National Transportation Safety Board

Washington, D.C. 20594

Safety Recommendation

Date: June 27, 2008

In reply refer to: A-08-16 through -20

The Honorable Robert A. Sturgell
Acting Administrator
Federal Aviation Administration
Washington, D.C. 20591

On February 18, 2007, about 1506 eastern standard time, Delta Connection flight 6448, an Embraer ERJ-170, N862RW, operated by Shuttle America, Inc., was landing on runway 28 at Cleveland Hopkins International Airport (CLE), Cleveland, Ohio, during snow conditions when it overran the end of the runway, contacted an instrument landing system (ILS) antenna,[1] and struck an airport perimeter fence. The airplane's nose gear collapsed during the overrun. Of the 2 flight crewmembers, 2 flight attendants, and 71 passengers on board, 3 passengers received minor injuries. The airplane received substantial damage from the impact forces. The flight was operating under the provisions of 14 *Code of Federal Regulations* (CFR) Part 121 from Hartsfield-Jackson Atlanta International Airport, Atlanta, Georgia. Instrument meteorological conditions prevailed at the time of the accident.

The National Transportation Safety Board determined that the probable cause of this accident was the failure of the flight crew to execute a missed approach when visual cues for the runway were not distinct and identifiable. Contributing to the accident were (1) the crew's decision to descend to the ILS decision height (DH) instead of the localizer (glideslope out) minimum descent altitude (MDA); (2) the first officer's long landing on a short contaminated runway and the crew's failure to use reverse thrust and braking to their maximum effectiveness; (3) the captain's fatigue, which affected his ability to effectively plan for and monitor the approach and landing; and (4) Shuttle America's failure to administer an attendance policy that permitted flight crewmembers to call in as fatigued without fear of reprisals.[2]

[1] When fully operational, ILS approach systems provide arriving aircraft with vertical (glideslope) and lateral (localizer) guidance to the runway.

[2] For more information, see *Runway Overrun During Landing, Shuttle America, Inc., doing business as Delta Connection Flight 6448, Embraer ERJ-170, N862RW, Cleveland, Ohio, February 18, 2007*, Aircraft Accident Report NTSB/AAR-08/01 (Washington, DC: NTSB, 2008), which is available on the Safety Board's website at <http://www.ntsb.gov/publictn/2008/AAR0801.pdf>.

The Approach

Minimums Required for the Approach

A notice to airmen included in the flight crew's preflight paperwork stated, "due to the effects of snow on the glide slope minimums temporarily raised to localizer only for all category aircraft. Glide slope remains in service. However, angle may be different than published." Also, the flight crew received two automatic terminal information broadcasts and a transmission from the controller that indicated that the glideslope to runway 28 was unusable because of snow buildup around the ILS glideslope antenna. As a result, the flight crew was required to use the 429-foot MDA for the nonprecision localizer (glideslope out) approach instead of the 227-foot DH for the precision (ILS) approach.

While on approach to the airport, the first officer told the captain that the glideslope had been captured.[3] Because the flight crewmembers then assumed that the glideslope was working properly, they used the ILS minimums instead of the required localizer minimums for the approach. However, the Safety Board concludes that, because the flight crewmembers were advised that the glideslope was unusable, they should not have executed the approach to ILS minimums; instead, they should have set up, briefed, and accomplished the approach to localizer (glideslope out) minimums. It is important to note that the flight crewmembers would have been required to execute a missed approach if they had been using the localizer (glideslope out) approach. No cockpit voice recorder (CVR) evidence or postaccident interview information indicated that either crewmember had the runway environment in sight by the MDA.

Visual References During the Approach

When the airplane was at an altitude of about 190 feet above ground level (agl), which was 239 feet lower than the MDA for the localizer (glideslope out) approach, the captain stated that he had the approach lights in sight. About 4 seconds afterward, the captain stated that the runway lights were in sight. However, when the airplane was at an altitude of 80 feet agl, the captain indicated that he could not see the end of the runway and stated, "let's go [around]." The first officer then stated that he had the end of the runway in sight.

According to Federal Aviation Administration (FAA) requirements (14 CFR 91.175) and company procedures, if sufficient visual references are not distinctly visible at or below the DH or MDA, execution of a missed approach is required. Also, the *Federal Aviation Regulations* clearly indicate that the pilot-in-command (PIC) has final authority and responsibility for the operation and safety of the flight. Thus, the Safety Board concludes that, when the captain called for a go-around because he could not see the runway environment, the first officer should have immediately executed a missed approach regardless of whether he had the runway in sight. The Safety Board further concludes that, when the first officer did not immediately execute a missed approach, as instructed, the captain should have reasserted his go-around call or, if necessary,

[3] For this accident, even though the glideslope's angle might have been different than published because of the snow buildup, the glideslope was still in service. The signal transmitter would have automatically shut down if the signal were to exceed preset parameters. If the glideslope signal could be received by an airplane, the glideslope would be considered to be safe but might not be completely accurate if snow were surrounding the antenna.

taken control of the airplane. During a postaccident interview, the captain stated that he thought a transfer of control to perform a missed approach at a low altitude might have been unsafe.

