Runway Overrun During Landing
Pinnacle Airlines Flight 4712
Bombardier/Canadair Regional Jet CL600-2B19, N8905F
Traverse City, Michigan
April 12, 2007

ACCIDENT REPORT

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Aircraft Accident Report

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National Transportation Safety Board

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

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Abstract: This report explains the accident involving a Bombardier/Canadair Regional Jet CL-600-2B19, N8905F, operated by Pinnacle Airlines, Inc., which ran off the departure end of runway 28 after landing at Cherry Capital Airport, Traverse City, Michigan. The safety issues discussed in this report include the pilots' actions and decision-making during the approach, landing, and landing roll; pilot fatigue and line check airman duty time regulations; weather and field condition information and ground operations personnel communications; and criteria for runway closures in snow and ice conditions. Safety recommendations concerning these issues are addressed to the Federal Aviation Administration.

CONTENTS

ABBREVIATIONS AND ACRONYMS

AC	**advisory circular**
ACARS	**aircraft communications addressing and reporting system**
AFD	**airport facility directory**
agl	**above ground level**
AIM	*Aeronautical Information Manual*
ALPA	**Airline Pilots Association**
ARC	**aviation rulemaking committee**
ARFF	**aircraft rescue and firefighting**
ARTCC	**air route traffic control center**
ASAP	**aviation safety action program**
ASOS	**automated surface observing system**
ATC	**air traffic control**
ATCT	**air traffic control tower**
ATIS	**automatic terminal information service**
°C	**degrees Celsius**

CAMI	**Civil Aerospace Medical Institute**
CDT	**central daylight time**
CFM	**company flight manual**
CFR	*Code of Federal Regulations*
cg	**center of gravity**
CLE	**Cleveland-Hopkins International Airport**
CRJ	**Bombardier/Canadair Regional Jet**
CTAF	**common traffic advisory frequency**
CVR	**cockpit voice recorder**
DOT	**Department of Transportation**
DSM	**Des Moines International Airport**
DTW	**Detroit Metropolitan Wayne County Airport**
°F	**degrees Fahrenheit**
FAA	**Federal Aviation Administration**
FCTM	**flight crew training manual**
FDR	**flight data recorder**
FLIR	**forward-looking infrared device**

FOM	**flight operations manual**
FOQA	**flight operational quality assurance**
GE	**General Electric**
Hg	**mercury**
IFR	**instrument flight rules**
ILS	**instrument landing system**
KIAS	**knots indicated airspeed**
MAC	**mean aerodynamic chord**
MDW	**Chicago Midway International Airport**
MEM	**Memphis International Airport**
METAR	**meteorological aerodrome report**
MLG	**main landing gear**
MSP	**Minneapolis-St. Paul International Airport**
MU	**coefficient of friction**
N1	**engine fan speed**
NASA	**National Aeronautics and Space Administration**
NOTAM	**notice to airmen**

NWA	**Northwest Airlines**
NWS	**National Weather Service**
OE	**operating experience**
OpSpec	**operations specification**
POI	**principal operations inspector**
RVR	**runway visual range**
S/N	**serial number**
SAFO	**safety alert for operators**
SOC	**system operations control**
SPECI	**special weather observation**
TAF	**terminal aerodrome forecast**
TR	**thrust reverser**
TVC	**Cherry Capital Airport**
Vapp	**approach landing speed (Vref + 5 knots)**
Vref	**reference landing speed**
WSFO	**National Weather Service forecast office**

EXECUTIVE SUMMARY

On April 12, 2007, about 0043 eastern daylight time, a Bombardier/Canadair Regional Jet (CRJ) CL600-2B19, N8905F, operated as Pinnacle Airlines flight 4712, ran off the departure end of runway 28 after landing at Cherry Capital Airport (TVC), Traverse City, Michigan. There were no injuries among the 49 passengers (including 3 lap-held infants) and 3 crewmembers, and the aircraft was substantially damaged. Weather was reported as snowing. The airplane was being operated under the provisions of 14 *Code of Federal Regulations* Part 121 and had departed from Minneapolis-St. Paul International (Wold-Chamberlain) Airport, Minneapolis, Minnesota, about 2153 central daylight time. Instrument meteorological conditions prevailed at the time of the accident flight, which operated on an instrument flight rules flight plan.

The National Transportation Safety Board determines that the probable cause of this accident was the pilots' decision to land at TVC without performing a landing distance assessment, which was required by company policy because of runway contamination initially reported by TVC ground operations personnel and continuing reports of deteriorating weather and runway conditions during the approach. This poor decision-making likely reflected the effects of fatigue produced by a long, demanding duty day, and, for the captain, the duties associated with check airman functions. Contributing to the accident were 1) the Federal Aviation Administration pilot flight and duty time regulations that permitted the pilots' long, demanding duty day and 2) the TVC operations supervisor's use of ambiguous and unspecific radio phraseology in providing runway braking information.

The safety issues discussed in this report include the pilots' actions and decision-making during the approach, landing, and landing roll; pilot fatigue and line check airman duty time regulations; weather and field condition information and ground operations personnel communications; and criteria for runway closures in snow and ice conditions.

1. FACTUAL INFORMATION

1.1 History of Flight

On April 12, 2007, about 0043 eastern daylight time,[1] a Bombardier/Canadair Regional Jet (CRJ) CL600-2B19, N8905F, operated as Pinnacle Airlines flight 4712, ran off the departure end of runway 28 after landing at Cherry Capital Airport (TVC), Traverse City, Michigan. There were no injuries among the 49 passengers (including 3 lap-held infants) and 3 crewmembers, and the aircraft was substantially damaged. Weather was reported as snowing. The airplane was being operated under the provisions of 14 *Code of Federal Regulations* (CFR) Part 121 and had departed from Minneapolis-St. Paul International (Wold-Chamberlain) Airport (MSP), Minneapolis, Minnesota, about 2153 central daylight time (CDT). Instrument meteorological conditions prevailed at the time of the accident flight, which operated on an instrument flight rules (IFR) flight plan.

The accident occurred on the fifth and final scheduled flight segment on the first day of a scheduled 4-day trip for the flight crew. The flight was scheduled to depart MSP about 2030 CDT for a scheduled arrival time at TVC of 2251. However, when the pilots arrived at the gate for the accident flight, the gate agent advised them that the flight release paperwork was not available and that the flight might be cancelled. About 2022 CDT (about 8 minutes before the accident flight was originally scheduled to depart), the Pinnacle dispatcher provided the captain with details, indicating that the flight could not be dispatched to TVC because the forecast winds at TVC resulted in a tailwind component that exceeded the CRJ's 10-knot landing tailwind component limitation. However, about 22 minutes later, the dispatcher advised the captain that the flight could be dispatched because a new forecast predicted a smaller tailwind component for the landing at TVC. Postaccident interviews indicate that Pinnacle's system operations control (SOC) duty manager had reviewed the observed conditions and forecast for TVC (from Northwest Airline's [NWA] meteorology department) and approved the release.

The flight's dispatch documentation, which listed Detroit Metropolitan Wayne County Airport (DTW) as a destination alternate airport, was subsequently issued about 2043 CDT. However, because the flight was delayed, an update of the airplane's flight management system database software was required before the airplane could depart. After installation of this software, the airplane was pushed back from the gate at MSP about 2144 CDT. The pilots taxied the airplane to the runway 30R deice pad, where it was deiced and the departure clearance was issued. About 2153 CDT, an MSP air traffic control tower (ATCT) controller issued a takeoff clearance, and the accident flight departed for TVC.

