



National Transportation Safety Board

Washington, D.C. 20594

Safety Recommendation

Date: August 28, 2007

In reply refer to: A-07-44 through -48
A-00-67 and -68 (Reiterated)
A-06-83 (Superseded)

Honorable Marion C. Blakey
Administrator
Federal Aviation Administration
Washington, DC 20591

On August 27, 2006, about 0606:35 eastern daylight time, Comair flight 5191, a Bombardier CL-600-2B19,1 N431CA, crashed during takeoff from Blue Grass Airport (LEX), Lexington, Kentucky. The flight crew was instructed to take off from runway 22 but instead lined up the airplane on runway 26 and began the takeoff roll. The airplane ran off the end of the runway and impacted the airport perimeter fence, trees, and terrain. The captain, flight attendant, and 47 passengers were killed, and the first officer 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 (CFR) Part 121 and was en route to Hartsfield-Jackson Atlanta International Airport, Atlanta, Georgia. Night visual meteorological conditions prevailed at the time of the accident.

The National Transportation Safety Board determined that the probable cause of this accident was the flight crewmembers' failure to use available cues and aids to identify the airplane's location on the airport surface during taxi and their failure to cross-check and verify that the airplane was on the correct runway before takeoff. Contributing to the accident were the flight crew's nonpertinent conversation during taxi, which resulted in a loss of positional awareness, and the Federal Aviation Administration's (FAA) failure to require that all runway crossings be authorized only by specific air traffic control (ATC) clearances.²

¹ The accident airplane was a Canadair regional jet (CRJ)-100 model, which is one of three models in the CL-600-2B19 series (the other two models are the CRJ-200 and CRJ-440). Bombardier acquired Canadair in December 1986.

² For more information, see *Attempted Takeoff From Wrong Runway, Comair Flight 5191, Bombardier CL-600-2B19, N431CA, Lexington, Kentucky, August 27, 2006*, Aircraft Accident Report NTSB/AAR-07/05 (Washington, DC: NTSB, 2007), which is available on the Safety Board's Web site at <<http://www.nts.gov/publictn/2007/AAR0705.pdf>>.

Efforts to Mitigate Airport Surface Operation Errors

Surface operation errors, including those that lead to wrong runway takeoff events, can be mitigated in several ways, such as improved flight deck procedures, the implementation of cockpit moving map displays or cockpit runway alerting systems, improved airport surface marking standards, and ATC policy changes. These systemwide interventions can provide the necessary redundancy to reduce the opportunity for human error during surface operations and, if an error were to occur, to stop it before it becomes catastrophic. These interventions can also help prevent runway incursions, which is an issue on the Safety Board's list of Most Wanted Transportation Safety Improvements.

Flight Deck Procedures

Well-designed flight deck procedures can be an effective countermeasure against surface operation errors. After this accident, the Safety Board recognized the need to improve industry standards for confirming an airplane's position at the departure runway before takeoff and, on December 12, 2006, issued Safety Recommendation A-06-83. This recommendation asked that the FAA require all 14 CFR Part 121 operators to establish procedures requiring all crewmembers on the flight deck to positively confirm and cross-check the airplane's location at the assigned departure runway before crossing the hold short line for takeoff.

On April 16, 2007, the FAA issued Safety Alert for Operators (SAFO)³ 07003, "Confirming the Takeoff Runway," in response to Safety Recommendation A-06-83. According to the SAFO, its purpose is to emphasize the importance of implementing standard operating procedures and training for flight crews to ensure that an airplane is at the intended runway.

SAFO 07003 was aimed at directors of safety, directors of operations, fractional ownership program managers, trainers, and pilots. The SAFO stated that pilots should positively confirm and cross-check the takeoff runway and the airplane's location at the assigned departure runway before crossing the hold short line and while in the takeoff position. The SAFO further stated that airplane-specific standard operating procedures should be established, implemented, and supported by pilot training that uses all available resources to confirm and cross-check an airplane's position. The SAFO mentioned that these resources included the horizontal situation indicators, which can confirm that an airplane's position is where the flight crew intended, and air traffic controllers, who can help confirm an airplane's position during taxi or at a hold short line.