In addition, the first officer stated that, when the airplane was at an altitude of about 10 feet agl, he momentarily lost sight of the runway. According to the first officer, a snow squall came through at that point and he "could not see anything." The Safety Board concludes that, because the first officer lost sight of the runway just before landing, he should have abandoned the landing attempt and immediately executed a missed approach.

The FAA currently requires that flight training for Part 121 pilots (both PIC and second-in-command) include "rejected landings that include a normal missed approach procedure after the landing is rejected. For the purpose of this maneuver the landing should be rejected at approximately 50 feet and approximately over the runway threshold." However, these training criteria are general in nature, and they do not specifically require that the rejected landings be made in changing weather environments. Thus, it is possible that pilots could satisfy the training requirement with a rejected landing that is accomplished while the airplane is in visual conditions.

This accident demonstrates that air carrier pilots can encounter rapidly changing weather conditions while preparing to land. It is important that these pilots be trained to execute missed approaches in such conditions so that the pilots are familiar with the rapid decision-making and maneuvering required in low visibility conditions near the ground.

The Safety Board concludes that the rejected landing training currently required by the FAA is not optimal because it does not account for the possibility that pilots may need to reject a landing as a result of rapidly deteriorating weather conditions. Thus, the Safety Board believes that the FAA should require Part 121, 135, and Part 91 subpart K operators[4] to include, in their initial, upgrade, transition, and recurrent simulator training for turbojet airplanes, (1) decision-making for rejected landings below 50 feet along with a rapid reduction in visual cues and (2) practice in executing this maneuver.

Landing Distance Assessments

At the time of the accident, Shuttle America did not require landing distance assessments based on conditions at the time of arrival. Safety Alert for Operators (SAFO)[5] 06012, "Landing Performance Assessments at the Time of Arrival (Turbojets)," which the FAA issued about 6 months before the accident, had urgently recommended that operators of turbojet airplanes develop procedures for flight crews to assess landing performance based on the actual conditions at the time of arrival, which might differ from the presumed conditions at the time of dispatch, and that an additional safety margin of at least 15 percent be added to actual landing distances.

The aircraft performance study included a landing performance data calculation that most closely matched the landing distance assessment that the flight crewmembers might have

[4] Title 14 CFR 91 subpart K applies to fractional ownership operations.

[5] The FAA established SAFOs in 2005 to convey "new important safety information directly to operators" as that information became available. SAFOs are not mandatory.

accomplished if Shuttle America had incorporated procedures that were consistent with SAFO 06012. This calculation was based on the reported winds, a braking action report of fair, and the accident airplane's flaps 5 configuration. The calculation assumed a touchdown point of 1,400 feet, the use of maximum reverse thrust until 60 knots, and full wheel braking and included an additional 15-percent stopping distance margin. The landing performance calculation showed that, on the basis of the conditions that had been reported to the flight crew at the time, the airplane could have landed with a factored touchdown point of 1,610 feet and come to a safe stop on the runway with a ground roll distance of 3,262 feet, for a total distance of 4,872 feet. However, the airplane's actual touchdown point and the flight crew's use of reverse thrust and braking were not in accordance with the assumptions used in the landing performance calculation.

Before the issuance of SAFO 06012, the FAA had planned to issue Operations Specification (OpSpec) N 8400.C082 to all 14 CFR Part 91 subpart K, 121, 125, and 135 turbojet operators in response to Safety Recommendation A-06-16 (urgent), the intent of which was to ensure adequate safety margins for landings on contaminated runways.[6] The FAA had intended for operators to comply with the OpSpec by October 2006 but instead encountered industry opposition to the OpSpec. Consequently, in August 2006, the FAA decided not to issue the mandatory OpSpec but rather to pursue formal rulemaking and issue the voluntary SAFO in the interim.

In its final report on the Southwest Airlines flight 1248 accident,[7] the Safety Board concluded, "although landing distance assessments incorporating a landing distance safety margin are not required by regulation, they are critical to safe operation of transport-category airplanes on contaminated runways." As a result, on October 4 and 16, 2007, the Board issued Safety Recommendations A-07-57 (urgent) and -61, respectively, to further address the need for landing distance assessments.