Postaccident crew interviews and review of the cockpit voice recorder (CVR) transcript indicated that the departure, climb, and en route portion of the flight from MSP

[1] Unless otherwise indicated, all times are eastern daylight time, based on a 24-hour clock.

to TVC was routine. The captain/check airman was the flying pilot and was overseeing the first officer's initial operating experience (OE)[2]; the first officer performed the duties of the monitoring pilot. The CVR recorded several instances during the accident flight in which the pilots indicated that they were tired. For example, the CVR recorded the following statements on the captain's channel: 1) about 2332:12, "yeah, just tired. Too late for this…;" 2) about 2341:53, "aw I'm tired dude, just (expletive) worn out;" and 3) about 0018:43 "…a wet dog ready to go to sleep tonight dude." Additionally, about 0020:41, the CVR recorded the first officer stating, "jeez, I'm tired." Further, several yawns were recorded on the captain's channel (about 2340:00, 0001:06, 0004:00, and 0009:47).

Because the TVC ATCT had closed at 2200 the night of the accident (consistent with its normal operations), the captain briefed the first officer regarding landing at TVC at night, after the tower closed, in snowy windy weather conditions. Records indicate that the Pinnacle dispatch personnel who were providing flight-following services for the accident flight occasionally provided the pilots with updated TVC weather information during earlier portions of the flight. Specifically, the aircraft communications addressing and reporting system (ACARS) log showed that about 2354, dispatch personnel sent weather updates to the accident airplane indicating IFR conditions with restricted visibility in light snow. After reviewing the weather information (about 2357), the captain made a public address statement advising the passengers that the winds at TVC were "dying down significantly…so it looks like we're gonna have no problems gettin' in this evening."

About 0010, the pilots listened to the TVC automated surface observation system (ASOS) for updated airport weather information, which indicated, in part, that winds were out of 040° at 7 knots and visibility of 1 1/2 miles in light snow. About 0021, the MSP Air Route Traffic Control Center (ARTCC) controller confirmed that the accident pilots had received the current TVC weather and began to issue radar vectors for the instrument landing system (ILS) approach to runway 28 at TVC.[3] About 0025, the captain sent a message to dispatch indicating that the TVC weather looked good for the approach, citing winds out of 040 degrees at 8 knots. Company dispatch personnel responded, stating, "[w]e show that too, looks like we should be good."

The weather data subsequently recorded by the TVC's ASOS showed that the conditions at TVC began to deteriorate rapidly after 0025, with visibility of 1/2 mile in moderate snow, sky obscured, and vertical visibility of 400 feet. The pilots did not listen to the ASOS again as they continued to follow air traffic control (ATC)-provided radar vectors for the ILS approach to TVC; however, they did obtain information regarding runway conditions from TVC airport operations personnel. For example, beginning about 0025, the CVR recorded a radio conversation between the captain and the TVC airport

[2] The first officer was hired by Pinnacle on January 3, 2007, and successfully completed his CRJ ground training and proficiency check in February and March 2007, respectively. For additional information, see section 1.5.2.

[3] The ILS approach to runway 28, with minimums of a 200-foot decision height and 1/2-mile visibility, was the only precision approach at TVC. Nonprecision approaches, with higher minimum requirements, were available to runway 36 (which was closed). Only circling approaches (which were also nonprecision approaches with higher minimum requirements) were available to runway 10.

operations supervisor regarding the runway condition and ongoing snow removal operations. The airport operations supervisor indicated that he had "multiple pieces of [snow removal] equipment" on runway 28 and that he was "running numbers for you as we speak." The captain indicated that they would be landing in about 13 minutes.

According to the CVR, about 0026:56, the airport operations supervisor radioed the pilots, advising that the braking action on runway 28 was "40 plus,"[4] with "thin wet snow [over] patchy thin ice…give us about [5 to 8] minutes to clear the runway…when you're ready to land." About 0029:10, the CVR recorded the captain stating, "there's snow removal on the field yet they're showing forty or better sounds like a contaminated… runway to me." During the next 4+ minutes, the CVR recorded additional conversation between the pilots, TVC operations, and MSP ARTCC personnel regarding the status of the snow removal equipment on the runway and the timing of the approach. About 0032:16 (about 6 minutes before the captain's estimated arrival time), the airport operations supervisor contacted the pilots to indicate that the last snow plow was off the runway. The captain responded, advising that the accident flight would be turning inbound and requesting additional airport traffic advisories if applicable.

About 0033, the captain advised the MSP ARTCC controller that the TVC runway was clear of snow removal equipment; the controller advised him that it would "be about another…2 minutes 'til I get you out far enough to turn you back onto the ILS." The pilots then discussed the length of the landing runway, and, about 0033:46, the captain stated, "…and at night it'll feel short too...with contaminant…more than likely." About 0034, the airport operations supervisor contacted the accident pilots again regarding their proximity to the airport. The captain replied that they expected an inbound turn clearance from the controller in about 1 minute, and the airport operations supervisor responded, "okay, roger that…it's comin' down pretty good here so ahhh (guess) I'll see you on the ground here." About 1 minute later, the airport operations supervisor queried the pilots about their progress, indicating "it's comin' down pretty good guys, just to give you a heads up." About 7 seconds later (about 0035:42), the controller issued the first of a series of heading changes, vectoring the accident pilots towards the approach to runway 28.

About 0036:19, the captain commented to the first officer, "…says it's comin' down good, which means its snowing…and we probably won't see the runway, so be ready for the missed [approach]." About 1 minute later, the airport operations supervisor contacted the pilots, stating "I need to know if [you] guys are gonna be landing soon 'cause I gotta… this is fillin' in pretty quick down here…so, ah, how far are you guys out?" The captain replied that they were intercepting the approach course inbound and anticipated landing in "4 1/2, 5 minutes at the most."

According to the CVR, at 0038:03.2, the airport operations supervisor stated, "…I don't know what the ah conditions [are] like…the runway, but I'm gonna call braking

[4] The "40 plus" braking report was based on the runway coefficient of friction values (.40+) obtained by ground personnel using an electronic recording decelerometer. Federal Aviation Administration guidance indicates that an airplane's braking performance starts to deteriorate and directional control begins to be less responsive at MU values of .40 or less.

action nil now.[5] 'Cause it's fillin' in real hard." However, during that transmission, beginning at 0038:04.3, the controller also contacted the pilots, issuing another heading change for the approach. CVR information and postaccident interviews indicated that the pilots did not recognize or acknowledge the airport operations supervisor's nil braking action report. About 0038:30, the controller cleared the pilots for the ILS runway 28 approach at TVC. Postaccident evaluation of the CVR revealed that the first officer was initially monitoring both the common traffic advisory frequency (CTAF) and MSP ARTCC frequencies but turned down the volume on the CTAF to hear the ATC assignment. The captain acknowledged the approach clearance, and the pilots continued toward the airport. About 0039:21, the CVR recorded the captain saying, "I mean, what kind of report's that, it's fillin in? Ya know doesn't tell me good, bad, fair, poor." About 24 seconds later, the controller advised the pilots, "…show you joining the [approach course], radar services terminated, change to advisory frequency approved."

