actually 150 feet wide but the outer portion of the runway was not maintained beyond the 75 feet indicated by the painted lines. The airport chart listed runway 8/26 as 75 feet wide.

Runway 4 had high intensity runway lights (HIRL), centerline lights (CL), touchdown zone lights (TDZ), a simplified short approach lighting system with runway alignment indicator lights (SSALR), a visual approach slope indicator (VASI-L), and runway visual range indicator (RVR). Runway 22 had HIRL, CL, runway end identification lights (REIL) and a VASI-L. Runway 8 had medium intensity runway lights [which were inoperative] (MIRL). Runway 26 had MIRL [which were inoperative] and REIL.

NOTAM # A-1682[6] stated that taxiway A was closed north of runway 8/26 until further notice. This information had been on the ATIS[7] the day before the accident but was not on the ATIS on the day of the accident. Runway 8/26 was listed as a daytime only runway in the Airport/Facility Directory. The ATIS information issued on the morning of the accident informed pilots that they should “use caution for construction on the air carrier ramp”.

[6] See Air Traffic Group Factual report.
[7] ATIS – Automatic Terminal Information Service

As stated earlier, the runway lights on runway 22 were illuminated and on step 3. Runway 26 lights were not illuminated.

5.0 COMPANY OVERVIEW

Comair, Inc. was founded in 1977 providing service between Cincinnati, Cleveland, and Akron-Canton, Ohio using Piper -Navajo airplanes. In 1981, the company added Piper-Chieftain and EMB-110 turboprop airplanes. In 1983, the company added both the Shorts SD 3-30 and Fairchild SA-227 airplanes. In 1984, the company added the SAAB-340 airplane and became a Delta Connection carrier. In 1988, the company added the EMB-120 airplane to the fleet. In June 1993, the company began adding the current fleet of 40- and 50- passenger Canadair Regional Jets (CRJs). In October of 2002, the company added the 70- passenger CRJ to the fleet. The company had fully transitioned to the CRJ airplane at the time of the accident. The accident airplane was a 50 seat airplane

In January 2000, Comair, Inc. was purchased by Delta Airlines, Inc. As a Delta Connection, Comair, Inc. served 97 cities, with an average of 772 flights a day and employed over 6,400 personnel. Comair had 1,631 pilots including 825 captains and 806 F/Os.

Comair completed an inspection by the Department of Defense (DOD) on March 8, 2006. The results of the inspection were satisfactory. There was only one minor operations discrepancy noted on the inspection, which concerned a difference in an altimeter setting by one crewmember.

6.0 BRIEFINGS

Comair procedures in the Comair Operations Manual Chapter 4 –Ramp & Taxi Operations, section 4.4.2 – Taxi Briefing, page 4-23 dated 09/01/05 (REV 2) stated in part:

> *The captain shall conduct a Taxi Briefing for each aircraft movement. For departures/repositioning, the Taxi Briefing shall be completed prior to aircraft movement. This briefing will include, but is not limited to the following:*
> 1. *"Comair Standard" taxi (Brief in its entirety for the first flight as a crew. Subsequent briefings may be abbreviated to Comair Standard.") Comair Standard [in part]:*
>   - *Both flight deck crewmembers will have appropriate airport diagrams out and available.*
>   - *Complicated or unexpected clearances shall be written down.*
>   - *Traversing runways and hot spots[8] requires extra vigilance.*
>   - *If unsure of position or instructions, we will clear any runways, stop, and call ATC.*
>   - *Runways and hotspots which may need to be traversed.*

7.0 TAXI

7.1 Comair taxi procedures

[8] Hot spots – are areas on the ramp that may be of concern to the pilots due to traffic, complexity, etc. They also may be designated spots on the airport diagram.