The Safety Board is encouraged that the FAA is providing renewed emphasis about the importance of cross-checking and confirming an airplane's position on a runway. The Board also notes that SAFO 06013, "Flight Crew Techniques and Procedures That Enhance Pre-takeoff and Takeoff Safety," addressed the issue of training and procedures for improving safety during taxi operations. This SAFO referenced Advisory Circular (AC) 120-74A, "Parts 91, 121, 125, and 135 Flightcrew Procedures During Taxi Operations," which outlined best practices for surface

³ FAA Order 8000.87, dated August 29, 2005, established SAFOs and stated, in part, that SAFOs conveyed "new important safety information" directly to operators as that information became available but that SAFOs were not mandatory.

operations. The AC indicated that these best practices include sterile cockpit procedures to protect against human error and procedures to maximize “heads-out” time for both pilots to provide necessary redundancy.

The FAA’s issuance of SAFO 07003 addressed the intent of Safety Recommendation A-06-83. However, SAFOs are, by definition, advisory only, and the recommendation asked the FAA to require all Part 121 operators to establish procedures requiring flight crewmembers to positively confirm and cross-check an airplane’s location at the assigned departure runway before crossing the hold short line for takeoff. Also, the Board’s survey of Part 121 operators found that many did not include the procedures recommended in SAFO 06013, which had been issued in September 2006. SAFO guidance may be an acceptable alternate response to a Board recommendation if an FAA survey finds that all Part 121 operators have implemented the recommended procedures.

Because the decision to implement a SAFO rests with an operator and because of the importance to flight safety that the information in SAFO 07003 (as well as SAFO 06013) be required and extended to Part 91K⁴ and 135 operators, Safety Recommendation A-06-83 is classified “Closed—Acceptable Alternate Action/Superseded.” In addition, the Safety Board concludes that a standard procedure requiring Part 91K, 121, and 135 pilots to confirm and cross-check that their airplane is positioned at the correct runway before crossing the hold short line and initiating a takeoff would help to improve the pilots’ positional awareness during surface operations. Therefore, the Safety Board believes that the FAA should require that all 14 CFR Part 91K, 121, and 135 operators establish procedures requiring all crewmembers on the flight deck to positively confirm and cross-check the airplane’s location at the assigned departure runway before crossing the hold short line for takeoff. This required guidance should be consistent with the guidance in AC 120-74A and SAFOs 06013 and 07003.

In addition, after the accident, the Safety Board also recognized the need to improve industry standards regarding takeoffs at night on unlighted runways. As a result, on December 12, 2006, the Board issued Safety Recommendation A-06-84, which asked the FAA to require all Part 121 operators to provide specific guidance to pilots on the runway lighting requirements for takeoff operations at night.

On May 11, 2007, the FAA issued Information for Operators (InFO)⁵ 07009, “Runway Lights Required for Night Takeoffs in Part 121.” This InFO recognized that, even though runway lighting varied among airports and runways, every pilot operating under Part 121 needed to understand the following: (1) pilots should not take off at night on a runway without lights; (2) pilots must check notices for airmen (NOTAM) for runway light outages and taxiway and runway closures, and takeoffs are not permitted on closed runways; and (3) a pilot must think beyond pertinent NOTAMs because inoperative runway lights do not necessarily cause a runway to be closed by the airport authority, or a runway may be unusable even if its runway lights are

⁴ Title 14 CFR 91 Subpart K applies to fractional ownership operations.

⁵ On October 20, 2006, the FAA issued Order N8000.91 to establish a method of sending information to operators in a timely manner. According to the order, an InFO message contains “valuable information for operators that should help them meet administrative requirements or certain regulatory requirements with relatively low urgency or impact in safety.” InFO messages are not mandatory.

fully operational. The InFO recommended that Part 121 directors of safety, directors of operations, trainers, and pilots collaborate to make these three points clearly understood by their flight crews and include these points in their pilot operating manuals, training programs, and plans for any night takeoff.

Even though the information in InFO 07009 is responsive to Safety Recommendation-A-06-84, InFOs are advisory only, and the recommendation asked the FAA to require Part 121 operators to provide pilot guidance on runway lighting requirements for night takeoff operations. However, if the FAA can determine, by surveying all Part 121 operators, that the guidance in the InFO has been adopted, then the Safety Board could consider the InFO to be an acceptable alternative action to the recommendation. Pending the results of an FAA survey of all Part 121 operators to determine whether they have adopted the guidance in InFO 07009, Safety Recommendation A-06-84 is classified “Open—Acceptable Alternate Response.”

