Runway Overrun During Landing
Shuttle America, Inc.
Doing Business as Delta Connection Flight 6448
Embraer ERJ-170, N862RW
Cleveland, Ohio
February 18, 2007

ACCIDENT REPORT

NTSB/AAR-08/01
PB2008-910401

National Transportation Safety Board

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NTSB/AAR-08/01
PB2008-910401
Notation 8002A
Adopted April 15, 2008

Aircraft Accident Report

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National Transportation Safety Board

490 L'Enfant Plaza, S.W.
Washington, D.C. 20594

National Transportation Safety Board. 2008. ***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.**

Abstract: This report explains the accident involving an Embraer ERJ-170, N862RW, operated by Shuttle America, Inc., which was landing on runway 28 at Cleveland-Hopkins International Airport, Cleveland, Ohio, during snow conditions when it overran the end of the runway, contacted an instrument landing system antenna, and struck an airport perimeter fence. The safety issues discussed in this report focus on (1) flight training for rejected landings in deteriorating weather conditions and maximum performance landings on contaminated runways, (2) standard operating procedures for the go-around callout, and (3) pilot fatigue policies. Safety recommendations concerning these issues are addressed to the Federal Aviation Administration.

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Abbreviations and Acronyms

AC	advisory circular
ACARS	aircraft communications addressing and reporting system
agl	above ground level
AIM	Aeronautical Information Manual
AMASS	airport movement area safety system
ARFF	aircraft rescue and firefighting
ASOS	automated surface observing system
ASRS	aviation safety reporting system
ATCT	air traffic control tower
ATIS	automatic terminal information service
ATL	Hartsfield-Jackson Atlanta International Airport
C	Celsius
CFR	*Code of Federal Regulations*
cg	center of gravity
CLE	Cleveland-Hopkins International Airport
CRM	crew resource management
CVR	cockpit voice recorder
DA	decision altitude
DH	decision height
DVDR	digital voice-data recorder
ESCO	Engineered Arresting Systems Corporation
EMAS	engineered materials arresting system
FAA	Federal Aviation Administration
FAR	Federal Aviation Regulations
FDR	flight data recorder
Hg	mercury
ILS	instrument landing system
IND	Indianapolis International Airport
MAC	mean aerodynamic chord
MDA	minimum descent altitude
MDW	Chicago Midway International Airport
METAR	meteorological aerodrome report

N_1	low pressure rotor speed
NASA	National Aeronautics and Space Administration
NOTAM	notice to airmen
NWS	National Weather Service
OpSpec	operations specification
ORD	O'Hare International Airport
PIC	pilot-in-command
POI	principal operations inspector
RSA	runway safety area
RVR	runway visual range
SAFO	safety alert for operators
SDF	Louisville International Airport-Standiford Field
SIC	second-in-command
SPECI	special weather observation
SRQ	Sarasota-Bradenton International Airport
TAF	terminal aerodrome forecast
VMC	visual meteorological conditions
WSR-88D	Weather Surveillance Radar-1988, Doppler

EXECUTIVE SUMMARY

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, Cleveland, Ohio, during snow conditions when it overran the end of the runway, contacted an instrument landing system (ILS) antenna, 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* 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 determines 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 instead of the localizer (glideslope out) minimum descent altitude; (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.

The safety issues discussed in this report focus on (1) flight training for rejected landings in deteriorating weather conditions and maximum performance landings on contaminated runways, (2) standard operating procedures for the go-around callout, and (3) pilot fatigue policies. Safety recommendations concerning these issues are addressed to the Federal Aviation Administration.

1. FACTUAL INFORMATION

1.1 History of Flight

On February 18, 2007, about 1506 eastern standard time,[1] 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,[2] 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 impact forces. The flight was operating under the provisions of 14 *Code of Federal Regulations* (CFR) Part 121 from Hartsfield-Jackson Atlanta International Airport (ATL), Atlanta, Georgia. Instrument meteorological conditions prevailed at the time of the accident.

According to weather observations, 15 inches of snow was on the ground at CLE at 0700 on February 17, 2007. Light snow fell from 0910 to 2156, with 1 inch of new snow reported during that period. Snow began to fall again from 0541 to 1201 on February 18, with 2 inches of new snow reported during the period, and from 1436 to 1538, with less than 1 inch of additional snow accumulation.

On the day of the accident, the captain traveled as a nonrevenue passenger on a flight from Louisville International Airport-Standiford Field (SDF), Louisville, Kentucky, to ATL to report for a scheduled 2-day trip. The captain was scheduled to report to SDF at 0525, and the flight to ATL had a scheduled arrival time of 0733. The first flight leg, from ATL to Sarasota-Bradenton International Airport (SRQ), Sarasota, Florida, was delayed because of weather. The flight departed ATL at 0914 and arrived at SRQ at 1042. The second flight leg departed SRQ at 1108 and arrived at ATL at 1242. The third flight leg, the accident flight, departed on time (with a different first officer) from ATL at 1305 and had an expected arrival time at CLE of 1451.

The accident flight was the first one in which the captain and the first officer had flown together. Shuttle America's common practice is for the captain to be the flying pilot for the first flight of any crew pairing. The captain reported that he received only about 1 hour of sleep during the night before the accident and, as a result, asked the first officer to be the flying pilot for the flight. The first officer reported that he would have preferred not to be the flying pilot because he had just completed a 3-day, 6-leg trip sequence but that he agreed to be the flying pilot because of the captain's references to fatigue and lack

[1] All times in this report are eastern standard time based on a 24-hour clock.

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

of sleep the night before. (The first officer did not verbalize this preference to the captain before the flight.)

The flight dispatcher provided the crew with a weather update about 1310, via the airplane's aircraft communications addressing and reporting system (ACARS), indicating that visibility was unrestricted with no snow. The cockpit voice recorder (CVR) recording began about 1316:10. Shortly afterward, the captain stated, "so tired … had about an hours sleep last night. I just tossed and turned." The dispatcher provided the crew with another ACARS weather update about 1407, again indicating that visibility was unrestricted with no snow.

About 1429:19, the flight crew received automatic terminal information service (ATIS) information Alpha,[3] which indicated that the ILS runway 24R approach was in use, the landing runway was 24R, the glideslopes for runways 24L and 28 were "unusable due to snow build-up," and braking action advisories were in effect. The first officer then briefed the ILS procedure for runway 24R. About 1442:41, the crew received ATIS information Bravo, which indicated that the ILS runway 28 approach was in use and that the landing runway was 28. Also, this ATIS repeated that the glideslopes for runways 24L and 28 were unusable and that braking action advisories were in effect. Neither flight crewmember discussed the information in each ATIS broadcast about the unusable glideslopes.

The weather information in the flight crew's preflight paperwork included a notice to airmen (NOTAM) for runways 24L and 28 that 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." During postaccident interviews, both pilots indicated that they had not read this NOTAM.

About 1450:14, the captain contacted CLE approach control, and the approach controller provided vectors for the ILS runway 28 approach. About 1453:06, the first officer briefed the ILS procedure for that runway, stating the location of the glideslope, descent altitude, minimum safe altitudes, and missed approach procedure. The first officer did not brief the runway length, and the captain did not request this information.[4] The approach controller then notified the flight crew that ATIS information Charlie was current and that the winds were from 290° at 18 knots, visibility was 1/4 mile with heavy snow, and the runway 28 runway visual range (RVR)[5] was 6,000 feet. The captain then stated, "one-quarter mile visibility … well we got the RVR. So we're good there." According to the Jeppesen March 24, 2006, ILS approach chart for CLE runway 28, the minimums for the precision (ILS) approach required an RVR of 2,400 feet or 1/2-mile visibility, and the minimums for the nonprecision localizer (glideslope out) approach required an RVR of 4,000 feet or 3/4-mile visibility.

[3] An ATIS is a continuous broadcast of recorded noncontrol information in selected terminal areas.

[4] Title 14 CFR 91.103 and company procedures required the pilot-in-command to be familiar with the runway lengths at airports of intended use. Company policy required pilots to review arrival data as part of the flight release at the beginning of the flight but did not require pilots to include a runway's length in an approach briefing.

[5] An RVR is a measurement of the visibility near a runway's surface. This measurement represents the horizontal distance that a pilot should be able to see down a runway from the approach end.

About 1458:46, the approach controller informed a Jet Link flight crew that the flight was cleared for an ILS runway 28 approach and that the glideslope was unusable. The Shuttle America flight crew heard this transmission, and the crew began to discuss how that flight could be cleared for an ILS approach if the glideslope were unusable. About 1459:10, the approach controller instructed the Shuttle America flight crew to descend from 6,000 to 3,000 feet, and the captain acknowledged this instruction. Afterward, the captain stated, "it's not an ILS if there's no glideslope," to which the first officer replied, "exactly, it's a localizer." During postaccident interviews, both pilots stated that they were confused by the term "unusable," but the CVR indicated that neither pilot asked the controller for clarification regarding the status of the glideslope.

About 1500:04, the approach controller instructed the flight crew to turn left onto a new heading and intercept the runway 28 localizer. The captain acknowledged this instruction. The first officer then stated, "wonder why they put it on two eight without a … glide slope if it's … ILS." About 1500:30, the controller instructed the crew to maintain 3,000 feet until established on the localizer and indicated that the flight was cleared for the ILS runway 28 approach and that the glideslope was unusable. The captain acknowledged the approach clearance and the altitude restriction but did not read back that the glideslope was unusable.

About 1501:09, the captain contacted the tower controller, stating "localizer to two eight." The controller then cleared the airplane to land on runway 28 and reported that the winds were from 310° at 12 knots and that the braking action was "fair."[6] The captain acknowledged the landing clearance.

About 1502:01, the first officer stated that the glideslope had been captured. During a postaccident interview, the first officer stated that he and the captain did the "mental math" for a 3° glideslope and that, on the basis of this calculation, they assumed that the glideslope was functioning normally. Also, the captain stated that the cockpit instrumentation showed the airplane on the glideslope with no warning flags. Because the flight crewmembers assumed that the glideslope was working properly, they used the ILS decision height (DH), which was 227 feet above ground level (agl), instead of the localizer (glideslope out) minimum descent altitude (MDA), which was 429 feet agl.

About 1502:25, the tower controller announced to all airplanes under his control that the runway 28 RVR was 2,200 feet. The controller did not ask the Shuttle America flight crew to acknowledge this information, and the crew did not provide an acknowledgment.

About 1502:39, the captain stated, "we're inside the [outer] marker,[7] we can keep going." The first officer then briefed the procedure to go around in case it became necessary

[6] Braking action is reported as good, fair, poor, or nil. According to the FAA (specifically, Safety Alert for Operators 06012), a runway with fair braking action has "noticeably degraded braking conditions"; as a result, pilots should "expect and plan for a longer stopping distance such as might be expected on a packed or compacted snow-covered runway."

[7] The outer marker was the final approach fix and was situated on the same line as the localizer and runway centerline.

to do so. About 1503:04, the first officer stated that the localizer and the glideslope were captured. Afterward, the tower controller announced to all airplanes under his control that the runway 28 RVR was 2,000 feet. Again, the controller did not ask the Shuttle America flight crew to acknowledge this information, and the crew did not provide an acknowledgment. The captain then stated to the first officer, "gotta have twenty four [hundred feet] to shoot … the ILS."

About 1503:54, the captain indicated that he was "gettin' some ground contact on the sides" but "nothing out front." The CVR recorded the electronic callouts "approaching minimums" about 1504:46 and "two hundred [feet agl], minimums" about 1504:53. One second later, the captain stated, "I got the lights," which was followed by the electronic callout "minimums" and the first officer's statement, "and continuing."

About 1504:58, the captain announced that the runway lights were in sight but then stated that he could not see the runway; this statement was immediately followed by "let's go [around]." The first officer then stated, "I got the end of the runway." About 1505:07, the CVR recorded the 50-foot agl electronic callout followed immediately by the captain's statements, "you've got the runway?" and "yeah, there's the runway, got it." During a postaccident interview, the first officer stated that, when the airplane was 10 feet agl, he momentarily lost sight of the runway because a snow squall came through and he "could not see anything." Flight data recorder (FDR) and CVR data showed that the airplane was about 1,050 feet past the runway threshold when it descended to a height of 10 feet agl.

The CVR recorded the sound of the airplane touching down about 1505:29. According to the aircraft performance study for this accident, the airplane touched down about 2,900 feet down the 6,017-foot runway. During postaccident interviews, the captain stated that he thought the airplane had touched down closer to the runway threshold (somewhere between taxiway U and runway 24L),[8] and the first officer stated that, during the landing rollout, he could not see the end of the runway or any distance remaining signs (which appeared every 1,000 feet).

FDR data showed that the ground spoilers deployed automatically and that the thrust reversers were deployed shortly after landing (as further indicated by the captain's statement "two reverse" about 1505:33). Although the thrust reversers were initially selected to the full reverse position upon landing, engine reverse thrust reached a peak of only 65 percent N_1 (low pressure rotor speed), compared with a maximum of 70 percent N_1, for about 2 seconds before the commanded reverse thrust tapered off to reverse idle during the landing rollout. In addition, FDR data showed that the first officer's initial wheel brake application was about 20 percent of maximum and remained relatively steady for about 8 seconds before increasing to 75 percent of maximum. Braking then increased to about 90 percent of maximum when the captain applied his brakes. The antiskid system did not modulate the brake pressure until the captain and the first officer applied their brakes aggressively.

[8] It is about 850 feet from the runway 28 threshold to the midpoint of taxiway U; it is about 1,860 feet from the runway 28 threshold to the midpoint of runway 24L.

The CVR recorded the sound of numerous impacts starting about 1505:50 and a sound similar to the airplane coming to a stop about 1505:57. The airplane came to rest on a snow-covered grass surface located southwest of the extended runway 28 centerline. Figure 1 shows the location of the airplane at the time of the captain's go-around callout and as it passed the runway threshold. Figure 1a shows the pertinent events from the airplane's touchdown to its overrun. Figure 2 shows the airplane in its final resting location.

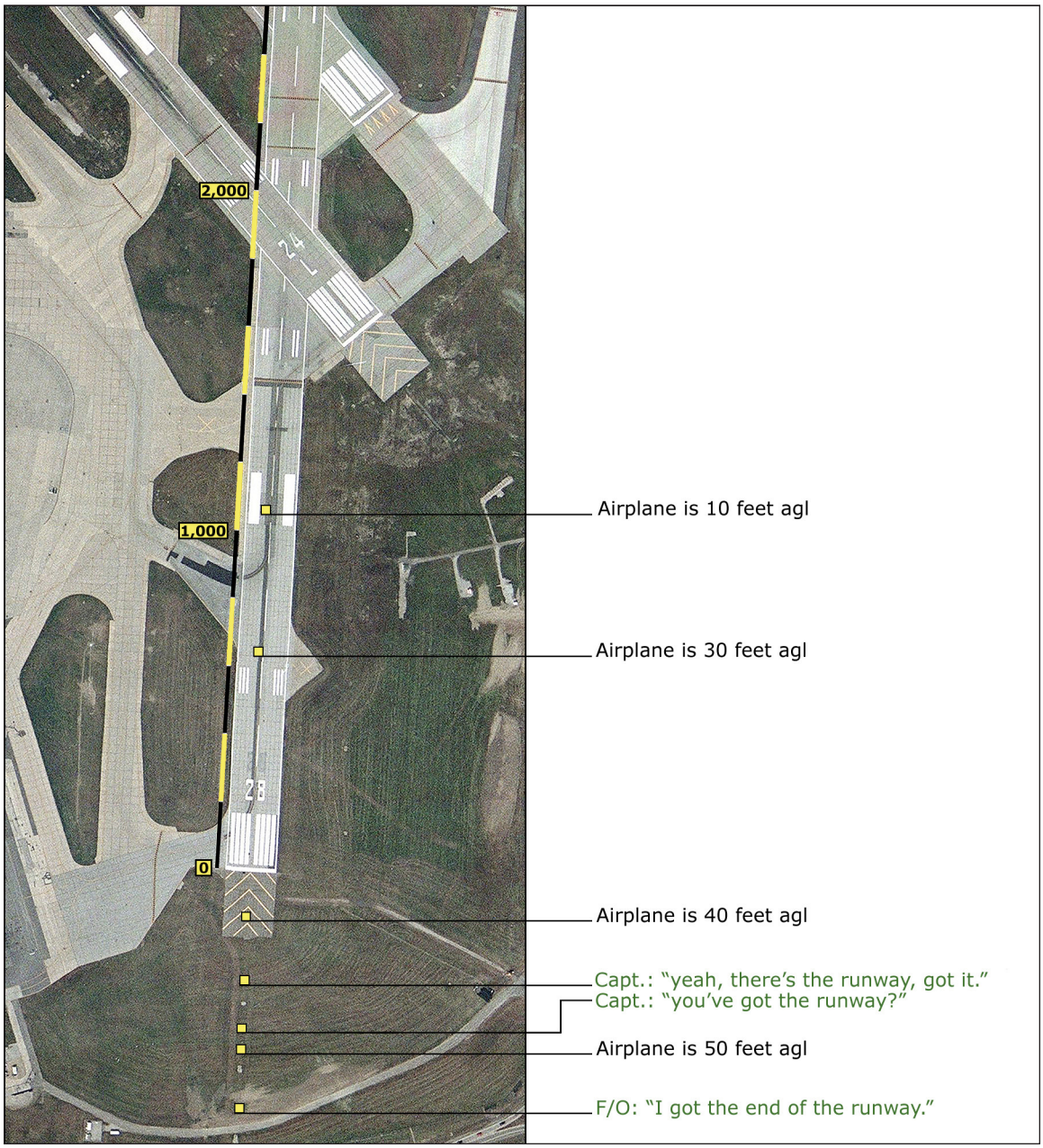

Figure 1. Location of Airplane Before Touchdown

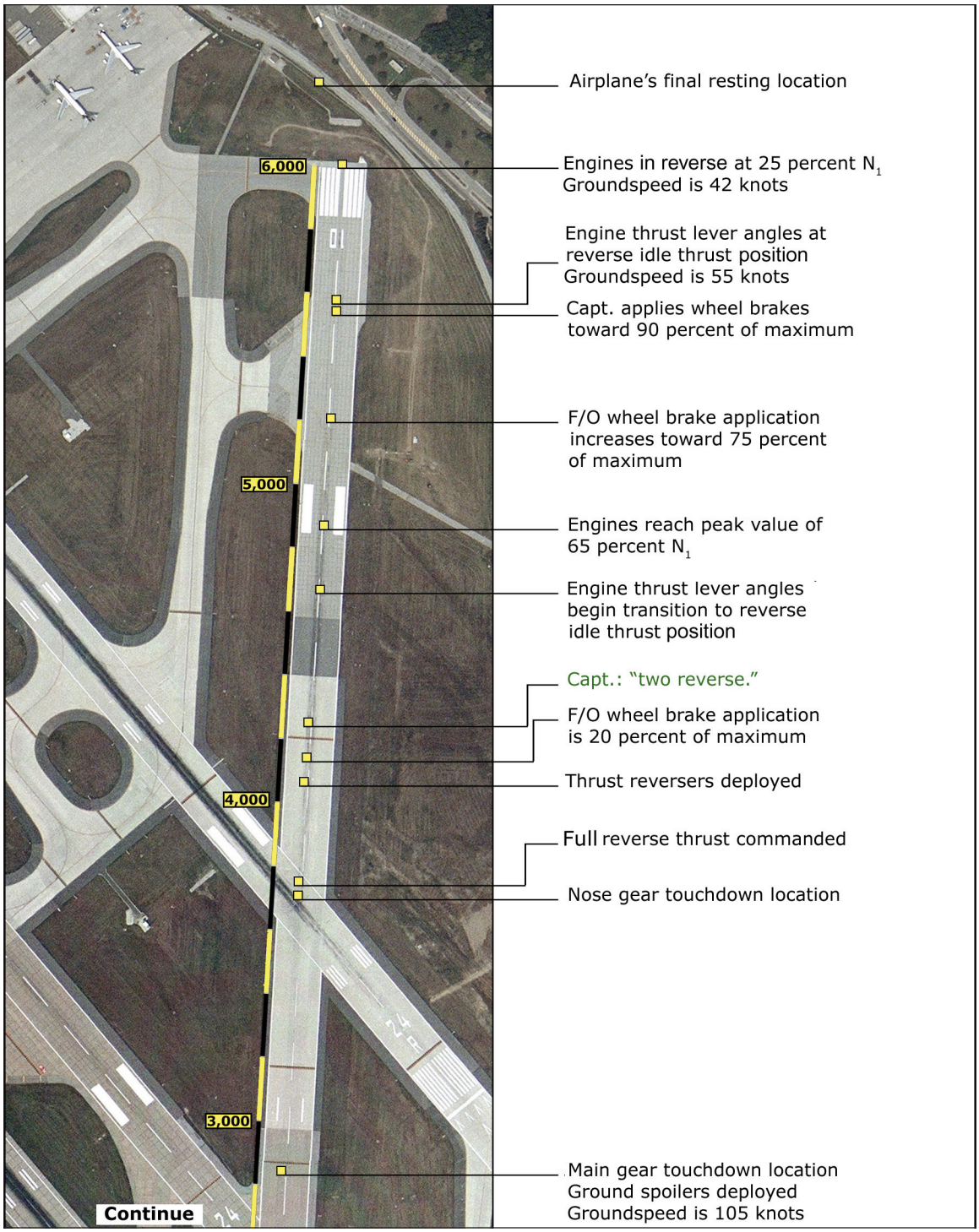

Figure 1a. Events From Touchdown to Overrun

Figure 2. Airplane's Location Southwest of the Extended Runway 28 Centerline
Source: Cleveland Hopkins International Airport

Available airport movement area safety system (AMASS)[9] video data showed that four flights (all transport-category airplanes, including two 737s) arrived without incident on runway 28 during the 10 minutes before the Shuttle America airplane landed. The airplane that directly preceded the Shuttle America airplane to the runway had arrived 2 minutes earlier.

About 1506:04, the tower controller asked the flight crew about the flight's status, but the crew did not initially respond. About 1507:04, the tower controller asked the flight crew again about the flight's status, and the first officer responded, "we're off the runway through the fence … everybody seems to be okay on board." The controller then informed the flight crew that emergency equipment was on the way. The flight crew later reported to Shuttle America and the controller that braking action on the runway was nil. The CVR recording ended at 1519:16.

[9] CLE's AMASS ground radar processor was connected to an airport surface detection equipment-3 radar located on top of the air traffic control tower.

1.2 Injuries to Persons

Table 1. Injury chart.

Injuries	Flight Crew	Cabin Crew	Passengers	Other	Total
Fatal	0	0	0	0	0
Serious	0	0	0	0	0
Minor	0	0	3	0	3
None	2	2	68	0	72
Total	2	2	71	0	75

Note: Section 1.15 provides information about the passengers' minor injuries.

1.3 Damage to Airplane

The airplane's nose landing gear, right wing leading edge, right wing leading edge devices, and both engine nacelles received substantial damage from the impact forces.

1.4 Other Damage

An ILS antenna and the airport perimeter fence were damaged.

1.5 Personnel Information

1.5.1 The Captain

The captain, age 31, held an airline transport pilot certificate and a Federal Aviation Administration (FAA) first-class medical certificate dated February 16, 2007, with a limitation that required him to wear corrective lenses while exercising the privileges of this certificate. The captain received a type rating on the ERJ-170 on June 29, 2005.

From April 2001 to May 2002, the captain worked for Atlantic Technologies, Inc., Huntsville, Alabama, flying the Cessna 210 while performing aerial survey work. From May to November 2002, the captain was a contract first officer flying the Sabreliner 65 and 40 for Haws Aviation in Huntsville. From December 2002 to December 2003, the captain was a first officer for Corporate Flight Management, Inc., Smyrna, Tennessee. The captain was hired by Chautauqua Airlines in December 2003 as an Embraer ERJ-145 first officer, and he was upgraded to captain with Shuttle America in May 2005.[10] The captain was

[10] Chautauqua Airlines, Shuttle America, and Republic Airlines are subsidiaries under Republic Airways Company and share the same seniority list.

based at Indianapolis International Airport (IND), Indianapolis, Indiana, and normally commuted 2 hours from his home in Louisville, Kentucky, to IND.

The captain's and Shuttle America's flight records indicated that he had accumulated 4,500 hours of total flying time, including 1,200 hours on the ERJ-170 and 1,100 hours as an ERJ-170 pilot-in-command (PIC). He had flown 782, 142, 41, and 5 hours in the 12 months, 90 days, 30 days, and 7 days, respectively, before the accident. (These times include the accident flight.) The captain's last line check occurred on December 22, 2006; his last recurrent proficiency check occurred on November 30, 2006; and his last recurrent ground training and crew resource management (CRM) training occurred on May 12, 2006. FAA records indicated no accident or incident history or enforcement action, and a search of records at the National Driver Register found no history of driver's license revocation or suspension.

The captain reported that he flew in snow conditions about 4 months each year and that the conditions on the day of the accident were the worst winter conditions in which he had ever flown. He had previously landed at CLE but not on runway 28. The captain also reported that he did not consider the runway 28 length or the difference in lengths between runways 24R (the previously assigned runway) and 28 because he was concentrating on the approach setup. In addition, the captain stated that he did not recall whether he reviewed the landing weight for runway 28 and that he did not review the landing distance data for the approach.

The captain was off duty (on vacation leave) during the 7 days before the accident. On Friday, February 16, 2007, the captain was waiting in the SDF terminal for a flight (on which he would travel via company jumpseat) to California so that he could visit his infant son. The captain did not recall how many hours of sleep he received the night before but did remember falling asleep in the terminal while waiting for a flight. The captain flew from SDF to O'Hare International Airport (ORD), Chicago, Illinois, that day en route to California. He spent the evening at a hotel in Chicago, went to sleep by 0000, and awoke between 0630 and 0700 on Saturday, February 17. The captain spent the afternoon at ORD, attempting to travel to California, but no jumpseats were available, so he returned to Louisville, arriving about 1800. He reported feeling well rested that day.

The captain was not originally scheduled to work on the day of the accident (he was scheduled to continue his vacation through the following days), but he had called crew scheduling on the night of February 17, 2007, to request a trip. He was offered and then accepted a 2-day trip assignment. The captain reported that he was unable to sleep later that night, stating that he received 45 minutes to 1 hour of sleep. He went to bed at 2000 but did not fall asleep until 0000 on February 18 and then awoke at 0100. He tossed in bed until about 0200, at which time he decided to get up and prepare for the 0525 report time at SDF.[11]

At the time of the accident, the captain had been on duty for 9 hours 40 minutes with a total flight time of 5 hours 2 minutes. Also, the captain had been awake for all but

[11] Because the captain had requested the accident trip sequence, crew scheduling allowed him to travel (as a nonrevenue passenger) to ATL directly from SDF rather than report to IND (his home base) for the trip.

about 1 hour of the previous 32 hours; he stated that his lack of sleep affected his ability to concentrate and process information to make decisions and, as a result, was not "at the best of [his] game." In addition, the captain reported that, for breakfast on the day of the accident, he ate graham crackers and drank orange juice while traveling as a nonrevenue passenger and then drank coffee and ate peanuts and chips later on. The captain stated that he was planning to eat lunch in ATL before the accident flight leg but was unable to do so because of the delays from the earlier flight legs and the change in first officers.

The captain stated that, when not flying, he typically went to bed between 2200 and 0000 and woke up between 0600 and 0800. The captain also reported that he had insomnia, which began 9 months to 1 year before the accident and lasted for several days at a time, and a 10-year chronic cough. According to his medical records, the captain met with a physician on August 3 and August 30, 2006, about his fatigue and chronic cough. The doctor's notes from August 3 showed that the captain had a chest x-ray and a pulmonary function test, which were interpreted as normal, and blood tests, which were also normal. The doctor's notes from August 30 indicated that the captain's fatigue was better but that he was occasionally having sleeping problems. The doctor instructed the captain to follow up in 6 months (which would have been after the date of the accident). The captain reported that he had tried over-the-counter sleeping pills (although it had been more than 6 months since he had done so) and that he had not used or been recommended to use prescription-strength sleeping pills.

According to the captain's attendance records from Chautauqua Airlines, the captain had no absences from December 2003 to March 2004, 8 sick occurrences totaling 14 sick days between April 2004 and February 2005, and no additional absences afterward. From May to August 2005, the captain completed upgrade training for Shuttle America with no reported sick occurrences during that time. Between September 2005 and January 2007, the captain had 11 sick occurrences totaling 26 sick days. (According to the attendance policy for these Republic Airways Company subsidiary airlines, an "occurrence" is a "continuous absence from scheduled duty or reporting late to work." The policy is further discussed in section 1.17.1.3.)