Safety Recommendation A-07-57 asked the FAA to immediately require all Part 121, 135, and 91 subpart K operators to conduct arrival landing distance assessments before every landing that are based on existing performance data and actual conditions and incorporate a minimum safety margin of 15 percent. This recommendation, which superseded Safety Recommendation A-06-16, was classified "Open—Unacceptable Response" on October 4, 2007, because it maintained the previous classification of Safety Recommendation A-06-16 and the FAA had not yet required landing distance assessments that incorporated a minimum safety margin of 15 percent.

Safety Recommendation A-07-61 asked the FAA to require all Part 121, 135, and 91 subpart K operators to accomplish arrival landing distance assessments before every landing that are based on a standardized methodology involving approved performance data, actual arrival

---

[6] Safety Recommendation A-06-16 (urgent), which was issued on January 27, 2006, asked the FAA to "immediately prohibit all 14 *Code of Federal Regulations* Part 121 operators from using the reverse thrust credit in landing performance calculations."

[7] National Transportation Safety Board, *Runway Overrun and Collision, Southwest Airlines Flight 1248, Boeing 737-74H, N471WN, Chicago Midway International Airport, Chicago, Illinois, December 8, 2005*, Aircraft Accident Report NTSB/AAR-07/06 (Washington, DC: NTSB, 2007).

conditions, and a means of correlating the airplane's braking ability with runway surface conditions using the most conservative interpretation available and that include a minimum safety margin of 15 percent. The Safety Board recognized that the standardized methodology recommended in Safety Recommendation A-07-61 would take time to develop and, thus, issued Safety Recommendation A-07-57 to ensure that landing distance assessments with at least a 15-percent safety margin were being performed in the interim.

In its December 17, 2007, response to Safety Recommendation A-07-57, the FAA reported that, on the basis of its survey of Part 121 operators, 92 percent of U.S. air carrier passengers were being transported by carriers that had adopted SAFO 06012 in full or in part. However, the FAA did not indicate the percentage of Part 121 carriers that had fully adopted the SAFO or those parts of the SAFO that had not been adopted by other Part 121 carriers. The Safety Board is especially concerned that among those parts of the SAFO that have not yet been adopted is the minimum 15-percent landing distance safety margin. Also, the FAA did not provide any information regarding whether SAFO 06012 had been adopted in full or in part by Part 135 and Part 91 subpart K operators. In addition, the FAA did not describe the actions that it would take to encourage those operators that have not complied with the SAFO (such as Shuttle America) to do so. Because all Part 121, 135, and 91 subpart K operators have not fully complied with SAFO 06012 and rulemaking that requires arrival landing distance assessments with a 15-percent minimum safety margin has not been implemented, Safety Recommendation A-07-57 remains classified "Open—Unacceptable Response."

In its January 8, 2008, response to Safety Recommendation A-07-61, the FAA stated that, in December 2007, it had announced the formation of an aviation rulemaking committee to review regulations affecting certification and operation of airplanes and airports for takeoff and landing operations on contaminated runways. The Safety Board recognizes that aviation rulemaking committees are part of the rulemaking process, but these committees have historically taken a long time to complete their work, and the FAA has not always acted in a timely manner after it receives recommendations from the committees. Pending the prompt completion of the aviation rulemaking committee's work and the FAA's timely action in response to the committee's recommendations, Safety Recommendation A-07-61 is classified "Open—Acceptable Response." The Board continues to urge the FAA to act expeditiously on Safety Recommendations A-07-57 and -61 because landing distance assessments are critical to safe landing operations on contaminated runways.

The Landing

Touchdown Zone

Shuttle America guidance indicated that the key to a successful landing was for pilots to make a stabilized approach using a glideslope, a glidepath, and/or visual cues so that the airplane crosses the landing threshold at an altitude of about 50 feet agl, which corresponds to a touchdown point of about 1,000 feet. Shuttle America guidance also stated that the acceptable touchdown range was 750 to 1,250 feet from the runway threshold, and the company's flight training acceptable performance standards indicated that the airplane should touch down smoothly at a point that is 500 to 3,000 feet beyond the runway threshold but not to exceed one-

third of the runway length. Thus, the accident airplane should have touched down at a point no longer than 2,006 feet down the runway.