Finally, in its report on the February 16, 2005, crash of a Cessna Citation 560 in Pueblo, Colorado, the Safety Board discussed the need for pilots to receive training in monitoring skills and have opportunities to practice these skills.⁶ On February 27, 2007, the Board issued Safety Recommendation A-07-13, which asked the FAA to “require that all pilot training programs be modified to contain modules that teach and emphasize monitoring skills and workload management and include opportunities to practice and demonstrate proficiency in these areas.”⁷ If this recommendation were implemented, pilots would receive training that would not only benefit in-flight operations but also airport surface operations.

Technological Initiatives

Advances in technology can provide pilots with improved positional awareness while navigating airport surfaces. Such technologies were discussed and illustrated at the Safety Board’s Runway Incursion Forum in March 2007. Cockpit moving map displays in which the aircraft’s position is superimposed on a map of the airport surface, including all runways, taxiways, and terminal areas, would help pilots orient themselves during navigation if they were to become lost, thus mitigating surface navigation errors. A cockpit moving map display could be an effective countermeasure against the type of perceptual error and confirmation bias⁸ that occurred with this accident. Efforts to establish digital maps of airports were included as part of

⁶ National Transportation Safety Board, *Crash During Approach to Landing, Circuit City Stores, Inc., Cessna Citation 560, N500AT, Pueblo, Colorado, February 16, 2005*, Aircraft Accident Report NTSB/AAR-07/02 (Washington, DC: NTSB, 2007). The report includes a discussion of the Safety Board’s previous work in the area of pilot monitoring.

⁷ On May 17, 2007, the FAA stated that 14 CFR Part 61 and the Aircraft Type Rating Practical Test Standard specifically addressed the cockpit resource management requirement for airman certification and checking. The FAA also stated that it would consider identifying in its work program a list of required inspections that would reemphasize to regional and flight standards district office managers the need to validate the training that is already required and verify its effectiveness.

⁸ Confirmation bias results from a tendency for people to primarily seek out confirming evidence of a belief while spending less effort to seek out negative evidence that can disconfirm the belief. Confirmation bias can cause a person to persist in holding an incorrect belief despite the availability of contradictory evidence. For the flight crew, confirmation bias was in place not only at the hold short line for runway 26 but also during the initial acceleration down the runway because the crew did not evaluate evidence that would contradict the airplane’s position on the airport surface at the time.

the FAA's Safe Flight 21 program, and cockpit-based tools for surface navigation were addressed in the FAA's 2002 Blueprint for Runway Safety. In addition, research showed that, if airborne electronic map displays were extended to airport surface navigation, they could significantly decrease navigational errors, such as wrong turns in low visibility conditions.⁹

On March 23, 2007, the FAA announced that it was accelerating the certification process to facilitate the installation in air carrier cockpits of class 2 electronic flight bags (EFB), which are portable devices that can display various textual and graphical data, including moving maps.¹⁰ The FAA's decision to accelerate the certification process and allow class 2 EFBs to be used for ground operations was the result of the agency's recognition that the requirements for the ground use of these devices could be relaxed compared with the more stringent class C standards for the airborne use of the devices. The FAA's decision to relax the standards for the ground use of class 2 EFBs was partly the result of the agency's review of human factors research on the safety benefits of these systems. According to the FAA, the research showed that pilots had better awareness of their position on the airport's surface using an "own ship" position display, and recent tests demonstrated that pilots typically glanced at such displays and then quickly looked out their windows to verify that information visually, thus eliminating the concern that pilots would be "heads down" too long for safe operations.

On April 30, 2007, the FAA issued AC 20-159, "Obtaining Design and Production Approval of Airport Moving Map Display Applications Intended for Electronic Flight Bag Systems," which provided guidance on the agency's streamlined certification process for the ground use of class 2 EFB moving map displays. The class C certification standards, which were established in 2003, will remain the same for these devices, but, according to the FAA, the new certification process should lower the cost for their deployment and implementation.

In addition to cockpit moving map displays, the Safety Board reviewed other available technologies that might have alerted the accident flight crewmembers about their surface navigation error. For example, after the Singapore Airlines flight 006 accident,¹¹ Boeing developed a wrong runway alert that compares the runway selected in the flight management computer (FMC) with the airplane's position or heading at the time of takeoff. This optional upgrade to engine indicating and crew alerting system (EICAS) software annunciates a

⁹ V. Battiste, M. Downs, and R.S. McCann, "Advanced Taxi Map Display Design for Low-Visibility Operations," *Proceedings of the Human Factors and Ergonomics Society*, pages 997-1001, 1996.