The captain's attendance records from Shuttle America also showed that he was unavailable for work on May 23 and July 30, 2006, resulting in two additional absence occurrences. The captain reported that his first unavailable attendance mark was the result of a dispute with crew scheduling. The captain reported that his second unavailable attendance mark happened after scheduled back-to-back trips. Specifically, the captain had flown a trip on July 29, returning to IND later in the evening than scheduled, and had to fly another trip on July 30. Even though his schedule allowed for 11 hours of rest before his scheduled report time, the captain did not receive adequate rest and called in as fatigued. The captain stated that he had called crew scheduling several hours before the trip "in a daze" to report his belief that it would be unsafe for him to fly. The captain also spoke with the Shuttle America chief pilot/ERJ-170 program manager that day about the company's fatigue policy, and the chief pilot/program manager told him that fatigue calls made outside of duty time would result in an unavailable attendance mark.

According to the captain, during the same conversation on July 30, 2006, the chief pilot/ERJ-170 program manager suggested that it might be possible for the captain to combine some of the occurrences on his attendance record if he produced a medical note covering a series of closely related sick days and the fatigue occurrence. The captain reported that he provided a medical note[12] and followed up with a telephone call to the chief pilot but stated that the chief pilot did not acknowledge receipt of the note or return the call. The chief pilot remembered speaking with the captain about how to classify the fatigue event but could not recall any other details of that conversation, and he did not recall whether he received the captain's medical note.

On January 16, 2007 (about 1 month before the accident), the Shuttle America assistant chief pilot notified the captain, in writing, that his attendance had reached an unacceptable level—nine absence occurrences (seven sick and two unavailable attendance marks) totaling 18 days within the previous 12 months—and that future occurrences would result in corrective action, which could include termination from the company. (According to the company's policy, eight absence occurrences would result in termination.) The captain had not received previous notification from Shuttle America about his attendance. The captain stated that, even though he was tired on the day of the accident, he did not cancel his trip because he thought that could result in his termination.

According to the captain, he did not smoke, and he consumed an average of one alcoholic beverage per day. The captain also stated that he did not take any prescription or nonprescription medications during the 72 hours before the accident and did not have an alcoholic beverage during the evening before the accident. The captain reported that his financial situation was poor during the year before the accident (and was gradually getting worse) and that he and his wife had separated during the month before the accident (with she and their infant son living in another state).

During the first two flights of the accident trip sequence, the captain flew with a different first officer than the accident first officer. The first officer for the first two flight legs stated that the captain flew the first leg and that he had indicated that he was "pretty tired."[13] The first officer also stated that he was impressed with the captain's piloting skills. The accident first officer stated that the captain seemed to be "by the book" but that no specific conversation occurred about the need to watch each other or call out items. This first officer believed that he could provide any input to the captain.

Four first officers who were paired with the captain before the accident had positive comments about his interpersonal and piloting skills. They stated that he was professional, followed standard operating procedures, gave complete briefings, and communicated with the crew. The proficiency check/line check airman who performed the captain's simulator check in November 2006 stated that the captain performed to standards and noted specifically that he demonstrated good CRM and exercised good

[12] The captain provided a copy of this medical note to the Safety Board. The note, which was dated August 3, 2006, indicated that the captain was being treated for fatigue and a chronic cough.

[13] The first officer who flew the first two flight legs with the captain also reported that he was tired because the first flight leg (ATL to SRQ) was scheduled to be an early flight and, before the flight, he had to commute to ATL.

decision-making. The proficiency check/line check airman who performed the captain's most recent line check in December 2006 stated that the captain performed to standards, made all of the callouts, performed all of the checklists, and maintained good overall control of the airplane. None of the pilots who were interviewed recalled the captain being tired or fatigued.

1.5.2 The First Officer

The first officer, age 46, held an airline transport pilot certificate and an FAA first-class medical certificate dated September 20, 2006, with a limitation that required him to possess glasses that correct for near vision while exercising the privileges of this certificate. The first officer received a type rating (second-in-command [SIC] privileges only) on the ERJ-170 on February 3, 2006.

From 1999 to 2002, the first officer worked as a flight instructor for Eagle East Aviation, North Andover, Massachusetts. From 2002 to 2005, the first officer flew Jetstream 4100 airplanes as an SIC for Atlantic Coast Airlines (which became Independence Air) while based at Washington Dulles International Airport, Chantilly, Virginia. The first officer was hired by Shuttle America as an ERJ-170 first officer in June 2005. The first officer was based at ORD and commuted there from his home in New Hampshire.

The first officer's and Shuttle America's flight records indicated that he had accumulated 3,900 hours of total flying time, including 1,200 hours on the ERJ-170 as an SIC. He had flown 997, 229, 96, and 30 hours in the 12 months, 90 days, 30 days, and 7 days, respectively, before the accident.[14] (These times include the accident flight.) The first officer's last proficiency check occurred on July 24, 2006; his last recurrent ground training occurred on June 30, 2006; and his last recurrent CRM training occurred on June 28, 2006. FAA records indicated no accident or incident history or enforcement action, and a search of records at the National Driver Register found no history of driver's license revocation or suspension.

The first officer had not previously landed at CLE. He had flown in snow conditions before but had not experienced a snow squall during landing until the accident flight.

From Sunday, February 11, to Wednesday, February 14, 2007, the first officer flew a 4-day, 6-leg trip sequence. His earliest flight during that trip sequence began at 1104, and the latest flight ended by 2315; his total flight time was 18 hours 27 minutes. The first officer was off duty on Thursday, February 15. He spent the night in Chicago and went to bed about 2200 or 2300.

On Friday, February 16, 2007, the first officer awoke about 0630 or 0730 to begin a 3-day, 6-leg trip sequence. He reported for duty at ORD at 0810, traveled as a nonrevenue

[14] According to 14 CFR 121.471, pilots flying domestic operations can fly up to 30 hours per week and 1,000 hours per calendar year. Although the first officer had flown 997 hours at the time of the accident, only those hours accumulated in January and February 2007 counted toward the calendar year limit.

passenger aboard two flights, and was the first officer of a flight that arrived at Chicago Midway International Airport (MDW) at 1939. On Saturday, February 17, the first officer reported for duty at 0615; completed three flights, the last of which ended at ATL at 1852; and went to bed about 2200.

On Sunday, February 18, the first officer reported for duty about 0550 and completed two flights, ending in ATL at 1049. His total flight time for the six flights was 11 hours 50 minutes. The first officer was originally scheduled to fly as a nonrevenue passenger from ATL to ORD. He had been away from home for 8 days and was scheduled to be on vacation the day after the accident. During the final leg of the 3-day trip sequence, crew scheduling contacted the first officer via ACARS to ask if he were willing to accept a trip from ATL to CLE that day, remain in Cleveland overnight, and return to ATL the next day as a flying pilot. The first officer agreed to fly the round trip because he could still return home during the evening of February 19 and keep his vacation schedule. He was on the ground at ATL for 2 hours 16 minutes before the accident flight departed. At the time of the accident, the first officer had been on duty about 9 hours 15 minutes, with a total flight time of 5 hours 30 minutes.

The first officer reported that he was in good health and that he had not taken any prescription or nonprescription medications and did not smoke or drink in the 3 days that preceded the accident. He reported his home life and financial situation as stable. The first officer reported that his normal bedtime was about 2200 and that his normal awakening time (when not flying) was about 0600.

During a postaccident interview, the captain stated that he did not like the way that the first officer flew the airplane during takeoff and up to cruise flight. Specifically, the captain indicated that the first officer manually flew the airplane to an altitude of about 30,000 feet[15] in a "very jerky" manner, but the captain did not mention anything to the first officer at the time. The captain did not report anything else remarkable about the first officer's piloting skills.

The captain stated that he did not specifically ask the first officer if he was uncomfortable flying the approach to landing and that the first officer did not indicate that he was uncomfortable. Three of four captains who had been previously paired with the first officer stated that he was below average in piloting skills. One of the captains stated that the first officer did a good job following standard operating procedures and performing checklists but that he seemed to be "behind the airplane." Another captain stated that the first officer relied too much on automation and was slow to respond to abnormalities. This captain did state that the first officer took criticism well and made efforts to improve.

The line check airman who provided the first officer with some of his initial operating experience stated that she had recommended him for further training because he needed to perfect his visual approaches. (The first officer received the recommended training.) A proficiency check/line check airman who had flown with the first officer

[15] FDR data showed that the autopilot was engaged at 28,000 feet.

several times indicated nothing remarkable about his experiences flying with the first officer and noted no deficiencies in his abilities or decision-making.

1.6 Airplane Information

The accident airplane was registered to Shuttle America with a registration certificate issue date of September 30, 2005. The airplane's estimated landing weight was 69,186 pounds, which was within the maximum landing weight of 72,310 pounds, as indicated in Embraer's airplane flight manual. The airplane's landing center of gravity (cg) was 20 percent mean aerodynamic chord (MAC), which was within the cg limits of 7 to 27 percent MAC.

The airplane was configured with 2 cockpit flight crew seats, 1 aft-facing flight attendant jumpseat on the forward bulkhead, 1 forward-facing flight attendant jumpseat on the aft bulkhead, 6 first-class passenger seats, and 64 coach-class passenger seats. The airplane was equipped with General Electric CF34-8E5 engines. The airplane was not equipped with autobrakes.

1.7 Meteorological Information

1.7.1 Airport Weather Information

CLE has an automated surface observing system (ASOS) that is maintained by the National Weather Service (NWS). Augmentation and backup of the ASOS are provided by NWS-certified observers in the CLE air traffic control tower (ATCT). The ASOS records continuous information on wind speed and direction, cloud cover (in feet agl), temperature, precipitation, and visibility (in statute miles). The ASOS transmits an official meteorological aerodrome report (METAR) each hour and special weather observations (SPECI) as conditions warrant. (Such conditions include a wind shift, change in visibility, and change in cloud cover or height.)

The following METAR and SPECI information was recorded surrounding the time of the accident:

- The 1436 SPECI indicated winds from 300° at 14 knots; visibility 8 miles in light snow; scattered clouds at 2,900 feet, ceiling broken at 3,400 feet, overcast at 7,000 feet; temperature -6° Celsius (C); dew point -12° C; altimeter setting 30.00 inches of mercury (Hg). The SPECI remarked that snow began at 1436.
- The 1451 METAR indicated winds from 290° at 18 knots; visibility 1/4 mile in heavy snow; scattered clouds at 1,100 feet, ceiling broken at 1,800 feet, overcast at 4,300 feet; temperature -7° C; dew point -11° C; altimeter setting 30.01 inches of Hg.

- The 1456 SPECI indicated winds from 300° at 16 knots; visibility 1/4 mile in heavy snow; ceiling broken at 600 feet, broken at 1,500 feet, overcast at 4,100 feet; temperature -7° C; dew point -11° C; altimeter setting 30.01 inches of Hg.
- The 1505 5-minute observation indicated winds from 330° at 16 knots gusting to 22 knots; visibility 1/2 mile in moderate snow; ceiling broken at 600 feet, broken at 1,700 feet, overcast at 3,400 feet; temperature -7° C; dew point -9° C; altimeter setting 30.02 inches of Hg.
- The 1517 SPECI indicated winds from 330° at 13 knots gusting to 16 knots; visibility 1/4 mile in heavy snow; ceiling broken at 300 feet, broken at 1,000 feet, overcast at 1,500 feet; temperature -8° C; dew point -11° C; altimeter setting 30.03 inches of Hg.

RVR values are normally determined by visibility sensors that are similar to those used in the ASOS (or by transmissometers). The RVR system measures visibility, background luminance, and runway light intensity to determine the distance a pilot should be able to see down the runway. The RVR sensors are located along and near the approach end of the runway. Between 1501 and 1509, the ATCT reported the RVR for runway 28 to be 2,400 feet or less. At 1506, the ATCT reported the RVR to be 1,400 feet.

1.7.2 National Weather Service Weather Information

The flight dispatcher released the accident flight at 1144 based on the CLE terminal aerodrome forecast (TAF) issued at 0953, which expected northwest winds of 12 knots and marginal visual flight rules conditions (that is, a ceiling between 1,000 and 3,000 feet and/or visibility of 3 to 5 statute miles) with light snow.

The TAF that was issued at 1226 on the day of the accident indicated the following: from 1500, winds from 310° at 15 knots gusting to 22 knots, visibility 6 miles in light snow showers, and ceiling overcast at 2,500 feet; temporarily between 1500 and 1900, visibility 2 miles in light snow showers and ceiling overcast at 1,200 feet.

The TAF was amended at 1444 (about 22 minutes before the accident) to indicate the following: from 1500, winds from 310° at 15 knots, visibility 5 miles in light snow showers, and ceiling overcast at 2,500 feet; temporarily between 1500 and 1700, visibility 1/2 mile in moderate snow showers and ceiling overcast at 800 feet.

The NWS had a Weather Surveillance Radar-1988, Doppler (WSR-88D) located at CLE. The WSR-88D is a 10-centimeter wavelength radar that measures, among other things, reflectivity (that is, echo intensity). The base reflectivity image at 1505 depicted a band of echoes moving across the Cleveland area; these echoes were consistent with those of moderate to heavy snow showers.

1.8 Aids to Navigation

The FAA issued a NOTAM regarding the runway 28 glideslope, stating, "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." This NOTAM was included in the flight crew's preflight paperwork, but both pilots indicated that they had not read the NOTAM.

No problems with any other navigational aids were reported.

1.9 Communications

No technical communications problems were reported.

1.10 Airport Information

CLE is located about 9 miles southwest of Cleveland at an elevation of 791 feet mean sea level. The airport had three parallel runways, 6L/24R, 6C/24C,[16] and 6R/24L, and one nonparallel runway, 10/28. Runway 28, the active runway for the accident flight, was 6,017 feet long and 150 feet wide. Runway 28 was equipped with an ILS and a 1,400-foot medium intensity approach lighting system with runway alignment indicator lights. According to airport personnel, about 3 percent of the operations conducted annually at CLE occur on runway 10/28.

The Safety Board examined the FAA's airport certification inspection reports for CLE for 2004 through 2006, and no uncorrected deficiencies were noted.

1.10.1 Runway Safety Area

FAA Advisory Circular (AC) 150/5300-13, "Airport Design," table 3-3, "Runway Design Standards for Aircraft Approach Categories," stated that the standard runway safety area (RSA) should be a width of 500 feet (250 feet on both sides of the extended runway centerline) and a length of 1,000 feet beyond each runway end. The runway 10 departure end had a full-width RSA that was 748 feet in length. The runway 28 departure end had an RSA that was 60 feet long and 275 feet wide.[17] The runway 10/28 longitudinal RSAs were measured along the extended runway centerline.

[16] Runway 6C/24C had been rarely used since 2004 because of an overlapping runway safety area with runway 6R/24L. In November 2007, runway 6C/24C was closed permanently, and work began to convert most of the runway to a taxiway.

[17] A full-width RSA did not exist beyond the runway 28 departure end threshold because of the presence of a fence, runway edge identifier lights, a localizer, a localizer building, two access roads near a National Aeronautics and Space Administration building, numerous trees, and a terrain drop (estimated by a September 2000 FAA document to be 670 feet from the departure end threshold).

Runway 10/28 was originally constructed in the early 1950s and was extended from its original length of 5,500 feet to its current length of 6,017 feet in 1958 (before the development of the current FAA airport design standards). As a result of a regulatory change that became effective on January 1, 1988, the FAA accepted the RSA conditions that existed at that time for airports certificated under Part 139. After that date, however, the FAA required that any significant runway expansion or reconstruction include RSAs that met standards acceptable to the FAA to the extent practicable. Runway 10/28 was partially reconstructed four times between 1981 and 2005 (for runway rehabilitation using a cement concrete overlay), but the runway was not expanded in size or weight-bearing capacity. Thus, the RSAs were not required to be changed.

In accordance with FAA Order 5200.8, "Runway Safety Area Program," the FAA inventoried CLE's RSA conditions in 2000. In a September 29, 2000, letter to CLE, the FAA recognized that runway 10/28 did not conform to agency standards and detailed some short- and long-term options to improve the RSAs as much as possible. The short-term improvements were to relocate the localizer building and remove trees located on the National Aeronautics and Space Administration's (NASA) Glenn Research Center property. The long-term improvements, characterized in the FAA's letter as "more complex and costly," were to (1) coordinate and agree with NASA to relocate its two primary entrance/exit road lanes that were within the RSA for the departure end of runway 28 to a distance of about 300 feet from the existing runway 10 (approach end) threshold and construct a 300-foot engineered materials arresting system (EMAS) within the vacated area and (2) shift the runway 300 feet to the east[18] and install another EMAS at the opposite end of the runway.

The FAA, in its September 2000 letter, asked CLE to conduct a study that evaluated the short- and long-term options to enhance the RSAs for runway 10/28. The FAA asked that CLE initiate the study immediately and that its recommendation be submitted to the FAA by March 2001. In response, CLE contracted for an RSA study, and an initial draft report was provided to the FAA in March 2004. CLE submitted revised draft reports in September 2006 and September 2007 as a result of FAA comments.

In its October 2007 letter responding to the latest draft report, the FAA stated that CLE needed to document why it is not practicable to improve the RSAs to meet current standards. The FAA's letter also stated that, although the draft report identified several alternatives for improving the RSAs, the draft did not recommend a preferred alternative and the implementation schedule for this alternative. The letter further stated that, even though the FAA's original goal was to bring all substandard RSAs into conformance by 2007, the deadline for improving runway 10/28 at CLE as much as practicable had been extended to 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. In

[18] FAA Order 5200.8, paragraph 4b, states, "when obtaining a standard RSA is not practicable through traditional means (e.g. land acquisition, grading, fill, etc.), alternatives must be explored. During some types of projects, it may be feasible to relocate, realign, shift, or change a runway in such a way that the RSA may be obtained. It is recognized that the costs of this kind of adjustment may be justified only in an extensive project, but the concept should be evaluated to determine if it is a practicable alternative."

addition, the letter stated, "since design and construction of the RSA improvements will need to begin promptly to meet this deadline, the RSA Study should be finalized and the preferred alternative selected as soon as possible." CLE had not resubmitted its RSA study to the FAA as of April 2008.

1.10.2 Airport Winter Operations

CLE's FAA-approved Airport Certification Manual, section 9, "Snow and Ice Control," dated November 7, 2006, stated that airport operations personnel were responsible for maintaining all paved airfield surfaces and lighting during snow and ice conditions, keeping all navigational aid snow clearance areas within snow depth limits for the specific type of glideslope antenna configuration, and notifying the local airways facilities sector office immediately upon engaging the snow removal plan. The manual also included the following information:

1) Ice, snow, and slush shall be removed as completely as practicable from appropriate air carrier movement areas.
2) Upon noticing that an accumulation is taking place on the field … Airport Operations shall issue an advisory … the advisory will include a field condition report … with the date and time … this will alert all concerned parties and will provide the necessary time to make a field inspection and issue a NOTAM.
3) The determination for commencement of a snow removal operation is based upon the evaluation of the existing field conditions, with present and forecast weather conditions being taken into consideration. Generally, a snow removal operation shall commence at the beginning of an accumulation of snow on the movement surface, and prior to an accumulation of one-half inch of slush or wet snow, or two inches of dry snow.
4) Friction measurement readings are conducted for touchdown, midpoint, and rollout and the results are disseminated … in the event a numeric reading of 20[19] or less is verified, that runway surface will automatically be closed to all airport operations.

FAA AC 150/5200-30A, "Airport Winter Safety and Operations," describes friction-measuring equipment for use on runways during winter operations and specifies the conditions that are acceptable to conduct friction surveys on frozen contaminated surfaces. The AC stated that a decelerometer was considered to be "generally reliable" when ice or wet ice and compact snow at any depth contaminated the runway surface. The AC also stated that it was "generally accepted" that friction surveys would be reliable as long as the depth of dry snow did not exceed 1 inch and/or the depth of wet snow/slush did not exceed 1/8 inch.

[19] According to a representative from CLE operations, the airport surveyed all of its operators to determine their limitations in friction-limited conditions. CLE selected a friction measurement reading of 20 because it was more conservative than the minimums allowed by the operators. (The higher the friction measurement reading, the greater the friction.)

As previously stated, on the day of the accident, CLE was receiving intermittent snowfall. The active runway was periodically alternated to allow for surface maintenance and friction testing, as discussed in table 2 along with other relevant events. Although runways 24L and 28 were both open at the time of the accident, runway 24L was being used for departures, and runway 28 was being used for arrivals.

Table 2. Information Regarding Runway Conditions at CLE on the Day of the Accident

Time	Event
0819	The airport was closed because of snow accumulation and nil braking (based on runway friction tests conducted with the use of a decelerometer).
0939	The airport was reopened, with runway 6L/24R as the active runway and runways 6R/24L and 10/28 closed. A NOTAM was issued, indicating that runway 6L/24R had a thin cover of snow and ice and that sand had been applied 60 feet wide. The NOTAM also included the runway friction values for runway 6L.
1025	A NOTAM was issued, indicating that runway 6R/24L was open with a thin cover of snow and ice and that sand had been applied 60 feet wide. The NOTAM also included the runway friction values for runway 6R.
1112	A NOTAM was issued, indicating that runway 6R/24L had a thin cover of snow over patchy packed snow and ice. The NOTAM also included the runway friction values for runway 6R.
1142	A NOTAM was issued, indicating that runway 6L/24R had scattered thin patches of packed snow and ice. The NOTAM also indicated that a broom snow removal vehicle had been used on the runway and that sand had been applied 60 feet wide. The NOTAM included the runway friction values for runway 6L.
1309	Snow removal operations began on runway 10/28.
1347	A NOTAM was issued, indicating that runway 10/28 had been opened with a thin cover of packed snow and ice. The NOTAM also indicated that a broom snow removal vehicle had been used on the runway and that sand had been applied 50 feet wide. The NOTAM further indicated that the runway friction values for runway 28 were 38 (touchdown and midpoint) and 41(rollout).
1349	A NOTAM was issued, indicating that runway 6R/24L was closed and that snow removal operations began on the runway.
1437	A NOTAM was issued, indicating that runway 6R/24L had been opened and was wet with scattered thin patched melting snow and ice. The NOTAM also indicated that a broom snow removal vehicle had been used on the runway. The NOTAM further indicated that the runway friction values for runway 24L were 41 (touchdown), 43 (midpoint), and 44 (rollout). This NOTAM canceled the one issued at 1349.
1440	Runway 6L/24R was closed.
1501	Flight 6448 was cleared to land on runway 28. Braking action was reported to the flight crew as fair (based on a 1457 report from a 737 pilot).
1506	The accident occurred.
1523	Reported conditions on runway 10/28 were 1/2-inch cover of snow over scattered thin patches of compacted snow. The reported friction values for runway 28 were 24 (touchdown), 25 (midpoint), and 30 (rollout). (The same decelerometer was used for the pre- and postaccident runway friction tests.)

Note: There were no reports of snow being cleared from the glideslopes. The runways and taxiways have higher priority for snow removal than glideslope antennas.

1.11 Flight Recorders

The airplane was equipped with two solid-state digital voice-data recorder (DVDR) systems, which comprised a CVR and an FDR. The DVDR systems were Honeywell DVDR-120-4x models, serial numbers 00471 (located in the aft section of the airplane) and 00483 (located in the forward section of the airplane). The DVDRs were designed to record 2 hours of audio data and a minimum of 25 hours of flight data.

The DVDRs were sent to the Safety Board's laboratory for readout and evaluation. The Board determined that the forward DVDR had stopped recording during the accident sequence but that the aft recorder continued recording until 1519:16, when the airplane was powered down. As a result, the CVR transcript was prepared from the information downloaded from the aft recorder, and the FDR data cited in this report were those from the aft recorder.

The DVDRs sustained no heat or structural damage, and the audio information and flight data were extracted normally and without difficulty. The CVR recording from the aft recorder contained four channels (the pilot, copilot, observer, and cockpit area microphones) of excellent-quality audio data.[20] A transcript was prepared of the entire recording (see appendix B). The FDRs recorded the required 88 as well as other parameters. About 27 hours of data were recorded on the aft FDR, including about 2 hours 20 minutes of data from the accident flight.

1.12 Wreckage and Impact Information

The airplane's nose gear collapsed during the overrun, and the airplane came to rest on a snow-covered grass surface located southwest of the extended runway 28 centerline. Witness marks included tire tracks in the soil and the snow. The airplane's final resting position was along a 256° true heading.

The airplane's brake control components were tested at the Crane Hydro-Aire facility in Burbank, California. All components were found to be within specifications. The brake control modules passed all areas of the test procedure with no out-of-limit conditions.

1.13 Medical and Pathological Information

In accordance with 14 CFR Part 121, Appendixes I and J, Shuttle America conducted postaccident drug and alcohol testing on the captain and the first officer.

[20] The Safety Board rates the audio quality of CVR recordings according to a five-category scale: excellent, good, fair, poor, and unusable. An excellent-quality recording is one in which virtually all of the crew conversations can be accurately and easily understood. The transcript that was developed might indicate only one or two words that were not intelligible. Any loss in the transcript is usually attributed to simultaneous cockpit/radio transmissions that obscured each other.

The company administered breathalyzer tests on the day of the accident at 1836 for the captain and 1821 for the first officer. Also, the company obtained urine samples on the day of the accident at 1845 from the captain and 1830 from the first officer. The urine specimens were tested for the following major drugs of abuse: marijuana, cocaine, phencyclidine, amphetamines, and opiates. All of the tests were negative.

1.14 Fire

No in-flight or postcrash fire occurred.

1.15 Survival Aspects

Three passengers reported accident-related injuries. These injuries were neck, back, spine, shoulder, and/or arm pain. Two of these passengers were transported to a hospital after the accident, but neither was admitted.

1.15.1 Emergency Response

According to the assistant fire chief at the CLE airport rescue and firefighting (ARFF) station, about 1506:30, the station received a call on the crash phone from the ATCT. The controller notified the ARFF station of "a possible alert 3"[21] and stated that he had lost sight of a landing airplane and was no longer in communication with the pilot. The controller also stated that he thought the airplane was off the end of runway 28. Six ARFF vehicles staffed with a total of nine ARFF personnel responded to the call about 1507. The assistant fire chief added that, upon leaving the station, the ARFF crews were faced with "blizzard conditions and a complete whiteout" and no visibility as a result of the falling snow and wind.

Before the ARFF vehicles and personnel arrived at the accident scene, the controller told the ARFF commander that he was in communication with the pilot, who reported that the airplane was off the runway and through a fence with no fire and no injuries on the airplane. The ARFF vehicles and personnel arrived on scene about 1509:25. ARFF personnel confirmed that there was no fire, and the ARFF commander spoke to the captain to confirm that there were no injuries aboard the airplane. Afterward, the commander directed ARFF personnel to ensure that there were no fuel leaks or sources of ignition in the area, and they confirmed that the airplane was secure. Cleveland Fire Department personnel arrived on scene about 1527.

The Shuttle America Corporation 170 General Operations Manual, chapter 1, Flight Crew Duties and Responsibilities, section 10, Emergency Evacuation, dated February 15, 2006, stated the following policy: "an actual evacuation may not be necessary.

[21] An alert 3 indicates that an aircraft has been involved in an accident on or near the airport.

The PIC's ultimate decision to evacuate versus normal exit through the main door and airstairs[22] should be made after analyzing all factors pertaining to the situation when the aircraft has come to a complete stop."

The captain stated that he considered an evacuation but then decided to keep everyone on board until the buses arrived because no one was in imminent danger, ARFF had informed him that the airplane was secure (that is, no fuel leaks or sources of ignition were in the area), and it had been snowing heavily outside. According to the ARFF chief, the flight crew and ARFF personnel agreed that, after shuttle buses arrived on scene, the passengers would deplane and be transported to the ARFF station. The CLE operations log showed that the passengers began deplaning about 1555. ARFF personnel assisted the passengers down the station's A-frame ladder, shown in figure 3, at the right front door (1R) exit. The ARFF chief and a CLE operations supervisor indicated that the ladder was open to its A-frame configuration during the deplaning. The ARFF log showed that passenger deplaning was completed by 1630. The flight attendants and flight crew deplaned afterward using the ladder. They were then transported to the ARFF station in an airport vehicle.

Figure 3. Accident Airplane and Ladder Used for Deplaning
Source: Cleveland Hopkins International Airport

[22] Some ERJ-170 airplanes (including the accident airplane) do not have integrated airstairs. Portable stairs are used instead.