CVR and flight data recorder (FDR) data showed that the accident pilots made a stabilized approach and that the airplane crossed the landing threshold at an altitude of about 40 feet agl. These data also showed that the airplane was about 1,050 feet past the runway threshold when the airplane's altitude was about 10 feet agl. According to the aircraft performance study, the airplane touched down at 2,900 feet, which was about one-half of the way down the 6,017-foot runway. (Even though the airplane crossed the landing threshold at an altitude that was 10 feet lower than that indicated in company guidance, the airplane touched down farther rather than closer to the threshold likely because the airplane floated for some distance.) The Safety Board concludes that, on the basis of company procedures and flight training criteria, the airplane's touchdown at 2,900 feet down the 6,017-foot runway was an unacceptably long landing.

Use of Reverse Thrust and Braking

Shuttle America guidance emphasized the importance of establishing the desired reverse thrust as soon as possible after touchdown. The guidance further indicated that immediate initiation of maximum reverse thrust at main gear touchdown was the preferred technique and that full reverse thrust would reduce the stopping distance on very slippery runways. In addition, the guidance stated that maximum reverse thrust was normally to be maintained until an airspeed of about 80 knots but could be used to a full stop during emergencies.

FDR data from the accident flight indicated that reverse thrust was not commanded until after nose gear touchdown (about 5 seconds after main gear touchdown), with the thrust levers initially selected to the full reverse position, and that the thrust reversers were deployed shortly afterward. However, full reverse thrust was commanded only until the airplane had decelerated to an airspeed of about 85 knots, and engine reverse thrust had increased only to a peak of 65 percent N_1 (low pressure rotor speed), compared with a maximum of 70 percent N_1, for about 2 seconds before continuously tapering off during the landing rollout. About 2,200 feet of runway remained when full reverse thrust was commanded, and about 1,100 feet of runway remained when the engines reached their peak reverse N_1. The commanded reverse thrust reached the idle setting with about 400 feet of runway remaining. About 4 1/2 seconds later, the airplane departed the runway with the engines at about 25 percent N_1.

Shuttle America guidance also stated that, after main gear touchdown, a constant brake pedal pressure should be smoothly applied to achieve the desired braking and that full braking should be applied on slippery runways. The guidance further stated that pilots should not attempt to modulate, pump, or improve the braking by any other special technique and that they should not release the brake pedal pressure until the airplane's speed has been reduced to a safe taxi speed. In addition, the guidance stated that braking effectiveness on contaminated runways is reduced because of low tire-to-runway friction and that stopping distances could increase as the contamination depth increased.

FDR data for the accident flight showed that the first officer's initial wheel brake application occurred with about 1,850 feet of runway remaining; this application was about

20 percent of maximum and remained relatively steady for the next 8 seconds. The first officer's braking application then began increasing to about 75 percent of maximum with about 800 feet of runway remaining. The captain then began applying his brakes to about 90 percent of maximum with about 450 feet of runway remaining.

The results of the aircraft performance study showed that reverse idle thrust had been commanded well before a safe stop could be ensured. Also, although FDR data did not indicate that the brakes were excessively modulated, the data did indicate that only light wheel braking was applied early in the landing rollout. Thus, the Safety Board concludes that the flight crewmembers did not use reverse thrust and braking to their maximum effectiveness; if they had done so, the airplane would likely have stopped before the end of the runway.

There is currently no specific training requirement for Part 121 and 135 pilots to practice maximum performance landings on contaminated runways. During line operations, pilots are likely to encounter contaminated runway conditions, so pilot proficiency in these conditions is just as important as pilot proficiency in landings with crosswinds, powerplant failures, and zero flaps, which are included in Part 121 training requirements. Also, this accident was one of three recent Safety Board investigations in which an air carrier airplane overran the end of a contaminated runway; Southwest Airlines flight 1248 and Pinnacle Airlines flight 4712 are the other two investigations.[8] Boeing safety data showed that, between 1997 and 2006, runway overruns were the fourth-largest cause of air carrier fatalities worldwide, resulting in 262 fatalities.[9]

The Safety Board concludes that specific training for pilots in applying maximum braking and maximum reverse thrust on contaminated runways until a safe stop is ensured would reinforce the skills needed to successfully accomplish such landings. Therefore, the Safety Board believes that the FAA should require Part 121, 135, and Part 91 subpart K operators to include, in their initial, upgrade, transition, and recurrent simulator training for turbojet airplanes, practice for pilots in accomplishing maximum performance landings on contaminated runways.

Runway Safety Area

The runway 28 departure end runway safety area (RSA), which was 60 feet long and 275 feet wide, was in compliance with the January 1988 FAA regulation that accepted the RSA conditions that existed at that time for airports certificated under Part 139. In 2000, in accordance with FAA Order 5200.8, "Runway Safety Area Program," the FAA inventoried the runway 28 departure end RSA and notified CLE about some short- and long-term options to enhance the RSA. CLE was asked to immediately evaluate the options for improving the RSA and make a recommendation by March 2001. However, even though CLE has conducted several studies on this issue and the FAA has provided comments on CLE's draft reports, CLE had not

[8] For more information about the Pinnacle Airlines accident, see *Runway Overrun During Landing, Pinnacle Airlines, Inc., Flight 4712, Bombardier/Canadair Regional Jet CL600-2B19, N8905F, Traverse City, Michigan, April 12, 2007*, Aircraft Accident Report NTSB/AAR-08/02 (Washington, DC: NTSB, 2008).