¹⁰ Class 2 EFBs operate using the airplane's power system.

¹¹ On October 31, 2000, Singapore Airlines flight 006, a Boeing 747, crashed during an attempted takeoff from a partially closed runway at Chiang Kai-Shek International Airport, Taoyuan, Taiwan. Of the 179 occupants aboard the airplane, 83 were killed. The report by Taiwan's Aviation Safety Council found that the pilots did not adequately review the taxi route to ensure that they understood that the route to runway 5L (the correct departure runway) required passing runway 5R (a parallel runway that was under construction and open only for taxi operations). The report also stated that the pilots did not verify the airplane's position with the taxi route as they were turning onto the runway and that the company's operations manual did not include a procedure to confirm an airplane's position on the active runway before initiating takeoff. The report concluded that the flight crew lost situational awareness and took off from the wrong runway despite numerous available cues that provided information about the airplane's position on the airport. The Aviation Safety Council recommended that Singapore Airlines "include in all company pre-takeoff checklists an item formally requiring positive visual identification and confirmation of the correct takeoff runway."

cautionary EICAS alert when a takeoff is attempted on a runway that is not the FMC-selected runway.¹²

Also, Honeywell developed the runway alert and advisory system (RAAS), which is a software addition to the company's enhanced ground proximity warning system (EGPWS). RAAS does not require the installation of additional hardware but does require an airplane to be equipped with a global positioning system. RAAS uses the same runway database as EGPWS to provide an aural advisory to pilots when their airplane is approaching or is on a runway during taxi operations. The RAAS system also provides pilots with an aural advisory when their airplane is on a runway of an operator-defined insufficient length or if the airplane is positioned for an intersection departure of insufficient length. In addition, RAAS provides an aural advisory to pilots if a takeoff is attempted on a taxiway. Research conducted by Honeywell indicated that RAAS could mitigate flight crew surface navigation errors that could lead to wrong runway takeoffs. Currently, eight CRJ airplanes have RAAS installed.

The Safety Board is encouraged by the FAA's actions with regard to cockpit moving map displays for surface navigation and cockpit runway alerting systems. However, these technologies have not been mandated despite their demonstrated safety benefits. These technologies need to be considered in the same category as existing technological interventions such as the traffic alert and collision avoidance system (commonly referred to as TCAS) and EGPWS. The Safety Board concludes that the implementation of cockpit moving map displays or cockpit runway alerting systems on air carrier aircraft would enhance flight safety by providing pilots with improved positional awareness during surface navigation. Therefore, the Safety Board believes that the FAA should require that all 14 CFR Part 91K, 121, and 135 operators install on their aircraft cockpit moving map displays or an automatic system that alerts pilots when a takeoff is attempted on a taxiway or a runway other than the one intended.

Airport Surface Marking Standards

In 2002, the FAA sponsored a study to determine whether paint markings would improve the situational awareness of pilots taxiing on an airfield. The study, which was undertaken by the Mitre Corporation, found that enhanced taxiway centerline markings (that is, parallel yellow dashed lines on a black background that appear on either side of a taxiway centerline for 150 feet before a runway holding position marking) and surface painted holding position signs (that is, white runway numbers on a red background that appear just before a runway holding position marking) were effective in increasing runway awareness among transport-category pilots.¹³

The FAA is expected to modify its airport marking standards according to the enhanced taxiway centerline marking recommendations from the Mitre Corporation's January 2005 report. Specifically, the FAA is requiring that, by June 30, 2008, all Part 139 airports with 1.5 million or

¹² According to Boeing, 14 air carriers currently have airplanes equipped with this alert.