1.15.2 Postaccident Communications With Dispatch

The Safety Board reviewed a transcript of postaccident cell phone conversations between the flight crew and dispatch (at IND). The first officer made the initial contact with dispatch and reported the accident to the dispatcher who was responsible for releasing the flight. He briefed the flight dispatcher on the events surrounding the overrun and told her that the flight attendants were going to deploy the 1R slide to deplane the passengers. The dispatcher acknowledged this information but also questioned whether to use a ladder. The captain subsequently called a dispatch coordinator, who had been advised about the overrun, and told him that a decision had not been made regarding whether to use a ladder or the 1R slide for deplaning. The captain stated his concern that a ladder could result in more injuries than the slide. The captain and the dispatch coordinator agreed that the flight crew and ARFF personnel should determine the safest way to deplane. The dispatch coordinator indicated that the slide could be deployed but cautioned that ARFF personnel needed to be located at the bottom of the slide because of the possibility of injuries.

Afterward, the flight dispatcher told the captain that the chief pilot (also at IND) did not want the slide deployed "at all cost" because he was concerned about people getting hurt. The captain then told the dispatch coordinator that, even though ARFF personnel wanted the slide deployed and people were concerned about using a ladder in the snow, the chief pilot did not want the slide to be deployed. The captain then reported that ARFF personnel were going to see if they could get a ladder to the 1R door. The ladder was then positioned at the 1R door and used for deplaning.

1.16 Tests and Research

1.16.1 Aircraft Performance Study

The Safety Board performed an aircraft performance study for this accident for which CVR, FDR, and radar data were correlated. Section 1.16.1.1 details information about the accident airplane's calculated ground track. Section 1.16.1.2 provides information about the braking ability achieved by the accident airplane during the rollout and the minimum braking ability required to safely stop the airplane. Section 1.16.1.3 discusses the results of an arrival assessment study using an additional landing distance safety margin of 15 percent, as recommended by the Board in Safety Recommendations A-07-57 (urgent) and -61.

1.16.1.1 Calculated Ground Track

Table 3 summarizes events that occurred during the landing rollout and indicates the runway distance remaining based on FDR, CVR, global positioning system, and radar data and the overlay of the airplane's calculated ground track on the CLE aerial diagram.

Table 3. Landing Rollout Events and Stopping Distances Remaining on Runway 28

Time	Event
1505:25	Main gear touchdown. Groundspeed was about 105 knots. **Remaining runway distance was about 3,100 feet**.
1505:25	Ground spoiler deployment.
1505:30	Nose gear touchdown.
1505:30.5	Left and right engine thrust lever angles transitioned from the idle setting to the full reverse thrust setting (commanded until airspeed was about 85 knots). **Remaining runway distance was about 2,200 feet**.
1505:32	Left and right thrust reversers deployed.
1505:33	First officer applied wheel brakes to about 20 percent maximum. **Remaining runway distance was about 1,850 feet**.
1505:36	Left and right engine thrust lever angles began transition from full reverse setting toward reverse idle thrust setting.
1505:38	Left and right engines were in reverse thrust, reaching a peak value of 65 percent N_1 for about 2 seconds (groundspeed was about 80 knots). **Remaining runway distance was about 1,100 feet**.
1505:40.5	First officer increased wheel braking. **Remaining runway distance was about 800 feet**.
1505:41.5	Peak longitudinal deceleration was about 0.25 G.[a]
1505:44	Captain applied wheel brakes. **Remaining runway distance was about 450 feet**.
1505:44.5	Left and right engine thrust lever angles were at reverse idle thrust setting (groundspeed was about 55 knots). **Remaining runway distance was about 400 feet**.
1505:46.5	First officer's wheel brake application was about 75 percent maximum. Captain's wheel brake application was about 90 percent maximum. **Remaining runway distance was about 200 feet**.
1505:48.5	Left and right engines were in reverse thrust with N_1 about 25 percent.
1505:49	Airplane departed runway. Groundspeed was about 42 knots.

[a] G is a unit of measurement that is equivalent to the acceleration caused by the earth's gravity (32.174 feet/second^2).

1.16.1.2 Braking Ability

The Safety Board estimated the braking ability (which has been associated in this report with the term airplane braking coefficient)[23] achieved during the airplane's rollout. FDR data, ERJ-170 aerodynamic data, and a General Electric CF34-8E5 engine model were used to estimate the lift, drag, and thrust forces acting on the airplane. The aerodynamic data were based on the airplane being configured with flap position 5, gear down, and ground spoilers deployed. (According to Shuttle America's ERJ-170 Pilot Operating Handbook, the flaps 5 configuration was the preferred landing setting.)

The ERJ-170 aerodynamic data and the CF34-8E5 engine model were used to estimate the minimum braking coefficient required to safely stop the airplane using an emergency stopping scenario and a scenario that was consistent with the performance

[23] Airplane braking coefficient is defined as the ratio of the retarding force due to braking relative to the normal force (that is, weight minus lift) acting on the airplane. The estimated airplane braking coefficient incorporates the effects of the runway surface, runway contaminants, and the airplane braking system (such as antiskid system efficiency, tire pressure, and brake wear).

assumptions embedded in the Embraer computerized airplane flight manual. Both scenarios required the airplane to stop within the available landing distance from the actual touchdown location. The emergency stopping scenario, by definition, assumed the deployment of ground spoilers, full wheel braking, and the sustained use of maximum reverse thrust until the airplane came to a complete stop. Landing performance numbers from the Embraer computerized airplane flight manual assumed the deployment of ground spoilers, use of maximum reverse thrust until the airplane decelerated to an airspeed of 60 knots, and full wheel braking.

The accident airplane's calculated braking coefficient for a sustained 5-second period of significant braking application exceeded the minimum braking coefficient needed to stop on the runway.[24] The sustained period of significant braking application began 6 seconds before the airplane departed the runway.

1.16.1.3 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,[25] even though the FAA had issued a safety alert for operators (SAFO)[26] in August 2006 recommending that such assessments be performed. (See section 1.18.3 for information about the SAFO and the Safety Board recommendation that led to the issuance of the SAFO.)

The Safety Board conducted an arrival assessment study to determine landing performance numbers for the ERJ-170 using an additional 15-percent safety margin, as recommended by the SAFO. The Embraer computerized airplane flight manual was used to estimate landing performance with the accident landing condition for two flap configurations and various runway surface conditions.

The factored landing performance data—that is, the data that included an additional 15-percent stopping distance margin—indicated that an ERJ-170 configured with flaps 5 or full flaps could land on a 6,017-foot runway with a surface condition of compact snow[27] with or without two-engine reverse thrust. If the ERJ-170 were configured with full flaps and two-engine reverse thrust, the airplane could land on a 6,017-foot runway with at least an additional 15-percent margin for all runway surface conditions

[24] The calculated braking coefficient for the accident airplane was about 0.15 during the sustained 5-second period of significant braking. With the emergency stopping scenario, the minimum braking coefficient required to stop the accident airplane within the available ground roll distance was 0.11. Landing performance numbers from the Embraer computerized airplane flight manual showed that, with the actual airplane touchdown location, a minimum braking coefficient of 0.13 would be required to stop the airplane in dry snow depths of 1 inch or less. (Reported conditions on runway 28 were 1/2-inch cover of snow over scattered thin patches of compacted snow.)

[25] Shuttle America provided its pilots with landing performance data for dispatch (factored and unfactored distances) in terms of maximum landing weights. Company policy required pilots to review this information as a part of the flight release at the beginning of the flight.

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

[27] According to the SAFO guidance, a reported braking action of fair (the accident condition) would translate to the compact snow contaminant type.

defined in the Embraer computerized airplane flight manual—dry, wet, compact snow, dry snow, wet snow, slush, and standing water—except wet ice.[28]

1.17 Organizational and Management Information

Shuttle America received its original certification in November 1998 and operated DeHavilland DH8 airplanes from Hartford, Connecticut. In October 2001, Shuttle America reorganized after obtaining a code-share agreement with US Airways and began operating its DH8 airplanes through a leasing and maintenance agreement with Allegheny Airlines. In September 2002, Shuttle America relocated its headquarters to Fort Wayne, Indiana, and operated the Saab SF-340. The company's code-share agreement with US Airways was terminated in October 2004.

In May 2005, Republic Airways Holdings, the parent company of Chautauqua Airlines, purchased Shuttle America and received approval to operate the ERJ-170. (By the end of 2005, Shuttle America had sold its Saab airplanes.) In August 2005, Republic Airways Holdings received certification for a third subsidiary airline, Republic Airlines.

Shuttle America began scheduled ERJ-170 service for United Airlines in June 2005 and Delta Air Lines in September 2005. During 2006, Shuttle America relocated its headquarters to Indianapolis. At the time of the accident, Shuttle America operated 47 ERJ-170 airplanes with up to 70 seats and employed 430 pilots.

1.17.1 Flight Manuals

1.17.1.1 Missed Approach Procedures

According to the Shuttle America Corporation ERJ-170 Pilot Operating Handbook, chapter 4, Normal Procedures,[29] section 43, Go Around, sufficient visual cues must exist for a pilot to continue an approach below the DH or the MDA.[30] The section stated that, if visual cues were lost after the DH or MDA because of snow flurries or heavy precipitation,

[28] At the time of the accident, the Embraer computerized airplane flight manual reported identical landing performance numbers for compact snow and ice runway surface conditions. The landing distance numbers for ice were generally nonconservative, but an alternate wet ice runway surface condition option was available. Shuttle America cited the nonconservative results for the ice runway surface condition as an obstacle in implementing arrival assessments that were consistent with the SAFO on landing distance assessments. Embraer subsequently updated its computerized airplane flight manual calculations for the ice runway surface condition option.

[29] The Normal Procedures information cited in this report was dated August 15, 2006.

[30] DH is used for a precision (ILS) approach; MDA is used for a nonprecision localizer-only approach.

the pilot should immediately initiate a go-around[31] and fly the published missed approach procedure as required by the Federal Aviation Regulations (FAR).[32]

Also, chapter 4, section 37, Instrument Procedures, stated that, if the runway were not in sight at the DH or the MDA, the monitoring pilot was to call out "minimums" and "no contact," and the flying pilot was to call out "go around" and execute a missed approach.

1.17.1.2 Landing Operations

The Shuttle America Corporation ERJ-170 Pilot Operating Handbook, chapter 4, Normal Procedures, section 46, Normal Landing, stated that the key to a successful landing was to make a stabilized approach by using a glideslope, a glidepath (vertical guidance), and/or visual cues, which should enable the airplane to cross the landing threshold about 50 feet above the ground (corresponding to a touchdown point of about 1,000 feet). The section added that the acceptable touchdown range was 750 to 1,250 feet (1,000 feet ± 250 feet) from the runway threshold.

Chapter 8 of the handbook, Training Maneuvers, section 5, Flight Training Acceptable Performance, dated March 14, 2005, stated that the airplane should touch down smoothly at a point that is 500 to 3,000 feet beyond the runway threshold and not exceed one-third of the runway length. This touchdown zone reference follows the FAA-approved guidance listed in the FAA's *Aeronautical Information Manual* (AIM) and FAA-S-8051-5D, Practical Test Standards.

The Normal Procedures section of the handbook also emphasized the importance of establishing the desired reverse thrust as soon as possible after touchdown. The section further stated 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. According to the handbook, maximum reverse thrust should be maintained until the airspeed approached 80 knots.

In addition, the Normal Procedures section of the handbook stated that, after main gear touchdown, a constant brake pedal pressure should be smoothly applied to achieve the desired braking and that full brake pedal should be applied on slippery runways. The section also stated that the antiskid system would adapt pilot-applied brake pressure to runway conditions but that, for slippery runways, several skid cycles would occur before the antiskid system established the correct amount of brake pressure for the most effective braking. In addition, the section stated that pilots should not attempt to modulate, pump,

[31] Shuttle America's policy required pilots to report each go-around executed. According to company records, from January 1, 2006, to April 22, 2007, 190 go-arounds were reported. The Shuttle America director of safety indicated that 95 percent of go-arounds were for traffic avoidance and that the remaining 5 percent were for other causes, such as unstabilized approaches and weather.

[32] Title 14 CFR 91.175, "Takeoff and Landing Under IFR," states that pilots are to "immediately execute an appropriate missed approach procedure … upon arrival at the missed approach point, including a DA [decision altitude]/DH where a DA/DH is specified and its use is required, and at any time after that until touchdown."

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.

Chapter 7 of the handbook, Weather Operations, section 1, Contaminated Runway Operations, dated March 14, 2005, stated that standing water, slush, snow, or ice causes a deteriorating effect on landing performance. The section also stated that braking effectiveness on contaminated runways is reduced because of low tire-to-runway friction. Further, the section stated that stopping distances could increase as the contamination depth increased. In addition, this section of the handbook noted that maximum reverse thrust could be used to a full stop during emergencies.

The Shuttle America Corporation 170 General Operations Manual contained guidance in two chapters on the subject of landing on a runway with braking action reported to be less than good. Chapter 2, Flight Preparation, section 7, Lower Than Standard Visibility Operations, dated October 15, 2006, stated the following: per 14 CFR 121.438, if the SIC has fewer than 100 hours in type under Part 121 operations[33] and the PIC is not an appropriately qualified check pilot, the SIC may not make any landings when the braking action on the runway to be used is reported to be less than good. (As stated in section 1.5.2, the first officer had 1,200 hours on the ERJ-170.) Chapter 7 of the manual, Enroute Operations, section 4, Instrument Approaches, dated February 15, 2006, stated that the captain would perform the approach and landing when reported braking action was less than good.

1.17.1.3 Attendance Policy

The Republic Airways Holdings Associate Handbook, chapter 8, Attendance/ Tardiness, dated August 1, 2006, provided the attendance policy at the Republic Airways subsidiary airlines. According to the Shuttle America director of safety, the handbook was provided electronically to all company employees, and a link to it appeared on the computer screen that employees used to log onto the company's computer system. The handbook stated that the policy was designed to encourage good attendance and provide a measure for fair treatment for any associate who was excessively absent or late for work. This policy had been in effect since 2005, when Shuttle America became a subsidiary of Republic Airways Holdings.

The handbook also stated that the airlines had a progressive (that is, graduated) disciplinary policy that could be implemented or accelerated at any time depending on the severity of the situation. According to the handbook, step one of the policy was a verbal warning, step two was a written warning, step three was a final warning and a disciplinary suspension of 3 days without pay, and step four was termination. The policy stated that, within a rolling 12-month period, four occurrences of absenteeism or tardiness would result in the verbal warning, six occurrences would result in the written warning, seven occurrences would result in the final warning and suspension, and eight occurrences would result in termination. (According to the handbook, an "occurrence"

[33] According to the CVR, the captain did not verify that the first officer had more than 100 hours in the ERJ-170. During a postaccident interview, the captain stated that he assumed that the first officer had at least the required time because he had been with the company for more than 1 1/2 years.

is a continuous absence from scheduled duty or reporting late to work.) The policy also emphasized that the final warning was "the last warning before termination." Excerpts from Shuttle America's attendance policy appear in appendix C.

Shuttle America did not hold pilots accountable for their attendance until January 2007 (the month before the accident). According to the chief pilot/ERJ-170 program manager, Shuttle America had grown quickly from a small to a large regional air carrier, and the company did not implement this policy upon becoming a subsidiary of its parent company. In January 2007, however, the company's assistant chief pilot issued written warnings to 70 pilots who had accrued eight or more absence occurrences in the previous 12 months. During February 2007, the assistant chief pilot issued written warnings to 13 additional pilots who had accrued eight or more absence occurrences in the previous 12 months; thus, during the first 2 months of 2007, 83 of the company's 430 pilots (19 percent) had received such warnings. The warnings were placed in the pilots' mailboxes. The letters stated, "future occurrences would result in further corrective action, which may be accelerated at any step, including termination." The assistant chief pilot stated that he spoke with only those pilots who called him after having received the warning. The company's director of safety stated that the chief pilot did not terminate those pilots who had already accumulated eight or more absence occurrences because he thought "it was not fair to terminate an employee who had not received previous notification from Shuttle America about his attendance issues."

The Republic Airways Holdings Associate Handbook did not contain any information about a pilot calling in as fatigued or the administrative implications of such a call. However, the Republic Airways Holdings pilot contract stated, "even though a pilot may be legal under the FARs, he has the obligation to advise the Company that, in his honest opinion, safety will be compromised due to fatigue if he operates as scheduled or rescheduled. This advisement must be furnished to Crew Scheduling at the earliest possible time to allow for the least possible disruption to service."

According to the Shuttle America chief pilot/ERJ-170 program manager, the company's fatigue policy is designed to assist those pilots whose fatigue is associated with a particular schedule or from the performance of their duties. For these cases, the company accepts fatigue as a potential consequence of the nature of the work and reschedules affected pilots after they have had sufficient time to rest. The chief pilot/program manager stated that the policy was not designed to protect pilots who do not use their personal time wisely to ensure fitness for flight and that pilots who do not live near their home base must arrange their schedules so that they will be fit to fly. The chief pilot/program manager stated that only fatigue calls made during a trip and while the pilot was on duty could result in a fatigue attendance mark and that calls made outside of duty time would result in an unavailable attendance mark.

According to the Shuttle America director of safety, a pilot who calls in sick or fatigued is removed from duty by the scheduling department. For sick calls, a pilot receives one absence occurrence and is paid for the missed trip if sick leave and/or vacation time are available. For fatigue calls, the chief pilot/ERJ-170 program manager talks with the pilot and then determines the actions, if any, to be taken. If the chief pilot determines that

the pilot's fatigue was "company induced" (that is, caused by a demanding company schedule), the call is classified as "fatigue" and results in no absence occurrences. If the chief pilot determines that the pilot's fatigue was not company induced, the call is classified as "unavailable" and results in one to four absence occurrences depending on whether the pilot is flying a schedule or is on reserve. Regardless of whether the call is classified as fatigue or unavailable, the pilot is not paid for the missed time, even if sick leave and/or vacation time are available. Company pilots expressed confusion about the fatigue policy and the ramifications of calling in as fatigued.

In addition, as a result of an administrative computer problem, from July 2005 to February 2007, Republic Airways Holdings inadvertently paid pilots for all sick, unavailable, or fatigue hours regardless of whether the sick leave was available or the unavailable or fatigue hours should have been compensated. As a result, the captain was paid for the 104 sick leave hours he used (even though he had 90 sick leave hours available) and all of the unavailable hours he accumulated during his tenure at Shuttle America.

1.17.2 Training

Shuttle America provided its pilots with some training and contracted with Chautauqua Airlines and Flight Safety International for most pilot training. Specifically, Flight Safety International provided all new hire and initial training on the ERJ-170, Chautauqua Airlines provided recurrent ground training, Shuttle America line check airmen provided the final initial operating experience, and Shuttle America proficiency check airmen provided initial and recurrent simulator checks at a Flight Safety International facility.

1.17.2.1 Crew Resource Management Training

Newly hired pilots at Shuttle America received a 6-hour CRM module at the end of the indoctrination course taught by Flight Safety International. A PowerPoint presentation included the following topics: the captain's authority, team building, decision behavior, inquiry and assertion, conflict resolution, workload management, and situational awareness. The presentation pointed out that the captain had final authority, specifically indicating that CRM is not to usurp the captain's authority and that CRM is leadership/following. The presentation also included 17 videos with a total time of about 2 hours. There was no instructor guide for this training.

The CRM module during recurrent training consisted of 1 hour of videos and a PowerPoint presentation taught by Chautauqua Airlines. The 2006 CRM module focused on communication and reviewed the following topics: chain of command, CRM definition, mutual respect, and teamwork. Pilots and flight attendants received recurrent CRM training together. The PowerPoint presentation indicated that pilots should be assertive and should communicate. Also, one video, "Approach and Landing Accidents," emphasized that flight crews could take action to avoid an accident, including adhering to standard operating procedures and being comfortable with the concept of a go-around.

The video encouraged pilots to go around if they lost visual reference and encouraged pilots to think about how the weather and the condition of the runway would affect an airplane's performance. The instructor for this training stated that pilots reported that the videos were out of date and that they wanted scenarios that represented real-life operational experiences.

No CRM training guidance indicated which pilot was responsible for the go-around callout or that the immediate response to this callout was the execution of a missed approach. During postaccident interviews, Shuttle America first officers stated that they would respond to a captain's go-around callout with an immediate missed approach. Some company captains (including a line check airman) stated that each flight crew should decide, at the start of a flight, how to respond to a go-around callout if one were necessary.

During a postaccident interview, the first officer stated that he did not recall taking a CRM training course. (The first officer completed initial CRM training in June 2005 and recurrent CRM training in June 2006.) Nevertheless, the first officer stated that he recognized that the captain was the leader of the flight and had final responsibility for the flight.

1.17.2.2 Captain Awareness Training

Shuttle America began providing its captains with a 4-hour captain awareness training course in May 2005, when the company became a subsidiary of Republic Airways Holdings. The course content included, among other things, the captain's roles, responsibilities, leadership, and decision-making. In addition, during the course, pilots were advised to contact their supervisor or chief pilot if their level of stress or fatigue was beyond their control.

In April 2004, Chautauqua Airlines began providing this training to new captain upgrades only. Thus, those Shuttle America captains who had upgraded at Chautauqua Airlines before April 2004 did not receive this training, even after their transfer to Shuttle America.

At the time of the accident, 133 of 259 Shuttle America captains (51 percent) had received captain awareness training. The accident captain received this training in July 2005. During a postaccident interview, he stated that the course "was not serious captain excellence training."

1.17.3 Postaccident Actions

After the accident, Shuttle America added five PowerPoint slides to the captain awareness training presentation to highlight the importance of the assertiveness component of captain leadership. One of the slides indicated that captains should "understand the need to make immediate … decisions and how to follow through." The assertiveness

slides concluded with the thoughts that a captain "must exercise authority" while being "a team player" with other flight crewmembers.

Also, on March 16, 2007, the Shuttle America chief pilot/ERJ-170 program manager issued a memorandum to ERJ-170 flight crewmembers with the subject, "Landing Restrictions." One of the two restrictions mentioned involved vertical guidance. The memorandum stated, "vertical guidance must be available for all instrument approaches when the weather is less than VMC [visual meteorological conditions] (i.e. ceilings less than 1,000 feet and/or visibility less than 3 miles)." The memorandum also stated that this information would be incorporated into the ERJ-170 Pilot Operating Handbook.

In addition, on March 28, 2007, the Shuttle America chief pilot/ERJ-170 program manager issued a memorandum to ERJ-170 flight crewmembers with the subject, "ERJ-170 Flight Standards Information Newsletter." The purpose of the newsletter was to review the ERJ-170 landing procedures contained in the pilot operating handbook. The newsletter stated that the procedures would be part of the check airmen's points of emphasis on line checks and proficiency checkrides. Among the landing procedures discussed in the newsletter were normal landing (touchdown range), normal landing (braking), normal landing (reverse thrust), approach clearance, go-around, and rejected landings. Within the discussion of each of these procedures, the appropriate pilot operating handbook references were cited. The following additional information was discussed about each of these procedures:

> Normal Landing
>
> There is printed material from the FAA both in the FARs and in the AIM that talks about the touchdown zone being the first 3,000 feet of the runway (no more than halfway down the runway). While we understand this general guidance for all aircraft, the fact is that the landing performance numbers … for the ERJ-170 [are] based on a touchdown at 1,000 feet from the threshold of the runway. Touching down 3,000 feet down on a 6,000 foot runway is at best a dangerous maneuver.
>
> Normal Landing (Braking)
>
> The key phrase … is "desired braking." If you are landing at MDW, then the desired braking is much more aggressive than if you are landing at IND on RWY 5L with 11,200 feet of runway … the pilot flying is allowed to determine the desired braking for the landing roll, except when landing on a short or slippery runway.
>
> Normal Landing (Reverse Thrust)
>
> Under normal circumstances, the pilot should be able to routinely use maximum reverse and minimum braking to bring the aircraft to a safe taxi speed.

The key phrase … is "normal circumstances." If you are landing at MDW and you have slush and snow on the runway, that, by definition, is not a normal circumstance and you are required to use the procedure for landing on a short or slippery runway (i.e. use full brake pedal). If you are landing at IND on RWY 5L with 11,200 feet of runway and the runway is dry, that is, by definition, considered to be a normal circumstance.

ATC Approach Clearance

Any time a pilot hears the phrase "glideslope unusable" they need to go to the portion of the approach chart that states "LOC (GS out)" and brief that specific approach with the appropriate MDA.

Go-Around

There have been several accidents over the past 30 years where the pilot flying has locked into the landing mode way too early and will not consider a go-around regardless of the circumstances they find themselves in as they approach the runway threshold. Somehow, we have to counter this type of mind set. From a Flight Standards perspective, I would expect you to execute a go-around maneuver whenever either pilot is in doubt as to the outcome of the maneuver.

Rejected Landings

Not executing a Rejected Landing when the circumstances dictate a go-around from the flare … simply because the pilot chooses not to execute the maneuver is unacceptable. Remember, this is not about the ego of the pilot flying the aircraft. This is about the safety of the 70 passengers who are flying on board our aircraft.

Approach Restrictions

The first officer should not be accomplishing the approach and landing in adverse weather conditions [a reported braking action of less than good and/or a reported crosswind component exceeding 15 knots]. This is not about the ego of the First Officer. This is about the safety of the 70 passengers who are flying on board the aircraft. With a slippery runway, if the First Officer makes the landing, the Captain is blind when it comes to monitoring the use of brakes by the First Officer. That is why it is important for the Captain to accomplish the approach and landing anytime the runway is slippery (i.e. braking action less than good).

1.17.4 Federal Aviation Administration Oversight

The principal operations inspector (POI) for Shuttle America was assigned to the company in 2002. Shuttle America was the only certificate that she oversaw at the time

of the accident. An aircrew program manager, an assistant POI, a principal maintenance inspector, and a cabin safety inspector were also assigned to the certificate.

The POI stated that she discussed the landing distance assessment SAFO with Shuttle America because the company was not meeting the provisions of the SAFO. Shuttle America told her that not enough definitive information had been included in the SAFO to enable the company to comply with it. The POI indicated that some of the unclear areas were the following: (1) the SAFO did not define the amount of time before landing to assess runway contamination or braking action, (2) data about the depth of a runway contaminant might not be available if an airport does not make this measurement, and (3) valid data about braking action might not be available if an airplane had not recently landed. The POI agreed with the company's position that it did not have to comply with the SAFO.

1.18 Additional Information

1.18.1 Survey on Fatigue and Attendance Policies

The Safety Board requested that the safety directors at the Air Transport Association and Regional Airline Association ask their members to respond to a Board survey on fatigue and attendance policies. Six of the 19 major Part 121 operators belonging to the Air Transport Association and 10 of the 25 regional Part 121 operators belonging to the Regional Airline Association responded to the survey. The survey's findings were as follows:

Details of the operator's fatigue policy in writing:

- All of the 6 major operators
- 4 of the 10 regional operators

An attendance policy in which progressive discipline was applied automatically for repeat users of sick leave during a given time period:

- 2 of the 6 major operators
- 7 of the 10 regional operators

A fatigue policy that allowed pilots to be relieved from flight duty if they reported being too tired to fly, even if their crew duty and rest times were within legal limits:

- All of the 6 major operators
- 9 of the 10 regional operators

A fatigue policy was conditional based on specific circumstances (for example, a lengthy in-flight or ground delay or postincident anxiety):

- 1 of the 6 major operators
- 5 of 9 regional operators (1 regional operator did not respond to this question)

A fatigue policy in which a fatigue call is classified as such on the pilots' record with the pilots relieved from duty without penalty:

- All of the 6 major operators
- 2 of the 10 regional operators (the other 8 regional operators classify the call as "unavailable," "sick," "not fit for duty," or another category based on the situation)

A fatigue policy in which pilots are allowed to make up the hours that were lost because of the event:

- 5 of the 6 major operators
- 5 of the 10 regional operators

Operators that perceived the number of fatigue calls received to be problematic:

- None of the 6 major operators
- 3 of the 10 regional operators

1.18.2 Aviation Safety Reporting System Fatigue-Related Reports

The Safety Board reviewed a sample of reports of in-flight fatigue-related incidents provided voluntarily by Part 121 pilots to the NASA Aviation Safety Reporting System (ASRS), which is a national repository for reports regarding aviation safety-related issues and events.[34] These reports were submitted by pilots between January 1, 1996, and December 31, 2006. For this timeframe, the ASRS database contained almost 5,200 reports of incidents involving fatigue-related issues during air carrier operations. A focused query produced more than 30 reports of incidents related to pilots calling in as fatigued or sick.