About 0040:46, the CVR recorded the captain advising TVC traffic on the CTAF that the flight was inbound from the final approach fix and about 2 minutes from the airport. The airport operations supervisor responded that all equipment was clear of the runway, adding, "…and again ah brakin' actions probably nil on the runway." About 0040:57, the captain asked, "Are you saying it's nil?" and the airport operations supervisor responded, "…haven't been out there to do a field report and it's been ah 5, 10 minutes, so I don't know what it's doin' now." About 0041:05, the captain replied, "ok," and then said to the first officer, "He's not reporting it nil, he's like he's sayin' it's nil. Heh."

Beginning about 0041:15, the pilots performed the before landing checklist, confirming appropriate landing gear, flap, and thrust reverser settings. About 0041:31, as the airplane descended through about 1,000 feet above ground level (agl) on the approach, the captain asked TVC airport operations "how deep of a [contaminant] would you say it is?" and airport personnel responded, "…I'd say it's probably close to half inch now." The captain responded, "okay, that's not bad, thank you" and explained to the first officer, "We're allowed 3 inches[6]…if it looks ugly when we're comin' in I'll go around…half inch is nothin'." As the approach descent continued, about 0042:05, the captain continued to discuss issues relevant to a possible go-around with the first officer. About 0042:42, the captain announced that the runway was in sight and that they would continue to a landing.

At 0042:42.9, about 1 second after the captain saw the runway, the CVR recorded an electronic voice stating, "minimums." The airplane touched down at 0043:03.7. Review of flight data recorder (FDR) data indicated that the accident airplane crossed

[5] TVC ground operations personnel are qualified to judge runway surface conditions based on ground vehicle handling characteristics as well as runway friction measuring equipment. During postaccident interviews, the TVC airport operations supervisor stated that, because he did not have time to do a full field condition measurement and report before the accident airplane arrived, he based his nil braking action reports on tests he conducted with his vehicle on runway 28, during which he perceived "minimal to nonexistent" braking action and "uncertain" directional control.

[6] According to the CRJ airplane flight manual, operations on runways with up to 3.75 inches of loose snow contaminant are permitted if all other operational criteria (for example, runway length) are met. The CRJ flight manual included more restrictive limitations for other contaminant categories, including compacted snow, standing water/slush, and ice.

the approach threshold of runway 28 at an airspeed of about 148 knots[7] and touched down on the runway about 2,400 feet from the threshold at an airspeed of 123 knots. The FDR data showed that the brakes were applied and the spoilers deployed immediately after the airplane touched down and that the thrust reversers were fully deployed within 4 seconds after touchdown. FDR information further showed that the thrust reversers were deployed and stowed twice during the landing roll. The first deployment occurred when the airplane was about 3,000 feet from the departure end of the runway, and the second deployment occurred when the airplane was about 1,100 feet from the departure end of the runway.

The airplane ran off the end of runway 28 at a ground speed of about 47 knots, on a heading of about 254°. It came to a stop on a heading of about 250°, about 100 feet west of the end of the 200-foot-long, 190-foot-wide blast pad pavement located off the end of runway 28.

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	0	0	0
None	2	1	49	0	52
Total	2	1	49	0	52

Note: Title 14 CFR 830.2 defines a serious injury as any injury that (1) requires hospitalization for more than 48 hours, starting within 7 days from the date that the injury was received; (2) results in a fracture of any bone, except simple fractures of fingers, toes, or the nose; (3) causes severe hemorrhages or nerve, muscle, or tendon damage; (4) involves any internal organ; or (5) involves second- or third-degree burns or any burns affecting more than 5 percent of the body surface. A minor injury is any injury that does not qualify as a fatal or serious injury.

1.3 Damage to Airplane

The airplane had substantial, but repairable, damage, primarily to the forward lower fuselage, including the nose gear well area.

1.4 Other Damage

No other damage was reported.

[7] Based on the airplane's estimated landing weight of 46,473 pounds, the pilots decided to use the more conservative landing card information, which indicated a landing reference speed (V_{ref}) of 142 knots (with up to 5 knots added for gusty winds) for a landing weight of 47,000 pounds.

1.5 Personnel Information

1.5.1 The Captain

The captain, age 27, was hired as a first officer by Pinnacle on May 11, 2001. He was upgraded to captain in April 2004 and to line check airman status in August 2006. The captain held a multiengine airline transport pilot certificate with a type rating in the CRJ. The captain held a first-class Federal Aviation Administration (FAA) airman medical certificate, dated February 14, 2007, with the limitation that he "must wear corrective lenses." During postaccident interviews, the captain stated that he was wearing contact lenses at the time of the accident.

The captain told investigators that he started flying in 1997, received his private pilot certificate in 1998, and his commercial pilot certificate, flight instructor certificates, instrument rating, and multiengine rating in 1999. He stated that he worked as a flight instructor at Henderson State University, Henderson, Arkansas, for about 2 years and also flew under contract with Arkansas Game and Fish Commission before he was hired by Pinnacle.

According to the captain's Pinnacle employment and flight records, he had flown about 5,600 hours total flight time, including about 4,200 hours in CRJs, of which about 2,500 hours were flown as CRJ captain. He had flown about 220, 54, 28, and 8 hours in the 90, 30, and 7 days and 24 hours, respectively, before the accident. Company records showed that the captain obtained his initial CRJ type rating in March 2004. His most recent line check occurred in April 2006, and his most recent CRJ proficiency check and recurrent ground training occurred in March 2007. A search of FAA records revealed no accident or incident history or enforcement actions for the captain. A search of the National Driver Register found no record of driver's license suspension or revocation.

The captain was based at Memphis International Airport (MEM), Memphis, Tennessee, and commuted from his home near Pensacola, Florida. He was married, and, 6 months before the accident, his wife had given birth to their first child. According to the captain, his personal and financial situations changed with the birth of his son and his wife quitting work. The captain characterized his health as good and indicated that there were no major health changes during the previous 6 months. The captain stated that when he was home without work demands, he typically went to bed about 2130 and awakened about 0730. However, he further stated that when he was home his sleep could be interrupted because he tried to provide relief for his wife during the night by responding when his son awakened.

About 2040 on April 6, the captain and the first officer completed a 2-day OE training trip.[8] The captain commuted home from Minneapolis to Pensacola on April 7. He

[8] The captain told investigators that he initially tried to find another check airman to conduct the first officer's OE because the accident pilots were personal friends. However, no other check airman was available. The captain stated that he attempted to perform the OE with the same strictness he would for any other candidate.

told investigators that he followed normal activities at home on April 8 and 9, although his sleep was interrupted at night by his son. The captain was initially scheduled to be off duty on April 10 but instead was rescheduled (on 3-day notice) to fly that day. He stated that he awoke about 0305 on April 10 and performed a checkride on a flight from Pensacola to MEM and then conducted captain line training during a trip from MEM to MSP. Upon arrival at MSP, the captain learned that the scheduling office had assigned him a flight extension (that is, a round trip flight to Louisville, Kentucky). The captain stated that he was prepared to accept the flight extension (because company policies permit pilots to refuse only one extension per month), but another captain was assigned in his place. The accident captain returned to the crew lounge and, about 1645 CDT, met the accident first officer for dinner. The captain stated that he drank alcohol with dinner but, consistent with company requirements, ceased alcohol consumption at least 12 hours before his scheduled reporting time for duty. He went to the hotel about 2200 to 2230 CDT and said he slept soundly through the night.