¹³ Cheryl R. Andrews, Steven L. Estes, Dr. Peter M. Moertl, and B. Oscar Olmos, *Summary of Airport Surface Marking Project*, Product No. 05W0000005, McLean, Virginia: Mitre Corporation, 2005.

more annual passenger enplanements have enhanced taxiway centerline markings before each runway holding position.¹⁴

According to AC 150/5340-1J, “Standards for Airport Markings,” the enhanced taxiway centerline markings were designed to make hold short lines more conspicuous to pilots and help prevent a loss of situational awareness. The markings were also intended to alert pilots that they were approaching a runway holding position and that they “should go into a ‘heads-up’ mode of operation until they determine the exact location of the holding position.”¹⁵

Even though the FAA-sponsored study found that surface painted holding position signs were effective in increasing positional awareness for pilots, the FAA did not modify its requirement for these holding position signs. Currently, the signs are only required where the width of the holding position on the taxiway is greater than 200 feet. From a human factors standpoint, surface painted holding position signs provide pilots with an unambiguous cue of their position on the airport surface. The central location of these position signs (adjacent to the taxiway centerline) increases their conspicuity, providing a critical redundancy to existing signage.

The Safety Board is encouraged by the FAA’s plan to incorporate enhanced taxiway centerline markings at airports with 1.5 million or more annual passenger enplanements. However, the Board is concerned that other Part 139 airports will not be required to implement these markings and that surface painted holding position signs will still only be required where the width of the holding position on the taxiway is greater than 200 feet. The Safety Board concludes that enhanced taxiway centerline markings and surface painted holding position signs provide pilots with additional awareness about the runway and taxiway environment. Therefore, the Safety Board believes that the FAA should require that all airports certificated under 14 CFR Part 139 implement enhanced taxiway centerline markings and surface painted holding position signs at all runway entrances.

Taxi and Takeoff Clearances

Title 14 CFR 91.129(i) permits pilots, after receiving taxi clearance, to cross all intersecting runways along the taxi route (without stopping) except for the assigned departure runway. On July 6, 2000, the Safety Board issued Safety Recommendations A-00-67 and -68, which asked, in part, that the FAA (1) amend 14 CFR 91.129(i) to require that all runway crossings be authorized only by specific ATC clearance and (2) amend FAA Order 7110.65 to require that, for aircraft that need to cross multiple runways, air traffic controllers issue an explicit crossing instruction for each runway after the previous runway has been crossed. The

¹⁴ According to the FAA’s passenger enplanement data for 2005 (the most recent data available), these markings will be required at 75 airports. LEX is not one of those airports; during 2005, it had about 0.5 million passenger enplanements.

¹⁵ AC 150/5340-1J also stated, “installation at other airports is at the option of the airport operator. If an airport operator decides to exercise this option, the enhanced markings must be installed at all holding positions on the airport.”

Board classified these safety recommendations “Open—Unacceptable Response” on April 11, 2006.¹⁶

If these safety recommendations had been implemented before this accident, the controller would have been required to issue a specific taxi clearance for the airplane to cross runway 26 and then issue a specific taxi clearance for the airplane to continue taxiing to runway 22. These procedures would have provided the flight crew with better awareness of the airplane’s position along the taxi route and would have required the controller to visually observe the airplane’s position and monitor the taxi as the airplane progressed toward the departure runway. Thus, the flight crew’s surface navigation error might have been prevented. In addition, Mitre reports cited pilot and controller concerns about the adequacy of runway crossing requirements, and most of these pilots and controllers thought that it would be beneficial to safety to modify 14 CFR 91.129(i) so that it required a specific clearance for each runway crossing.¹⁷ The Safety Board concludes that this accident demonstrates that 14 CFR 91.129(i) might result in mistakes that have catastrophic consequences because the regulation allows an airplane to cross a runway during taxi without a pilot request for a specific clearance to do so. Therefore, the Safety Board reiterates Safety Recommendations A-00-67 and -68.

In addition, no FAA guidance specifically prohibits issuing a takeoff clearance until all intersecting runways to the departure runway have been crossed. On January 4, 2007, the LEX air traffic manager issued a notice that stated that controllers at the tower were not to issue takeoff clearances for runway 22 until the departing airplanes were observed to have completely crossed runway 26.¹⁸ Such guidance would benefit other airports with intersecting runways. On June 1, 2007, the FAA issued Notice N JO 7110.468, “Takeoff Clearance,” to amend the required phraseology for issuing departure instructions. According to this notice, a controller has to specifically clear an airplane across all intervening runways before issuing a takeoff clearance.¹⁹ However, this guidance does not instruct controllers to wait until an airplane has crossed the runways before issuing the takeoff clearance.

¹⁶ In its April 11, 2006, letter to the FAA, the Safety Board stated that it met with the FAA on June 30, 2005, to discuss safety recommendations related to runway incursions. During the meeting, the FAA stated its belief that no safety problem existed when proper procedures were followed and that pilots should never cross a runway unless authorized to do so. The Safety Board’s letter expressed concern about situations in which pilots might be lost or believe that they had received permission to move to a position that was different than the one that the controller intended.