The ASRS reports described various experiences concerning air carrier programs allowing pilots to remove themselves from flight status because of fatigue. Some of the air carrier pilots reported using such programs successfully, whereas other pilots reported that they hesitated to use such programs because of fear of retribution. In addition, other pilots reported that they attempted to call in as fatigued but encountered company resistance.

[34] 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.

For example, a February 2006 ASRS report[35] from a captain of a regional jet stated that she and the first officer "were sort of robotic and tired" because of three consecutive early report times, and the first officer stated the following:

> I even called scheduling and spoke to a supervisor [twice] asking him to take me off the rest of the trip because I was so exhausted. He tried to work that out, but said we were short staffed … I told him that I wouldn't call in fatigued because they didn't have the staffing … in hindsight, I feel that I should have called in fatigued instead of fighting the exhaustion.

1.18.3 Federal Aviation Administration Guidance

Safety Alert for Operators 06012

On August 31, 2006, the FAA issued SAFO 06012, "Landing Performance Assessments at the Time of Arrival (Turbojets)." This SAFO 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 conditions presumed at time of dispatch. Those conditions include weather, runway condition, airplane weight, and braking systems to be used. The SAFO also recommended that, once the actual landing distance was determined, an additional safety margin of at least 15 percent be added to that distance.

Before the issuance of SAFO 06012, the FAA had planned to issue mandatory Operations Specification (OpSpec) N 8400.C082 to all 14 CFR Part 91 subpart K,[36] 121, 125, and 135 turbojet operators (in response to Safety Recommendation A-06-16, the intent of which was to ensure adequate safety margins for landings on contaminated runways).[37] The OpSpec would have required (1) the use of an operationally representative air distance, (2) the use of data that are at least as conservative as the manufacturer's data, (3) the use of the worst reported braking action for the runway during landing distance assessments, and (4) the operators' addition of an extra margin of at least 15 percent to the landing distance calculation. The FAA had intended for operators to comply with the OpSpec by October 2006, but the FAA encountered industry opposition to the OpSpec. As a result, on August 31, 2006, the FAA decided not to issue the mandatory OpSpec but rather to pursue formal rulemaking and issue the SAFO in the interim.

[35] According to the report, the captain, as the nonflying pilot, did not properly configure the flaps for landing. On final approach, the ground proximity warning system annunciated a "too low flaps" warning. Neither she nor the first officer had previously recognized that the flaps were at the incorrect setting. The crew then executed a missed approach. The captain reported that "a contributing factor to this event was being tired."

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

[37] 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." The recommendation was classified "Closed—Unacceptable Action/ Superseded" on October 4, 2007. Safety Recommendation A-07-57, which is discussed in section 1.18.5, superseded Safety Recommendation A-06-16.

Advisory Circular 120-71A

On February 27, 2003, the FAA issued AC 120-71A, "Standard Operating Procedures for Flight Deck Crewmembers." The AC was designed to provide advice and recommendations about developing, implementing, and updating standard operating procedures, which, according to the AC, "are universally recognized as basic to safe aviation operations." The AC addressed the go-around procedure in the context of stabilized approaches and stated that the flying pilot should make the go-around callout.

Advisory Circular 91-79

On November 6, 2007, the FAA issued AC 91-79, "Runway Overrun Prevention." The AC stated the following under the heading "Failure to Assess Required Landing Distance Based on Conditions at Time of Arrival":

> (1) Conditions at the destination airport may change between the time of departure and the time of arrival. SOPs [standard operating procedures] should include a procedure for assessing the required landing distance based on the conditions that are known to exist as you near the destination. As a recommended practice, calculate and discuss the landing distance required after receipt of the automated terminal information service (ATIS), during the descent briefing, and prior to the top of descent. If airport and associated runway surface conditions are forecast to worsen, develop an alternate plan of action in the event that a missed approach or go around becomes necessary.
>
> (2) The unfactored landing distances in the manufacturer-supplied AFM [airplane flight manual] reflect performance in a flight test environment that is not representative of normal flight operations. The operating regulations require the AFM landing distances to be factored when showing compliance with the predeparture landing distance requirements. These factors are intended to account for pilot technique, atmospheric and runway conditions, and other items to ensure that the flight is not dispatched to a destination where it will be unable to land. As part of the operator's Safety Management System and SOP, the FAA recommends using either factored landing distances or adding a safety margin to the unfactored landing distances when assessing the required landing distance at the time of arrival. This landing safety margin should not be confused with the regulatory predeparture runway requirements.

1.18.4 Related Accidents

Southwest Airlines Flight 1248

On December 8, 2005, Southwest Airlines flight 1248 ran off the departure end of runway 31C after landing at MDW during snow conditions. After overrunning the

runway, which had a usable landing distance of 5,826 feet, the airplane rolled through a blast fence and an airport perimeter fence and then onto an adjacent roadway, where it struck an automobile before coming to a stop. A child in the automobile was killed, one automobile occupant received serious injuries, and three other automobile occupants received minor injuries. Eighteen of the 103 airplane occupants received minor injuries, and the airplane was substantially damaged.

The Safety Board determined that the probable cause of this accident was the pilots' failure to use available reverse thrust in a timely manner to safely slow or stop the airplane after landing, which resulted in a runway overrun. This failure occurred because the pilots' first experience and lack of familiarity with the airplane's autobrake system distracted them from thrust reverser usage during the challenging landing.

Contributing to the accident were Southwest Airlines' (1) failure to provide its pilots with clear and consistent guidance and training regarding company policies and procedures related to arrival landing distance calculations; (2) programming and design of its on-board performance computer, which did not present inherent assumptions in the program critical to pilot decision-making; (3) plan to implement new autobrake procedures without a familiarization period; and (4) failure to include a margin of safety in the arrival assessment to account for operational uncertainties. Also contributing to the accident was the pilots' failure to divert to another airport given the reports that included poor braking action and a tailwind component greater than 5 knots. Contributing to the severity of the accident was the absence of an EMAS, which was needed because of the limited RSA beyond the departure end of runway 31C.[38]

Pinnacle Airlines Flight 4712

On April 12, 2007, Pinnacle Airlines flight 4712 overran the end of the runway while landing during snow conditions at Cherry Capital Airport, Traverse City, Michigan. The 3 crewmembers and 49 passengers were not injured, and the airplane received substantial damage.

At the time of the accident, snow removal operations were in progress at the airport, and the flight crew communicated directly with airport operations regarding the runway conditions. After landing, the airplane overran the departure end of runway 28, which was 6,501 feet long with a 200-foot-long paved blast pad beyond the threshold. The airplane entered a grassy snow-covered field beyond the blast pad, and the nose gear separated about 93 feet beyond the end of the pavement. The airplane came to rest oriented about 20° left of the runway centerline with the right main gear sunken into the ground at a point about 100 feet beyond the end of the pavement.[39]

[38] 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).

[39] For more information about this ongoing investigation, see DCA07FA037 at the Safety Board's Web site at <http://www.ntsb.gov>.

1.18.5 Previous Related Safety Recommendations

Landing Distance Assessments[40]

As a result of the Southwest Airlines flight 1248 accident, the Safety Board issued Safety Recommendation A-07-61 on October 16, 2007. Safety Recommendation A-07-61 asked the FAA to do the following:

> 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.

The Safety Board recognized that the standardized methodology recommended in Safety Recommendation A-07-61 would take time to develop. As a result, the Board also issued Safety Recommendation A-07-57 on October 4, 2007,[41] asking the FAA to do the following until the standardized methodology could be developed:

> 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. (Urgent)

The FAA responded to Safety Recommendation A-07-57 on December 17, 2007, and Safety Recommendation A-07-61 on January 8, 2008. For both recommendations, the FAA stated that a survey of Part 121 operators indicated "92 percent of U.S. airline passengers are now being carried by air carriers in full or partial compliance with the practices recommended in SAFO 06012 [landing distance assessments with a 15-percent safety margin]." The FAA also stated that its POIs would continue to encourage their assigned air carriers to incorporate the elements contained in this SAFO. In addition, the FAA stated that, on December 6, 2007, it 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.

[40] The Safety Board's Most Wanted List of Transportation Safety Improvements includes the need for landing distance assessments with an adequate safety margin for every landing. In its discussion of this issue, the Board indicated that runway overruns have continued to occur when flight crews have not performed a landing distance assessment before landing on a contaminated runway.

[41] Safety Recommendation A-07-57 retained the previous classification of "Open—Unacceptable Response" for Safety Recommendation A-06-16 (urgent) because the FAA had not yet required landing distance assessments that incorporated a minimum safety margin of 15 percent.

Runway Safety Areas

As a result of the Southwest Airlines flight 1455 accident in Burbank, California,[42] the Safety Board issued Safety Recommendations A-03-11 and -12 to the FAA on May 6, 2003. Safety Recommendations A-03-11 and -12 asked the FAA to do the following:

> 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)

On January 30, 2004, these safety recommendations were classified "Open—Acceptable Response." On July 7, 2006, the FAA responded only to Safety Recommendation A-03-11. The Safety Board's February 15, 2007, response indicated that Safety Recommendation A-03-11 remained classified "Open—Acceptable Response" and noted that the FAA had not addressed Safety Recommendation A-03-12 in its 2006 letter. The Board stated that, during its June 2006 public hearing on the Southwest Airlines flight 1248 accident, the FAA's director of airport safety and standards testified that it was possible that the FAA would consider a runway improvement project to be completed even with an RSA that did not meet the dimensional standards or have an EMAS installed. The Board further stated that this testimony described an unacceptable response to Safety Recommendation A-03-12 and requested additional information to clarify the testimony so that the 2004 classification of this recommendation could be updated.

On November 20, 2007, the FAA responded to both safety recommendations. With regard to Safety Recommendation A-03-11, the FAA stated that it had an ambitious program to accelerate RSA improvements, including yearly targets to ensure completion of all practicable RSA improvements by 2015. The FAA also stated that more than 80 percent of the RSA improvements would be completed by 2010. The FAA further stated that it had completed 314 RSA improvements since 2000.

With regard to Safety Recommendation A-03-12, the FAA stated that, at the public hearing for the Southwest Airlines flight 1248 accident, its director of airport safety and standards also testified that highly constrained runways often do not have enough room to install EMAS cost-effectively and that other alternatives would better meet the FAA's

[42] National Transportation Safety Board, *Southwest Airlines Flight 1455, Boeing 737-300, N668SW, Burbank, California, March 5, 2000*, Aircraft Accident Brief NTSB/AAB-02/04 (Washington, DC: NTSB, 2002).

goal to improve safety as much as possible for such runways. The FAA indicated that it had issued guidance (two orders and one AC) that described the important role that EMAS plays in improving runway safety. For example, according to the FAA, a 2004 change to AC 150/5300-13 defined those conditions in which EMAS could provide full compliance with RSA design standards.[43]

[43] The FAA had previously 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.

2. ANALYSIS

2.1 General

The captain and the first officer were properly certificated and qualified under Federal regulations.

The accident airplane was properly certificated, equipped, and maintained in accordance with Federal regulations. The recovered components showed no evidence of any preimpact structural, engine, or system failures.

Although marginal visual flight rules weather conditions existed at CLE during most of the accident flight, the weather conditions had rapidly deteriorated while the airplane was on approach, with moderate to heavy snow reported during the approach and at the time of the landing.

The approach and tower controllers that handled the accident flight performed their duties properly and ensured that the flight crew had timely weather and runway condition information. Airport personnel at CLE appropriately monitored runway conditions and provided snow removal services in accordance with the airport's FAA-approved snow removal plan. The emergency response to the accident scene was timely.

This analysis discusses the accident sequence, pilot training in the areas of rejected landings and maximum performance landings on contaminated runways, standard operating procedures regarding the go-around callout, flight crew fatigue, and pilot attendance and fatigue policies.

2.2 Accident Sequence

2.2.1 The Approach

2.2.1.1 Minimums Required for the Approach

The weather information in the flight crew's preflight paperwork included a NOTAM for runway 28 that 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." As a result, for the approach to runway 28, the flight crew was required by FAA and company guidance to use the MDA for the nonprecision localizer (glideslope out) approach, which was 202 feet higher than the DH for the precision (ILS) approach.

During postaccident interviews, both pilots indicated that they had not read the localizer minimums NOTAM. Thus, the flight crew did not accomplish a critical part of its preflight responsibilities. About 1429:18, the flight crew received ATIS information Alpha, which reported that the landing runway was 24R and that the glideslopes for runways 24L and 28 were "unusable" because of snow buildup. Also, about 1442:41, the crew received ATIS information Bravo, which reported that the landing runway was now runway 28 and repeated that the glideslopes for runways 24L and 28 were unusable. According to the CVR, after receiving both ATIS information broadcasts, the flight crew discussed the runways in use but did not discuss the information about the unusable glideslopes.

About 1458:46, the approach controller informed a Jet Link flight crew that the flight was cleared for an ILS runway 28 approach and that the glideslope was unusable. The Shuttle America flight crew heard this transmission and then began to discuss how that flight could be cleared for an ILS approach if the glideslope were unusable.[44] For example, the captain stated, "it's not an ILS if there's no glideslope," to which the first officer replied, "exactly, it's a localizer." Because the accident flight crewmembers did not respond to the glideslope information in the ATIS information broadcasts, the first indication of their awareness of the unusable glideslope was after they overheard the approach clearance issued to the Jet Link flight crew.

During postaccident interviews, both pilots stated that they were confused by the term "unusable." However, other Shuttle America pilots who were interviewed after the accident stated that they were familiar with the term "unusable" in reference to a glideslope, and one check airman stated that he had used this specific term in various simulator scenarios. Nevertheless, neither of the accident pilots asked the controller for clarification about the status of the glideslope.

According to FAA Order 7110.65, "Air Traffic Control," paragraph 4-8-1, "Approach Clearance," an airplane conducting an ILS approach when the glideslope is reported to be out of service is to be advised of such at the time that the approach clearance is issued. The paragraph indicated that the term "unusable" was appropriate phraseology to use when a glideslope was out of service.[45] However, 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. Thus, the approach controller provided conservative guidance to the flight crewmembers when he told them, at the time of the ILS approach clearance to runway 28, that the glideslope was unusable.

[44] If the glideslope component of an ILS approach system becomes unreliable or inoperative, the approach can still be flown to the MDA published on the approach chart. According to the FAA's *Instrument Procedures Handbook*, "the name of an instrument approach, as published, is used to identify the approach, even if a component of the approach aid is inoperative or unreliable."

[45] The FAA's *Instrument Procedures Handbook* states, "the controller … must advise the aircraft at the time an approach clearance is issued that the inoperative or unreliable approach aid component is unusable."

About 1501:09, the captain contacted the tower controller, stating "localizer to two eight." However, about 1 minute later, the first officer told the captain that the glideslope had been captured. During a postaccident interview, the first officer stated that he and the captain did the "mental math" for a 3° glideslope and that, on the basis of this calculation, they assumed that the glideslope was functioning normally. The captain further stated that the cockpit instrumentation showed the airplane on the glideslope with no warning flags. Regardless, the flight crew should not have disregarded the information provided by the controller and on the ATIS information broadcasts about the glideslope being unusable and should have used the localizer minimums for the approach.

Because the flight crewmembers assumed that the glideslope was working properly (the CVR recorded no additional discussion about the unusable glideslope), they used the ILS minimums instead of the localizer (glideslope out) minimums for the approach, as indicated by the "two hundred, minimums" electronic callout recorded by the CVR later in the approach (the DH for the ILS approach was 227 feet agl). 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. The MDA for the localizer (glideslope out) approach to runway 28 was 429 feet agl. No CVR evidence or postaccident interview information indicated that either crewmember had the runway environment in sight by that altitude.

2.2.1.2 Runway Visual Range

FAA Order 7110.65, paragraph 2-9-2, Operating Procedures, states that a controller should maintain an ATIS message that reflects the most current arrival and departure information and should ensure that pilots receive the most current pertinent information. Paragraph 2-8-2, Arrival/Departure Runway Visibility, states that a controller should issue the current touchdown RVR for the runway in use when prevailing visibility is 1 mile or less or the RVR indicates a reportable value (6,000 feet or less) regardless of the prevailing visibility. About 1453:42, the approach controller notified the flight crew that ATIS information Charlie was current, visibility was 1/4 mile with heavy snow, and the runway 28 RVR was 6,000 feet.[46] The CVR transcript showed that the captain acknowledged the RVR at that time by stating to the first officer, "well we got the RVR. So we're good there." (The ILS runway 28 approach required an RVR of 2,400 feet or 1/2-mile visibility.)

The ILS runway 28 localizer (glideslope out) approach minimums required an RVR of 4,000 feet or 3/4-mile visibility. About 1459:30, when the airplane was at an altitude of about 5,200 feet agl and was located 8.3 miles from the outer marker, the RVR dropped to 4,000 feet and continued to decrease for the remainder of the flight. Because the flight

[46] FAA-H-8083-15A, *Instrument Flying Handbook*, states the following: "RVR is horizontal visual range, not slant visual range, and is used in lieu of prevailing visibility in determining minimums for a particular runway."

crew should have accomplished the ILS runway 28 approach to localizer (glideslope out) minimums instead of ILS minimums, the controlling RVR for the approach to runway 28 was 4,000 feet and not 2,400 feet.

The flight crew was not aware that the RVR had decreased to 4,000 feet, and the approach controller, having already issued the 6,000-foot RVR, was not required to provide this additional RVR information to the crew. However, if the crewmembers had been using the localizer (glideslope out) approach and had been aware of the decrease in RVR below the value required for the approach, they would have been required to execute a missed approach before reaching the final approach segment.

About 1502:25, the tower controller reported that the RVR was 2,200 feet. At that time, the airplane was at an altitude of about 2,000 feet agl and was located at the outer marker. About 1502:39, the captain told the first officer, "we're inside the [outer] marker, we can keep going." According to 14 CFR 121.651, if a pilot has begun the final approach segment of an instrument approach procedure and later receives a weather report indicating below-minimum conditions, the pilot may continue the approach down to published minimums. Thus, the flight crew could continue the approach, even though the RVR was below the values required for the ILS runway 28 approach.

2.2.1.3 Visual References During the Approach

When the airplane was at an altitude of about 190 feet agl [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 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 FARs clearly indicate that the 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, 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.

When the airplane had passed through an altitude of 50 feet agl, the captain questioned the first officer about whether he actually had the runway in sight; this question most likely indicated that the captain still did not see the runway environment. However, less than 1 second later, the captain stated, "yeah, there's the runway, got it." Even though the captain regained sight with the runway environment, the first officer should have executed the commanded missed approach before that time.

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 SIC) 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 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.

2.2.1.4 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. SAFO 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 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 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. 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, 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 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.

Because landings on contaminated runways can be challenging, it is important that pilots have all of the information necessary to make landing distance assessments, for example, dry versus wet snow on the runway. On October 16, 2007, the Safety Board issued Safety Recommendation A-07-62, which asked the FAA to "develop and issue formal guidance regarding standards and guidelines for the development, delivery, and interpretation of runway surface condition reports." The FAA indicated that the aviation rulemaking committee would also establish standards for runway surface condition reporting and minimum surface conditions for continued operations. (The Board is currently evaluating the FAA's response to this recommendation.)

Because the active runway and arrival conditions may change while a flight is en route, preflight landing assessments may not be sufficient to ensure a safe stopping distance at the time of the flight's arrival. Also, an additional 15-percent safety margin would help to account for conditions that could not be completely quantified and planned procedures that might not be accomplished. The Safety Board concludes that pilots need to perform landing distance assessments because they account for conditions at the time of arrival and add a safety margin of at least 15 percent to calculated landing distances and that this accident reinforces the need for pilots to execute a landing in accordance with the assumptions used in the assessments.

The Safety Board recognizes that SAFO 06012 addressed the need for flight crews to assess landing performance based on actual conditions and add a 15-percent safety margin to actual landing distances. However, SAFOs are, by definition, advisory only, and the recommendations asked the FAA to require arrival landing distance assessments that included a minimum safety margin of 15 percent for all Part 121, 135, and 91 subpart K operators. Such assessments would have been mandated by OpSpec N 8400.C082.

Since the time of the accident, Shuttle America has been working closely with its aircraft performance data vendor, Embraer, and the FAA to develop an automated airplane performance system for the ERJ-170 that includes support for landing distance assessments based on conditions at time of arrival. According to Shuttle America, with this system, the flight crew would request landing performance numbers (based on the Embraer computerized airplane flight manual) by specifying the airport, runway, runway surface condition (that is, braking action report and/or contaminant type and depth report), temperature, pressure, wind, planned landing weight, landing flap, visibility, anti-ice status, and stall protection ice speed. The crew's request would then be sent via ACARS to a ground server and be processed by the aircraft performance data vendor. An arrival landing distance report would be sent back to the crew via ACARS, typically within 30 seconds. The arrival landing distance report would include crew-specified input conditions, crew-specified airplane configuration information, and calculated landing distance data (both factored and unfactored). Shuttle America indicated that it would use the guidance in SAFO 06012 to translate reported braking action (when available) to contaminant type and depth and that it would not take credit for thrust reversers operating in any landing performance calculation, including arrival assessments for contaminated runway operations.

The automated airplane performance system for the Shuttle America ERJ-170 has been ground tested, flight tested, and approved by the FAA for a 6-month operational trial period beginning on February 15, 2008. During the operational trial period, the calculated arrival landing distance data are expected to provide pilots with supplemental landing performance information.

2.2.2 The Landing

2.2.2.1 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 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.) During postaccident interviews, the captain stated that he thought the airplane had touched down closer to the runway threshold, and the first officer stated that, during the landing rollout, he could not see the end of the runway or any distance remaining signs. (On the basis of the airplane's touchdown point, airspeed at touchdown, the airplane's nose-high pitch attitude, the flight crew's workload, and available visual cues, it is unlikely that the flight crew would have seen the 3,000-foot distance remaining sign. The Safety Board was not able to determine whether available visual cues would have enabled the crew to see the 2,000- and 1,000-foot distance remaining signs.) 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.

2.2.2.2 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 (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 aircraft performance study for this accident showed that the airplane's calculated braking coefficient for a sustained 5-second period of significant braking exceeded the minimum braking coefficient needed to stop on the runway. The sustained period of significant braking began 6 seconds before the airplane departed the runway, and the minimum braking coefficient was calculated using both the airplane manufacturer's computerized airplane flight manual landing performance methods and an emergency stopping scenario. Thus, the airplane could have been stopped before the end of the runway if the braking that was achieved during the sustained period of significant braking had also been achieved during the early portion of the landing rollout (with the use of maximum reverse thrust at the assumed levels).[47]

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. 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.[48]

[47] The emergency stopping scenario assumed the use of maximum reverse thrust until the airplane came to a complete stop, and Embraer's computerized airplane flight manual flight performance numbers assumed the use of maximum reverse thrust until the airplane decelerated to an airspeed of 60 knots.

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

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.

2.2.3 Runway Safety Area

The runway 28 departure end 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 yet made its recommendation for improving the runway 28 RSA. The Safety Board concludes that the RSA for 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 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 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.

2.2.4 Passenger and Crew Deplaning

Shuttle America's emergency evacuation guidance to ERJ-170 pilots stated, "an actual evacuation may not be necessary. The PIC's ultimate decision to evacuate … should be made after analyzing all factors pertaining to the situation when the aircraft has come to a complete stop." The captain stated that he considered an evacuation but then decided to keep everyone on board the airplane and deplane once buses arrived on scene to transport the passengers to the ARFF station.

The captain's decision not to evacuate the passengers was appropriate because the crew did not see evidence of fire, smoke, or major structural damage; no one was in imminent danger; and ARFF personnel had informed him that the airplane was secure (that is, no fuel leaks or sources of ignition were in the area). Further, because the airplane was off the runway and no shelter was available, the passengers would have been exposed to heavy snow conditions until the buses arrived, which occurred 50 minutes after the accident.

According to the transcript of postaccident conversations between the flight crew and dispatch, the dispatcher assigned to the flight told the captain that the company's chief pilot (located at IND) did not want the slide deployed "at all cost" because he was concerned about people getting hurt. However, the captain had final authority and responsibility for the operation and safety of the flight, and he ultimately decided to have the passengers and crew deplane using an A-frame ladder at the 1R exit.

No one was injured during the deplaning, but the decision to use the A-frame ladder, rather than the evacuation slide, to deplane the occupants and protect against injuries could have actually increased the risk of injuries. In this accident, the nose gear collapsed, which would have resulted in a very shallow slide angle at the 1R exit; passengers were not deplaning under emergency conditions; and ARFF personnel were available to assist passengers as they exited. The Safety Board concludes that the Shuttle America chief pilot's instruction not to use the slide was inappropriate because he did not have the same knowledge as the flight crew and on-scene ARFF personnel and his instruction restricted the options for deplaning the passengers. During the Southwest Airlines flight 1248 runway overrun, the airplane's nose gear had collapsed (similar to the Shuttle America airplane). The passengers on the Southwest airplane, however, deplaned using a slide with ARFF personnel assistance, and no injuries occurred.

In 2000, the Safety Board issued a safety study on emergency evacuations of commercial airplanes. The study included 46 evacuations that occurred between September 1997 and June 1999 and involved 2,651 passengers. The study compiled general statistics on the evacuations, including the types and number of passenger injuries sustained. Of the 46 evacuations, only one accident (American Airlines flight 1420 in Little Rock, Arkansas) included fatalities, major structural damage, and cabin fire, and more injuries were sustained in that accident than in the other 45 evacuation cases combined. The study found, "the majority of serious evacuation-related injuries in the Safety Board's study cases, excluding the Little Rock, Arkansas, accident of June 1, 1999, occurred at airplane door and overwing exits without slides." Also, the Board found that, of the 12 evacuations that involved the use of an operating slide, only one serious injury resulted.[49]

2.3 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

[49] National Transportation Safety Board, *Emergency Evacuation of Commercial Airplanes*, Safety Study NTSB/SS-00/01 (Washington, DC: NTSB, 2000).

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 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, as 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.

The Safety Board had previously recognized the need for standard operating procedures for the go-around callout. On August 25, 2000, the Board issued Safety Recommendation A-00-94 in response to its findings from the FedEx flight 14 accident in Newark, New Jersey.[50] Safety Recommendation A-00-94 asked the FAA to do the following:

> Convene a joint government-industry task force composed, at a minimum, of representatives of manufacturers, operators, pilot labor organizations, and the Federal Aviation Administration to develop, within 1 year, a pilot training tool to do the following: promote an orientation toward a proactive go-around.

On May 15, 2002, the FAA stated that its joint government-industry task force, the Commercial Aviation Safety Team, had recommended the use of the Approach and Landing Accident Reduction training guide, which was developed by a task force headed by the Air Transport Association. The training guide was included as an appendix to the FAA's Flight Standards Information Bulletin for Air Transportation 01-12. The FAA indicated that the training guide and the FAA bulletin "explicitly promote an orientation to a proactive go-around" through recommended flight crew training. The FAA bulletin stated, "the unwillingness of pilots to execute a go-around and missed approach when necessary was the cause, at least in part, of some approach and landing accidents. This unwillingness may stem from direct or indirect pressures to sacrifice safety in favor of other considerations, such as schedules or costs." The bulletin stressed the importance of a

[50] National Transportation Safety Board, *Crash During Landing, Federal Express, Inc., McDonnell Douglas MD-11, N611FE, Newark International Airport, Newark, New Jersey, July 31, 1997*, Aircraft Accident Report NTSB/AAR-00/02 (Washington, DC: NTSB, 2000).

corporate safety culture promoting a proactive go-around policy. As a result of the FAA's actions, the Safety Board classified Safety Recommendation A-00-94 "Closed—Acceptable Action" on October 22, 2002.

Safety Recommendation A-00-94 focused on training in executing a missed approach after a go-around callout but did not address the need for standard operating procedures and terminology to ensure that a proactive go-around can occur. Standard operating procedures and terminology are essential, 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,[51] as was the case with the accident flight crew. The Safety Board concludes that the captain's use of 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.

2.4 Pilot Fatigue

2.4.1 The Captain

The captain was off duty and on vacation leave during the 7 days before the accident. He was originally scheduled not to work on the day of the accident, but he had opted to shorten his awarded vacation time and called crew scheduling the night before

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

the accident to request a new assignment. Crew scheduling then offered, and the captain accepted, the 2-day trip assignment. The captain reported that he felt well rested on the day before the accident. However, the captain reported that he was unable to sleep that night, stating that he received only 45 minutes to 1 hour of sleep. 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.[52]

Shuttle America's common practice is for the captain to be the flying pilot for the first flight of any crew pairing, and this flight was the first one in which the two pilots had flown together. However, because of his lack of sleep, the captain had asked the first officer to be the flying pilot.