[9] *Statistical Summary of Commercial Jet Airplane Accidents, Worldwide Operations, 1959-2006*, Aviation Safety, Boeing Commercial Airplanes (Seattle, Washington: Boeing, 2007).

yet made its recommendation for improving the runway 28 RSA. The Safety Board concludes that the RSA for CLE runway 28 still does not meet FAA standards.

The FAA's goal for improving the runway 28 RSA as much as practicable had been 2007, but the deadline for the improvement to runway 28 is now September 2010. According to CLE, the deadline was changed to 2010 because the FAA and CLE had not yet finalized a solution and the FAA anticipated that the timeline to allocate funds for and complete the project would take until 2010.

One of the options for improving the runway 28 RSA was to shift runway 10/28 to the east and then construct a 300-foot engineered materials arresting system (EMAS) at the departure end of runway 28. At the Safety Board's request, the EMAS manufacturer, Engineered Arresting Systems Corporation (ESCO), calculated how far the accident airplane would have traveled into an EMAS if one had been installed at the departure end of runway 28. These calculations assumed that runway 10/28 would have been shifted to the east and that an arrestor bed that was 281 feet in length would have been installed 35 feet from the departure end of runway 28. ESCO used the airplane's calculated groundspeed at the time that the airplane departed the runway (42 knots), together with engineering models and assumptions, to predict that the airplane would have traveled 127 feet into the arrestor bed before stopping (for a total of 162 feet beyond the runway threshold).

On May 6, 2003, the Safety Board issued Safety Recommendation A-03-11, which asked the FAA to require Part 139 certificated airports to upgrade all RSAs that could, with feasible improvements, be made to meet the minimum standards established by FAA Advisory Circular (AC) 150/5300-13. This recommendation had been classified "Open—Acceptable Response" on January 30, 2004, and February 15, 2007. In its November 20, 2007, response, the FAA stated that more than 80 percent of all RSA improvements were expected to be completed by the end of 2010. The FAA also stated that the remaining RSA improvement projects had "particularly challenging" circumstances that would delay the completion of the improvements to 2015. Safety Recommendation A-03-11 remains classified "Open—Acceptable Response" pending the completion of improvements to bring all RSAs up to standards wherever practical.

Safety Recommendation A-03-12, which was issued with Safety Recommendation A-03-11, asked the FAA to require Part 139 certificated airports to install an EMAS in each RSA that could not, with feasible improvements, be made to meet the minimum standards established by AC 150/5300-13. This recommendation had been classified "Open—Acceptable Response" on January 30, 2004. The FAA subsequently stated that 24 EMAS beds had been installed at 19 U.S. airports and that it expected to install another 12 EMAS beds at 7 U.S. airports during 2008. Runway 28 at CLE is not among those runways expected to receive an EMAS in 2008.

In its November 20, 2007, response, the FAA stated that it would continue to promote and fund the installation of EMAS for certain runways. The FAA also stated that, for highly constrained runways that do not have enough room to install EMAS, other alternatives would better meet the agency's goal to improve runways with substandard RSAs as much as possible. However, the FAA did not describe the alternatives that it was considering or had approved for those runways with a substandard RSA for which an EMAS is not a viable option.

A runway with a substandard RSA and no EMAS or alternative poses a safety risk for airplanes that inadvertently overrun a runway. Safety Recommendation A-03-12 remains classified "Open—Acceptable Response" pending a description of those alternatives to EMAS that the FAA has considered or approved and the installation of an EMAS or an alternative for each runway end with an RSA that does not meet the dimensional standards prescribed by the FAA.

Standard Operating Procedures for the Go-Around Callout

When the airplane was at an altitude of 80 feet agl, the captain indicated that he could not see the end of the runway and stated, "let's go [around]." The first officer then stated that he had the end of the runway in sight and continued with the approach.