The Comair Operations Manual Chapter 4 –Ramp & Taxi Operations, section 4.4.1 – General Taxi Procedures, page 4-23 dated 09/01/05 (REV 2) stated in part:

- *Both pilots' stations must be occupied during all self-powered aircraft ground movements.*
- *Airport Diagrams or Low Visibility Taxi Charts (if applicable) shall be out and available for both crewmembers' use.*
- *Both crewmembers shall monitor the initial taxi call. Both must agree on the route prior to aircraft movement.*
- *Prior to taxi the captain shall perform a Taxi Briefing.*
- *During taxi the captain shall verbalize the essential elements of taxi clearances received, emphasizing runway crossings and hot spots.*
- *During taxi both crewmembers shall monitor the progress of the taxi. Utilize HSI[9], diagrams and signage to confirm position.*
- *In the event a taxi clearance will take the aircraft into a part of the airport that was not briefed, or if either crewmember lacks complete understanding of the taxi clearance, the crew shall stop the taxi, refer to the airport diagram and query ATC if required.*

Comair procedures were that both engines were to be started on the first flight of the day prior to taxi.

During the investigation, investigators observed a line crew perform normal Comair CRJ engines start and taxi procedures, including the performance of the checklists, in a flight simulator at the Flight Safety simulator training facility located in Erlanger, Kentucky, which was used by Comair. The investigators also observed a normal start and taxi operation by a Comair crew during two nighttime taxi operations in Comair CRJs that were conducted for familiarization and observation at LEX.[10] Investigators were also able to observe the normal start and taxi operations while riding a Comair CRJ cockpit jumpseat during a passenger flight from Cincinnati/Northern Kentucky International Airport (CVG), Covington, Kentucky.

7.2 Captain responsibilities and duties during taxi

The Comair Operations Manual, chapter 4 – Ramp & Taxi operations, section 4.4.4 – Airport/Field Taxi, page 4-25 dated 09/01/05 (REV 2) stated in part:

> *When clear of the ramp, the captain shall verbalize the essential elements of the taxi clearance placing special emphasis on:*
>
> - *Runway crossings*
> - *Hold short lines*
> - *Hold short instructions*
> - *Runway incursion hotspots*
>
> *Exercise extreme caution at all times when approaching or operating on any runway.*

[9] HSI – Horizontal Situation Indicator – located on the primary flight display. See attachment 3.
[10] See the addendum to the Human Factors Group Chairman's Factual report.

It was also the responsibility of the captain and F/O to maintain situational awareness at all times.

The captain taxied the airplane. The Comair Operations Manual, Chapter 4-Ramp & Taxi Operations, section 4.4.3 – Ramp Taxi, page 4-24 dated 09/01/05 (REV 2) stated "taxi speeds into and out of the gate or ramp parking area shall be conducted at a speed not to exceed that of a fast walk". Comair procedures were for no checklist items to be requested until well clear of any congested area. The captain was to call for the Taxi, Before Takeoff, and Line-up checklists[11] to be performed.

7.3 F/O responsibilities and duties during taxi

The F/O was to perform the Taxi, Before Takeoff, and Line-up checklists during the taxi. These checklists contained both "Challenge and Response" and "Verbal Response" items. The Challenge and Response items were read by the F/O and responded to by the captain. The pilot completing the checklist verbalized the Verbal Response items. The Taxi checklist was to be started after the airplane was well clear of any congested areas. The Before Takeoff checklist was normally to be performed after the second engine was started; as this was the first flight of the day, both engines were started prior to taxi. The Line-up checklist was to be performed after the airplane was cleared onto the active runway.

As this was the first flight of the day, both engines would be started before taxi. Starting both engines would reduce some F/O duties and provide additional time during the taxi. However, any time saved by starting both engines was offset because the F/O had additional first flight of the day procedures to perform during the Taxi and Before Takeoff checklists:

- During the taxi check, the F/O would check his brakes for operation.
- During the taxi check, the F/O would check the radar control panel if weather was a concern.
- During the before takeoff checklist, the F/O would check the anti-ice cowl and wing system and also check the 14th stage isolation valve.
- During the before takeoff checklist, the F/O would check the engine automatic performance reserve (APR).

7.4 Sterile Cockpit Procedures

14 CFR Part 121 regulations stated in part:

> *121.542 Flight crewmember duties.*
> *(a) No certificate holder shall require, nor may any flight crewmember perform, any duties during a critical phase of flight except those duties required for the safe operation of the aircraft.*

[11] See attachment 4 – the Comair CRJ pilot's checklist

(b) No flight crewmember may engage in, nor may any pilot in command permit, any activity during a critical phase of flight which could distract any flight crewmember from the performance of his or her duties or which could interfere in any way with the proper conduct of those duties.
(c) For the purposes of this section, critical phases of flight includes all ground operations involving taxi, takeoff and landing, and all other flight operations conducted below 10,000 feet, except cruise flight.