The captain's duty schedule on the day of the accident, although consistent with Part 121 regulations, was demanding and might have exacerbated the effects of his sleep deprivation. The captain reported for duty at 0525, which was earlier than his normal time of awakening (when not flying) of between 0600 and 0800. While on duty, the captain had limited opportunity for rest and did not get a planned eating break because of the 26- and 23-minute turnaround times between flights. The accident occurred almost 10 hours into the captain's duty day, at which time he had been awake for about 31 of the 32 preceding hours. Also, the accident occurred at a time when the human body normally reaches a physiological low level of performance and alertness.[53]

Fatigue can degrade all aspects of performance, but it has been especially associated with difficulties in assimilating new information and assessing risk.[54] Also, some reports have indicated a reduction in leadership behavior with increased fatigue.[55] In addition, in its 1994 safety study of flight crew-involved, major air carrier accidents, the Safety Board found that a time since awakening of 11 hours or more, especially under significant workload demands, could be associated with degraded performance and decision-making in flying situations.

Although the captain recognized that he was tired, he might not have fully recognized the extent that his performance during the flight could be impaired. Studies

[52] The captain received a written warning in January 2007 about his nine unexcused absence occurrences within the previous 12 months. One of these unexcused absence occurrences happened after the captain attempted, unsuccessfully, to call in as fatigued. The written warning indicated that future absence occurrences (including fatigue calls that were not considered to be "company induced") could result in termination. Section 2.5.1 provides additional information about this issue.

[53] D.M.C. Powell, M.B. Spencer, D. Holland, E. Broadbent, and K.J. Petrie, "Pilot Fatigue in Short-Haul Operations: Effects of Number of Sectors, Duty Length, and Time of Day," *Aviation, Space, and Environmental Medicine*, Vol. 78, No. 7 (2007): 698-701.

[54] (a) W.D.S. Killgore, T.J. Balkin, and N.J. Wesensten, "Impaired Decision-Making Following 49 Hours of Sleep Deprivation," *Journal of Sleep Research*, Vol. 15, No. 1 (2006): 7-13. (b) J.A. Caldwell, "Fatigue in the Aviation Environment: An Overview of the Causes and Effects as Well as Recommended Countermeasures," *Aviation, Space, and Environmental Medicine*, Vol. 68 (1997): 932-938.

[55] D.R. Haslam, "The Military Performance of Soldiers in Sustained Operations," *Aviation, Space, and Environmental Medicine*, Vol. 55 (1984): 216-221.

have shown that fatigued individuals have difficulty recognizing or predicting fatigue-related impairments in their own performance and abilities.[56]

The captain's decisions and actions before and during the accident flight showed evidence of performance deficiencies that were consistent with the known effects of fatigue. Such evidence is as follows:

- Before the flight, the captain did not adequately review the flight release paperwork, which would have provided him with an early warning of the glideslope status at CLE.
- The captain had not previously landed on runway 28 yet did not consider how the runway conditions (braking action reported to be fair) and the short runway length (6,017 feet compared with the 9,000-foot length of the previously assigned runway, 24R) could affect landing performance.
- Although he and the first officer were confused when the approach controller told them that the glideslope was unusable, the captain allowed the precision approach to continue to ILS minimums.
- While in deteriorating weather conditions, the captain did not take command and make the landing himself but instead placed this responsibility with a first officer whom he had just met and whose piloting abilities he questioned.
- When he lost visibility after descending through the DH, the captain did not reinforce his go-around callout or respond otherwise after the first officer did not execute the missed approach, as instructed.
- The captain did not continuously monitor the first officer's landing actions, including the touchdown point, use of thrust reverse, and braking application.

The captain's performance during the accident flight was inconsistent with previous reports of his abilities. Specifically, several first officers who had been paired with the captain had positive comments about his leadership and piloting skills, and a proficiency check/line check airmen stated that the captain performed to standards, demonstrated good CRM, and exercised good decision-making. During a postaccident interview, the captain stated that his lack of sleep affected his ability to concentrate and process information to make decisions and that, as a result, he was not "at the best of [his] game." The Safety Board concludes that the captain was fatigued, which degraded his performance during the accident flight.

2.4.2 The First Officer

The first officer had been flying a heavy schedule before the accident flight and, at the time of the accident, had flown the maximum 30 hours allowed by Federal regulations

[56] C.B. Jones, J. Dorrian, S.M. Jay, N. Lamond, S. Ferguson, and D. Dawson, "Self-Awareness of Impairment and the Decision to Drive After an Extended Period of Wakefulness," *Chronobiology International*, Vol. 23, No. 6 (2006): 1253-1263.

for a 7-day period. He had been away from home for 8 days and was scheduled to begin a vacation the day after the accident. Crew scheduling contacted the first officer during the final leg of his flight schedule to ask if he would accept the round trip from ATL to CLE, and the first officer accepted the trip because it would still allow him to keep his vacation schedule. The first officer stated that he would have preferred not to be the flying pilot for the accident leg because he had just completed a 3-day, 6-leg trip sequence but agreed to do so because the captain indicated that he was tired.

Similar to the captain, the first officer was subject to an early awakening time and an accident time associated with the development of fatigue. However, the first officer reported that he had no difficulty sleeping. Also, his performance deficiencies during the flight were not necessarily indicative of degraded alertness because other company pilots, including a line check airman, considered his piloting skills to be average or below average. Further, because the first officer was likely eager to complete the additional flight after having already completed a 3-day, 6-leg trip sequence, his actions during the approach and landing might have been unrelated to fatigue.

The Safety Board concludes that, even though the first officer had been flying a heavy schedule through the time of the accident, there was insufficient evidence to determine whether fatigue was a factor in his performance during the flight.

2.5 Pilot Attendance Policies

2.5.1 Shuttle America

The attendance policy at the Republic Airways subsidiary airlines (including Shuttle America) was included in the Republic Airways Holdings Associate Handbook. One section of the policy focused on absenteeism and tardiness in terms of the number of occurrences (described as "a continuous absence from scheduled duty or reporting late to work") that accumulated during a rolling 12-month period. According to Shuttle America pilots who were interviewed after the accident, pilots could receive an occurrence if they were sick, fatigued, or unavailable for duty. According to the Shuttle America director of safety, for sick calls, a pilot would receive one absence occurrence. 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 (that is, caused by a demanding company schedule), 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 (see appendix C).

The attendance policy also 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.

Although the attendance policy had been in effect since 2005, Shuttle America did not hold pilots accountable for their attendance until January 2007. According to the chief pilot/ERJ-170 program manager, Shuttle America had grown quickly from a small to a large regional air carrier, and the company did not implement this policy upon becoming a subsidiary of its parent company. 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.

Even though the attendance policy specified the issuance of a verbal warning as the first step in the progressive discipline policy (the written warning was specified as the second step), a verbal warning had not been issued to the affected pilots. Also, the company's assistant chief pilot (or other pilot manager) did not speak with any of the affected pilots in advance of the written warning to determine whether legitimate medical issues existed. If Shuttle America had been progressively warning pilots, the captain would have earlier recognized that the company considered his attendance record to be problematic. Further, the company might have been able to assist the captain (by encouraging him to obtain medical treatment) and better track medical issues in its pilot community to ensure that no safety-of-flight issues existed.

The captain was one of the Shuttle America pilots who received a written warning during January 2007. By that time, he had accumulated nine absence occurrences (totaling 18 days) within the previous 12 months. According to the policy, with nine absence occurrences, the captain could have been terminated. However, the company's director of safety indicated that the chief pilot "felt it was not fair to terminate an employee who had not received previous notification from Shuttle America about his attendance issues."

One of the captain's nine absence occurrences happened after he attempted to call in as fatigued on July 30, 2006. The captain reported that he completed a trip late in the evening of July 29. Although his schedule allowed for 11 hours of rest before his scheduled report time on July 30, the captain felt the need to call in as fatigued rather than fly the back-to-back trip. When the captain spoke with the Shuttle America chief pilot/ERJ-170 program manager about his fatigue, the captain was advised of the company's fatigue policy: only fatigue calls made during a trip and while the pilot was on duty could result in a fatigue attendance mark, and calls made outside of duty time would result in an unavailable attendance mark.

The Republic Airways Holdings pilot contract stated, "even though a pilot may be legal under the FARs, he has the obligation to advise the Company that, in his

honest opinion, safety will be compromised due to fatigue if he operates as scheduled or rescheduled." Despite this contract wording, the captain received an unavailable attendance mark instead of a fatigue attendance mark.

In addition, the captain stated that, during the July 30, 2006, telephone call, the chief pilot/ERJ-170 program manager suggested that it might be possible for the captain to combine some of his absence occurrences if he provided a medical note. The captain reported providing the medical note and following up with a telephone call to the chief pilot but stated that the chief pilot did not acknowledge receipt of the note or return the call. The chief pilot remembered speaking with the captain about how to classify the fatigue event but could not recall any other details of the conversation or whether he had been provided with the captain's medical note.

The Republic Airways Holdings Associate Handbook had been provided electronically to all Shuttle America employees. However, none of the Shuttle America pilots interviewed after the accident mentioned this handbook when asked about the company's attendance policy. The pilots stated that the policy was not clearly communicated, and some of the pilots stated their confusion about the administrative implications or consequences of calling in as fatigued. Some pilots also stated that sick and fatigue calls from company pilots were not handled uniformly. Further, the company's attendance policy was not included in the Shuttle America Corporation 170 General Operations Manual, which would be the customary place for such information, and information on the attendance policy was not formally presented during flight crew training.

During postaccident interviews, the Shuttle America chief pilot/ERJ-170 program manager and director of operations recognized that the attendance policy did not include specific details about the company's sick leave and fatigue policies. The chief pilot indicated that the company would fix this problem. As of April 2008, Shuttle America has not made any major changes to its attendance policy but is now administering its progressive discipline policy as written.

The Safety Board has had a longstanding concern with the impairing effects of human fatigue on transportation safety.[57] One valuable method for attempting to limit the effects of fatigue on pilots and 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 captain had previously experienced difficulty when he tried to call in as fatigued. Also, he had received a warning letter indicating that future absence occurrences would result in further corrective action, including the possibility of termination. The

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

captain stated that, even though he received only 1 hour of sleep the night before the accident, he did not cancel the accident trip sequence because he thought that the company would have fired him.

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. The Safety 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.

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.[58] 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.[59] 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.[60]

2.5.2 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 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

[58] 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 AIM discusses fatigue as a factor that pilots should evaluate as part of determining their fitness for flight.

[59] The Safety Board investigated a previous accident in which a pilot's action might have resulted from concerns about a potential disciplinary activity. Specifically, according to the Board's report on the accident, a Piper Apache PA-23 pilot, who was an Eastern Airlines captain commuting to his duty station, was highly motivated to land his private airplane despite the less than minimum visibility required because of his perceived need to report to work on time. During the landing, however, the Piper airplane struck a Pan American Boeing 727. The Board found that the pilot had previously received a disciplinary letter because he had reported late for an assigned flight. For more information, see National Transportation Safety Board, *Piper PA-23-150, N2185P, and Pan American World Airways Boeing 727-235, N4743, Tampa Florida, November 6, 1986,* Aircraft Accident Report NTSB/AAR-87/06 (Washington, DC: NTSB, 1987).

[60] In its investigation of the FedEx flight 1478 accident, the Safety Board found that, even though the company had a policy allowing pilots to remove themselves from a flight schedule because of fatigue, both pilots involved in the accident indicated that they had never turned down a trip because of fatigue. The Board determined that both pilots' fatigue contributed to the cause of the accident. For more information, see National Transportation Safety Board, *Collision With Trees on Final Approach, Federal Express Flight 1478, Boeing 727-232, N497FE, Tallahassee, Florida, July 26, 2002*, Aircraft Accident Report NTSB/AAR-04/02 (Washington, DC: NTSB, 2004).

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 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.

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.[61]

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 Air Transport Association, should develop a specific, standardized policy for Part 121, 135, and Part 91 subpart K operators that would

[61] As part of its current 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.

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.

3. CONCLUSIONS

3.1 Findings

1. The captain and the first officer were properly certificated and qualified under Federal regulations.

2. The accident airplane was properly certificated, equipped, and maintained in accordance with Federal regulations. The recovered components showed no evidence of any preimpact structural, engine, or system failures.

3. Although marginal visual flight rules weather conditions existed at Cleveland Hopkins International Airport during most of the accident flight, the weather conditions had rapidly deteriorated while the airplane was on approach, with moderate to heavy snow reported during the approach and at the time of the landing.

4. The approach and tower controllers that handled the accident flight performed their duties properly and ensured that the flight crew had timely weather and runway condition information. Airport personnel at Cleveland Hopkins International Airport appropriately monitored runway conditions and provided snow removal services in accordance with the airport's Federal Aviation Administration-approved snow removal plan. The emergency response to the accident scene was timely.

5. Because the flight crewmembers were advised that the glideslope was unusable, they should not have executed the approach to instrument landing system minimums; instead, they should have set up, briefed, and accomplished the approach to localizer (glideslope out) minimums.

6. 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.

7. 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, taken control of the airplane.

8. 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.

9. The rejected landing training currently required by the Federal Aviation Administration 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.

10. Pilots need to perform landing distance assessments because they account for conditions at the time of arrival and add a safety margin of at least 15 percent to calculated landing distances, and this accident reinforces the need for pilots to execute a landing in accordance with the assumptions used in the assessments.

11. 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.

12. 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.

13. 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.

14. The runway safety area for Cleveland Hopkins International Airport runway 28 still does not meet Federal Aviation Administration standards.

15. The Shuttle America chief pilot's instruction not to use the slide was inappropriate because he did not have the same knowledge as the flight crew and on-scene airport rescue and firefighting personnel and his instruction restricted the options for deplaning the passengers.

16. The captain's use of 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.

17. 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.

18. The captain was fatigued, which degraded his performance during the accident flight.

19. Even though the first officer had been flying a heavy schedule through the time of the accident, there was insufficient evidence to determine whether fatigue was a factor in his performance during the flight.

20. 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.

21. 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.

22. 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.

23. 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.

3.2 Probable Cause

The National Transportation Safety Board determines 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 instrument landing system decision height instead of the localizer (glideslope out) minimum descent altitude; (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.

4. RECOMMENDATIONS

4.1 New Recommendations

As a result of the investigation of this accident, the National Transportation Safety Board makes the following recommendations:

--To 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)

4.2 Previously Issued Recommendations Classified in This Report

Safety Recommendations A-03-11 and -12 are classified "Open—Acceptable Response" in section 2.2.3 of this report.

Safety Recommendation A-07-57 (urgent) is classified "Open—Unacceptable Response" and Safety Recommendation A-07-61 is classified "Open—Acceptable Response" in section 2.2.1.4 of this report.

BY THE NATIONAL TRANSPORTATION SAFETY BOARD

Mark V. Rosenker
Chairman

Robert L. Sumwalt
Vice Chairman

Deborah A. P. Hersman
Member

Kathryn O'Leary Higgins
Member

Steven R. Chealander
Member

Adopted: April 15, 2008

Member Higgins filed the following concurring statement on April 21, 2008, and was joined by Members Hersman and Chealander.

BOARD MEMBER STATEMENT

Member Kathryn O'Leary Higgins, Concurring:

I concur with nearly all of this report documenting the runway overrun of Shuttle America at Cleveland Airport last February. I support the recommendations we made to the FAA to work with industry and labor to develop non-punitive procedures for reporting fatigue. I am disappointed, however, that we did not take the opportunity to go further and support fatigue risk management initiatives that have shown promise in the rail and marine industries and that are being undertaken in parts of the aviation community. I understand staff and Board Member concerns that a recommendation urging the Federal Aviation Administration and the aviation community to develop fatigue risk management programs may be premature, but I do not agree.

To date our recommendations on fatigue have focused almost exclusively on scheduling practices, hours of service and duty time. That is appropriate when the accident related fatigue is work related. In this case the captain suffered from insomnia for at least a year before the accident that apparently was brought on by issues in his personal life. His insomnia led to several absences. The captain reported his inability to sleep to the chief pilot and was told to see a doctor and get documentation to confirm his problem. He saw his physician twice in the six months before the accident and provided the requested documentation to the chief pilot. He was offered no assistance by the company and was warned, along with other pilots, that further absences would jeopardize his job. On the day of the accident he had been awake for about 31 of the previous 32 hours. He knew he was too tired to fly the last leg of the trip and turned the controls over to the first officer. His fatigue contributed to the accident, putting 75 passengers and crew at risk.

While I strongly support our recommendations to develop and implement non-punitive reporting procedures, I believe we missed an opportunity to deal with the larger fatigue related issues identified in this accident. The captain's fatigue was not the result of irresponsible scheduling practices. He requested the trip after several days of vacation. Our recommendations that focus on scheduling and work policies will do nothing to address crew fatigue that occurs for other reasons. But that fatigue is no less a safety risk, placing crew and passengers in a "dangerous situation that could have been avoided" (conclusion 22). The gaps that currently exist in our usually redundant system will continue unless we pursue a different strategy.

The limited research I have done suggests that implementing fatigue risk management as part of a safety management system offers a promising approach. Work on this approach for aviation has been done in Australia, New Zealand and Canada. The railroad and marine industries have also tested the concept of fatigue risk management for crews. The Flight Safety Foundation, in their testimony before the House Aviation Subcommittee last June, made the case for taking a comprehensive approach to managing fatigue in the aviation industry: "The Flight Safety Foundation believes the best way to reduce fatigue among today's aviation workforce is through a non-prescriptive program

which monitors fatigue. A system which goes beyond traditional flight- and duty-time regulations and incorporates a fatigue risk management system (FRMS) is essential for reducing the level of fatigue…. An effective FRMS would include a fatigue risk management policy, education and awareness training programs, a crew fatigue-reporting mechanism with associated feedback, procedures and measures for monitoring fatigue levels, procedures for reporting, investigating, and recording incidents in which fatigue played a role, and processes for evaluating information on fatigue levels and fatigue-related incidents, implementing interventions and evaluating their effects."

Fatigue has been on the Safety Board's Most Wanted List for 18 years. The Safety Board has been recognized for our leadership on this issue. Our recommendations have made a difference. But, as the staff have told me, we are not likely to get any more changes when it comes to hours of service. We need a different approach. We need new ideas. I believe fatigue risk management offers a promising new approach to this vexing issue. I hope the staff will look into the work that has been done on fatigue management in this country and elsewhere and come back to the Board with their views. I am pleased that the FAA is holding a forum in late spring 2008 on fatigue in aviation and I'm delighted that the Board will be represented. But the Safety Board should not take a back seat on this issue. We must lead and I pledge to do all I can to ensure that we do.

5. APPENDIXES

APPENDIX A

INVESTIGATION AND HEARING

Investigation

The National Transportation Safety Board was notified of this accident on February 18, 2007. The investigation was initially assigned to the Safety Board's Central Region. Responsibility for the investigation was then transferred to Board headquarters, where another accident involving a runway overrun during snow conditions (Southwest flight 1248 at Chicago Midway International Airport) was already under investigation.

The following investigative teams were formed: Operations, Human Performance, Air Traffic Control, Meteorology, Aircraft Performance, and Survival Factors. Specialists were assigned to conduct the readout of the digital voice-data recorders at the Safety Board's laboratory in Washington, D.C.

Parties to the investigation were the Federal Aviation Administration, Shuttle America, the International Brotherhood of Teamsters, and Embraer Aircraft Holding, Inc. In accordance with the provisions of Annex 13 to the Convention on International Civil Aviation, Centro de Investigaçáo e Prevençáo de Acidentes Aeronauticos (the Safety Board's counterpart agency in Brazil) participated in the investigation as the representative of the State of Design and Manufacture.

Public Hearing

No public hearing was held for this accident.

APPENDIX B

COCKPIT VOICE RECORDER

The following is the transcript from the cockpit voice recorder of the aft Honeywell DVDR-120-4x model digital voice-data recorder, serial number 00471, installed on an Embraer ERJ-170, N862RW, which overran the end of the runway during snow conditions at Cleveland Hopkins International Airport on February 18, 2007.

LEGEND

CAM	Cockpit area microphone voice or sound source
HOT	Flight crew hot microphone voice or sound source
RDO	Radio transmissions from accident aircraft, N862RW
GND	Radio transmission from Atlanta ground controller
RMP	Radio transmission from Atlanta ramp control
TWRA	Radio transmission from Atlanta tower controller
DEP	Radio transmission from Atlanta departure controller
CTRA	Radio transmission from Atlanta center controllers
CTRI	Radio transmission from Indianapolis center controllers
CLEOP	Radio transmission from Cleveland Shuttle America operations
APR1	Radio transmission from 1st Cleveland approach controller
APR2	Radio transmission from 2nd Cleveland approach controller
TWRC	Radio transmission from Cleveland Airport tower controller
CF	Cell Phone sound or source
-1	Voice identified as Captain
-2	Voice identified as First Officer
-3	Voice identified as aircraft mechanical voice
-4	Voice identified as Ground Crewman
-5	Voice identified as female Flight Attendant

-6	Voice identified as male Flight Attendant
-?	Voice unidentified
*****	Unintelligible word
#	Expletive
@	Non-pertinent word
( )	Questionable insertion
[ ]	Editorial insertion

Note 1: Times are expressed in eastern standard time (EST).

Note 2: Generally, only radio transmissions to and from the accident aircraft were transcribed.

Note 3: Words shown with excess vowels, letters, or drawn out syllables are a phonetic representation of the words as spoken.

Note 4: A non-pertinent word, where noted, refers to a word not directly related to the operation, control or condition of the aircraft.

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME (EST) & SOURCE	CONTENT	TIME (EST) & SOURCE	CONTENT
13:16:09.7 **BEGINNING of RECORDING** **BEGINNING of TRANSCRIPT**			
13:16:13.5 **HOT-2**	wonder if they give us a heading * out of here? they usually do. they are going to do that today.		
13:16:17.3 **HOT-1**	yeah.		
13:16:18.6 **HOT-2**	send 'em the ATIS.		
13:16:32.7 **HOT-2**	must be, are you excited about the Colts?		
13:16:35.7 **HOT-1**	uh, no. I don't watch football.		
13:16:37.9 **HOT-2**	no?		
13:16:38.6 **HOT-1**	naw.		
13:16:53.7 **HOT-2**	oh boy, I almost told them not to pick up a trip. I wanted to go home you know.... I've been gone like eight days.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME (EST) & SOURCE	CONTENT	TIME (EST) & SOURCE	CONTENT
		13:17:02.1 **INT-4**	flight deck, ground.
		13:17:03.1 **INT-1**	hey, how's it going?
		13:17:04.0 **INT-4**	just fine, we're ready to go.
		13:17:05.1 **INT-1**	all right, I'm gonna release the brakes. we'll give 'em a call.
13:17:10.5 **HOT-1**	which transition is this again?		
13:17:13.3 **HOT-2**	what's VVX?		
13:17:13.8 **HOT-1**	God, I forgot.		
13:17:14.9 **HOT-2**	VXV, shoot, all right.		
		13:17:17.3 **RDO-2**	ramp, Shuttlecraft six four, four, eight at the gate Bravo seventeen. uuh, Summit three departure. ready to push.

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME (EST) & SOURCE	CONTENT	TIME (EST) & SOURCE	CONTENT
		13:17:27.8 **GND**	** Shuttlecraft sixty-four forty-eight at seventeen?
		13:17:32.0 **RDO-2**	that's correct. Shuttlecraft forty-eight seventeen, Summit three.
		13:17:36.9 **GND**	** tail south.
		13:17:38.4 **RDO-2**	tail south, sixty-four forty-eight.
13:17:40.1 **HOT-2**	** we're cleared to push, tail south.		
		13:17:42.2 **INT-1**	roger, brakes released, tail south.
13:17:46.9 **HOT-1**	*, so tired.		
13:17:50.2 **HOT-2**	yeah, I know, I've had.... done two or three in a row.... early shows.		
13:17:55.9 **HOT-1**	had about an hours sleep last night. I just tossed and turned.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME (EST) & SOURCE	CONTENT	TIME (EST) & SOURCE	CONTENT
		13:17:59.5 **INT-4**	* you're cleared to start.
		13:18:01.4 **INT-1**	* thanks.
13:18:02.0 **HOT-1**	cleared to spin one please sir.		
13:18:06.3 **HOT-2**	tried to get uh, sleeping pills from a friend of mine, mild ones, when I have an early show 'bout ten o'clock.		
13:18:14.6 **HOT-1**	oh yeah.		
13:18:15.4 **HOT-2**	... put you right to sleep.		
		13:18:36.6 **INT-4**	set the brakes please. you have a safe one.
		13:18:38.9 **INT-1**	all right, the brakes are set. you're cleared to disconnect. thanks guys.
		13:18:42.0 **INT-4**	see ya.
13:18:47.2 **HOT-1**	[sound of cough and sneeze] *.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME (EST) & SOURCE	**CONTENT**	**TIME (EST) & SOURCE**	**CONTENT**
13:18:54.4 **HOT-2**	* goes World. do you know @? he works for World.		
13:18:59.6 **HOT-1**	* think I've met him.		
13:19:14.4 **HOT-2**	wave off?		
13:19:15.2 **HOT-1**	yeah.		
13:19:23.2 **HOT-1**	after start.		
13:19:30.9 **HOT-2**	after start, flight controls, verified checked.		
13:19:33.2 **HOT-2**	EICAS checks, *** on.		
13:19:34.9 **HOT-1**	complete.		
13:19:35.2 **HOT-1**	** complete, thanks.		
		13:19:38.1 **RDO-2**	ramp, sixty-four forty-eight's ready to taxi from uh, Bravo seventeen.