¹⁷ *Reports by Airline Pilots on Airport Surface Operations: Part 2. Identified Problems and Proposed Solutions for Surface Operational Procedures and Factors Affecting Pilot Performance*, Technical Report No. MTR94W0000060.v2, McLean, Virginia: Mitre Corporation, 1994. *Reports by Air Traffic Control Tower Controllers on Airport Surface Operations: The Causes and Prevention of Runway Incursions*, Technical Report No. MTR98W0000033, McLean, Virginia: Mitre Corporation, 1998.

¹⁸ In addition, in its July 17, 1989, letter transmitting Safety Recommendation A-89-74, the Safety Board noted that the controllers at Houston Hobby Airport, Houston, Texas, were required to observe airplanes cross the approach end of runway 17 before issuing a clearance for takeoff for runway 12. This requirement was the result of two pilot deviation events in early 1989 that involved departures of U.S. air carrier airplanes from the wrong runway at the airport. For information about Safety Recommendation A-89-74, see the final report for this accident.

¹⁹ The notice indicated that this information would be incorporated into FAA Order 7110.65 on February 14, 2008.

The Safety Board concludes that, if controllers were required to delay a takeoff clearance until confirming that an airplane has crossed all intersecting runways to a departure runway, the increased monitoring of the flight crew's surface navigation would reduce the likelihood of wrong runway takeoff events. Therefore, the Safety Board believes that the FAA should prohibit the issuance of a takeoff clearance during an airplane's taxi to its departure runway until after the airplane has crossed all intersecting runways.

Controller Monitoring Responsibility

FAA Order 7110.65, paragraph 2-1-2, "Duty Priority," states that controllers should "give first priority to separating aircraft and issuing safety alerts" and that "good judgment shall be used in prioritizing all other provisions of this order based on the requirements of the situation at hand." Visual monitoring of takeoffs and landings is not specifically required by the order, so a controller's decision whether to monitor a takeoff or landing is thus left to his or her judgment.

Unless other active, flight safety-related control tasks demand attention, controllers should visually monitor departing and arriving airplanes because such monitoring can allow the detection of unexpected threats to flight safety, including surface navigation errors. Thus, the monitoring of takeoffs and landings should have a higher priority than performing administrative tasks because such tasks, although required, do not directly affect flight safety, whereas visual monitoring of takeoffs and landings provides a safety protection.

The Safety Board recognizes that controllers may not be able to continuously monitor all takeoffs and landings in their area of operations. Research on performance criteria for ATC specialists indicated that local (tower) controllers spent about 38 percent of their time looking out of tower cab windows.²⁰ These controllers were looking at the digital bright radar indicator tower equipment and flight progress strips during most of their other time, which was necessary because these sources of information were routinely changing and thus required visual attention. Even though controllers cannot continuously monitor departing and arriving airplanes, controllers can prioritize their duties so that they give priority to monitoring tasks over the performance of administrative tasks.

The LEX controller stated that he monitored the takeoff of departing airplanes when arriving airplanes were on final approach so that he could ensure that the departing airplanes took off in time to maintain adequate separation. The controller stated that he might decide to watch other airplanes take off but that this decision depended on whether he needed to attend to other duties. The controller's decision to perform the traffic count²¹ instead of monitoring the Comair flight's departure, in addition to his description of his normal monitoring practices for departing airplanes, suggested that he did not regard the visual monitoring of takeoffs and landings as a necessary flight safety activity. However, after the accident, the controller

²⁰ K. Cardosi and A. Yost, *Controller and Pilot Error in Airport Operations: A Review of Previous Research and Analysis of Safety Data*, Technical Report No. DOT/FAA/AR-00/51 (Washington, DC: Department of Transportation, 2001).

²¹ The traffic count was an administrative record-keeping task. The standard operating procedure at LEX was to perform the traffic count on an hourly basis. However, the controller stated that he normally accumulated flight progress strips throughout the night and performed the traffic count once toward the end of his shift.

acknowledged that it might have been possible for him to detect that the accident airplane was on the wrong runway if he had been looking out the tower cab windows.