When the airplane was about 45 feet agl, the captain stated that he had regained sight of the runway environment. Nevertheless, the first officer's response to the captain's go-around callout did not meet with the Safety Board's expectation that the immediate response to a go-around callout, regardless of which pilot called for the go-around, should be the execution of a missed approach. However, no Shuttle America crew resource management (CRM) training guidance included this information or indicated that either pilot could call for a go-around, if necessary. Also, postaccident interviews with company pilots and check airmen indicated varying understandings of the role of the monitoring pilot (in particular, a monitoring captain) in initiating a go-around callout. In addition, FAA AC 120-71A, "Standard Operating Procedures for Flight Deck Crewmembers," stated that the flying pilot (in this case, the first officer) was responsible for making the go-around callout; the guidance made no reference that the monitoring pilot could also make this callout, if necessary.

The first officer would have had enough time to execute a missed approach before the captain regained sight of the runway environment. However, the first officer's failure to respond to the captain's go-around command might be, in part, a result of unclear guidance in company procedures. Specifically, Shuttle America's ERJ-170 Pilot Operating Handbook specifies that the phrase "go around" is to be stated out loud by the flying pilot to initiate a missed approach, but the operating procedures do not provide comparable terminology for the monitoring pilot to initiate the same action. Further, the captain's statement of "let's go" did not comply with any standard terminology and might have suggested to the first officer that the captain's command was tentative—especially given that the captain did not subsequently insist on discontinuing the approach.

Standard operating procedures and terminology are essential to ensure that a proactive go-around can occur, especially for pilots who have never flown together so that they can immediately coordinate and effectively communicate. In fact, in its safety study of flight crew-involved, major air carrier accidents, the Safety Board found that familiar crews made fewer serious errors than crews that had just begun flying together and that flight crew-involved errors were more likely to occur when pilots were flying together for the first time,[10] as was the case with the accident flight crew. The Safety Board concludes that the captain's use of

[10] National Transportation Safety Board, *A Review of Flightcrew-Involved, Major Accidents of U.S. Air Carriers, 1978 Through 1990*, Safety Study NTSB/SS-94/01 (Washington, DC: NTSB, 1994).

imprecise terminology for the go-around callout, his failure to clearly assert the callout, and the lack of a clear company procedure that would allow the monitoring pilot to make the callout contributed to the first officer's failure to discontinue the approach.

It is critical to flight safety that either flight crewmember be able to call for a go-around if either pilot believes that a landing would be unsafe. Also, although CRM principles prescribe that some cockpit decisions can be made by crew consensus, others, including the go-around callout, require immediate action without question because of the airplane's proximity to the ground. Even in those circumstances in which a go-around might not have been necessary, it is better for pilots to exercise caution first and discuss the situation later rather than potentially place the flight at risk. After the accident, Shuttle America issued guidance to its pilots, stating that a missed approach should be executed whenever either pilot is in doubt about the outcome of the landing.

The Safety Board concludes that both flying and monitoring pilots should be able to call for a go-around because one pilot might detect a potentially unsafe condition that the other pilot does not detect. Therefore, the Safety Board believes that the FAA should require Part 121, 135, and Part 91 subpart K operators to have a written policy emphasizing that either pilot can make a go-around callout and that the response to the callout is an immediate missed approach.

Pilot Attendance Policies

Shuttle America

Shuttle America's attendance policy included a progressive discipline policy for excessive absence occurrences, which could be implemented or accelerated at any time depending on the severity of the situation. According to the discipline policy, the first step was a verbal warning, which would result with four occurrences of absenteeism or tardiness during a rolling 12-month period, and the last step was termination from the company, which would occur after eight such occurrences.[11]

Although the attendance policy had been in effect since 2005, Shuttle America did not hold pilots accountable for their attendance until January 2007. During January and February 2007, the Shuttle America assistant chief pilot issued written warnings to 83 of the company's 430 pilots (19 percent) who had accrued eight or more absence occurrences during the previous 12 months. The warning letters stated, "future occurrences would result in further corrective action, which may be accelerated at any step, including termination." The future absence occurrences could include fatigue calls made while a pilot was off duty or determined not to be company induced (that is, caused by a demanding company schedule). The captain was one of the Shuttle America pilots who received a written warning during January 2007.

The captain stated that, even though he received only 1 hour of sleep the night before the accident flight, he did not cancel the accident trip sequence because he thought that the company

[11] The second and third steps were a written warning and a final warning/disciplinary suspension of 3 days without pay, respectively.

would have fired him. In its final report on this accident, the Safety Board concluded that the captain was fatigued, which degraded his performance during the accident flight.

The Safety Board has had a longstanding concern with the impairing effects of human fatigue on transportation safety.[12] One valuable method for attempting to limit the effects of fatigue on pilots and to discourage them from working while fatigued is company programs that allow pilots to remove themselves from duty if they believe they are fatigued to a degree that could compromise safety (even if they are legal to fly under duty time regulations). However, if a company fatigue policy were not administered properly or lacked specific procedures, the result could be opposite to its intended purpose. Specifically, pilots might be hesitant or feel intimidated to call in as fatigued; as a result, the policy could actually pressure pilots to fly when tired.