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME (EST) & SOURCE	CONTENT	TIME (EST) & SOURCE	CONTENT
		13:19:43.0 **RMP**	Shuttlecraft sixty-four forty-eight, left side point niner. good day.
		13:19:46.9 **RDO-2**	left side, point niner, sixty-four forty-eight.
13:19:49.5 **HOT-1**	take that out.		
13:19:50.8 **HOT-2**	that garbage or is it ****?		
13:20:06.5 **HOT-1**	garbage *****. like an actual passenger's bag.		
13:20:10.7 **HOT-2**	yeah.		
13:20:55.2 **HOT-2**	** two north.		
13:20:58.8 **HOT-1**	I think so.		
13:21:00.5 **HOT-1**	where the hell the numbers go?		
13:21:05.2 **HOT-2**	*****.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME (EST) & SOURCE	**CONTENT**	**TIME (EST) & SOURCE**	**CONTENT**
		13:21:07.2 **RDO-2**	ground, sixty-four forty-eight uh, three north, Victor.
		13:21:12.8 **GND**	Shuttlecraft six four four eight, Atlanta ground, runway two two six left, taxi via Foxtrot.
		13:21:16.5 **RDO-2**	two six left via Foxtrot, sixty-four forty-eight.
13:21:19.3 **HOT-1**	Foxtrot, two six left.		
13:21:22.0 **HOT-?**	who is this?		
13:21:23.8 **HOT-2**	clear on the right.		
13:21:28.5 **HOT-?**	God.		
13:21:35.2 **INT-2**	why were you laughing over the PA?		
13:21:37.4 **INT-5**	what?		
13:21:37.6 **INT-2**	why were you laughing over the PA?		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME (EST) & SOURCE	CONTENT	TIME (EST) & SOURCE	CONTENT
13:21:39.1 **INT-5**	why was I laughing over the PA? oh, @, @ was sticking his tongue out an me.		
13:21:44.8 **INT-2**	** I just talked to * * I caught you snickering.		
13:21:48.9 **INT-5**	he was making funny faces so I started laughing.		
13:21:53.1 **INT-2**	that's gonna go in my report.		
13:21:54.7 **INT-5**	you're gonna do what?		
13:21:56.4 **INT-2**	that's gonna go on my report.		
13:21:57.7 **INT-5**	oh, it is?		
13:21:58.3 **INT-2**	yeah.		
13:21:59.0 **INT-5**	that's good to know.... 'cause since you can't tell time and I'd be worried about you *** report.... it was sometime in the afternoon around the eighteenth.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME (EST) & SOURCE	**CONTENT**	**TIME (EST) & SOURCE**	**CONTENT**
13:22:10.9 **INT-2**	I don't read and write that well either so it's, probably gonna be pretty much illegible. they usually throw it away 'cause I turn it in in *.		
13:22:17.6 **INT-5**	*** your turtle ran away. ******.		
13:22:25.1 **INT-2**	yep, embarrassing.		
13:22:26.9 **INT-5**	yeah, probably.		
13:22:28.6 **INT-2**	all right, we'll get out of here in a minute.		
13:22:30.5 **INT-5**	excellent.		
13:22:31.2 **INT-2**	all right, bye.		
13:22:31.6 **INT-5**	bye.		
13:22:34.7 **HOT-1**	new frequency?		
13:22:38.7 **HOT-2**	yeah, we're up on tower now.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME (EST) & SOURCE	**CONTENT**	**TIME (EST) & SOURCE**	**CONTENT**
13:22:40.9 **HOT-2**	yeah, it's * three zero one seven now on the meters.		
13:22:48.9 **HOT-1**	one seven?		
13:22:49.7 **HOT-2**	yeah.		
13:23:01.3 **HOT-1**	looks like we're gonna get right out of here.		
13:23:03.3 **HOT-2**	yeah.		
13:23:05.4 **HOT-2**	spin two?		
13:23:06.5 **HOT-1**	sure, please sir.		
13:23:15.1 **HOT-2**	that's where we're parking.		
13:24:08.6 **HOT-2**	*** table, 'kay two six left, ten thousand. first fix is, SNUFFY, a thousand feet. V nav?		
13:24:19.4 **HOT-1**	yep.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME (EST) & SOURCE	CONTENT	TIME (EST) & SOURCE	CONTENT
13:24:20.6 **HOT-2**	ICAS verified checked.		
13:24:21.6 **HOT-1**	checked.		
13:24:22.0 **HOT-2**	flaps verified two.		
13:24:24.1 **HOT-1**	two.		
13:24:24.6 **HOT-2**	brake temperature green. pitch trim verified, three point five and green.		
13:24:27.9 **HOT-1**	three five green.		
13:24:28.6 **HOT-2**	takeoff data one thirty-six, one forty-one, one forty-four, one ninety-four, flex thirty-six.		
13:24:34.0 **HOT-1**	one thirty-six, one forty-one, one forty-four, one ninety-four, flex thirty-six, which is up to... do you want to flex at all?		
13:24:40.4 **HOT-2**	yeah, that's fine.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME (EST) & SOURCE	CONTENT	TIME (EST) & SOURCE	CONTENT
13:24:41.2 **HOT-1**	I don't care.		
13:24:42.5 **HOT-2**	takeoff briefing complete. taxi check is complete.		
13:24:44.9 **HOT-1**	thank you. they'll give us that, friggin right turn at the marker.		
13:24:49.9 **HOT-2**	yeah.		
13:24:51.2 **HOT-1**	which, half the time I don't even get that little middle marker symbol.		
13:25:01.8 **HOT-2**	yeah I know, I don't get it half the time either. I turn the marker beacon on and hope to hear it.		
13:25:06.2 **HOT-1**	yeah.		
13:25:20.8 **HOT-1**	[sound of cough]		
13:25:37.3 **HOT-1**	I didn't say anything to them. I didn't know if you want to or not, the passengers. I didn't realize how short on time we were.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME (EST) & SOURCE	CONTENT	TIME (EST) & SOURCE	CONTENT
13:25:46.5 **HOT-1**	aw.... *, I don't, it's up to you. I don't care. it's uh, nineteen degrees and overcast. it's snowing there.		
13:25:55.5 **HOT-2**	nineteen degrees and overcast. it's kinda late now, isn't it?		
13:25:59.1 **HOT-1**	it doesn't matter. I don't care.		
13:26:01.8 **HOT-2**	naw.		
13:26:04.8 **HOT-1**	[sound of cough and sneeze]		
13:26:07.3 **HOT-2**	all right....		
13:26:09.7 **HOT-2**	actually you know what, I will talk to 'em.		
13:26:11.5 **HOT-1**	two six left is loaded. I got one.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME (EST) & SOURCE	**CONTENT**	**TIME (EST) & SOURCE**	**CONTENT**
13:26:14.8 **PA-2**	ladies and gentlemen, it looks like we're number three for departure. I'd like to say welcome aboard Delta flight number uh, sixty-four forty-eight to Cleveland. hour and twenty-one minute flight. thirty-five thousand feet. **, Cleveland's weather is nineteen degrees, overcast skies, uuum, looks like we'll be number three. welcome aboard flight number six four four eight, to Cleveland.		
13:26:54.5 **PA-2**	ladies and gentlemen, we're now number two. flight attendants please prepare the cabin for takeoff, thank you.		
13:27:18.8 **HOT-1**	this is uh, tower?		
13:27:20.6 **HOT-2**	yeah, tower departure on one.		
13:27:42.2 **HOT-1**	let's see, we did the taxi, right?		
13:27:43.9 **HOT-2**	yeah, complete.		
		13:28:14.2 **TWRA**	Shuttlecraft sixty-four forty-eight I want you to hold short of two six left. that RJ in between the parallels got a flow time he's gotta meet or they are gonna put a big delay on him.

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME (EST) & SOURCE	**CONTENT**	**TIME (EST) & SOURCE**	**CONTENT**
		13:28:22.1 **RDO-2**	short of two six left, sixty-four forty-eight.
13:28:25.0 **HOT-1**	that's Eagle *** they're giving everybody else big delays.		
13:28:27.2 **HOT-2**	yeah.		
13:28:42.3 **HOT-1**	we should get on the radios. this is so typical. always waiting on Eagle.		
13:28:47.3 **HOT-2**	yeah.		
13:28:58.0 **HOT-2**	you ever flown with... oh, you're at Indy. I don't know if he's at Indy or not, this guy named @ something. he's in my training class. F/O from Trans States.		
13:29:08.9 **HOT-1**	that doesn't sound familiar.		
13:29:10.7 **HOT-2**	I think he may actually be out of Columbus.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME (EST) & SOURCE	CONTENT	TIME (EST) & SOURCE	CONTENT
		13:29:43.5 **TWRA**	Shuttlecraft sixty-four forty-eight, runway two six left, taxi into position and hold.
13:29:47.6 **HOT-2**	two six left, position and hold, Shuttlecraft sixty-four forty-eight.		
13:29:51.8 **HOT-2**	position and hold. flight attendants notified.		
13:29:54.1 **HOT-1**	right.		
13:29:54.6 **HOT-2**	takeoff min fuel quantity verified. nine thousand four hundred eighty-five required. ** ten thousand six ten on board.		
13:30:00.9 **HOT-1**	nine four eighty-five required, ten six ten's aboard.		
13:30:03.9 **HOT-2**	TA/RA takeoff config.		
13:30:06.6 **HOT-3**	takeoff okay.		
13:30:07.7 **HOT-2**	checked. before takeoff checklist is complete. clear on final.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME (EST) & SOURCE	**CONTENT**	**TIME (EST) & SOURCE**	**CONTENT**
13:30:35.7 **HOT-1**	you got the brakes?		
13:30:36.9 **HOT-2**	my brakes, my controls.		
13:30:37.4 **HOT-1**	your controls.		
13:30:43.5 **HOT-1**	[sound of several coughs]		
		13:30:56.9 **TWRA**	Shuttlecraft sixty-four forty-eight, the wind is three two zero at one seven, at the middle marker turn right heading runway two eight five, runway two six left, cleared for takeoff.
		13:31:05.4 **RDO-2**	two eight five at the marker two six left, cleared takeoff, Shuttlecraft six-four forty-eight.
13:31:09.3 **HOT-1**	you have two eighty-five.		
13:31:12.3 **HOT-2**	TOGA.		
13:31:13.4 **HOT-1**	TOGA set.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME (EST) & SOURCE	**CONTENT**	**TIME (EST) & SOURCE**	**CONTENT**
13:31:20.1 **HOT-1**	eighty knots.		
13:31:21.2 **HOT-2**	checked.		
13:31:35.2 **HOT-1**	V one.		
13:31:37.0 **HOT-1**	rotate.		
13:31:43.1 **HOT-1**	positive rate.		
13:31:43.9 **HOT-2**	gear up.		
13:31:44.3 **HOT-1**	gear up.		
13:31:58.5 **HOT-2**	heading.		
13:31:59.8 **HOT-1**	heading.		
13:32:08.4 **HOT-1**	flight level change speed two ten.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME (EST) & SOURCE	**CONTENT**	**TIME (EST) & SOURCE**	**CONTENT**
13:32:10.3 **HOT-2**	V nav?		
13:32:12.3 **HOT-1**	V nav, **.		
		13:32:23.0 **TWRA**	Shuttlecraft sixty-four forty-eight, heading two eight five. contact Atlanta departure.
		13:32:26.4 **RDO-1**	two eighty-five, departure good day, Shuttlecraft sixty-four forty-eight.
		13:32:29.1 **TWRA**	so long.
		13:32:32.6 **RDO-1**	departure, Shuttlecraft sixty-four forty-eight's three thousand.
13:32:35.1 **HOT-2**	flaps one.		
		13:32:35.6 **DEP**	Shuttlecraft sixty-four forty-eight, Atlanta departure, verify climbing to ten.
13:32:35.8 **HOT-1**	flaps one.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME (EST) & SOURCE	CONTENT	TIME (EST) & SOURCE	CONTENT
		13:32:38.9 **RDO-1**	affirm, climbing to one zero thousand, Shuttlecraft sixty-four forty-eight.
		13:32:41.9 **DEP**	Shuttlecraft sixty-four forty-eight. you are radar contact. cleared direct SNUFY, join the Summit three.
13:32:43.0 **HOT-2**	flaps up.		
		13:32:46.2 **RDO-1**	direct SNUFY, join the Summit three, Shuttlecraft sixty-four forty-eight.
13:32:50.9 **HOT-1**	all right, flaps up and direct SNUFY.		
13:32:54.6 **HOT-2**	SNUFY.		
13:33:48.3 **HOT-1**	[sound of cough]		
		13:34:35.2 **DEP**	Shuttlecraft sixty-four forty-eight, traffic eleven o'clock five miles southeast bound, eleven thousand E one forty-five.
13:34:40.5 **HOT-2**	got it.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME (EST) & SOURCE	**CONTENT**	**TIME (EST) & SOURCE**	**CONTENT**
		13:34:41.9 **RDO-1**	in sight, Shuttlecraft sixty-four forty-eight.
13:35:01.1 **HOT-3**	traffic, traffic.		
13:35:04.1 **HOT**	[sound similar to altitude alerter]		
13:35:05.7 **HOT-2**	nine thousand for ten thousand.		
13:35:06.9 **HOT-1**	nine thousand for ten thousand.		
13:35:38.1 **HOT-1**	she put us on time, **.		
13:35:39.6 **HOT-2**	cool.		
13:35:53.4 **HOT-2**	nice of her.		
13:35:54.8 **HOT-1**	yeah it was.		
		13:36:23.9 **DEP**	Shuttlecraft sixty-four forty-eight, climb maintain one four thousand.

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME (EST) & SOURCE	**CONTENT**	**TIME (EST) & SOURCE**	**CONTENT**
		13:36:28.3 **RDO-1**	one four thousand, Shuttlecraft sixty-four forty-eight.
13:36:31.4 **HOT-2**	one four thousand set. flight level change.		
		13:37:16.4 **DEP**	Shuttlecraft sixty-four forty-eight, contact Atlanta center one three three point one.
		13:37:21.4 **RDO-1**	thirty-three point one good day, Shuttlecraft sixty-four forty-eight.
		13:37:31.2 **RDO-1**	center good afternoon, Shuttlecraft sixty-four forty-eight at eleven thousand climbing one four thousand.
		13:37:35.6 **CTRA**	Shuttlecraft sixty-four forty-eight Atlanta center roger, climb maintain flight level two three zero.
		13:37:40.2 **RDO-1**	climbing two three zero, Shuttlecraft sixty-four forty-eight.
13:37:45.2 **HOT-2**	two three oh, set.		
13:37:46.2 **HOT-1**	two three oh, set.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME (EST) & SOURCE	**CONTENT**	**TIME (EST) & SOURCE**	**CONTENT**
13:38:14.5 **HOT-1**	wow, she lied about ten whole minutes.		
13:38:17.2 **HOT-2**	I know.		
13:38:22.5 **HOT-2**	is that @?		
13:38:28.9 **HOT-1**	I've had her fudge you know four or five minutes before but not ten.		
13:38:36.5 **HOT-1**	oh well, I'll take it.		
13:38:46.9 **HOT-1**	she wants me.		
13:38:51.2 **HOT-2**	have you ever met her?		
13:38:52.7 **HOT-1**	no.		
13:38:53.3 **HOT-1**	no, I'm talking about that, that girl on the radio.		
13:38:55.8 **HOT-2**	aah.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME (EST) & SOURCE	CONTENT	TIME (EST) & SOURCE	CONTENT
13:38:56.1			
HOT-1	she sounded kinda cute. I've been burnt like that before though. sounds can be deceiving.		
13:39:03.3			
HOT-2	yeah.		
13:40:51.4			
HOT-2	eighteen thousand standard.		
13:40:53.9			
HOT-1	standard.		
		13:41:23.7	
		CTRA	Shuttlecraft sixty-four forty-eight, contact Atlanta center one two five point niner two.
		13:41:28.5	
		RDO-1	two five niner two good day, Shuttlecraft sixty-four forty-eight.
		13:41:39.0	
		RDO-1	center, Shuttlecraft sixty-four forty-eight, two zero zero climbing two three oh.
		13:41:42.8	
		CTRA	Shuttlecraft sixty-four forty-eight, Atlanta center, climb and maintain flight level two five zero.

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME (EST) & SOURCE	CONTENT	TIME (EST) & SOURCE	CONTENT
		13:41:47.3 **RDO-1**	climb maintain two five zero, Shuttlecraft sixty-four forty-eight.
13:41:50.3 **HOT-2**	two five zero set.		
13:41:51.6 **HOT-1**	two five zero set.		
13:43:01.6 **HOT-2**	Holiday Inn Select.		
13:43:28.0 **HOT-1**	I think I remember this place.		
13:43:30.1 **HOT-2**	yeah, is it nice?		
13:43:31.4 **HOT-1**	yeah.... and there's a, there used to be this little hot blond that worked, worked behind the counter with a big rack that everybody talked about.		
13:43:40.1 **HOT-2**	is that right?		
13:43:40.6 **HOT-1**	yeah.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME (EST) & SOURCE	CONTENT	TIME (EST) & SOURCE	CONTENT
13:43:52.7 **HOT**	[sound similar to altitude alerter]		
13:43:54.2 **HOT-2**	twenty-four for twenty-five.		
13:43:55.2 **HOT-1**	twenty-four for twenty-five.		
13:44:01.8 **CAM**	[sound similar to flight attendant call chime]		
13:44:03.1 **INT-2**	hello.		
13:44:03.9 **INT-6**	hey.		
13:44:04.6 **INT-2**	what's up?		
13:44:05.2 **INT-6**	I called and, crap, hang on....		
		13:44:06.6 **CTRA**	Shuttlecraft uh, sixty-four forty-eight, climb and maintain flight level three three zero and out of two seven zero in four minutes.

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME (EST) & SOURCE	**CONTENT**	**TIME (EST) & SOURCE**	**CONTENT**
		13:44:14.7 **RDO-1**	three three zero and out of two seven zero in four minutes, Shuttlecraft sixty-four forty-eight.
13:44:19.0 **HOT-1**	three three zero?		
13:44:20.2 **HOT-2**	three three zero set.		
13:44:24.7 **INT**	[discussion over the interphone between Captain and Flight Attendant about room accommodations for the layover]		
13:45:41.1 **HOT-2**	autopilot on please. thanks.		
13:45:42.9 **HOT-1**	autopilot on.		
13:45:53.7 **HOT-1**	your ACARS message from....		
13:46:01.7 **HOT-2**	Atlanta to CLF?		
13:46:04.6 **HOT-1**	huh?		
13:46:18.0 **HOT-2**	Cleveland.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME (EST) & SOURCE	CONTENT	TIME (EST) & SOURCE	CONTENT
13:47:42.4 **HOT-1**	wonder if there is a.... CLF? no.		
13:47:50.5 **HOT-2**	there's no such place.		
13:47:51.9 **HOT-1**	that's good.		
13:50:02.9 **HOT-2**	any good rumors about the company? the Delta thing true?		
13:50:07.4 **HOT-1**	what's that?		
13:50:08.3 **HOT-2**	thirty-five one seventy-fives.		
13:50:10.2 **HOT-1**	I don't know. I haven't heard anything. I bought a bunch of stock hoping that something else would come out and it's gonna skyrocket but....		
13:50:20.4 **HOT-2**	it's gone up recently, hasn't it?		
13:50:21.9 **HOT-1**	it, it's fluctuated a good bit. I'm making about uh, I don't know about a hundred dollars a day sometimes on it. it fluctuates so much, I just buy it low and sell it high and then re-buy it again after it falls.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME (EST) & SOURCE	**CONTENT**	**TIME (EST) & SOURCE**	**CONTENT**
13:50:35.0 **HOT-2**	is that right?		
13:50:35.7 **HOT-1**	yeah.		
13:50:36.3 **HOT-2**	you doing well on it?		
13:50:37.2 **HOT-1**	* not doing too bad. it's uh, the most reliable stock I've found so far 'cause it, it's constantly goes up and down. it uh, was over nineteen....		
13:50:46.5 **HOT**	[sound similar to altitude alerter]		
13:50:47.7 **HOT-1**	... ago but now it's down to eighteen.		
13:50:50.0 **HOT-2**	thirty-two for thirty-three.		
13:50:51.1 **HOT-1**	thirty-two for thirty-three. I'm out of money or I'd buy as much as I could right now.		
13:50:55.6 **HOT-2**	how much you buy at a time?		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME (EST) & SOURCE	CONTENT	TIME (EST) & SOURCE	CONTENT
13:51:01.7 **HOT-1**	I only got enough money to work with about five hundred shares so.		
13:51:06.1 **HOT-2**	that's not bad.		
13:51:06.9 **HOT-1**	yeah, well, once it gets, once I think it hits the low spot for the day I'll buy as much as I can then it goes up, it goes up thirty cents, I make two or three hundred dollars.		
13:51:18.1 **HOT-2**	yeah.		
13:51:18.8 **HOT-1**	I turn around and I sell it. and then uh, it'll drop back down I buy it back up again. so, every time I buy another ten or fifteen shares.... the value of my stock keeps going up.... over the past month and a half, I've probably made, I don't know, close to two grand, off....		
13:51:41.1 **HOT-2**	wow.		
13:51:41.7 **HOT-1**	... just doing that.		
13:51:43.2 **HOT-2**	really.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME (EST) & SOURCE	**CONTENT**	**TIME (EST) & SOURCE**	**CONTENT**
		13:51:43.7 **CTRA**	Shuttlecraft sixty-four forty-eight it's gonna be a couple minutes before I have higher. traffic for you, two o'clock two zero miles miles southwest above you at flight level three four zero is a seven thirty seven.
		13:51:53.0 **RDO-1**	roger, looking, Shuttlecraft sixty-four forty-eight.
13:51:56.8 **HOT-1**	if I had a lot more money I could make substantial cash just playing this game.		
13:52:04.1 **HOT-2**	*.		
13:52:04.2 **HOT-1**	I don't have enough money, involved....		
13:52:17.9 **HOT-2**	you go through a broker or you just do it on your own?		
13:52:20.8 **HOT-1**	I just do it on my own which.... I've had to learn the hard way. I started with ten grand, and I whittled that to about four.		
13:52:28.5 **HOT-2**	oh #.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME (EST) & SOURCE	CONTENT	TIME (EST) & SOURCE	CONTENT
13:52:29.4			
HOT-1	yeah it hurt. and now, starting to figure stuff out a little bit. gradually working it back up. I had to stop uh, going for the major payoffs, I just....		
13:52:44.7			
HOT-2	yeah.		
13:52:45.5			
HOT-1	as long as I make twenty bucks, I'm happy. I could make twenty bucks about five times a day, doing all right.		
13:52:55.1			
HOT-2	yep.... do you have the frequencies and gates on this? I don't have it in my book....		
13:53:05.1			
HOT-1	uum.		
13:53:05.4			
HOT-2	kinda weird.		
13:53:07.4			
HOT-1	might be new.... I don't have all my uh….		
13:53:14.4			
HOT-2	#.		
13:53:15.6			
HOT-1	I don't have all my stuff in, my book yet.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME (EST) & SOURCE	CONTENT	TIME (EST) & SOURCE	CONTENT
13:53:18.6 **HOT-2**	is it on here?		
13:53:21.7 **HOT-2**	Cleveland gate D, D two? that sound right?		
13:53:28.4 **HOT-1**	I've been in here before.		
13:53:29.6 **HOT-2**	ops is one twenty-nine five five.		
13:53:31.7 **HOT-1**	gate B two?		
13:53:32.7 **HOT-2**	yeah, what it says B two, right?		
13:53:34.9 **HOT-1**	yep, two nine five five.		
13:53:37.0 **HOT-2**	two nine five five, yeah.		
13:53:38.6 **HOT-1**	sweet.		
13:53:50.9 **HOT-1**	yeah.		
13:53:51.4 **HOT-2**	that's why the rich keep getting richer you know….		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME (EST) & SOURCE	CONTENT	TIME (EST) & SOURCE	CONTENT
13:53:53.4 **HOT-1**	yeah.		
13:53:54.0 **HOT-2**	'cause they have the money to throw around.		
13:53:56.9 **HOT-1**	yeah.... I wish I'd been a little smarter about it to begin with though.		
13:54:01.2 **HOT-2**	yeah, everybody loses, learns a lesson.		
13:54:06.1 **HOT-1**	uh, you know @.		
13:54:07.6 **HOT-2**	oh yeah. good friends with @.		
13:54:09.1 **HOT-1**	are you?		
13:54:09.7 **HOT-2**	he made a # load of money on the market.		
13:54:11.6 **HOT-1**	yeah, I, I was talking to him about it. he got me interested in it again. [sound of cough] he was telling me he just read some books on it and in his first year, he took two thousand dollars and turned it into a hundred grand.		

	INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION
TIME (EST) & SOURCE	CONTENT	TIME (EST) & SOURCE	CONTENT
13:54:24.3 **HOT-2**	yeah, he told me the same thing. he read books on it. but he's read about thirty books. you know that. he set me down, I was in Chicago ***. where would I go. I even forget what it was now. but it's like a seminar on some kind of investing he does.		
13:54:26.3 **HOT-1**	wow.		
13:54:39.7 **HOT-1**	yeah.		
13:54:40.3 **HOT-2**	and I do, the seminar's in downtown Chicago and I happened to be there, and I went down to the seminar. and it was kind of like, he said I know it's kind of tricky to learn and stuff, but.... yeah, he does pretty good.		
		13:55:04.4 **CTRA**	Shuttlecraft sixty-four forty-eight, climb and maintain flight level three four zero.
		13:55:08.4 **RDO-1**	climbing three four zero, Shuttlecraft sixty-four forty-eight.
13:55:10.5 **HOT-2**	three four zero set.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME (EST) & SOURCE	CONTENT	TIME (EST) & SOURCE	CONTENT
		13:55:11.1 **CTRA**	and Shuttlecraft sixty-four forty-eight, contact Atlanta center one three four point zero seven.
13:55:11.7 **HOT-1**	set.		
13:55:15.8 **HOT**	[sound similar to altitude alert signal]		
		13:55:16.5 **RDO-1**	thirty-four oh seven good day, Shuttlecraft sixty-four forty-eight.
13:55:19.5 **HOT-1**	thirty-three thirty-four.		
13:55:20.6 **HOT-2**	thirty-three thirty-four.		
13:55:34.3 **HOT-2**	so this won't let you go up to seven eight 'til you're at cruise? is that why it's still seven four?		
13:55:38.9 **HOT-1**	yeah, it's still in the climb. you can change it in there and it will change on there.		
		13:55:47.6 **RDO-1**	center, Shuttlecraft sixty-four forty-eight's thirty-three three climbing three four oh.

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME (EST) & SOURCE	**CONTENT**	**TIME (EST) & SOURCE**	**CONTENT**
		13:55:51.7 **CTRA**	Shuttlecraft sixty-four forty-eight Atlanta center roger, climb and maintain flight level three five zero.
		13:55:56.3 **RDO-1**	climbing three five zero, Shuttlecraft sixty-four forty-eight.
13:55:58.5 **HOT-2**	three five zero set.		
13:55:59.9 **HOT-1**	set.		
13:56:00.3 **HOT-2**	did @ tell you what he paid in taxes the first year he made some money.		
13:56:03.2 **HOT-1**	yeah like wrote a check for like thirty grand or something. it's more than he made... working as a....		
13:56:08.9 **HOT-2**	thirty forty grand I think he *.		
13:56:10.8 **HOT-1**	ah... more than he made working as a paramedic.		
13:56:15.8 **HOT-2**	yeah... yeah... is that the same time he got divorced? I can't remember.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME (EST) & SOURCE	CONTENT	TIME (EST) & SOURCE	CONTENT
13:56:32.5 **HOT-1**	I don't know.		
13:56:39.0 **HOT-2**	shoot, I should, I don't have the money right now but, could do that too.... ****.		
13:56:44.4 **HOT-?**	[sound similar to altitude alerter]		
13:56:47.0 **HOT-2**	does @ buy and sell the stock thirty-four for thirty-five?		
13:56:49.0 **HOT-1**	I don't know if he does or not. thirty-four for thirty-five.		
13:56:51.7 **HOT-2**	he's into uh, what's he into?		
13:56:53.5 **HOT-1**	told me he's into options.		
13:56:55.7 **HOT-2**	yeah options, that's what it was.		
13:56:56.4 **HOT-2**	that's what it was. yeah, that's what I went to the seminar, the seminar... oh, God... real tricky. if this happens, this happens and it's all these....		
13:56:57.0 **HOT-1**	I don't even understand what that's about.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME (EST) & SOURCE	**CONTENT**	**TIME (EST) & SOURCE**	**CONTENT**
13:57:38.4 **HOT-2**	yeah he was, I just tried to call him the other night when I was in uh.... Albuquerque and talked to him about being like Captain *** you know what dude? I'd wait.... wait for the like the one-seventy or one thirty-five.		
13:57:53.4 **HOT-1**	that what he heard?		
13:57:55.2 **HOT-2**	he told me there would be a lot of one seventy-fives at Delta.		
13:57:59.3 **HOT-1**	* is he... I had a, a PC with him in a month ago and he's like, the Frontier things a done deal. I can't believe they haven't announced it yet. and it's still another month or two before they finally announced it.		
13:58:11.7 **HOT-2**	yeah.		
13:58:12.2 **HOT-1**	they knew what was going on.		
13:58:14.0 **HOT-2**	I met a guy, before I started this, like I said I've gone for eight days. it's four days on, a day off of this three day.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME (EST) & SOURCE	**CONTENT**	**TIME (EST) & SOURCE**	**CONTENT**
13:58:19.7 **HOT-1**	uh huh.		
13:58:20.5 **HOT-2**	I was down in the cafeteria and I met this Captain. I don't know where, ** Chicago, maybe Indy based. and he said uh, he just flew with the FO *. 'cause you know this is weird. I just got my schedule to pickup planes in Brazil. and they said they haven't mentioned it yet ** Delta look at my schedule. it says thirty-five one seventy-five. he said it was seventy-six seats, no first class.		
13:58:44.5 **HOT-1**	wow. I wonder why?		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME (EST) & SOURCE	CONTENT	TIME (EST) & SOURCE	CONTENT
13:58:49.7			
HOT-2	I heard they were gonna do from like Chicago to LA.... and I flew with a couple of guys that go pick up the planes an... you know @? he told me he goes like, he told me, lad I tell you I went down to get the last plane. I said goodbye to him like thank God for everything. I probably won't see you again for a long time. and he said, oh no, the second quarter of next year which is, you know now, or coming up, he said you might as well just get an apartment here. he said what do you mean? he said Delta called ** conference call and said how fast can you make these things. about two a month and they said well can you make them any faster. and they said well, we do have a hanger or something we could do some stuff to help move it along. we could probably get three a month. they said we would like to put an order in for.... I heard forty-eight back then.		
13:59:38.7			
HOT-1	wow.		
13:59:39.4			
HOT-2	he said forty-eight but, the rumor lately is thirty-five, one seventy-fives.		
		14:01:34.8	
		CTRA	Shuttlecraft sixty-four forty-eight contact Indianapolis center on one three four point two two.