Note: Taxi is defined as "movement of an airplane under its own power on the surface of an airport."

The Comair Operations Manual, Chapter 5 – Operational Policies, Section 5.13.2 Critical Phases of Flight/Sterile cockpit, pages 5-61 & 5-62, dated 12/01/05 (REV 4) stated in part:

- *Critical phase of flight includes all ground operations involving taxi, takeoff and landing, and all other flight operations conducted below 10,000 ft, except cruise flight. Taxi is defined as "movement of an aircraft under its own power on the surface of the airport."*

- *No flight crewmember shall perform any duties during a critical phase of flight except those duties required for the safe operation of the aircraft.*

- *No flight crewmember may engage in, nor may any pilot-in-command permit, any activity during a critical phase of flight which could distract any flight crewmember from the performance of his duties or which could interfere in any way with the proper conduct of those duties. Activities such as …….engaging in nonessential conversations within the flight deck……..…*

7.5 Accident Flight Taxi Route

As previously stated, the accident flight crew received a clearance to runway 22[12]. The normal taxi route to runway 22 or runway 26 utilized taxiway A. The taxi clearance as stated by ATC allowed the crew to taxi across runway 26 enroute to the assigned takeoff runway.

There were no designated "hotspots" on the ramp area or along the taxi route. Areas of concern for the crew along the taxi route would have been (1) the crossing of runway 26 and (2) the fact that a portion of the original taxiway A between runway 26 and runway 22 was under construction and therefore taxiway A was altered beyond runway 26[13]. The accident crew was not informed of the change to taxiway A by either (1) the controller, (2) the ATIS, or (3) the company flight paperwork.

[12] See attachment 5 - Jeppesen LEX airport diagram chart 11-1, which was used by the crew.
[13] See Survival Factors Group Chairman Factual report

Interviews with Comair crewmembers revealed that crews considered the taxi to runway 22 to be a "short" taxi but most crewmembers indicated that there would have been time to perform the required checklists.

An American Eagle Airlines flight and a Skywest Airlines flight departed prior to the accident flight. Both carriers taxied out on the altered taxiway A and departed from runway 22.

8.0 Takeoff Procedures

8.1 Setting the Heading Bug

The Comair CRJ Flight Standards Manual Vol. I, Chapter 3 –Normal Procedures, Section 3.7.3 – Before Starting Engines, page 3-63 dated 11/30/05 (REV 29), stated in part that crewmembers should "*set course selectors and heading bug*".

The Comair CRJ Flight Standards Manual Vol. II, Chapter 7 – Maneuvers and Normal Procedures, Section 7.3.4 – Heading Bug, page 7-9 dated 11/30/05 (REV 29), stated in part:

- *For departure:*
  If a turn is required at or below 400 feet AGL[14], set HDG [heading] bug to the heading required by ATC, departure procedure or runway heading as appropriate.

- *If a straight out departure is planned or a turn is required by departure procedures above 400 feet AGL, set HDG bug to the runway heading.*

Post-accident interviews indicated that some crewmembers would set the heading bug on the heading of the departure runway unless a turn was planned shortly after takeoff.

The ATIS information indicated that the departure runway was runway 22 and the controller cleared the flight to taxi to runway 22. The FDR indicated that the accident pilots had their heading bug set to 227 degrees which corresponded closely with the 226 degrees magnetic heading for runway 22 as depicted on their Jeppesen airport chart. The course selector was set to 226 degrees.

8.2 Heading Select Mode

The Comair CRJ Flight Crew Operating Manual was a Bombardier document used by Comair. The Comair CRJ Flight Crew Operating Manual (FCOM), Chapter 3 – Automatic Flight Control System, Section 1 Flight Control and Guidance, subsection D – Lateral Modes of Operation, Part 3 – Heading Select Mode, page 03-20-9, REV 56, Jan 31/03 stated in part: "*Pushing the HDG knob will set the selected heading to the current heading.*" Post-accident interviews indicated that after the aircraft had been taxied into the takeoff position on the runway, most Comair pilots would press on the heading knob to sync the aircraft heading with the heading bug. Pilots reported that this sync of the heading bug and runway heading would

[14] AGL – above ground level

normally only cause a minor movement of the bug. As stated, the FDR indicated the accident pilots had preselected the runway 22 magnetic heading of 227 on the heading bug. The FDR indicated the heading bug remained on the 227 degree setting during the takeoff which indicated that the accident crew did not push the HDG knob prior to takeoff. If they had pushed the HDG knob when in takeoff position, the heading bug would have moved about 40 degrees to the right on the HSI and the crew may have noticed the movement.