The Safety Board concludes that shortcomings in Shuttle America's attendance policy limited its effectiveness because the specific details of the policy were not documented, in writing, and were not clearly communicated to pilots, especially the administrative implications or consequences of calling in as fatigued.[13] The Board further concludes that Shuttle America's failure to administer its attendance policy as written might have discouraged some of the company's pilots, including the accident captain, from calling in when they were sick or fatigued because of concerns about the possibility of termination.[14]

It is important to note that pilots have a personal responsibility to monitor their own fitness for duty and avoid flying when they have a physical deficiency that could compromise safety.[15] On the day of this accident, the captain recognized that he was fatigued; he warned his first officers that he was tired; and, because of his fatigue, he directed the accident first officer to fly the accident leg. The captain did not advise Shuttle America of his fatigue or remove himself from duty because he thought he would be terminated if he took this action. However, the Safety Board concludes that, by not advising the company of his fatigue or removing himself from duty, the captain placed himself, his crew, and his passengers in a dangerous situation that could have been avoided.

Industry

With the help of the Air Transport Association and the Regional Airline Association, the Safety Board conducted an industry survey regarding fatigue and attendance policies, receiving

[12] Reducing accidents and incidents caused by human fatigue is an issue on the Safety Board's Most Wanted List of Transportation Safety Improvements.

[13] According to the Shuttle America director of safety, for fatigue calls, the chief pilot/ERJ-170 program manager would talk with the pilot and then determine how to classify the call. If the chief pilot determined that the pilot's fatigue was company induced, the call would be classified as "fatigue" and result in no absence occurrences. However, if the chief pilot determined that the pilot's fatigue was not company induced, the call would be classified as "unavailable" and result in one to four absence occurrences depending on whether the pilot was flying a schedule or was on reserve.

[14] In April 2008, Shuttle America indicated that it was administering its progressive discipline policy as written.

[15] Title 14 CFR 61.53 and 63.19 preclude required flight crewmembers from flight duty while they have a known medical or physical deficiency. Although the regulations do not specifically cite fatigue, the FAA's *Aeronautical Information Manual* discusses fatigue as a factor that pilots should evaluate as part of determining their fitness for flight.

responses from 6 major and 10 regional Part 121 operators that belonged to one of these associations. The survey responses revealed that all of the major and all but one of the regional operators had a fatigue policy in which pilots were allowed to call in as fatigued, even when they were within the legal flight and duty time limitations. The survey also revealed that most of the regional operators employed a progressive discipline policy for excessive absenteeism, which is consistent with industry practices for regional operations.

The survey showed that the way in which the major and regional operators administered their fatigue policies differed. For example, for all of the major operators, a fatigue call is classified as such for administrative purposes on a pilot's record; however, only 20 percent of the regional operators indicated that they classified a fatigue call in that manner. Also, for regional operators, the administrative implications of a fatigue call are more likely to depend on specific circumstances or the timing of the call (while on duty or off duty) compared with major operators, and regional airline pilots are less likely than major airline pilots to be afforded an opportunity to make up the lost hours. Further, all of the major operators had specific details of their fatigue policy documented, in writing, but most of the regional operators did not.

To further understand issues associated with operator fatigue policies, the Safety Board reviewed a sample of more than 30 National Aeronautics and Space Administration Aviation Safety Reporting System (ASRS) reports of in-flight incidents that were provided voluntarily by air carrier flight crewmembers from January 1, 1996, to December 31, 2006. These reports showed a range of experiences with company fatigue programs allowing pilots to remove themselves from flight duty because of fatigue. Specifically, some air carrier pilots reported using a fatigue program successfully, some pilots reported a hesitation to use the program because of a fear of retribution, and some pilots reported attempting to call in as fatigued but instead encountered company resistance.[16]

Although fatigue policies that allow pilots to remove themselves from duty because of fatigue appear to be widespread in the aviation industry, these policies vary in the amount of specific details included, and not all of the policies appear to be equally successful at preventing fatigued pilots from flying. In some cases, the administration of such policies and any associated disciplinary actions could intimidate or discourage pilots from using the policy despite their fatigue.[17]

It is important for air carriers to have a detailed, written policy that allows pilots to call in as fatigued, when necessary. It is also important for pilots to make personal decisions about their fitness for duty without fear of company reprisals. The Safety Board concludes that a fatigue policy that allows flight crewmembers to call in as fatigued without fear of reprisals would be an effective method for countering fatigue during flight operations. Therefore, the Safety Board believes that the FAA, in cooperation with pilot unions, the Regional Airline Association, and the

[16] Because ASRS reports are submitted voluntarily, the existence of reports concerning a specific topic in the ASRS database cannot be used to infer the prevalence of that problem within the National Airspace System.