Administrative tasks should not have priority over radar and tower monitoring tasks. The Safety Board concludes that, if controllers were to focus on monitoring tasks instead of administrative tasks when aircraft are in the controller's area of operations, the additional monitoring would increase the probability of detecting flight crew errors. Therefore, the Safety Board believes that the FAA should revise FAA Order 7110.65, "Air Traffic Control," to indicate that controllers should refrain from performing administrative tasks, such as the traffic count, when moving aircraft are in the controller's area of responsibility.

Controller Judgment, Vigilance, and Safety Awareness

In its final report on the Comair flight 5191 accident, the Safety Board concluded that the controller did not detect the flight crew's attempt to take off on the wrong runway because, instead of monitoring the airplane's departure, he performed a lower-priority administrative task that could have waited until he transferred responsibility for the airplane to the next ATC facility.

On April 10, 2007, the Safety Board issued Safety Recommendation A-07-34, which asked the FAA to require all air traffic controllers to complete instructor-led initial and recurrent training in resource management skills to improve controller judgment, vigilance, and safety awareness. On July 13, 2007, the FAA stated that it had delivered cockpit resource management (CRM) workshops, posters, and follow-up support to several ATC tower and terminal radar approach control facilities. The FAA also stated that the CRM implementation plan for fiscal years 2007 through 2009 included instructor-led training at "a percentage of" the highest-error-rate terminal and en route facilities and CRM training for initial hires in the FAA Academy and college training initiative programs. The FAA further stated that it would develop plans to train additional controllers on an initial and a recurrent basis.

The Safety Board is encouraged that the FAA has provided CRM training to some ATC facilities but is concerned that such training may not be provided to all controllers, including those at smaller facilities (such as LEX). The Board is also concerned about the FAA's plans for recurrent CRM training at only a percentage of the terminal and en route facilities with the highest error rates. The FAA needs to ensure that all controllers (and not just those at highest-error-rate facilities) receive this training on an initial and a recurrent basis. Pending this action, Safety Recommendation A-07-34 is classified "Open—Acceptable Response."

Controller Fatigue

In its final report on the Comair flight 5191 accident, the Safety Board also concluded that the controller was most likely fatigued at the time of the accident,²² but the extent that

²² The controller reported that, on August 26, 2006, he awoke at 0540, worked from 0630 to 1430, and took a nap between about 1530 and 1730 (the quality of his sleep during the nap was described as "not real good"). As a result, the controller had slept about 2 hours in the 24 hours that preceded the accident (which is much less than the nominal sleep period of about 8 hours), and he had been continuously awake for more than 12 hours since his nap. In addition, the controller was adapted to sleeping at night, and the accident occurred at a time when he would have

fatigue affected his decision not to monitor the airplane's departure could not be determined in part because his routine practices did not consistently include the monitoring of takeoffs.

On April 10, 2007, the Safety Board issued Safety Recommendations A-07-30 and -31 to the FAA to address its concerns about the potential impact of fatigue on air traffic controller performance.²³ Safety Recommendation A-07-30 asked the FAA to work with the National Air Traffic Controllers Association (NATCA) to reduce the potential for controller fatigue by (1) revising controller work scheduling policies and practices to provide rest periods that are long enough for controllers to obtain sufficient restorative sleep and by (2) modifying shift rotations to minimize disrupted sleep patterns, accumulation of sleep debt, and decreased cognitive performance. Safety Recommendation A-07-31 asked the FAA to develop a fatigue awareness and countermeasures training program for controllers and personnel who are involved in the scheduling of controllers for operational duty that addresses the incidence of fatigue in the controller workforce, causes of fatigue, effects of fatigue on controller performance and safety, and the importance of using personal strategies to minimize fatigue.

On July 5, 2007, the FAA responded to Safety Recommendations A-07-30 and -31. The FAA stated that it had convened a working group to develop shift rotation and scheduling guidelines and that NATCA would be invited to participate in the group. The FAA also stated that it would develop, within 12 months, and implement a fatigue awareness and countermeasures training program to be used by all FAA Air Traffic Organization operational service units. Pending (1) the development of guidance for controller work scheduling policies and practices to provide rest periods that are long enough for controllers to obtain sufficient restorative sleep and (2) the modification of shift rotations to minimize disrupted sleep patterns, accumulation of sleep debt, and decreased cognitive performance, Safety Recommendation A-07-30 is classified "Open—Acceptable Response." Pending the development and implementation of a fatigue awareness and countermeasures training program for controllers and personnel involved in the scheduling of controllers for operational duty, Safety Recommendation A-07-31 is classified "Open—Acceptable Response."