8.3 Runway Update

Comair procedures were to program the departure runway into the flight management system (FMS) prior to taxi.

The Comair Operations Manual, Section – Bulletins, Bulletin 05-010, pages 10 & 11[15] dated 9/01/05 provided information on runway updates. The bulletin stated that runway updates were important and the best type of runway update was to press the take off/ go around (TOGA) buttons to display the flight director command bars. Pressing the TOGA buttons performed an automatic runway update. The update would be to the programmed departure runway, which was a known position in the FMS. Ensuring the airplane was actually on the end of the programmed runway when the update was performed ensured the best and most accurate update. The update was more important in airplanes without global positioning systems (GPS) because those airplanes used dead reckoning (DR) to calculate its position during taxi. Airplanes equipped with GPS used it to update the airplane's position in the FMS during taxi. The accident airplane was a GPS equipped airplane. Comair Bulletin 05-010 stated that runway updates were good procedure even in GPS equipped airplanes.

The Comair CRJ Flight Standards Manual Vol. II, Chapter 7 – Maneuvers and Normal Procedures, Section 7.4.3 – Description, page 7-13 dated 11/30/05 (REV 29), stated in part:

- *The PF should depress the Takeoff/Go-Around (TOGA) switch, to enable the flight director to display the target pitch attitude. The heading bug will be set as described in Heading Bug for departure in the Operating Protocol section of this chapter.*

Comair said that from a standardization standpoint, their philosophy and procedures on all airplanes in the fleet was to push the TOGA buttons, for the purpose of runway update and to display the command bars for takeoff. Pilots were advised to push the TOGA button as the airplane took the takeoff position on the runway.

Prior to a night taxi at LEX in the Comair CRJ, the Operations group requested the pilot to program runway 22 as the departure runway in the FMS system. When the airplane was positioned in a takeoff position on runway 26, a runway update was performed and the resultant map shift of the pilot flight display (PFD) was barely detectable to the investigators even though they were concentrating on the display.

[15] See attachment 6 – Comair Bulletin 05-010

8.4 Normal Takeoff

F/O Polehinke was the PF during the accident flight. Captain Clay was the Pilot Not Flying (PNF)[16] during the accident flight.

The Comair CRJ Flight Standards Manual VOL II, Chapter 7 – Maneuvers and Procedures, Section 7.4.4 – Normal Takeoff, pages 7-14 and 7-15 dated 11/30/05 (REV 29) stated in part:

> *The Normal Takeoff procedure is the standard takeoff procedure. It is the takeoff procedure that provides the greatest level of passenger comfort while providing operational flexibility within the ATC environment. The Normal Takeoff procedure should be utilized unless performance restrictions or environmental conditions dictate otherwise.*
>
> 1. *The PF will release the brakes (if being held) allowing the aircraft to roll throughout the takeoff.*
>
> 2. *The PF will advance the Thrust Levers smoothly and evenly toward the approximate takeoff N_1[17] setting. At approximately 70% N_1 or slightly above, the PF will call "Set thrust".*
>
> 3. *After the PF calls "Set thrust,"*
>   - *If it is the first officer's takeoff, he will remove his hand from the Thrust Levers and place it on the control yoke. The captain will set the takeoff N_1 and maintain control of the Thrust Levers.*
>
> 4. *When N1 reaches the desired takeoff setting, the PNF will call "Thrust Set". Takeoff thrust will be set prior to 60 knots.*
>
> 5. *The PF will utilize rudder pedal steering to maintain the runway centerline. Use of the tiller steering should be avoided.*
>
> 6. *The PNF will call "100 knots" when the airspeed reaches 100 knots. The PF will respond "Check". This provides a crew incapacitation check and an airspeed crosscheck. It also provides the captain with airspeed information for rejected takeoffs.*
>
> 7. *The PNF will call "V_1", "Rotate," and "V_2" as appropriate. The V_1 call should be made so that upon reaching V1, the callout has been completed. At V_1 the captain will remove his hand from the Thrust Levers.*
>
> 8. *At V_R, the PF will rotate the aircraft smoothly towards the target pitch attitude (flight director) in one continuous motion (at a rate of approximately 3 degrees per second)*

[16] Pilot Not Flying (PNF) was the term used by Comair at the time of the accident. Comair had issued a revision to their Operations Manual, which changed this to Pilot Monitoring (PM) but that change had not yet been received by the accident pilots.