On April 11, the captain awoke about 0700 CDT and ate breakfast at the hotel. He and the accident first officer caught a shuttle to the airport about 0800 CDT and checked in for their day about 0900 CDT. (The pilots caught an earlier airport shuttle than they needed for their scheduled 0940 report time because they anticipated weather-related shuttle delays.) The pilots' trip sequence began with a round trip from MSP to Cleveland-Hopkins International Airport (CLE), Cleveland, Ohio, with a 28-minute turnaround at CLE. During the 1-hour, 41-minute layover at MSP before their next flight, the captain ate lunch at an airport fast food outlet. The pilots then flew a round trip from MSP to Des Moines International Airport (DSM), Des Moines, Iowa, with a 22-minute turnaround at DSM. The pilots had a scheduled 30-minute turnaround at MSP before they were to depart for TVC, and the captain stated that he planned to eat a quick dinner during that time because he knew that all restaurants in Traverse City would be closed when they arrived. However, the flight from DSM to MSP arrived about 15 minutes later than scheduled. Upon the pilots' arrival, Pinnacle ground personnel advised the captain that their departure for TVC was delayed and that the flight would likely be canceled because of forecast wind conditions at TVC. (For additional information regarding the weather at TVC and the flight's dispatch, see section 1.7.) The captain stated that he was not sure when or if the flight to TVC would be released and was receiving updated information from Pinnacle dispatch, which resulted in a "rolling delay." He and the first officer stopped briefly for a beverage at an MSP coffee shop but did not eat dinner at the airport.

The captain stated that it was snowing and windy in MSP all day and that the trip sequence made them work. The first officer flew the legs from MSP to CLE and DSM, where the weather was better; the captain flew the return legs to MSP and landed in difficult crosswinds. The captain told investigators that, when they were en route to TVC, he realized that it had been a long day and that he was more tired than he had realized before the flight departed.

Company pilots who had flown with the captain[9] described him as professional, knowledgeable, approachable, and polite. The accident first officer described the captain as a good pilot with strong teaching abilities and a willingness to help.

1.5.2 The First Officer

The first officer, age 28, was hired as a first officer by Pinnacle on January 3, 2007. He held a commercial pilot certificate with a single-engine rating, issued in April 2000, a flight instructor certificate issued in July 2001, and a commercial pilot certificate with a multiengine rating issued in March 2002. Between April 2001 and his hire date with Pinnacle, the first officer was employed in various flight instructor and 14 CFR Part 135 freight and charter pilot positions. The first officer held a first-class FAA airman medical certificate, dated November 3, 2006, with the limitation that he "must wear corrective lenses." During postaccident interviews, the first officer stated that he was wearing glasses at the time of the accident. According to the first officer's Pinnacle employment and flight records, he had flown about 2,600 hours total flight time, including 22 hours in CRJs. He had flown about 22, 22, 15, and 8 hours in the 90, 30, and 7 days, and 24 hours, respectively, before the accident. Company records showed that the first officer obtained his initial CRJ ground training and proficiency check in February and March 2007, respectively, and was accomplishing his OE training at the time of the accident.[10] A search of FAA records revealed no accident or incident history or enforcement actions for the first officer. A search of the National Driver Register found no record of driver's license suspension or revocation.

The first officer was based at MEM and resided in the area, having relocated from California after he was hired by Pinnacle. The first officer was single and told investigators that his personal situation had changed when his mother died in November 2006. He reported that his financial situation had also changed and that he was having difficulty paying his bills because he was in training and earning a low starting salary at Pinnacle. The first officer characterized his health as good and indicated that there were no major health changes during the previous 6 months. The first officer told investigators that, when he did not have work demands, he typically went to bed about 2200 and awakened about 0800; however, he described his schedule as "crazy" and indicated that he sometimes slept until noon.

After the captain and the accident first officer completed their 2-day OE training trip on April 6, the first officer was off duty for several days, during which he visited relatives in San Diego, California. The first officer stated he went to bed about 2200 on April 9 and awakened between 0400 and 0430 on April 10 to catch a flight to MSP. The first officer told investigators that he arrived at MSP about midday, drank juice at an airport

[9] Five pilots were interviewed, including two first officers, a captain/check airman who had recently flown normal line trips with the captain, a captain who had completed a recent checkride administered by the accident captain, and the acting chief pilot, who had administered previous checkrides.

[10] Pinnacle records indicate that the first officer completed about 44 hours of CRJ simulator time and about 22 hours (of the minimum required 25 hours) of OE, consistent with the company's standard new-hire first officer training.

shop, then met with the accident captain to review the flight paperwork for the April 11 trip sequence. The first officer stated that after reviewing the paperwork, he and the captain ate dinner together and socialized until about 2145 CDT. The first officer indicated that he had a beer with dinner and went to sleep that night at the hotel about 2200 CDT. He awakened on April 11 about 0630 CDT, and he and the captain caught the shuttle to the airport and checked in for the day.

The first officer stated that he and the captain had fast food at MSP for lunch when they returned from CLE, then flew the round trip to DSM. The first officer indicated that the pilots were scheduled to have a 30-minute turnaround upon their return to MSP before departing for TVC. However, he stated that the MSP-TVC flight release was delayed, and the flight's departure was further delayed because of deicing. The first officer stated that he was a little tired during the accident flight but felt okay.

The first officer was described favorably by two company simulator instructors as a pleasant person and dedicated student with flying skills commensurate with his flight time. The accident captain described the first officer as progressing normally toward OE approval, with above average airplane handling skills but below average skills on airplane systems and company procedures.

1.6 Airplane Information

1.6.1 General

The accident airplane, serial number (S/N) 7905, was manufactured by Bombardier and received its FAA airworthiness certificate in December 2003. According to the manufacturer, the CRJ was designed for use in regional airline operations and has swept-back wings with winglets and a T-tail.[11] The airplane was equipped with two tail-mounted General Electric (GE) CF34-3B1 turbofan engines, which were installed new in December 2003. At the time of the accident, the airplane had accumulated about 8,219 total flight hours and 6,462 cycles.[12]

According to flight dispatch information, the airplane's actual takeoff weight for the accident flight was 49,473 pounds; the estimated TVC landing weight was 46,473 pounds. Airplane documentation indicates that the maximum structural takeoff and landing weights are 53,000 and 47,000 pounds, respectively. The calculated landing center of gravity (cg) was 13.7 percent mean aerodynamic chord (MAC), and the airplane's cg range extended from 9 to 35 percent MAC.

[11] A T-tail is a design in which the airplane's horizontal tail surfaces are mounted to the top of the vertical tail surfaces above the fuselage.

[12] An airplane cycle is one complete takeoff and landing sequence.

1.6.2 Airplane Deceleration Device Information

Each main landing gear (MLG) wheel assembly is equipped with inboard and outboard hydraulic disc brake assemblies. The brakes are applied when the pilot(s) apply pressure to the brake pedals, resulting in mechanical inputs to the dual brake control valves through the brake control push/pull mechanism. Resultant hydraulic pressure to the brake assemblies is modulated by the airplane's antiskid control system, which is designed to provide optimum braking efficiency under all runway surface conditions.

Pneumatically operated thrust reversers on the airplane's engines are also used to slow the airplane after landing. When the thrust reversers are deployed, blocker doors change the direction of the engine fan air, moving it outward and forward to create reverse thrust. The thrust reversers are operated by levers located on the forward side of the thrust levers on the throttle quadrant.

The National Transportation Safety Board's postaccident examination of related FDR data and testing and examination of associated system components revealed no evidence of preimpact fault or anomaly in the braking, antiskid, or thrust reverser systems.