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME (EST) & SOURCE	CONTENT	TIME (EST) & SOURCE	CONTENT
		14:01:40.1 **RDO-1**	three four two, two good day, Shuttlecraft sixty-four forty-eight.
		14:01:48.9 **RDO-1**	center good afternoon, Shuttlecraft sixty-four forty-eight, three five oh.
		14:01:53.6 **CTRI**	Shuttlecraft sixty-four forty-eight, Indy center roger.
		14:03:23.2 **CTRI**	Shuttlecraft sixty-four forty-eight, turn ten degrees left, vector traffic.
		14:03:28.0 **RDO-1**	ten left, Shuttlecraft sixty-four forty-eight.
14:03:31.2 **HOT-2**	ten degrees left.		
14:06:35.7 **HOT-2**	I'm gonna lose my headset.		
14:06:37.7 **HOT-1**	*.		
		14:08:50.3 **CTRI**	Shuttlecraft sixty-four forty-eight cleared direct Tiverton.

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME (EST) & SOURCE	**CONTENT**	**TIME (EST) & SOURCE**	**CONTENT**
14:08:54.7 **HOT-2**	yeah.		
		14:08:55.4 **RDO-1**	direct Tiverton, Shuttlecraft sixty-four forty-eight, thanks.
14:09:01.3 **HOT-2**	Tiverton, like it?		
		14:13:07.3 **CTRI**	Shuttlecraft sixty-four forty-eight, contact Indy center one two four, correction, one one niner point five two.
		14:13:15.2 **RDO-1**	nineteen fifty-two, good day, Shuttlecraft sixty-four forty-eight.
		14:13:22.6 **RDO-1**	Indy center good afternoon, Shuttlecraft sixty-four forty-eight three five oh.
		14:13:27.0 **CTRI**	Shuttlecraft sixty-four forty-eight Indy center, roger.
14:20:39.1 **PA-5**	ladies and gentlemen, the Captain has turned off the fasten seatbelt sign *******. for your convenience there are lavatories located in the front and rear of the aircraft.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME (EST) & SOURCE	CONTENT	TIME (EST) & SOURCE	CONTENT
		14:22:50.9 **CTRI**	Shuttlecraft sixty-four forty-eight descend and maintain flight level three four zero.
		14:22:55.0 **RDO-1**	three four zero, Shuttlecraft sixty-four forty-eight.
14:22:58.8 **HOT-2**	three four zero set.		
14:23:04.0 **HOT-1**	[sound similar to altitude alerter]		
		14:24:26.5 **CTRI**	Shuttlecraft sixty-four forty-eight, contact Indy center one two five point zero seven.
		14:24:31.3 **RDO-1**	twenty-five oh seven, good day, Shuttlecraft sixty-four forty-eight.
		14:24:37.9 **RDO-1**	Indy center good afternoon, Shuttlecraft sixty-four forty-eight three four oh.
		14:24:43.2 **CTRI**	Shuttlecraft sixty-four forty-eight Indy center, roger.

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME (EST) & SOURCE	**CONTENT**	**TIME (EST) & SOURCE**	**CONTENT**
		14:28:25.0 **CTRI**	Shuttlecraft sixty-four forty-eight, cross three five miles south of Tiverton at and maintain flight level two four zero.
		14:28:34.7 **RDO-1**	thirty-five south of Tiverton at two four zero, Shuttlecraft sixty-four forty-eight.
14:29:04.6 **HOT-2**	two four zero set.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME (EST) & SOURCE	**CONTENT**	**TIME (EST) & SOURCE**	**CONTENT**
		14:29:18.6 **ATIS**	Cleveland-Hopkins Airport arrival Information Alpha. one eight five eight Zulu special. wind three one zero at one four, gusts two one. visibility one zero. ceiling two thousand niner hundred broken. temperature minus six, dew point minus one three. altimeter two niner, niner, niner. ILS runway two four right approach in use. landing runway two four right. departure ATIS frequency one three two point three seven five. runway six center, two four center closed. runway one zero two eight closed. taxiway Alpha (Golf one), Zulu closed. taxiway Juliet between taxiway Sierra and Whiskey snow bank taxi caution advised. south cargo ramp closed. precision approach path indicator two four left precision approach path indicator two eight, out of.... service. runway two four left and two eight glideslope's unusable due to snow build-up. braking action advisories are in effect. bird activity in the vicinity of the airport, caution advised. pilots read back all runway assignments. read back all runway hold short instructions. pavement failure at intersection of Juliet and Whiskey. advise on initial contact you have information Alpha.
14:29:51.0 **HOT-2**	#.		
14:29:52.5 **HOT-1**	what's up?		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME (EST) & SOURCE	CONTENT	TIME (EST) & SOURCE	CONTENT
14:29:53.6 **HOT-2**	two four right.		
14:29:56.5 **HOT-1**	oh, you know on this too, if you arm the V nav, it'll descend by itself.		
14:30:00.7 **HOT-2**	yeah, yeah.		
14:32:35.1 **HOT**	[sound similar to vertical track alert]		
		14:33:16.4 **CTRI**	Shuttlecraft sixty-four forty-eight, contact Indy center one three two point eight two, thirty-two, eighty-two.
		14:33:22.0 **RDO-1**	thirty-two eighty-two, good day, Shuttlecraft sixty-four forty-eight.
		14:33:34.7 **RDO-1**	Indy, good afternoon, Shuttlecraft sixty-four forty-eight, three four oh, crossing thirty-five this side of Tiverton at two four oh.
		14:33:42.1 **CTRI**	Shuttlecraft sixty-four forty-eight, Indy center roger.
14:33:46.0 **HOT-2**	how come it's not heading down?		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME (EST) & SOURCE	CONTENT	TIME (EST) & SOURCE	CONTENT
14:33:47.4 **HOT-1**	it's not armed. you're still in the manual mode.		
		14:33:50.5 **CTRI**	Shuttlecraft sixty-four forty-eight uh, descend and maintain flight level two three zero with the same restriction.
14:33:56.6 **HOT-2**	uuh.		
		14:33:57.4 **RDO-1**	same restriction down to two three zero for Shuttlecraft sixty-four forty-eight.
14:34:02.1 **HOT-2**	did he say down to two three zero?		
14:34:03.7 **HOT-1**	yeah two three zero's the new, same restriction. **, hit uh, V nav and it should *** there goes the change, FMS ***.		
14:34:26.1 **HOT-1**	what the hell is it doin'?		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME (EST) & SOURCE	**CONTENT**	**TIME (EST) & SOURCE**	**CONTENT**
14:34:30.2 **HOT-1**	* it's trying to slow to seven six.		
14:34:50.8 **HOT-?**	[sound of two chimes]		
14:34:53.7 **HOT**	[sound similar to flight attendant chime]		
14:34:55.3 **INT-1**	why don't you leave those people alone?		
14:34:56.8 **INT-5**	excuse me?		
14:34:57.3 **INT-1**	why don't you leave those people alone?		
14:34:58.7 **INT-5**	can't you leave me alone? you're always hollering.		
14:34:59.7 **INT-1**	they're probably trying to sleep.		
14:35:01.9 **INT-1**	I'm just trying to do my jobby job.		
14:35:03.8 **INT-5**	since when?		
14:35:07.5 **INT1**	If you pay attention once in a while.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME (EST) & SOURCE	CONTENT	TIME (EST) & SOURCE	CONTENT
14:35:09.3 **INT-5**	I'm sorry.		
14:35:10.7 **INT-1**	um, what do you got in the way of specials?		
14:35:13.9 **INT-5**	uh, one wheelchair.		
14:35:15.6 **INT-1**	is that it?		
14:35:16.3 **INT-5**	I guess so.		
14:35:17.9 **INT-1**	all right, we'll be there in about uh, thirty minutes.		
14:35:22.0 **INT-5**	thirty?		
14:35:24.1 **INT-1**	thirty-six to be exact. oh and we're staying, I don't know if he told you we're staying at the Holiday Inn select.		
14:35:27.8 **INT-5**	cool.		
14:35:28.6 **INT-1**	I remember now, that's a pretty cool hotel.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME (EST) & SOURCE	**CONTENT**	**TIME (EST) & SOURCE**	**CONTENT**
14:35:31.4 **INT-5**	hmm.		
14:35:32.1 **INT-1**	that's a pretty cool hotel.		
14:35:34.1 **INT-5**	awesome.		
14:35:35.1 **INT-1**	sweet, okay.		
14:35:36.2 **INT-5**	all righty, bye.		
14:36:21.8 **HOT-2**	the Mexican drug lords are going to like uh, National Parks, United States. mostly California and they dr, and they grow marijuana right in their own # back yard.		
14:36:33.1 **HOT-1**	nice.		
14:36:34.0 **HOT-2**	unbelievable.		
14:36:51.3 **HOT-2**	I'll brief if you want.		
14:36:53.3 **HOT-1**	all right, go for it.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME (EST) & SOURCE	CONTENT	TIME (EST) & SOURCE	CONTENT
14:36:55.4 **HOT-2**	* controls….		
14:36:59.1 **HOT-2**	twenty-six * with two three zero.		
14:37:01.4 **HOT-1**	roger.		
14:37:03.8 **HOT-2**	** two four right. six may, two thousand five. one eleven point five, five set both sides are IPVY, ** two thirty-seven. glide slopes * at twenty-seven hundred. is nine eighty seven on the baro. ** seven eighty. ** to the east, thirty-one hundred to the west. ** twenty-two hundred. two and half we have. *** if we go missed it's climb to thirty-one hundred then climbing right turn to three thousand direct to the Dryer VOR and hold. it'll be a teardrop entry. we'll get off at uh, I don't know, Golf.		
14:37:39.8 **HOT-1**	uuh, two four right.		
14:37:43.1 **HOT-2**	Kilo.		
14:37:43.9 **HOT-1**	November, Papa.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME (EST) & SOURCE	CONTENT	TIME (EST) & SOURCE	CONTENT
14:37:46.2 **HOT-2**	am I looking at the wrong one?		
14:37:48.8 **HOT-1**	Golf's the parallel, I think.		
14:37:53.6 **HOT-2**	aw yeah, November.		
14:37:55.3 **HOT-1**	that's a long taxi.		
14:38:02.0 **HOT-2**	any questions?		
14:38:03.0 **HOT-1**	nope.		
14:38:17.7 **HOT**	[sound similar to altitude alerter]		
14:38:19.3 **HOT-1**	twenty-four for twenty-three.		
14:38:21.5 **HOT-2**	twenty-four for twenty-three.		
14:38:29.0 **HOT-?**	****.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME (EST) & SOURCE	CONTENT	TIME (EST) & SOURCE	CONTENT
		14:38:35.3 **CTRI**	Shuttlecraft sixty-four forty-eight, contact Indy center one two four point four five.
		14:38:40.0 **RDO-1**	two four point four five, good day, Shuttlecraft sixty-four forty-eight.
		14:38:49.9 **RDO-1**	center, good afternoon, Shuttlecraft sixty-four forty-eight two three oh.
		14:38:54.2 **CTRI**	Shuttlecraft sixty-four forty-eight, descend and maintain one five thousand. Cleveland altimeter three zero zero two.
		14:39:01.5 **RDO-1**	down to one five thousand and three zero, zero two, Shuttlecraft sixty-four forty-eight.
14:39:06.9 **HOT-2**	fifteen thousand.		
14:39:09.3 **HOT-1**	fifteen seen.		
14:39:22.6 **HOT-2**	no ramp frequency here I don't think, huh? oh, wait a second. they contact you one twenty-seventeen.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME (EST) & SOURCE	CONTENT	TIME (EST) & SOURCE	CONTENT
14:39:32.5 **HOT-1**	where do you see that?		
14:39:37.9 **HOT-2**	arrival operation from concourse C oh, and all aircraft movements from the south side of concourse B, contact ramp one twenty nine seven.		
14:39:45.4 **HOT-1**	oh, okay.		
14:39:46.7 **HOT-1**	I guess that will be the tower.		
14:39:48.8 **HOT-2**	huh.		
14:39:49.2 **HOT-1**	that'll be the ground probably.		
14:39:50.7 **HOT-2**	yeah.		
14:41:34.5 **HOT-2**	#. the # Mexican drug lords, man. they're taking over the uh, Colombia drug lords and they uh, lately they have been, telling people, showing people how serious they are. they cut your head off and leave it, the last time I went to a discotheque. rolled five heads onto the dance floor.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME (EST) & SOURCE	CONTENT	TIME (EST) & SOURCE	CONTENT
14:41:46.3 **HOT-1**	yeah.		
14:41:56.5 **HOT-1**	damn.		
14:41:58.6 **HOT-2**	they mean business.		
14:42:02.2 **HOT-1**	cripes, that's here in the U.S.?		
14:42:04.3 **HOT-2**	no, in Mexico.		
14:42:05.1 **HOT-1**	oh, okay.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME (EST) & SOURCE	**CONTENT**	**TIME (EST) & SOURCE**	**CONTENT**
		14:42:40.9 **ATIS**	Cleveland-Hopkins Airport arrival Information Bravo. one eight five eight Zulu special. wind three one zero at one four, gusts two one. visibility one zero. ceiling two thousand niner hundred broken. temperature minus six, dew point minus one three. altimeter two niner, niner, niner. ILS runway two eight approach in use. landing runway two eight. departure ATIS frequency one three two point three seven five. runway six center, two four center closed. taxiway Alpha closed. taxiway Juliet between taxiway Sierra and Whiskey snowbank taxi caution advised. south cargo ramp closed. precision approach path indicator two four left precision approach path indicator two eight, out of.... service. runway two four left and two eight glideslope's unusable due to snow build-up. braking action advisories are in effect. bird activity in the vicinity of the airport, caution advised. pilots read back all runway assignments. read back all runway hold short instructions. pavement failure at intersection of Juliet and Whiskey. advise on initial contact you have information Bravo.
14:42:40.8 **HOT-2**	'k, is it two nine, nine, nine, two triple nine?		
14:42:44.2 **HOT-1**	he gave us three double oh two, is the last he gave us.		
14:42:49.8 **HOT-2**	uh, descent checklist.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME (EST) & SOURCE	CONTENT	TIME (EST) & SOURCE	CONTENT
14:42:51.5 **HOT-1**	all right.		
14:43:00.7 **HOT-1**	shoulder harness verified on.		
14:43:02.0 **HOT-2**	on.		
14:43:02.2 **HOT-1**	* belt is on, altimeter's verified. thirty oh two set here.		
14:43:05.3 **HOT-2**	thirty oh two set.		
14:43:06.6 **HOT-1**	landing data is set, EICAS is checked, approach briefing.		
14:43:09.7 **HOT-2**	complete.		
14:43:10.1 **HOT-1**	descent checklist complete.		
14:43:27.8 **HOT**	[sound similar to altitude alerter]		
14:43:30.0 **HOT-2**	sixteen for fifteen.		
14:43:31.5 **HOT-1**	sixteen, fifteen.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME (EST) & SOURCE	CONTENT	TIME (EST) & SOURCE	CONTENT
14:43:49.6 **HOT-1**	you take one for for a second and I'll call in range.		
14:43:50.7 **HOT-2**	I have one.		
		14:43:57.6 **RDO-1**	Cleveland ops, Shuttlecraft sixty-four forty-eight's in range.
		14:44:36.5 **RDO-1**	Cleveland ops, Shuttlecraft sixty-four forty-eight.
		14:44:57.0 **RDO-1**	[sound of cough] Cleveland ops, Shuttlecraft sixty-four forty-eight's in range.
		14:45:04.1 **CLEOP**	**shuttle, sixty-four forty-eight, you copy?
		14:45:07.6 **RDO-1**	* in range. 'bout uh, twenty out. need one wheelchair please.
		14:45:30.0 **RDO-1**	you copy that for sixty-four forty-eight?
14:45:50.4 **HOT-2**	# man.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME (EST) & SOURCE	CONTENT	TIME (EST) & SOURCE	CONTENT
14:45:52.5 **HOT-1**	all right, I'm back on one. I gave up. jerk.		
14:45:54.7 **HOT-2**	no changes.		
14:45:58.6 **HOT-1**	he, he answered me after I called him like three t.... he finally said, copy that for sixty-four forty-eight. but he didn't give me a gate, he wouldn't answer the wheelchair.		
14:46:08.7 **HOT-2**	oh, God.		
14:46:09.4 **HOT-1**	he just never answered me back.		
14:46:11.8 **HOT-1**	like... jerk.		
14:46:39.5 **HOT-1**	I'll be off again.		
14:46:40.9 **HOT-2**	got one.		

	INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION
TIME (EST) & SOURCE	CONTENT	TIME (EST) & SOURCE	CONTENT
14:46:43.4			
PA-1	yeah, folks from the flight deck, currently about uh, hundred and twenty miles southwest of the airport. gonna have have you on the ground here in about twenty minutes. current weather is mostly cloudy. twenty-one degrees. winds picked up here a little bit. it's uh, gusting about twenty-five miles an hour on the ground. expect it to be a little bumpy as we get lower. 'preciate having you on board today. like to see you aboard on another Delta connection flight operated by Shuttle America. like to ask the flight attendants please prepare the cabin for arrival.		
14:47:09.1			
HOT-1	[sound of cough]		
14:47:13.3			
PA-1	they're parking at terminal uh, B, gate two. Bravo two's our gate.		
14:47:18.7			
HOT-1	all right, back on one.		
14:47:21.6			
HOT-2	no changes.		
14:47:30.8			
HOT-1	[sound of cough]		
14:47:32.4			
HOT-2	@ has a partner though that does his investing.		
14:47:35.5			
HOT-1	does he?		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME (EST) & SOURCE	**CONTENT**	**TIME (EST) & SOURCE**	**CONTENT**
14:47:36.2 **HOT-2**	yeah. guy that's pretty sharp that watches it you know with him or, more full time.		
14:47:44.8 **HOT-1**	yeah....		
14:47:58.7 **HOT-2**	I don't know if he's done what I asked him if the other day if the other day how he's gonna invest it if he makes a hundred thousand like he did....		
14:48:06.6 **HOT-1**	yeah.		
14:48:07.3 **HOT-2**	before.		
14:48:11.0 **HOT-1**	** all of his stuff paid for and....		
14:48:13.2 **HOT-2**	yeah.		
14:48:13.8 **HOT-1**	*** he said like his car, motorcycle, his house....		
14:48:18.3 **HOT-2**	is that right?		
14:48:19.2 **HOT-1**	so he said.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME (EST) & SOURCE	CONTENT	TIME (EST) & SOURCE	CONTENT
14:48:19.8 **HOT-2**	I know he's got some toys.		
14:48:21.4 **HOT-1**	yeah.		
14:48:21.8 **HOT-2**	... a motorcycle an....		
14:48:24.1 **HOT-1**	[sound of cough] he said all that stuff's paid for and he just works here for basically the benefit, the medical and stuff. he said uh, I think he told me as soon as he clears, I think he said ten thousand a month income, he was going to quit altogether. [sound of several coughs]		
14:48:44.5 **HOT-2**	I would too.		
14:48:46.0 **HOT-2**	he made a lot of money working here last year.		
14:48:48.8 **HOT-1**	what's that, he did?		
14:48:51.1 **HOT-2**	yeah he did.		
14:48:55.7 **HOT-1**	I was surprised how much I made. it's like uh, must have picked up a whole butt load of overtime.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME (EST) & SOURCE	CONTENT	TIME (EST) & SOURCE	CONTENT
14:49:02.0 **HOT-2**	yeah.		
		14:49:02.6 **CTRI**	Shuttlecraft sixty-four forty-eight, Cleveland one three four point niner.
		14:49:06.3 **RDO-1**	three four niner, good day, Shuttlecraft sixty-four forty-eight.
		14:49:21.3 **CTRI**	Shuttlecraft sixty-four forty-eight, cross KEATN at one zero thousand, two five zero knots. altimeter three zero, zero, eight.
		14:49:27.3 **RDO-1**	KEATN at two fifty at ten, Shuttlecraft sixty-four forty-eight.
		14:49:31.8 **CTRI**	and roger, the Cleveland altimeter, I think I just gave it wrong twice. it's three zero, zero, zero for everybody landing Cleveland.
14:49:39.5 **HOT-2**	did he say three zero, zero?		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME (EST) & SOURCE	CONTENT	TIME (EST) & SOURCE	CONTENT
14:49:41.3 **HOT-1**	yep.		
14:49:43.8 **HOT-2**	ten thousand set.		
14:49:44.8 **HOT-1**	ten thousand.		
14:49:52.0 **HOT-?**	oops.		
		14:49:53.1 **CTRI**	Shuttlecraft sixty-four forty-eight, contact Cleveland approach, one two four point zero.
		14:49:57.7 **RDO-1**	two four point zero, good day. Shuttlecraft sixty-four forty-eight.
14:50:02.7 **HOT-1**	[sound of several coughs]		
14:50:10.2 **HOT-1**	was it Alpha, weather?		
14:50:11.9 **HOT-2**	uuh, yeah.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME (EST) & SOURCE	CONTENT	TIME (EST) & SOURCE	CONTENT
		14:50:14.1 **RDO-1**	approach good afternoon, Shuttlecraft sixty-four forty-eight's fifteen thousand descending ten thousand at KEATN, Alpha.
		14:50:19.7 **APR1**	Shuttlecraft sixty-four forty-eight Cleveland approach, depart KEATN heading three five zero vectors ILS runway two eight approach. Cleveland altimeter two niner, niner, niner.
		14:50:27.7 **RDO-1**	two niner, niner, niner KEATN uh, heading....
14:50:31.4 **HOT-1**	what was it?		
14:50:32.1 **HOT-2**	three five zero.		
		14:50:32.1 **RDO-1**	three five zero for two eight, Shuttlecraft sixty-four forty-eight.
14:50:36.8 **HOT-2**	two eight now. take your.…		
14:50:41.4 **HOT-1**	that sucks.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME (EST) & SOURCE	**CONTENT**	**TIME (EST) & SOURCE**	**CONTENT**
14:50:42.9 **HOT-2**	yeah, I almost put that in at first and then I....		
14:50:47.9 **HOT-2**	aw #, we're not gonna make KEATN by then.		
14:50:56.6 **HOT-1**	KEATN by ten in two minutes.		
14:50:57.7 **HOT-2**	*.		
14:51:03.0 **HOT-2**	'k, T program. I-P-X-T, I-P-X-T.		
14:51:18.0 **HOT-2**	preview two-eighty.		
14:51:25.6 **HOT-?**	[sound similar to altitude alerter]		
14:51:28.5 **HOT-2**	eleven thousand for ten thousand.		
14:51:30.4 **HOT-1**	eleven for ten.		
14:52:07.7 **HOT-2**	descend to a thousand twenty now.		
14:52:37.0 **HOT-2**	you got a heading.... three-fifty.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME (EST) & SOURCE	**CONTENT**	**TIME (EST) & SOURCE**	**CONTENT**
14:53:06.0 **HOT-2**	'kay, let's see. okay we got PARMA and OPTOO. 'kay uh, one ten point seven, * ten point seven, I-P-X-P. two eighty inbound. glideslope's at PARMA at twenty-six fifty-eight. descent altitudes a thousand twenty in the baro. touchdown is seven ninety-one. minimum safe is thirty-one hundred to the east, twenty-seven to the west. if we have to go missed, climb to fourteen hundred feet, then climbing left turn to three thousand to the Dryer VOR and hold, teardrop. two and a half we have. PAPI on the right hand side. we'll get off at uh, I don't know, all the way down at Delta, I guess.		
		14:53:41.6 **APR1**	*attention all aircraft, new ATIS Charlie, current wind, two niner zero at one eight. visibility one quarter with heavy snow. ceiling.... I'm sorry it's uh one thousand one hundred scattered. ceiling's one thousand eight hundred broken, four thousand three hundred overcast. temperature's seven, minus seven. dew point minus one, one. altimeter two niner, niner, niner. runway two eight RVR, six thousand.
14:53:57.0 **HOT-1**	dude, one quarter mile visibility.		
14:53:59.6 **HOT-2**	I thought he did too.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME (EST) & SOURCE	**CONTENT**	**TIME (EST) & SOURCE**	**CONTENT**
14:54:02.4 **HOT-1**	well we got the RVR. so we're good there.		
14:54:07.6 **HOT-2**	man..... San Antonio's gonna be eighty degrees and sunny.		
14:54:14.0 **HOT-1**	yeah. there's half naked women everywhere.		
		14:54:18.2 **CLEOP**	sixty-four forty-eight, you copy?
14:54:20.6 **HOT-2**	I heard that the La Quin... the La Quinta hotel is pretty.... good pool that....		
14:54:26.5 **HOT-1**	aw, I've never been there.		
14:54:27.9 **HOT-2**	you've never been there? I was there once.		
		14:54:34.3 **APR1**	Shuttlecraft sixty-four forty-eight, descend and maintain seven thousand.
		14:54:37.0 **RDO-1**	seven thousand, Shuttlecraft sixty-four forty-eight.