[17] N_1 – indicates fan speed in percent RPM.

9.0 REJECTED TAKEOFFS

The Comair CRJ Flight Standards Manual VOL I, Chapter 3 - Normal Procedures, Section 3.7.3 Before Starting Engines, page 3-61 dated 11/03/05 (REV 29) contained the Comair Standard briefing which stated in part:

> *Any abnormalities before V_1, call the malfunction. If an abort is required, the captain will call "ABORT" and carry out the Reject Procedure.*

The Comair CRJ Flight Standards Manual, Chapter 3 - Normal Procedures, Section 3.7.3 Before Starting Engines, page 3-61 and 3-62 dated 11/03/05 (REV 29) also stated in part:

> *The captain will perform all rejected takeoffs in the CRJ. The following provides the captain guidelines in the handling of malfunctions during the takeoff phase.*
>
> - *At speeds below 100 knots, a takeoff shall be rejected for any of the following: system failures, unusual noise or vibration, tire failure, abnormal acceleration, engine failure and/or fire, unsafe takeoff configuration, unable to fly or fire warning.*
> - *At speeds equal to or greater than 100 knots but below V_1, it is recommended to reject the takeoff only for an engine failure and/or fire, or perception that the aircraft is unsafe or unable to fly.*
> - *The pilot who first notices the problem will state the malfunction (i.e. "Engine Failure," "Engine Fire," "Oil Pressure," etc.). Using the guidelines stated above, the captain will make the decision whether to continue or reject the takeoff.*

10.0 Taxi and Runway Confirmation Procedures

Post accident, Safety Board investigators conducted a survey of several Part 121 air carriers to determine if they had procedures for identifying the correct taxi route, their location during taxi, and confirmation of the correct runway for takeoff. The responses varied as to whether there were procedures in place and what they were. Most airlines had a pre-taxi briefing that included a discussion of the taxi route and the departure runway. Most carriers required that pilots have their taxi charts out during taxi. Two airlines required a readback of the runway identifier anytime there was a Hold Short clearance, a Position and Hold clearance, or a Takeoff clearance. One airline verified the departure runway as part of the Takeoff checklist. One airline had a procedure that the F/O was to cross check the runway heading with the airplane heading and verify that runway was the correct takeoff runway. Among some airlines, Safety Board investigators could not determine any standard procedures for verification that the crew was on the correct runway for departure.

Comair Airlines required a pre-taxi briefing, but did not require a readback of the runway identifier when they had a Hold Short clearance, a Position and Hold clearance, or a Takeoff clearance. As stated earlier, Comair pilots were to set the heading bug on the departure runway, but there were no procedures in place to ensure/confirm that they were on the correct runway prior to departure.

Post accident, the FAA issued a Safety Alert for Operators (SAFO) 06013[18] on September 1, 2006. The subject of the SAFO was "Flight crew techniques and procedures that enhance pre-takeoff and take-off safety". The purpose of the SAFO was "To provide techniques, procedures and items for consideration in training programs that emphasize safe operations in the pre-takeoff and take-off phases of flight".

The SAFO contained reminders of existing FAA aircraft ground operation guidance.

The recommended action of the SAFO was not mandatory for operators of transport category airplanes.

Comair did not have any procedures for readback of the runway when responding to any clearances to hold short of, taxi into position on, or takeoff from a runway. There was no specific Federal Regulation requiring a readback.

11.0 Guidance to Pilots on Runway Lighting Requirements at Night

11.1 Comair Procedures and Guidance

A review of Comair manuals was conducted and did not reveal any guidance or procedures to aid pilots on decisions when confronted with normal operations on an unlit runway on a dark night. There was guidance for specific runway lighting during a low visibility takeoff, which was done in accordance with Comair's Operations Specification C056.