1.7 Meteorological Information

1.7.1 Cherry Capital Airport Weather Forecast/Predispatch Information

According to National Weather Service (NWS) weather charts, on the day of the accident, a low pressure system and associated occluded front[13] were approaching TVC from the south-southwest. The weather charts showed an extensive area of IFR conditions[14] extending throughout most of the Great Lakes region, including northern Michigan. Across the state of Michigan, the charts showed winds from the east-northeast about 15 knots, temperatures in the mid to low 30s (°Fahrenheit [F]), snow and freezing rain across the central and northern portions of the state, and rain over southern Michigan.

About 1540 on April 11, the Gaylord, Michigan, NWS Forecast Office (WSFO) issued a winter weather message warning that a rapidly developing low pressure system would result in heavy snow across northern Michigan, with total snowfall accumulations of 6 to 8 inches and possible strong winds.

About 1645 on April 11, the NWS Hydrometeorological Prediction Center Heavy Snow Discussion update/advisory highlighted the upper Great Lakes and northeastern United States (an area that included the accident region) for potential heavy snow and

[13] An occluded front is formed when a cold front overtakes a warm front.

[14] IFR conditions are defined as a ceiling or lowest layer of clouds reported as broken or overcast, or vertical visibility into a surface-based obscuration of less than 1,000 feet agl, and/or visibility less than 3 statute miles.

icing conditions. This advisory indicated that a major low pressure system producing an area of heavy wet snow[15] was moving into the northern Great Lakes region (including northern Michigan) and was expected to produce continuous, frequently heavy snowfall in the area before gradually dissipating during the subsequent 24 hours. About 2337 on April 11, the Gaylord WSFO issued a short-term forecast for the northern Michigan region (including the TVC area) that warned that a winter storm warning was in effect for snow, which was expected to be heavy at times, and strong winds out of the northeast through early morning April 12.

The NWS terminal aerodrome forecast (TAF)[16] that was issued for TVC about 1929 on April 11 predicted wind from 080° at 19 knots gusting to 30 knots, visibility 2 miles in light and blowing snow, and ceiling overcast at 2,500 feet; between 2000 and 0000, temporary conditions of visibility 3/4 mile in light and blowing snow, and ceiling overcast at 500 feet. From 0000 to 0600, the TVC TAF predicted wind from 040° at 18 knots gusting to 26 knots, visibility 1/2 mile in moderate and blowing snow, and sky obscured with a vertical visibility of 800 feet.

Pinnacle dispatch personnel were not able to release the accident flight based on the NWS TAF because the winds at TVC exceeded the CRJ tailwind landing limitation of 10 knots. Dispatch personnel advised the company SOC of this dispatch problem. Upon review of updated weather information, the SOC contacted NWA's meteorology department[17] to request review and possible revision of the TVC forecast. About 2130 on April 11, NWA meteorologists issued an amended TAF for TVC that predicted wind from 050° at 10 knots, winds gusting to 18 knots, visibility of 4 miles in light snow, ceiling overcast at 2,500 feet agl, with temporary conditions of visibility of 1 mile in light and blowing snow, and ceiling overcast at 1,000 feet agl.

About 1 hour later, based on new weather satellite information, the NWS issued an amended forecast for TVC that predicted the following:

> Until 0200 on April 12: winds from 080 degrees at 11 knots, winds gusting to 20 knots; visibility 4 miles in light snow, ceiling overcast at 2,500 feet agl, with temporary conditions of visibility 1 mile in light snow, blowing snow, and ceiling overcast at 1,500 feet agl valid.

The NWS amended TVC weather forecast was issued about the time the airplane was pushed back from the gate at MSP and was not included in the pilot's dispatch information.

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[15] According to meteorologists, snow is considered to be wet when it has a high liquid water content, and typically occurs at temperatures above 28° F. On surfaces, wet snow produces slush and rapidly deteriorating braking conditions.

[16] According to FAA Order 7110.10, TAFs are scheduled to be prepared and issued four times a day (about 1930, 0130, 0730, and 1330 eastern daylight time).

[17] The NWA meteorology department is an FAA-approved Enhanced Weather Information System provider that provides weather-related services to Pinnacle under contract. Its personnel continuously monitor applicable weather trends and are authorized to issue forecasts and advisories at any time as deemed appropriate.

1.7.2 Dispatch Weather Information

The weather information provided in the airplane's dispatch release paperwork was based on information obtained from the NWA Worldflight system, which provided meteorological aerodrome reports (METARs),[18] TAFs, pilot reports, notices to airmen (NOTAM), and NWA adverse weather advisories.

About 2146, the dispatcher issued the flight's dispatch documentation, which included the previously discussed NWA-amended TVC weather forecast information and 3 hours of alternate airport (DTW) weather observations. The 3 hours of DTW observations indicated strong easterly winds gusting to 26 knots, visibility of 1 1/4 to 1 1/2 miles in light-to-moderate rain and mist, with ceilings between 600 and 800 feet. Published minimums for ILS approaches to DTW's easterly runways were ceilings of 200 feet and visibility of 1/2 mile.[19]

1.7.3 Updated Cherry Capital Airport Weather/Airport Information

While the flight was en route, the pilots had several possible sources of information regarding the TVC weather and airport/runway surface condition, including: 1) Pinnacle dispatch/flight-following personnel; 2) MSP ARTCC; 3) TVC ASOS; and 4) TVC ground operations personnel reports. Records showed that a Pinnacle dispatcher provided the pilots with updated TVC ASOS weather information at 2354 and 0023; on both occasions the information indicated winds within acceptable landing limits and visibility as low as 1 1/2 miles in light snow. Additionally, the MSP ARTCC controller advised the pilots that he observed weather radar returns consistent with a snow squall in the TVC area on his en route radar display when the airplane was descending for the approach.

Surface weather observations at TVC are made every minute by the ASOS, which is located near the glideslope antenna for runway 28. After the TVC ATCT closes, these ASOS weather observations are broadcast continuously over the automated terminal information system (ATIS) frequency and were, therefore, available to the pilots during the airplane's descent, approach, and landing. CVR evidence shows that the pilots accessed the TVC ASOS weather information once during the accident flight, more than 30 minutes before the airplane landed. At that time, the ASOS broadcast indicated winds out of 040° at 7 knots and visibility of 1 1/2 miles in light snow.

The ASOS system is augmented by FAA-contracted, NWS-certified weather observers located at the general aviation terminal north of runway 28. The METARs and special weather observations (SPECI) issued by the NWS around the time of the accident indicated the following conditions:

[18] METARs are generated by the airport's ASOS and subsequently amended/augmented as needed by NWS observers.

[19] Subsequent DTW weather observations also showed conditions consistently above approach/landing minimums; however, technically, Pinnacle dispatch should have included a second alternate destination and corresponding additional fuel in the dispatch release.

SPECI at 0030: wind from 040 degrees at 8 knots, visibility 1/2 mile in light[20] snow, sky obscured vertical visibility 400 feet, temperature 0° C, dew point temperature minus 1° C, altimeter 29.52 inches Hg [mercury]. Remarks…hourly precipitation since 2353 at 0.03 inches.

SPECI at 0045: wind from 020 degrees at 8 knots, visibility 1/4 mile in heavy snow, sky obscured vertical visibility 200 feet, temperature 0° C, dewpoint temperature minus 1° C, altimeter 29.52 inches Hg. Remarks… hourly precipitation since 2353 at 0.07 inches.