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME (EST) & SOURCE	CONTENT	TIME (EST) & SOURCE	CONTENT
14:54:40.0 **HOT-2**	seven thousand set.		
14:54:41.3 **HOT-1**	seven set.		
14:54:42.1 **HOT-2**	ten thousand two-fifty manual.		
14:54:43.3 **HOT-1**	roger that.		
14:54:43.6 **PA-1**	[sound of chime] flight attendants prepare for approach and landing.		
14:54:54.8 **HOT-1**	aah, you have to do one of them dashboard approaches now.		
14:54:58.1 **HOT-2**	what's that?		
14:54:59.2 **HOT-1**	you have to do one of them there dashboard approaches down to….		
14:55:03.9 **HOT-2**	down to the mins?		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME (EST) & SOURCE	**CONTENT**	**TIME (EST) & SOURCE**	**CONTENT**
14:55:04.9 **HOT-1**	yeah.		
14:55:06.4 **HOT-2**	sounds like it doesn't it?		
14:55:08.0 **HOT-1**	six thousand RVR. screw that, I'm going home.		
14:55:29.2 **HOT-2**	what's, actuate vectors again?		
14:55:33.3 **HOT-1**	what is it?		
14:55:35.3 **HOT-2**	yeah, does it accept vectors?		
14:55:36.9 **HOT-1**	yeah, it's just gonna give you PARMA to the runway.		
14:55:52.0 **HOT-?**	*.		
14:55:52.6 **HOT**	[sound similar to altitude alert]		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME (EST) & SOURCE	CONTENT	TIME (EST) & SOURCE	CONTENT
		14:56:26.4 **APR1**	Shuttlecraft sixty-four forty-eight turn right heading zero four zero.
		14:56:30.0 **RDO-1**	zero four zero, Shuttlecraft sixty-four forty-eight.
14:56:33.7 **HOT-2**	zero four zero.		
14:56:36.5 **HOT-1**	"royer."		
		14:57:40.1 **APR**	Shuttlecraft sixty-four forty-eight turn right heading zero seven zero. descend and maintain six thousand.
		14:57:44.9 **RDO-1**	zero seven zero, down to six thousand, Shuttlecraft sixty-four forty-six.
14:57:48.4 **HOT-2**	zero seven zero down to six thousand.		
		14:57:49.8 **APR1**	Shuttlecraft sixty-four forty-eight, when able, maintain one eight zero knots and contact Cleveland approach one, one, niner point six two.
14:57:56.6 **CAM**	[sound similar to altitude alerter]		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME (EST) & SOURCE	**CONTENT**	**TIME (EST) & SOURCE**	**CONTENT**
		14:57:57.7 **RDO-1**	we'll slow to one eighty when able and uh, nineteen sixty -two, good day, Shuttlecraft sixty-four forty-eight.
		14:58:02.8 **APR1**	good day sir.
14:58:05.2 **HOT-2**	seven for six.		
14:58:06.6 **HOT-1**	seven for six.		
		14:58:21.7 **RDO-1**	approach, Shuttlecraft sixty-four forty-eight six five leveling six thousand.
		14:58:26.1 **APR1**	Shuttlecraft sixty-four forty-eight Cleveland approach roger, fly heading zero one zero.
		14:58:30.4 **RDO-1**	zero one zero, Shuttlecraft sixty-four forty-eight.
14:58:34.3 **HOT-?**	now.		
14:58:41.6 **HOT-2**	flaps one.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME (EST) & SOURCE	CONTENT	TIME (EST) & SOURCE	CONTENT
		14:58:42.8 **APR2**	Jetlink twenty two thirty-five, six miles from PARMA....
14:58:45.2 **HOT-1**	flaps one.		
		14:58:45.8 **APR2**	... maintain three thousand 'til established on the localizer. cleared ILS runway two eight approach. glideslope unusable.
14:58:50.2 **HOT-2**	what? glideslope unusable. can't be a quarter mile visibility. what the heck's going on here?		
14:58:56.9 **HOT-1**	glideslope's unusable.		
14:59:00.9 **HOT-2**	what the?		
		14:59:10.1 **APR2**	Shuttlecraft sixty-four forty-eight descend and maintain three thousand.
		14:59:13.2 **RDO-1**	three thousand, Shuttlecraft sixty-four forty-eight.
14:59:15.2 **HOT-2**	three thousand set.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME (EST) & SOURCE	**CONTENT**	**TIME (EST) & SOURCE**	**CONTENT**
14:59:17.0 **HOT-1**	three set.		
14:59:19.0 **HOT-2**	flaps two.		
14:59:25.8 **HOT-1**	flaps two. it's not an ILS if the glideslope is unusable.		
14:59:29.4 **HOT-2**	how can it be quarter mile visibility?		
14:59:31.1 **HOT-2**	should I ** put the flaps two down yet?		
14:59:34.6 **HOT-1**	what's that?		
14:59:35.4 **HOT-2**	I shouldn't have flaps two yet.		
		14:59:36.8 **APR2**	Shuttlecraft sixty-four forty-eight turn left heading three five zero.
		14:59:41.2 **RDO-1**	left three five zero, Shuttlecraft sixty-four forty-eight.
14:59:46.6 **HOT-1**	it's not an ILS if there's no glideslope.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME (EST) & SOURCE	**CONTENT**	**TIME (EST) & SOURCE**	**CONTENT**
14:59:48.8 **HOT-2**	exactly, it's a localizer.		
14:59:50.8 **HOT-1**	yeah.		
14:59:58.5 **HOT-2**	localizer.		
15:00:02.1 **HOT-1**	we can still shoot it?		
		15:00:03.8 **APR2**	Shuttlecraft sixty-four forty-eight, turn left heading three zero zero. intercept the runway two eight localizer.
		15:00:08.4 **RDO-1**	three zero zero intercept two eight localizer, Shuttlecraft sixty-four forty-eight.
15:00:11.3 **HOT-2**	three zero, zero to intercept.		
15:00:16.5 **HOT-1**	roger.		
15:00:20.5 **HOT-2**	flaps three.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME (EST) & SOURCE	CONTENT	TIME (EST) & SOURCE	CONTENT
15:00:22.3 **HOT-1**	flaps three.		
15:00:25.4 **HOT-2**	wonder why they put it on two eight without a local, glide slope if it's uh...?		
15:00:28.5 **HOT-1**	I don't know.		
15:00:29.8 **HOT-2**	ILS....		
		15:00:29.9 **APR2**	Shuttlecraft sixty-four forty-eight, seven miles from PARMA. maintain three thousand 'til established on the localizer. cleared ILS runway two eight approach, glideslope unusable.
15:00:40.4 **HOT-1**	what 'til established, three thousand?		
15:00:41.7 **HOT-2**	three thousand.		
		15:00:42.7 **RDO-1**	three thousand 'til established, cleared ILS two eight, Shuttlecraft sixty-four forty-eight.
15:00:48.8 **HOT-1**	[sound of coughs]		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME (EST) & SOURCE	CONTENT	TIME (EST) & SOURCE	CONTENT
		15:00:52.2 **APR2**	Shuttlecraft sixty-four forty-eight, maintain one eight zero knots 'til PARMA. contact tower now one two four point five.
		15:00:58.8 **RDO-1**	one eighty 'til PARMA and twenty-four five good day, Shuttlecraft sixty-four forty-eight.
		15:01:02.1 **APR2**	good day.
15:01:03.5 **HOT-1**	[sound of coughs]		
		15:01:08.9 **RDO-1**	tower good afternoon, Shuttlecraft sixty-four forty-eight uh um, localizer to two eight.
		15:01:15.1 **TWRC**	Shuttlecraft sixty-four forty-eight Cleveland tower, runway two eight, cleared to land. wind three one zero at one two. braking action reported fair.
		15:01:22.8 **RDO-1**	cleared to land two eight, Shuttlecraft sixty-four forty-eight.
15:01:26.2 **HOT-1**	this is just, feels wrong.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME (EST) & SOURCE	**CONTENT**	**TIME (EST) & SOURCE**	**CONTENT**
15:01:28.3 **HOT-2**	yeah, something's # up.		
15:01:29.4 **HOT-2**	so while we're eight miles from the runway so eight tenths * twenty-four hundred.		
15:01:31.9 **HOT-1**	[sound of cough]		
15:01:33.8 **CAM**	[sound of tone similar to altitude alerter]		
15:01:34.8 **HOT-2**	twenty-four hundred plus eight hundred, thirty-two hundred so we should be about thirty-two hundred feet.		
15:01:38.8 **HOT-1**	we need to go down a lot faster.		
15:01:42.6 **HOT-2**	flaps three.		
15:01:44.1 **HOT-1**	we're already at three.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME (EST) & SOURCE	CONTENT	TIME (EST) & SOURCE	CONTENT
15:01:44.9 **HOT-2**	all right, you know what, gear down, landing checklist.		
15:01:47.6 **HOT-1**	gear down.		
15:01:48.2 **CAM**	[sound similar to landing gear being operated]		
15:01:50.1 **HOT-1**	[sound of multiple coughs]		
15:01:51.1 **CAM**	[sound of two hi-lo chimes]		
15:01:56.7 **HOT-1**	I got ground contact.		
15:01:59.6 **HOT-1**	okay, they're just....		
15:02:01.0 **HOT-2**	glideslope capture.		
15:02:02.7 **HOT-1**	yeah.		
15:02:05.8 **HOT-1**	uuh.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME (EST) & SOURCE	CONTENT	TIME (EST) & SOURCE	CONTENT
15:02:07.8 **HOT-1**	flight attendants notified EICAS check. landing gear verified down three green.		
15:02:10.5 **HOT-2**	down three green, flaps five, set V approach. below the line.		
15:02:16.6 **HOT-?**	oops.		
15:02:22.9 **HOT-1**	flaps verified five.		
15:02:24.3 **HOT-2**	five.		
15:02:25.0 **HOT-1**	landing checklist complete.		
		15:02:25.0 **TWRC**	runway two eight RVR is two thousand two hundred.
15:02:29.7 **HOT-1**	are we inside the marker?		
15:02:31.5 **HOT-2**	uuuh, yep.		
15:02:32.1 **HOT-1**	yep.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME (EST) & SOURCE	CONTENT	TIME (EST) & SOURCE	CONTENT
15:02:35.4 **HOT-2**	what'd he say it'd up to, anyway?		
15:02:39.1 **HOT-1**	we're inside the marker, we can keep going.		
15:02:41.8 **HOT-1**	this is # up.		
15:02:45.9 **HOT-2**	if we have to go around, go around TOGA. flaps two, positive rate, gear up. heading or FMS nav. tell tower, flaps one, flaps up.		
15:02:54.6 **HOT-1**	I'm gonna go ahead and.... tell 'em I missed up here.		
15:03:01.6 **HOT-1**	[sound of several coughs]		
15:03:03.8 **HOT-2**	localizer's captured, glideslope's captured.		
		15:03:12.6 **TWRC**	and runway two eight RVR now is two thousand.
15:03:16.4 **HOT-2**	Jesus....		
15:03:17.7 **HOT-1**	gotta be fun.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME (EST) & SOURCE	CONTENT	TIME (EST) & SOURCE	CONTENT
15:03:28.1 **HOT-1**	gotta have twenty four to shoot, the fricken ILS.		
15:03:35.0 **HOT-1**	thousand feet.		
15:03:41.3 **HOT-1**	we're cleared to land.		
15:03:46.5 **HOT-1**	[sound of multiple coughs]		
15:03:54.2 **HOT-1**	gettin' some ground contact on the sides. nothing out front.		
15:04:04.6 **HOT-1**	sound of multiple coughs]		
15:04:29.1 **HOT-1**	five hundred bug, sinking five hundred.		
15:04:40.4 **HOT-1**	why the hell is it turning?		
15:04:43.0 **HOT-2**	the winds.		
15:04:44.4 **HOT-1**	shifting?		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME (EST) & SOURCE	CONTENT	TIME (EST) & SOURCE	CONTENT
15:04:46.4 **HOT-2**	yeah.		
15:04:46.4 **HOT-3**	approaching minimums.		
15:04:48.8 **HOT-1**	[sound of cough]		
15:04:49.1 **HOT-2**	Jesus.		
15:04:52.6 **HOT-3**	two hundred, minimums....		
15:04:53.6 **HOT-1**	I got the lights....		
15:04:54.5 **HOT-3** .	..minimums.		
15:04:54.7 **HOT-2**	..and continuing.		
15:04:57.6 **HOT-1**	runway lights are in sight.		
15:05:04.8 **HOT-1**	I can't see the runway dude, let's go.		
15:05:06.3 **HOT-2**	I got the end of the runway.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME (EST) & SOURCE	CONTENT	TIME (EST) & SOURCE	CONTENT
15:05:07.1 **HOT-3**	fifty....		
15:05:07.4 **HOT-1**	you've got the runway?		
15:05:08.0 **HOT-1**	yeah, there's the runway, got it.		
15:05:08.9 **HOT-3**	forty. auto-pilot, auto-pilot.		
15:05:12.7 **HOT-3**	thirty.		
15:05:12.8 **HOT-1**	holy #.		
15:05:14.7 **HOT-3**	ten.		
15:05:19.3 **HOT-2**	oh # dude.		
15:05:24.7 **HOT-1**	oh #.		
15:05:28.9 **CAM**	[sound of touchdown]		
15:05:32.7 **HOT-1**	two reverse.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME (EST) & SOURCE	**CONTENT**	**TIME (EST) & SOURCE**	**CONTENT**
15:05:39.1 **HOT-1**	oh #.		
15:05:40.8 **HOT-2**	#.		
15:05:42.4 **HOT-2**	oh #... no... [sound of gasp]		
15:05:46.3 **HOT-2**	[sound of groan]... #.		
15:05:50.3 **CAM**	[sound of numerous impacts and rumbling noise for seven seconds]		
15:05:51.7 **CAM-3**	landing gear.		
15:05:54.6 **CAM**	[sound of numerous chimes start and continue for fifty seconds]		
15:05:56.7 **CAM**	[sound similar to aircraft coming to a stop]		
15:05:57.7 **HOT-2**	#.		
15:06:01.9 **HOT-2**	#.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME (EST) & SOURCE	**CONTENT**	**TIME (EST) & SOURCE**	**CONTENT**
		15:06:03.7 **TWRC**	Shuttlecraft sixty-four forty-eight, say status.
15:06:09.3 **CAM-?**	#.		
15:06:22.7 **CAM-2**	#.		
15:06:29.8 **CAM-2**	oh #.		
15:06:34.6 **CAM-2**	* get ahold of anybody?		
15:06:43.7 **CAM-2**	#.		
15:06:51.9 **CAM-?**	**.		
15:06:51.9 **CAM-1**	everybody okay?		
15:06:52.5 **CAM-?**	yeah.		
15:06:57.3 **CAM-1**	see if you can call and get some*.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME (EST) & SOURCE	CONTENT	TIME (EST) & SOURCE	CONTENT
		15:07:01.3 **RDO-2**	tower, Shuttlecraft sixty-four forty-eight.
		15:07:03.6 **TWRC**	Shuttlecraft sixty-four forty-eight, say your status.
		15:07:06.2 **RDO-2**	yeah, we're off the runway through the fence uh, everybody seems to be okay on board.
		15:07:10.7 **TWRC**	Shuttlecraft sixty-four forty-eight roger. equipment's on the way.
		15:07:14.3 **RDO-2**	thank you.
15:09:02.6 **CAM-2**	yes, everybody's okay, right?		
15:09:03.9 **CAM-?**	yes.		
15:09:04.1 **CAM-2**	everybody's okay. I'm calling the company now.		
15:09:08.3 **CAM-1**	you wanna tell them braking action is nil?		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME (EST) & SOURCE	**CONTENT**	**TIME (EST) & SOURCE**	**CONTENT**
15:09:09.7 **CAM-2**	braking action is no, none at all.		
15:09:27.8 **CAM-2**	[one side of a cell phone conversation between First Officer and company official] man, I can't believe we had the runway at the very last second * runway , the lights and went in and then I landed *** blowing. then I landed and put the brakes on and saw the end of the fence and said what? put the brakes ** turn to.... [cell phone conversation continues]		
		15:09:41.1 **TWRC**	Shuttlecraft sixty-four forty-eight, tower.
15:09:52.9 **CAM-2**	full b, uh full right? full, seventy.		
		15:10:05.9 **TWRC**	Shuttlecraft sixty-four forty-eight, tower.
		15:10:10.2 **RDO-1**	go ahead.
		15:10:11.1 **TWRC**	do you know the uh, number of persons on board?

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME (EST) & SOURCE	CONTENT	TIME (EST) & SOURCE	CONTENT
		15:10:15.4 **RDO-1**	seventy plus four crew.
		15:10:17.7 **TWRC**	seventy plus four crew, thank you.
		15:10:19.4 **RDO-1**	and the braking action is nil.
		15:10:21.7 **TWRC**	got that.
		15:10:22.8 **CF-2**	**** everybody's o, everybody's okay, uh they got equipment coming on board, ** we went, ** the last second, landed, it's really windy, high snow, no braking action. we went right through a fence. ** landing gear's broken, I know that.... everybody's good, everybody's fine... uuh we were on two eight. they it changed two eight, from two four left. the glide slope was working, the glide slope was working, came in....
		15:10:58.1 **CF-2**	and uh, real windy, like I said, the last second we got the runway, landed. *** no braking action at all. slip, slip, slip, slip, turn plan to the end. we couldn't we went off the embankment through a fence and on to a side road. the uh NASA, hold on, the NASA or NTSB's here. hold on just a second....

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME (EST) & SOURCE	**CONTENT**	**TIME (EST) & SOURCE**	**CONTENT**
15:11:15.1 **CAM**	[sound of two chimes]		
15:11:17.7 **CAM-2**	who are you guys, NASA?		
		15:11:19.7 **CF-2**	...yeah, NASA's here already. 'cause they were sitting at the end of the runway watching **. And they said we came out of nowhere. they couldn't see us or anything.... nobody's hurt.... yeah...
		15:11:45.7 **CF-2**	*****.... okay.
15:12:00.1 **CAM-1**	are they gonna, they trying to deplane us do you know?		
15:12:02.4 **CAM-?**	** I have not idea.		
15:12:04.6 **CAM-2**	we get to get a hold of *, we have to get a hold of the people and find out what they want us to do.		
		15:12:08.4 **RDO-1**	and tower, Shuttlecraft sixty-four forty-eight.
15:12:10.6 **CAM-2**	*****.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME (EST) & SOURCE	CONTENT	TIME (EST) & SOURCE	CONTENT
		15:12:11.2 **TWRC**	Shuttlecraft sixty-four forty-eight, go ahead.
15:12:12.5 **CAM-?**	*****.		
		15:12:13.4 **RDO-1**	know if you have any transportation for passengers headed this way?
		15:12:16.2 **CF-2**	…* it's just a freak thing **** the runway, *** the runway. and I landed* kinda windy, I was trying to like ** centerline. couldn't see the centerline. soon as I landed I put the brakes on, no brakes at all. just slip, slip, slip, slip, oh oh, my God **** runway. ***freaking out, I knew we crash **....
		15:12:18.0 **TWRC**	I just know the uh, vehicles are out there. stand by, I'll see what they got.
15:12:23.6 **CAM**	[sound of two chimes]		
		15:12:43.9 **CF-2**	... yeah everybody's okay. nobody's hurt.... I don't know. ***.... how long ago ****? ten minutes ago, five minutes ago?

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME (EST) & SOURCE	**CONTENT**	**TIME (EST) & SOURCE**	**CONTENT**
15:12:56.8 **CAM-1**	five minutes ago.		
		15:12:57.7 **CF-2**	…five minutes ago, yeah.... yeah.... okay.... ***.... yeah.
		15:13:26.7 **TWRC**	Shuttlecraft sixty-four forty-eight, they're working on getting the vehicles out there for the uh, passengers. they should be there shortly.
		15:13:33.0 **RDO-1**	okay, thanks a lot.
15:13:35.6 **CAM-?**	They’re working on some transportation to get everybody off the airplane.		
		15:13:39.7 **TWRC**	and can you say what you're uh, tail number is?
		15:13:42.4 **RDO-1**	say again?
		15:13:43.3 **TWRC**	what's the uh, N number?
		15:13:44.7 **RDO-1**	eight six two Romeo Whiskey.

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME (EST) & SOURCE	CONTENT	TIME (EST) & SOURCE	CONTENT
		15:13:46.7 **TWRC**	eight six two Romeo Whiskey, thanks.
		15:13:59.8 **RDO-1**	and uh, we would like some medical assistance just in case out here.
15:14:04.7 **PA-5**	ladies and gentlemen right now the Captain is uh, in communication with the airport ***** how long it's going to be but they're working on it right now. ****** so if anyone needs to be checked out or just wants to be checked real quick both of those um, should be coming soon but we're not sure just when.		
		15:14:08.9 **TWRC**	and the vehicles are out there. they, should have that capability.
15:14:43.5 **PA-5**	is there anyone here who would like to see a paramedic?.... okay thank you.		
		15:14:44.7 **CF-2**	***** said not good on the landing. and then when we landed it was like none. as soon as we touched down **** and all of a sudden I see the runway pushed the brakes more and more and more and ***** try to steer it ****. I just kept sliding and sliding and sliding ** right, down an bank and right into a fence *** hear the bang....

	INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION
TIME (EST) & SOURCE	**CONTENT**	**TIME (EST) & SOURCE**	**CONTENT**
15:15:08.1 **CAM**	[several unintelligible comments between crewmembers]		
15:15:21.8 **CAM-?**	oh God.... #.		
		15:15:34.0 **CF-2**	…yes....*******....
15:15:43.3 **CAM-1**	I think we should have went around. they said, they said the braking action was fair.		
		15:15:49.9 **CF-2**	they said the braking was fair? **** not good…
15:15:54.1 **CAM-1**	no, we wouldn't have landed then.		
		15:15:56.6 **CF-2**	they said braking was fair.
15:16:00.2 **CAM-?**	everybody all right inside?		
15:16:02.1 **CAM-1**	nobody wants ***.		
		15:16:02.9 **CF2**	***** runway ***.... all right....

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME (EST) & SOURCE	**CONTENT**	**TIME (EST) & SOURCE**	**CONTENT**
15:16:13.1 **CAM**	[several unintelligible comments from outside the cockpit]		
15:16:23.6 **CAM-1**	you want us to just blow the slides?		
15:16:25.8 **CAM-?**	*.		
15:16:26.4 **CAM-1**	blow the slides?		
15:16:27.8 **CAM-?**	*.		
15:16:29.0 **CAM-?**	uh, probably better do it out the back.		
15:16:33.0 **CAM-?**	is it?		
15:16:34.8 **CAM-?**	I'm just worried about the ***.		
15:16:37.2 **CAM-?**	how about the other side. we got ****.		
15:16:44.8 **CAM-2**	the fence *****.		
15:16:48.9 **CAM**	[knocking sound]		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME (EST) & SOURCE	**CONTENT**	**TIME (EST) & SOURCE**	**CONTENT**
15:16:50.8 **CAM**	[sound similar to cockpit window being opened]		
15:16:52.7 **CAM-?**	can you blow that door ***side?		
15:16:54.3 **CAM-?**	yep.		
		15:16:55.2 **CF-2**	**** the slide now one the.... yeah ** want 'em to do that? Hold on, hold on ***. only way to get our ** a fence on the side of the plane *****....
15:16:58.7 **CAM**	[sound of two chimes]		
		15:17:39.0 **TWRC**	Shuttlecraft sixty-four forty-eight, I have another question.
		15:17:42.3 **RDO-1**	go ahead.
		15:17:43.1 **TWRC**	what was your departure point?
		15:17:45.1 **RDO-1**	Atlanta.

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME (EST) & SOURCE	CONTENT	TIME (EST) & SOURCE	CONTENT
		15:17:46.0 **TWRC**	thank you.
		15:17:49.8 **CF-2**	... no, just one....
		15:18:22.2 **CF-2**	... yeah * fire trucks here *******.
15:18:30.9 **CAM-?**	you all alright?		
15:18:32.5 **CAM-1**	yeah, I don't think anybody wants any assistance **.		
		15:18:48.8 **CF-2**	yeah, I think my body's in shock ***. hold on, ****.
15:18:59.8 **CAM-?**	we've asked, nobody needs any ***.		
		15:19:04.1 **CF-2**	... ****....
15:19:16.3 **END of TRANSCRIPT** **END of RECORDING**			

APPENDIX C

SHUTTLE AMERICA'S ATTENDANCE POLICY

Chautautauqua Airlines
Republic Airlines
Shuttle America

Associate Handbook
Chapter 8 Attendance/Tardiness
Section 1 Policy

Chapter 8
Attendance/Tardiness

Section 1 Policy

This policy supersedes and replaces all prior absence or attendance / tardiness policies and procedures. The following guidelines, in this section, may **not** be applicable to all associates. Associates are to refer to their Collective Bargaining Agreement where applicable.

A. Introduction / Statement of Policy:

We believe our associates are committed to coming to work on a regular schedule and on time. It is each associate's responsibility to report to work on time each day and to work the full scheduled workday or shift. We also recognize that associates experience sickness on occasion or are late to work for reasons beyond their control.

Tracking attendance, absences or tardiness is not intended to reflect negatively on any associate. Absences / tardiness are noted only to ensure that in rare instances of excessive absenteeism from the job associates are treated impartially and with fairness. For this reason, we have an Attendance and Tardiness Policy. The program is designed to encourage good attendance and provide a measure for fair treatment for any associate who is absent or late for work excessively.

In addition, this policy is designed to educate associates regarding their continuing obligation to report for and complete their scheduled shift and to return to work as expeditiously as possible after an absence. All associates are expected to return to active status after any absence or leave as soon as they are capable of resuming their job duties - even in the event they can return to work for a remaining portion of their scheduled shift. Associates are required to **personally contact** their Supervisor or, where applicable, Crew Scheduling (Flight Crew Members) as soon as possible regarding their absence or tardiness. If the associate's Supervisor is unavailable, they should contact their Supervisor's Manager.

Attendance / tardiness records are not part of an associate's personnel record unless disciplinary action is necessary. The actual attendance record will be maintained by each associate's immediate Supervisor / Manager.

Any Associate that abuses or takes advantage of "playing the system" of this policy could be subject to corrective action up to and including termination. Some examples of "playing the system" are calling in sick prior to a vacation or holiday or swap day, a pattern of sick days during the week, taking days off under the guise of illness or not receiving an approved vacation then calling in sick. This includes a pattern of attendance issues as soon as an occurrence has dropped off.

B. Occurrences of Absenteeism / Tardiness:

The focus of this program shall be frequency of "occurrences" of absenteeism / tardiness based on a cumulative occurrence system. An occurrence shall be a continuous absence from scheduled duty or reporting late to work. Occurrences of absenteeism / tardiness will vary in duration according to the nature of the event, and may range from 6 minutes (tardiness) to several weeks or more for a single event within a rolling twelve-month period. (Example: Reporting late for a scheduled duty REV. 5, 3 MAR 2003shift or an entire day's absence for a cold is one occurrence. Three consecutive day's absence due to having the flu shall be one occurrence or event).

Occurrences of Absenteeism / Tardiness

Occurrences for absenteeism / tardiness shall occur and accumulate, within an active rolling twelve - month period, when the following occurs:

Tardiness / Lateness - 1 occurrence:An associate reports more than 5 minutes late but less than 2 hours for a scheduled duty shift or fails to complete the scheduled shift.

Absenteeism / Sick Call - 1 occurrence: An associate is absent from scheduled work (more than 2 hours) or scheduled duty shift. Associate fails to return to work from vacation or leave on the day and time set for return. A Pilot or Flight Attendant that is absent for a scheduled duty assignment, incurs a missed trip event or reports to the Company that he/she is unavailable during a scheduled day of reserve prior to contact by the Company.

No Call / No Show - 4 occurrences: An associate fails to return to work from vacation or leave on the day and time set for return (fails to call or show) or associate fails to show or call for scheduled duty shift. Two (2) consecutive days without authorization or no call / no show notification to management will be considered a voluntary termination. The only exception for an associate unable to "no call / no show" is if they are personally hospitalized.

C. Absences / Tardiness Non - Chargeable under this Policy:

Republic Airways recognizes that some reasons for absence are appropriately excluded from being counted towards disciplinary action. Therefore, absences for the following reasons shall not be counted, provided proper documentation is produced and approved in advance of the event, as occurrences of absenteeism / tardiness:

- Funeral / Bereavement Leave- limits and procedures as stated in Associate Handbook.
- Jury Duty.
- Court Subpoena - civil or criminal cases in which associate is not a named party.
- Approved Military Leave.
- Workers' Compensation injuries or illnesses which has been filed and approved.
- Approved Family Medical Leave (FMLA).
- Approved Short Term Disability.
- Approved Vacation Leave or time off (paid or unpaid).
- Lack of work or emergency closing or layoff.

Note: Days missed or tardiness / late arrivals for a scheduled shift due to previous overtime, road trips, scheduled training classes, weather conditions or individual or facility / business conditions will be handled on an individual basis as approved by the Supervisor or Manager of the Department. Serious illness or injury may also be excluded; depending on the circumstances and as approved by the Supervisor or Manager of the Department with copies to the Vice President of the Department and the Human Resources Director.

D. Progressive Policy

The disciplinary process is progressive in nature but may be implemented or accelerated at any step, including termination, depending upon the severity of the situation. Example: In the case of a no call - no show and an associate's failure to properly notify their Supervisor / Manager of absence pursuant to this policy for a period of two or more days, termination will be warranted on the first offense or considered a voluntary quit.

E. Excessive Events of Absenteeism / Tardiness - Corrective Action:

Time Period	Number of Occurrences			
Within Previous	4	6	7	8
12 Months	Verbal	Written	Final/Suspension	Termination

Step #1- Verbal Warning: After the accumulation of **4 occurrences** of tardiness/ absenteeism as defined in this policy within an active rolling twelve-month period, the associate will be notified by their Supervisor / Manager that their attendance is a problem that needs their corrective attention. In addition, during this discussion, the Attendance / Tardiness Policy will be reviewed, and a copy provided to the associate, to ensure the associate understands the policy and the disciplinary steps that will be taken if absences / tardiness continue. The associate is to sign that they have received a copy of our Attendance Policy. This First Warning and signature of receipt of this policy will be forwarded to the Human Resources Department and placed in their personnel file.

Step #2 - Written Warning; After accumulating **6 occurrences of tardiness** / absenteeism within an active rolling twelve-month period from the date of the action, a disciplinary letter will be issued to the associate that their attendance is at an unacceptable level and that it requires their immediate attention to correct it. This letter will warn of further disciplinary action up to and including termination of employment if absences or tardiness continue. This Written Warning Letter will be placed in their personnel file. If associate completes 6 months of perfect attendance after receiving a written warning they will have 1 occurrence removed from their record.

Step #3 - Final Warning/Suspension: when an associate incurs **7 occurrences** of tardiness/absenteeism in an active rolling twelve-month period from the date of the action. The associate will be issued a final written warning letter that their tardiness or attendance continues to be at an unacceptable level which will include a disciplinary **suspension of three unpaid days off** as determined by Management. The associate must realize that this is the last warning before termination. This Final Warning Letter will be placed in their personnel file.

Step #4 - Discharge or Termination: If the associate has failed to correct their absenteeism / tardiness after receiving a first written warning, a second written warning, and a final warning of termination with suspension, the associate will be subject to termination of employment with Republic Airways, Inc. or if the associate accumulates **8 occurrences**.

F. Absence / Tardy Notification

Associates must personally (not spouses, relatives or others) contact their immediateSupervisor or their Supervisor's Manager or where applicable Crew Scheduling prior to the beginning of your scheduled shift if it will be necessary for the associate to be absent or late to work. Upon returning to their scheduled shift, associates are required to report to their immediate Supervisor (with their time card - where applicable) to discuss their absence / tardiness with their Manager. If the associate knows in advance that they will be absent, notification to their Manager should be made as far in advance as possible.

G. Management Guidelines

Associate disciplinary actions should be administered by the appropriate Supervisor / Manager within five (five) working days after the associate returns to work unless unusual circumstance or other business demands prevail. Any level of discipline shall be reviewed and approved by the appropriate Supervisor's Manager prior to communications with the associate. Management has the discretion to suspend (with or without pay) pending investigation of the associate before termination.

Note: The appropriate Vice President of the Department must approve all terminations prior to notification with the associate by any Supervisor or Manager. In advance, the Human Resource Director should be notified of any termination.