The Comair CRJ Fleet Manager stated that Comair did not have any guidance in the Comair Operations Manual on departures from unlit runways, aside from their requirements for low visibility takeoffs.

11.2 FAA Procedures and Guidance

The FAA was asked if they had any policy or regulations against the use of an unlit runway at night by a Part 121 airline. The FAA Flight Standards Service, AFS-1 responded with a memorandum[19] dated November 22, 2006 that stated in part:

> *14 CFR Sections 121.97 and 121.117 place the burden on the air carrier to determine if an airport (runway) is adequate for the operation, to include lighting. It is understood that the POI would review the data an air carrier has gathered to determine if an airport is acceptable or not. In the case of the Lexington [LEX] accident, the NOTAM on reduced lighting would not have been a factor because it was a temporary condition and not part of the start up of service.*
>
> *14 CFR section 121.590 requires that an air carrier, and the pilots being used by an air carrier, must use a certificated land airport in the United States that is classified for the type airplane to be operated and the type of operation to be conducted. This means an airport has to be certificated and maintained under 14 CFR Part 139 to be used by an*

[18] See attachment 7 - SAFO
[19] See attachment 8 – FAA memorandum

air carrier. 14 CFR section 139.1 addresses the rule's applicability for the certification and operation of airports in the United States. Section 139.311 specifies that the certificate holder (airport operator) must provide and maintain lighting systems for air carrier operations when the airport is open at night. Deviations are authorized by Opspec [operations specifications] for items such as flare pots in lieu of standard runway lighting. If the runway lighting is not available at night, or a suitable substitute authorized by the Administrator is not available, neither the air carrier, nor the pilot being used by an air carrier, may operate if it is contrary to their Opspec. A copy of Comair's Opspec C067 is attached for reference, showing no such authorization for alternate runway lighting was approved for Lexington [LEX] airport.

11.3 Part 121 Airlines Guidance

Post accident, Safety Board investigators conducted a survey of several of the Part 121 air carriers to determine if they had procedures or guidance for operations on an unlit runway at night. The responses indicated that only a few airlines had any specific guidance for pilots concerning operations from unlit runways at night. One airline stated that flights were not authorized to takeoff or land during the period from 20 minutes after official sunset until 20 minutes before official sunrise at an airport where the runway lights are inoperative unless adequate substitute lighting is available (company manuals explained what the substitute lighting could be). One airline allowed a takeoff on a dark/unlit runway if the visibility was ¼ mile/RVR[20] 1600 or greater, and the available lights and/or markings provided forward visual reference adequate, in the "captain's judgment", to continuously identify the takeoff surface and maintain directional control throughout the takeoff run. Another airline had a statement that if the runway edge lights were inoperative, the MIRL may be required. One airline stated that takeoffs from unlit runways were prohibited unless given permission from the Director of Operations.

12.0 CRJ - Takeoff/Climb Thrust Procedures

The Comair CRJ Flight Standards Manual, Chapter 6B– "Performance" contained procedures for flight crews to determine thrust setting for takeoff, which also included procedures for determining a Reduced "Flex" Thrust setting.

The use of a Reduced "Flex" Thrust takeoff must be in accordance with the limitations outlined within the Comair CRJ Flight Standards Manual Chapter 2 – "Limitations" and the instructions contained within Chapter 6B – "Performance." Furthermore, the decision to use Reduced "Flex" Thrust Takeoffs was at the discretion of the captain.

The availability of a Reduced "Flex" Thrust takeoff was dependent upon the actual aircraft weight (considering bleed configuration and headwind/tailwind conditions), the departure runway and the temperature. To determine the thrust settings for takeoff, the flight crew would reference the Thrust Setting chart contained within the *Runway Analysis Manual*. From this chart, the flight crew could determine the thrust settings for takeoff, including a Reduced "Flex"

[20] RVR – runway visual range

Thrust setting. If the conditions (weight, departure runway and temperature) allowed a takeoff to be conducted using the Reduced "Flex" Thrust procedures, the corresponding thrust was displayed. If conditions did not allow a Reduced "Flex" Thrust takeoff, the takeoff data card contained a dash (-) in corresponding column denoting that a reduced thrust setting was not available.