METAR at 0053: wind from 020 degrees at 8 knots, visibility 1/4 mile in moderate snow,[21] sky obscured vertical visibility 200 feet, temperature 0° C, dewpoint temperature minus 1° C, altimeter 29.51 inches Hg. Remarks… hourly precipitation since 2353 at 0.08 inches.

The pilots received some updated TVC weather (and runway surface condition) information during their radio communications with TVC ground operations personnel as they approached TVC. For example, about 18 minutes before the airplane landed, the pilots contacted TVC ground operations personnel and were advised that snow removal equipment was on the runway. About 2 minutes later, the TVC airport operations supervisor advised the pilots that the measured braking action on runway 28 was .40+ with "thin wet snow [over] patchy thin ice." During the next few minutes, the CVR recorded additional communications between the pilots and TVC ground personnel regarding the snow removal progress and runway condition. Then, about 9 minutes before the airplane landed, the TVC airport operations supervisor contacted the pilots for an updated position and told them, "it's comin' down pretty good here." Less than 2 minutes later, after the pilots advised that they were about 5 minutes from touchdown, the TVC airport operations supervisor stated, "…it's comin' down pretty good…just to give you a heads up."[22] The pilots did not listen to the ASOS 5-minute observation that was logged by the system about 3 minutes before the accident, which showed 1/4 mile visibility in heavy snow with sky-obscured vertical visibility of 200 feet.

1.8 Aids to Navigation

No problems with any navigational aids were reported.

[20] According to NWS guidance and the ASOS augmentation supervisor, the light snow reported in this SPECI should have been identified as moderate. The accident pilots did not obtain the erroneous snow intensity report.

[21] According to NWS guidance and the ASOS augmentation supervisor, the moderate snow reported in this weather observation should have been identified as heavy.

[22] Observations for TVC the morning after the accident indicated that a total of 4 inches of new wet snow fell overnight.

1.9 Communications

No technical communications problems were reported.

1.10 Airport Information

TVC is located about 2 miles south of Traverse City, Michigan, at an elevation of about 624 feet. The airport has two asphalt runways (10/28 and 18/36). Runway 28, the active runway at the time of the accident, is 6,501 feet long by 150 feet wide, with a 200-foot-long by 190-foot-wide blast pad, and is equipped with an ILS approach.[23] (Runway 18/36 was closed at the time of the accident.) All four TVC runway ends had standard, 500-foot-wide runway safety areas that extended 1,000 feet beyond the runway ends.

The Safety Board examined the FAA's airport certification inspection records for TVC from the years 2004, 2005, and 2006 and did not note any unresolved deficiencies related to winter operations.

1.10.1 Cherry Capital Airport Closed Tower Operations

According to FAA Order 7110.65, *Air Traffic Control*, "The primary purpose of the ATC system is to prevent a collision between aircraft operating in the system and to organize and expedite the flow of traffic…. In addition to its primary function, the ATC system has the capability to provide (within certain limitations) additional services." Because the TVC ATCT was closed during the accident flight's approach to the airport, the primary provider of ATC services for this flight was the MSP ARTCC. TVC airport diagrams and approach charts showed ASOS and airport ground/traffic contact information available for use when the TVC ATCT was not in operation.

FAA policies dictate that the operating hours of ATCT facilities are determined based on the amount of traffic at the airport, specifically the number of flight operations per hour. Based on the FAA's criteria, the published hours of operation for the TVC ATCT are 0700 to 2200. (The accident flight was originally scheduled to arrive at TVC about 2251, after the TVC ATCT was closed.) According to TVC policies, the ATCT will remain open longer than the designated hours if an inbound or outbound flight crew requests such staffing. The FAA indicated that such requests were not common, and no such request was made the night of the accident.

FAA Order 7110.65 also states that, when ATC towers are open, controllers are required to provide arriving pilots with "airport traffic control service based only upon

[23] As previously mentioned, the ILS approach to runway 28 is the only precision approach at TVC.

observed or known traffic and airport conditions."[24] The order states that controllers should provide pilots with useful airport and landing area conditions and braking action reports and advisories in a timely manner.

According to published airport documents, when the TVC ATCT is closed, pilots are able to obtain current weather information through the TVC ASOS. TVC records indicate that, as part of the closing tower checklist on the night of the accident, the TVC ATCT controller turned off the ATIS recording then activated a switch transferring the TVC ASOS recorded weather information to be broadcast on the ATIS frequency. Additionally, current weather and runway surface condition information may be obtained from airport ground operations personnel over the CTAF. The accident pilots were in contact with ground operations personnel for about 18 minutes before landing and received weather and runway surface condition information from them.

1.10.2 Radio Phraseology Guidance and Training Requirements

When an airport's ATCT is closed, direct communications between arriving pilots and airport ground operations personnel may be necessary. Information related to procedures and phraseology used by pilots when operating at an airport after its ATCT is closed is available in the *Aeronautical Information Manual* (AIM). Additional pertinent radio communication information is published and available to pilots in applicable airport facility directories (AFD) and airport instrument approach charts. Records showed that both pilots had experience operating at airports without operating control towers, and, during postaccident interviews, both pilots stated that they were aware of the procedures and communications required for such operations.

According to Federal airport certification regulations (14 CFR Part 139, "Certification of Airports"), airport operations personnel are required to receive initial and annual recurrent training on airport communications that addresses radio communications with the ATCT during the tower's hours of operation, communications on the CTAF when the ATCT is not operating, and procedures for reporting unsafe airport conditions. The FAA recommends that airports consult the AIM chapter titled, "Radio Communications, Phraseology, and Techniques," (which emphasizes the importance of precision, conciseness, and proper radio technique in successful radio communication and provides examples of proper phraseology and technique) to develop their airport personnel training programs. Airport operators can also find information on the content and delivery of airfield condition reports in the AIM and in Advisory Circular (AC) 150/5200-28C, "Notices to Airmen (NOTAMS) for Airport Operators."

TVC personnel stated that they referred to radio communication guidance in the AIM in the development of their airport operations personnel training and that all

[24] Records indicate that there was no other traffic operating around TVC when the accident airplane arrived. The most recent passenger-carrying air carrier flight (NWA Airlink/Mesaba flight 3721, a SF-34 turboprop) arrived at 1441 on April 11. According to NWA representatives, two NWA flights that were scheduled to arrive at TVC later that day were cancelled because the predicted tailwind component at TVC exceeded the limitations in the company's winter operations guidance. Two air carrier airplane-positioning flights landed at TVC later on April 11, the latest of which arrived about 2045.

operations personnel working the night of the accident had completed the required training. In addition, the operations supervisor was also a licensed pilot and was therefore familiar with airport/ATC communications from a pilot's perspective.

1.10.3 Cherry Capital Airport Winter Operations

AC 150/5200-30A, "Airport Winter Safety and Operations," dated October 1, 1991, provides airport operators with guidance for the development of a snow and ice control plan, procedures for conducting and reporting the results of runway friction surveys and for snow removal and control. According to the AC, the guidance and standards provided "are recommended by the [FAA] for winter operations at all civil airports." Therefore, the AC identifies "triggers" that an airport might use to begin snow removal operations, such as snow type and depth and runway surface condition reports. The AC does not identify thresholds that an airport might use to close a runway because of observed type and depth of contamination, adverse friction measurements, or limited braking action on that surface.[25]

The TVC airport certification manual contains a section titled "Cherry Capital Airport Snow Plan," which outlines the airport's snow and ice removal procedures, consistent with the FAA's guidance, for airport employees and tenants. The snow plan specifies that the airport is responsible for the following:

- determining when snow removal operations begin;
- making visual and mechanical checks of snow, ice, slush…bank height, and friction measurements[26] on airport operational surfaces;
- completing field condition reports after each check; and
- disseminating related information as needed.