[17] As part of its investigation of the Pinnacle Airlines flight 4712 accident, the Safety Board interviewed the accident captain (who was also a check airman). This captain stated that, even though the company had a policy that allowed pilots to remove themselves from trips because of fatigue, he had never called in as fatigued. Further, the captain stated that the company initiated a "fact-finding mission" whenever a pilot called in as fatigued.

Air Transport Association, should develop a specific, standardized policy for Part 121, 135, and Part 91 subpart K operators that would allow flight crewmembers to decline assignments or remove themselves from duty if they were impaired by a lack of sleep. The Safety Board further believes that, once the fatigue policy described in Safety Recommendation A-08-19 has been developed, the FAA should require Part 121, 135, and Part 91 subpart K operators to adopt this policy and provide, in writing, details of the policy to their flight crewmembers, including the administrative implications of fatigue calls.

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

> Require 14 *Code of Federal Regulations* Part 121, 135, and Part 91 subpart K operators to include, in their initial, upgrade, transition, and recurrent simulator training for turbojet airplanes, (1) decision-making for rejected landings below 50 feet along with a rapid reduction in visual cues and (2) practice in executing this maneuver. (A-08-16)
>
> Require 14 *Code of Federal Regulations* Part 121, 135, and Part 91 subpart K operators to include, in their initial, upgrade, transition, and recurrent simulator training for turbojet airplanes, practice for pilots in accomplishing maximum performance landings on contaminated runways. (A-08-17)
>
> Require 14 *Code of Federal Regulations* Part 121, 135, and Part 91 subpart K operators to have a written policy emphasizing that either pilot can make a go-around callout and that the response to the callout is an immediate missed approach. (A-08-18)
>
> In cooperation with pilot unions, the Regional Airline Association, and the Air Transport Association, develop a specific, standardized policy for 14 *Code of Federal Regulations* Part 121, 135, and Part 91 subpart K operators that would allow flight crewmembers to decline assignments or remove themselves from duty if they were impaired by a lack of sleep. (A-08-19)
>
> Once the fatigue policy described in Safety Recommendation A-08-19 has been developed, require 14 *Code of Federal Regulations* Part 121, 135, and Part 91 subpart K operators to adopt this policy and provide, in writing, details of the policy to their flight crewmembers, including the administrative implications of fatigue calls. (A-08-20)

Also, the following previously issued recommendation to the Federal Aviation Administration is classified "Open—Unacceptable Response":

> Immediately require all 14 *Code of Federal Regulations* Part 121, 135, and 91 subpart K operators to conduct arrival landing distance assessments before every landing based on existing performance data, actual conditions, and incorporating a minimum safety margin of 15 percent. (A-07-57) (Urgent)

In addition, the following previously issued recommendations to the Federal Aviation Administration are classified "Open—Acceptable Response":

> Require all 14 *Code of Federal Regulations* Part 139 certificated airports to upgrade all runway safety areas that could, with feasible improvements, be made to meet the minimum standards established by Advisory Circular 150/5300-13, "Airport Design." The upgrades should be made proactively, not only as part of other runway improvement projects. (A-03-11)

> Require all 14 *Code of Federal Regulations* Part 139 certificated airports to install engineered materials arresting systems in each runway safety area available for air carrier use that could not, with feasible improvements, be made to meet the minimum standards established by Advisory Circular 150/5300-13, "Airport Design." The systems should be installed proactively, not only as part of other runway improvement projects. (A-03-12)

> Require all 14 *Code of Federal Regulations* Part 121, 135, and 91 subpart K operators to accomplish arrival landing distance assessments before every landing based on a standardized methodology involving approved performance data, actual arrival conditions, a means of correlating the airplane's braking ability with runway surface conditions using the most conservative interpretation available, and including a minimum safety margin of 15 percent. (A-07-61)

In response to the recommendations in this letter, please refer to Safety Recommendations A-08-16 through -20. If you would like to submit your response electronically rather than in hard copy, you may send it to the following e-mail address: correspondence@ntsb.gov. If your response includes attachments that exceed 5 megabytes, please e-mail us asking for instructions on how to use our Tumbleweed secure mailbox procedures. To avoid confusion, please use only one method of submission (that is, do not submit both an electronic copy and a hard copy of the same response letter).

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

[Original Signed]
By: Mark V. Rosenker
Chairman