The Operations Group determined that at the accident conditions of an aircraft weight of 49,087 lbs., a temperature of 24° C and a departure from runway 22 at LEX, the Thrust Setting chart indicated that a Reduced "Flex" Thrust takeoff was not available. The FDR indicated that the accident flight performed a full power takeoff.

13.0 Usage of a 75-foot Wide Runway for Takeoff

13.1 Runway 26 at LEX

As previously noted, runway 26 was actually 150-foot wide but the painted markings on the runway surface indicated the runway was 75-foot wide. The airport did not maintain the runway surface outside the painted markings so the runway was designated as a 75-foot wide runway.

13.2 Comair Procedures

A review of Comair manuals did not reveal any guidance or information on the use of 75-foot wide runways for takeoff or landing.

13.3 FAA Policy or Regulations

A review of 14 CFR Part 121 regulations by investigators did not reveal any restrictions or limitations on the use of a 75-foot runway for takeoff or landing.

The FAA was asked if they had a policy on Part 121 air carriers departing from a 75-foot wide runway and if there was a restriction on the width of the runway for Part 121 carriers. The FAA Memorandum[21] from Flight Standards Service AFS-1 dated November 22, 2006 stated in part:

> *While the FAA has no operation or certification regulations that address runway width requirements, they are addressed in an airports document, Advisory Circular (AC) 150/5300-13, Airport Design. This document is an airports design document and not an operations document. However, airplanes fall into different design groups (ADG) from I to VI based on wing span. Runways are to be designed to the highest ADG planned to operate from that runway. If an airport wants to receive FAA funds for runway improvements, it must conform with guidance in the AC or have an FAA-approved modification to standards. Airport operators generally use FAA funding for runway projects; therefore, in effect the design criteria in the AC becomes an "airports operations document." In order to conform with the AC, airports generally restrict*

[21] See attachment 8 – FAA memorandum

operations on runways to aircraft in the ADG that the runway is designed for. This is noted in the airport facility directory, such as "runway 26 restricted to single-engine daylight operations only." It is up to the flightcrew and the air carrier to comply with these restrictions. Air traffic [ATC] is obligated to advise the flightcrew of these restrictions (through the airport facility directory) but have no overriding authority of the flightcrew's decision.

Note: A review of the CL-600-2B19 AFM Limitations, Pilot Reference Manual, and Type Certificate Data Sheet have [indicate] no explicit regulation or certification restriction that would have prevented their taking off on a 75-foot wide runway. There is an AFM runway slope limitation but no limitations as to runway width.

14.0 NOTICES TO AIRMEN (NOTAMS)

The Flight Standards District Office (FSDO) located in Lincoln, Nebraska published a "Plane Talk" Volume 17 issue 1 dated March 2004[22] as part of its Aviation Safety Program. This issue contained information on Notices to Airmen (NOTAMs) that provide the following summarized information.

Notam information was classified into three categories. These were NOTAM (D) or distant, NOTAM (L) or local, and Flight Data Center (FDC) NOTAMs. NOTAMs provided essential information that could affect a pilot's decision to make a flight. NOTAMs provided critical information such as runway closures, navigational aid (NAVAID) status or Temporary Flight Restrictions.

Local NOTAMS included information such as taxiway closure, personnel and equipment near or crossing runways and lighting aids. Local NOTAMS were not attached to the hourly weather reports. Flight Service Stations (FSS) maintained local NOTAMS for only the facilities in their area.

Flight Data Center (FDC) NOTAMs were regulatory in nature.

The FAA Aviation Safety Inspectors Handbook, 8400.10 CHG 18, Volume 3 Operator Technical Administration, Chapter 6 Operational Control, Section 1 General Topics, paragraph 1151 Flight Information, page 3-588 to 3-590 stated in part:

- *NOTAM (D)s or distant dissemination information, pertains to navigational aids (NAVAID), landing areas, airport lighting facilities, and other data that is normally not published, such as parachute jumping areas, restricted areas, and some air shows. NOTAM (D)s are appended to electronically transmitted weather reports, such as the Service A network. NOTAM (D)s are disseminated for all NAVAIDs that are part of the National Airspace System (NAS) as well as all public-use airports, seaplane bases, and heliports listed in the A/FD[23].*