TVC's snow plan also specifies that snow removal operations are to be conducted from runway end to runway end to a minimum clearance width of 150 feet and should begin before about 2 inches of dry snow or 1/2 inch of wet snow has fallen. The latest revision of the TVC snow plan, issued in April 2006, differs from the previous version in that it reflects an increase in pertinent personnel and snow removal equipment and contains revised contact information.

In November 2005, the FAA Office of Airports for the Great Lakes Region sent a letter to all Part 139 airport operators in the region reminding them of requirements for operations during snow and ice conditions. This letter stated, in part:

[25] Type and depth of contamination reports are based on visual observations made by ground personnel; runway friction measurements are taken by ground personnel using measurement equipment and reported in MU values; and runway braking action reports are based on subjective pilot reports (good, fair, poor, or nil).

[26] According to FAA guidance, airport personnel should conduct friction measurements on runways covered with compacted snow and/or ice to quantify the slipperiness of pavement surfaces.

> The airport must implement a standard operating procedure to close any pavement available to air carriers when braking action/friction values reach an equivalent level of nil braking based on the air carrier aircraft utilizing the airport. The airport can obtain the threshold for nil braking action by referencing aircraft operating manuals or contacting the airlines for an aircraft or airline specific correlation table.

According to the TVC airport assistant manager, airport personnel discussed the content of the FAA's letter at a snow plan meeting held September 22, 2006. The airport then contacted each air carrier operating into TVC and requested the necessary airplane operating criteria; however, at the time of the accident, no air carrier had provided the required information. Therefore, the TVC airport's snow plan did not specify a type and/or depth of runway contaminant or coefficient of friction (MU) value[27] that would automatically result in airport closure.[28] According to a December 20, 2007, letter from the FAA airport certification inspector to the TVC airport director, no violation of 14 CFR Part 139 was noted during the investigation of this accident.

1.10.4 Cherry Capital Airport Winter Operations the Night of the Accident

On the night of the accident, TVC airport operations personnel coordinated with Pinnacle Airlines dispatch personnel and were advised to expect the arrival of flight 4712 about 0037. About 2135, a TVC field condition report recorded no snow or ice on the runway and MU values of .40+ on all segments of the runway.[29] Snow began to fall at TVC about 20 minutes after this report, and, about 0006, a TVC field condition report for runway 28 indicated "thin wet snow over patchy thin ice, MU values of .40/.37/.39."[30] Snow removal operations were initiated shortly thereafter in preparation for the airplane's arrival. TVC crews had cleared the full length and width of runway 28 by about 0029, and a TVC field condition report indicated "thin wet snow on runway 28, over patchy thin ice" and friction measurements resulting in MU values of .40+/.40+/.40+.[31] A TVC field report entered about 0055 indicated that postaccident runway friction measurements taken on runway 28 indicated MU values of .17/.17/.17.

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[27] MU values are obtained from runway friction measuring devices and reported in a range from 0.0 to 1.0, where 0.0 is the lowest friction value, and 1.0 is the theoretical best friction value available. (Runway friction measurements are also sometimes reported in a range from 0 to 100.)

[28] After the accident, TVC received operational criteria information from the air carriers operating into the airport; as a result, the airport now restricts air carrier operations when MU values of .27 or less are measured or when nil braking action is reported by pilots or TVC ground operations personnel.

[29] Although this report indicated "no snow or ice on the runway," runway friction surveys are only performed when there is contamination on airport surfaces. Friction testing devices provide MU values for the first, second, and third segments of a runway.

[30] A NOTAM was not issued for this MU reading because TVC ground personnel were not able to reach the nearest FAA automated flight service station when they tried to report it.

[31] Although FAA guidance indicates that an airplane's braking performance starts to deteriorate and directional control begins to be less responsive at MU values of .40 or less, the FAA does not recognize a correlation between MU values and the descriptive terms (such as good, fair, poor, or nil) that are used in pilot braking action reports.

1.11 Flight Recorders

1.11.1 Cockpit Voice Recorder

The accident airplane was equipped with an L-3 Communications Model FA 2100-1020 CVR, S/N 263068. The CVR showed no signs of damage and was sent to the Safety Board's laboratory in Washington, D.C., for readout and evaluation. The CVR was played back normally and without difficulty and contained good quality[32] audio information. The recording started at 2252:01.3 and continued uninterrupted until 0055:44.8, when the pilots shut off electrical power on the airplane. A partial transcript was prepared for the 2-hour, 4-minute, 8-second recording (see appendix B).

1.11.2 Flight Data Recorder

The accident airplane was equipped with an L-3 Communications Fairchild Model FA2100 solid-state FDR, S/N 000228080. The FDR was sent to the Safety Board's laboratory for readout and evaluation; it was received in good condition, and the data were extracted normally from the recorder. The FDR recorded about 375 parameters of airplane flight information, including altitude, air and ground speed, heading, wind direction and speed, control wheel and column position, elevator/aileron/rudder position, engine fan speed, thrust reverser status (arm advisory/deployed/unlocked), acceleration (vertical, lateral, and longitudinal), spoiler and antiskid status, landing-gear weight on wheels, and brake pedal application and pressure.

1.12 Wreckage and Impact Information

The airplane came to rest on a southwesterly heading about 100 feet west of the end of the blast pad surface located off of runway 28 at TVC. Three tracks were found in the snow and ground, extending between the end of the runway and the airplane's landing gear. The airplane was resting, right wing low, on the forward lower fuselage and the main landing gear; the nose landing gear was found separated from the fuselage. Most of the airplane damage observed was in the lower forward fuselage area. Specifically, the aft bulkhead of the nose gear bay, which is part of the airplane's pressure bulkhead, exhibited substantial damage. Postaccident examination of the engine controls and the throttle quadrant (including the thrust levers) in the flight deck area, associated linkages below the cockpit floor level, and the powerplants and thrust reversers revealed no evidence of pre- or postimpact anomalies.

[32] The Safety Board uses the following categories to classify the levels of CVR recording quality: excellent, good, fair, poor, and unusable. A good quality recording is one in which most of the flight crew conversations could be accurately and easily understood.

1.13 Medical and Pathological Information

In accordance with Federal regulations, Pinnacle conducted postaccident drug testing on urine specimens obtained from the captain and first officer within 4 hours of the accident.[33] The test results were negative. Required postaccident alcohol testing was not conducted. Pinnacle reported that this omission occurred because company officials initially believed that the event was classified as an incident (in which case such testing was not required by Federal regulation) rather than an accident. Title 14 CFR Part 121 Appendix J, Section B1 states that a decision to forgo the administration of a postaccident alcohol test "shall be based on the employer's determination, using the best available information at the time of the determination, that the covered employee's performance could not have contributed to the accident." Appendix J further states, "if a test required by this section is not administered within 2 hours following the accident, the employer shall prepare and maintain on file a record stating the reasons the test was not promptly administered…records shall be submitted to the FAA upon request of the Administrator or his or her designee." A Pinnacle representative indicated that such a record was neither prepared nor requested by an FAA representative.

1.14 Fire

No evidence of an in-flight fire was found, and a postcrash fire did not occur.