Therefore, the National Transportation Safety Board recommends that the Federal Aviation Administration:

Require that all 14 *Code of Federal Regulations* Part 91K, 121, and 135 operators establish procedures requiring all crewmembers on the flight deck to positively confirm and cross-check the airplane's location at the assigned departure runway before crossing the hold short line for takeoff. This required guidance should be consistent with the guidance in Advisory Circular 120-74A and Safety Alert for Operators 06013 and 07003. (A-07-44)

normally been asleep and when circadian factors would tend to diminish alertness. Thus, the controller's recent duty times and sleep patterns indicated that he would have been experiencing some fatigue at the time of the accident.

²³ Also on April 10, 2007, the Safety Board issued Safety Recommendation A-07-32 to the National Air Traffic Controllers Association to address this issue. The recommendation is currently classified "Open—Await Response."

Require that all 14 *Code of Federal Regulations* Part 91K, 121, and 135 operators install on their aircraft cockpit moving map displays or an automatic system that alerts pilots when a takeoff is attempted on a taxiway or a runway other than the one intended. (A-07-45)

Require that all airports certificated under 14 *Code of Federal Regulations* Part 139 implement enhanced taxiway centerline markings and surface painted holding position signs at all runway entrances. (A-07-46)

Prohibit the issuance of a takeoff clearance during an airplane's taxi to its departure runway until after the airplane has crossed all intersecting runways. (A-07-47)

Revise Federal Aviation Administration Order 7110.65, "Air Traffic Control," to indicate that controllers should refrain from performing administrative tasks, such as the traffic count, when moving aircraft are in the controller's area of responsibility. (A-07-48)

Also, the Safety Board reiterates the following previously issued recommendations to the Federal Aviation Administration:

Amend 14 *Code of Federal Regulations* (CFR) Section 91.129(i) to require that all runway crossings be authorized only by specific air traffic control clearance, and ensure that U.S. pilots, U.S. personnel assigned to move aircraft, and pilots operating under 14 CFR Part 129 receive adequate notification of the change. (A-00-67)

Amend Federal Aviation Administration Order 7110.65, "Air Traffic Control," to require that, when aircraft need to cross multiple runways, air traffic controllers issue an explicit crossing instruction for each runway after the previous runway has been crossed. (A-00-68)

In addition, the following previously issued recommendation to the Federal Aviation Administration is classified "Closed—Acceptable Alternate Action/Superseded":

Require that all 14 *Code of Federal Regulations* Part 121 operators establish procedures requiring all crewmembers on the flight deck to positively confirm and cross-check the airplane's location at the assigned departure runway before crossing the hold-short line for takeoff. (A-06-83)

The following previously issued recommendation to the Federal Aviation Administration is classified "Open—Acceptable Alternate Response":

Require that all 14 *Code of Federal Regulations* Part 121 operators provide specific guidance to pilots on the runway lighting requirements for takeoff operations at night. (A-06-84)

Finally, the following previously issued recommendations to the Federal Aviation Administration are classified “Open—Acceptable Response”:

Work with the National Air Traffic Controllers Association to reduce the potential for controller fatigue by revising controller work-scheduling policies and practices to provide rest periods that are long enough for controllers to obtain sufficient restorative sleep and by modifying shift rotations to minimize disrupted sleep patterns, accumulation of sleep debt, and decreased cognitive performance. (A-07-30)

Develop a fatigue awareness and countermeasures training program for controllers and for personnel who are involved in the scheduling of controllers for operational duty that will address the incidence of fatigue in the controller workforce, causes of fatigue, effects of fatigue on controller performance and safety, and the importance of using personal strategies to minimize fatigue. This training should be provided in a format that promotes retention, and recurrent training should be provided at regular intervals. (A-07-31)

Require all air traffic controllers to complete instructor-led initial and recurrent training in resource management skills that will improve controller judgment, vigilance, and safety awareness. (A-07-34)

Chairman ROSENKER, Vice Chairman SUMWALT, and Members HERSMAN, HIGGINS, and CHEALANDER concurred with these recommendations. Members Hersman and Higgins filed concurring statements, which are attached to the Aircraft Accident Report for this accident.

[Original Signed]

By: Mark V. Rosenker
Chairman