- *NOTAM (L) or local information includes such information as airport and taxiway construction and certain airport lighting. This information is directly relevant to surface movement guidance*

[22] See attachment 9 – "Plane Talk" issue
[23] A/FD – Airports/Facility Directory

and control. NOTAM (L)s can also contain information that is expected to be in effect for less than 1 hour concerning NAVAIDS, lighting, and runways. NOTAM (L)s are not normally transmitted beyond the area of coverage for the local FSS [flight service station] or automated flight service station (AFSS)

(a) POI Responsibility. POIs must ensure that the operator's GOM [general operations manual] contains specific procedures for the acquisition and dissemination of local NOTAM information to flightcrews and operational control personnel. Operational control personnel must be provided with a positive means to collect, analyze, and disseminate current NOTAM (L) information to flightcrews.

(b) Obtaining NOTAM (L) Information. This information may be obtained from the FSS having responsibility for the geographic area in which the destination airport is located. Another acceptable means for operators to acquire this information is to task an authorized agent with collecting this information and reporting it to the operator's operational control center.

NOTE: FAA inspectors and National Transportation Safety Board (NTSB) accident investigators have reported that a failure of operators to provide NOTAM (L) data to flightcrews has been a contributing factor in several accidents and incidents. For example, a Part 121 operator dispatched a flight of approximately 30 minutes' duration to a destination at which the instrument landing system (ILS) was reported by NOTAM (L) to be out of service. This particular flight could not be dispatched in compliance with FAR 121.613 without an operational ILS.

The Comair System Operational Control (SOC) provided the following information[24]:

- Comair received NOTAMs (D) and (FDC) electronically over the ARINC[25] communications line from Jeppesen into their Operations Control. Local NOTAMs were not sent to the Flight Planning System. Local NOTAMs were issued on ATIS.
- The reception of NOTAMs was an automated process. NOTAMs were updated as soon as the governing body published the NOTAM and Jeppesen distributed it to Comair.
- All published NOTAMs (D) and (FDC) were communicated to the pilots. All published NOTAMs (D) and (FDC) were attached to the dispatch release and displayed for Departure, Arrival, and Alternates when the dispatch release was printed.

The accident crew did not receive the NOTAM (L) #A-1682, which would have informed them that taxiway A north of runway 8/26 was closed until further notice. The ATIS informed the crew of "construction on the air carrier ramp". The Comair system was not set up to receive local NOTAMs and Comair would need to contact the local flight service station for the local NOTAM.

15.0 FAA OVERSIGHT

[24] The information was provided by SOC but was presented to the Operations Group by the Director of Corporate Safety for Comair Airlines.
[25] ARINC – Aeronautical Radio Incorporated.

The FAA Certificate Management Office (CMO) for the Comair Airlines certificate was in Atlanta, Georgia. The Certificate Management Unit (CMU), which handled the everyday oversight, was located in Louisville, Kentucky. The Principal Operations Inspector (POI) had been in that position for about three and a half years at the time of the accident. The Comair CMU had an assistant POI who had been in that position for about two years. There were also two aircrew program managers (APM) in the CMU with about ten years and about two years experience in those positions. There was a cabin safety inspector (CSI) in the CMU who had been in that position for about three years.

Comair Airlines oversight was conducted under the Air Transportation Oversight System (ATOS) at the time of the accident and Comair had been an ATOS carrier since June 1, 2006. Previously, FAA oversight was conducted under the National Program Guidelines (NPG).

A review of FAA ATOS records indicated that about 120 element performance inspections (EPI) and about seven safety attribute inspections (SAI) had been conducted on Comair airlines in the three months prior to the accident that the carrier had been under the ATOS system.

A review of FAA's NPG Program Tracking and Reporting Subsystem (PTRS) revealed that during oversight in the 24 months prior to the accident, the FAA conducted the following records of activity:

- 1,073 inspections pertaining to the 1500 code series. This series was concerned with Airmen Certification oversight.
- 2,473 inspections pertaining to the 1600 code series. This series was concerned with Surveillance.
- 143 inspections pertaining to the 1700 code series. This series was concerned with Investigations.
- There were 17 inspection records that pertained to the accident captain and 10 records that pertained to the accident F/O. These were normal oversight inspections.

Submitted by:

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David Tew
Air Safety Investigator, Operations
January 12, 2007