1.15 Survival Aspects

1.15.1 Aircraft Rescue and Firefighting Response

According to postaccident interviews, the TVC operations supervisor saw the airplane go off the end of the runway and telephoned the 911 central dispatch operator to initiate the emergency response. The 911 central dispatch operator then activated the crash alarm at the TVC aircraft rescue and firefighting (ARFF) station[34] and notified other (off-airport) Traverse City fire stations and police via radio. Postaccident interviews indicated that the first responding TVC ARFF firefighter[35] was delayed slightly in reaching the airplane because he was unsure of the airplane's exact location on the airport. The firefighter could not see the accident airplane because of reduced visibility in falling snow and initially was unable to make radio contact with TVC operations personnel to get more information because of congestion on radio frequencies. During postaccident interviews,

[33] As required by the National Institute for Drug Abuse, the specimens were tested for the following drugs: marijuana, cocaine, opiates, phencyclidine, and amphetamines.

[34] TVC ARFF station personnel respond to the crash alarm and do not receive a verbal initial notification.

[35] The TVC ARFF schedule resulted in one on-duty airport firefighter between 2300 and 0700 the night of the accident. Off-airport firefighting personnel also responded to the accident site and arrived around the same time as the TVC firefighter.

the TVC firefighter told investigators that he heard several references to runway 10 on the radio but that such references could refer to anywhere along the length of the runway; he did not know where the accident was until he heard a radio transmission indicating "we're on the numbers of 10."

According to the TVC assistant airport manager, this communication difficulty likely occurred because the ARFF truck radio was set to automatically scan several frequencies, including city, airport, fire department, and police frequencies, and an off-airport multiple fire alarm occurred about the time of the accident. The assistant airport manager stated that the scan feature on the ARFF truck has been disabled since the accident so that the radio remains on the TVC fire frequency unless manually switched. TVC also revised its airport emergency plan, adding a requirement for verification of communication between ARFF and TVC operations personnel when an emergency occurs while the TVC ATCT is closed.

In accordance with current FAA guidance (contained in AC 150/5200-10B), the TVC ARFF vehicle was equipped with a forward-looking infrared (FLIR) device that was designed to help drivers steer the vehicle at night and in fog and to detect warm objects under those conditions. The ARFF firefighter stated that he used the FLIR during the accident response but reported that it did not help him locate the airplane because of the heavy snowfall and because there was no fire (heat source) to detect.

1.15.2 Airplane Egress

Postaccident interviews with the flight crew indicated that the pilots promptly evaluated the condition of the airplane; the captain examined the cabin and checked for passenger/flight attendant injuries while the first officer inspected the outside of the airplane. Upon examination, the pilots determined that the fuselage was intact and that there were no injuries. The first officer reported that he did not smell any leaking fuel.[36] The captain told investigators that because the airplane seemed secure with no apparent risk of fire and because of the severe winter weather conditions (including heavy blowing snow) outside the airplane, he decided to follow Pinnacle's "expeditious deplaning" procedures[37] for deplaning. He kept the passengers on board the airplane until the emergency responders arrived. After the first emergency responders arrived at the airplane, they coordinated with the pilots and assisted with the subsequent deplaning and passenger transportation to the airport terminal.

All airplane occupants exited through the left front cabin door and stairs. The captain and first officer stood at the bottom of the airstairs to oversee and assist with the egress, while the flight attendant assisted in the cabin. Postaccident interviews with

[36] A small fuel leak from the bottom of the right wing was later detected and successfully stopped by emergency personnel.

[37] Pinnacle's guidance concerning expeditious deplaning states, in part, "Some emergencies or abnormal situations may arise that are not… 'life-or-death' in nature….In these situations, an 'expeditious deplaning' is conducted. Passengers and crew would exit the aircraft in an orderly manner through the normal cabin exit." See section 1.17.3 for more information about these procedures.

the flight and cabin crewmembers and emergency response personnel indicated that the passengers deplaned in an orderly manner and were shuttled to the airport terminal in police cars and ambulances.

1.16 Tests and Research

1.16.1 Airplane Simulation and Study of Airplane Performance During the Accident Sequence

The Safety Board reviewed available FDR, CVR, air route surveillance radar, and meteorological data to study the airplane's performance during the approach to landing and landing roll. The airplane's touchdown point and location of critical FDR events during the landing roll were determined, and an engineering simulation was conducted to estimate the airplane's braking ability (braking coefficient).[38] The performance study showed that the accident airplane's braking ability was more than four times worse than that of a normal dry runway.

The Safety Board's study showed that, after a stabilized approach to runway 28, the airplane crossed the runway threshold at an airspeed of about 148 knots. The airplane subsequently touched down at an airspeed of 123 knots about 2,400 feet from the runway's approach threshold. The calculated winds at touchdown were between 7 and 8 knots from 030° to 035°, resulting in a calculated tailwind component of 3 knots. FDR data showed that, immediately after mainwheel touchdown, the spoilers deployed, and then—at nosewheel touchdown—the brake pressure was applied followed by thrust reverser deployment.

As stated previously, the thrust reversers were deployed and stowed twice during the landing roll. The initial deployment occurred just after touchdown; after the reversers deployed, the engine fan speed increased from idle speed to about 45 percent. As the airplane decelerated through about 90 knots (with about 2,100 feet of landing distance remaining), the pilots stowed the thrust reversers and the engine fan speed reduced to idle. About 6 seconds after the pilots first stowed the thrust reversers, and as the airplane was decelerating with about 1,100 feet of landing distance remaining, the thrust reversers were again deployed. The engine fan speed rapidly increased to about 80 percent before the pilots stowed the reversers again. The airplane ran off the end of the runway, with thrust reversers stowed, at a ground speed of about 47 knots and reached the end of the 200-foot-long runway 28 overrun pavement at a ground speed of about 45 knots.

The FDR data showed that after the initial thrust reverser deployment, the airplane heading changed, moving about 3° airplane nose right, relative to the runway heading. A left rudder deflection was then recorded, and the airplane heading realigned with the

[38] 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 condition of the airplane's braking system (such as antiskid system efficiency, tire pressure, and brake wear).

runway heading. The airplane heading changed again after the second thrust reverser deployment, moving about 7° airplane nose right, relative to the runway heading. The FDR recorded another left rudder deflection, and the airplane heading moved back nose left. As the airplane continued to decelerate and its heading moved farther nose left, the FDR recorded a maximum right rudder input and subsequent deflection. However, the airplane heading continued to move nose left, reaching about 25° nose left of the runway heading as it reached the end of the runway. (After it ran off the runway, the airplane reached a maximum deviation from the runway heading of about 55° nose left.)

In a December 11, 2007, memorandum to the Safety Board, Bombardier, the airplane manufacturer, stated that its review of the accident FDR data was consistent with the Safety Board's. Bombardier's memorandum also stated that the data showed that, after the thrust reversers were deployed the second time and engine fan speed increased to about 80 percent, "the aircraft began to turn…(to the left)…the pilot reversed the rudder (to the right) as the…aircraft nose left yaw increased, full right rudder eventually being applied, but the aircraft continued to yaw left." According to Bombardier, "[t]his aircraft response would be typical of a loss of directional stability and rudder effectiveness due to reverser deployment [on a contaminated/slippery runway] at low airspeed in a crosswind from the right."

The Bombardier memorandum further stated the following:

> …techniques used by the pilot during the landing are broadly consistent with the advice…for landing on possibly contaminated runways; specifically, the pilot did restrict the use of the thrust reversers at higher speeds to prioritize maintaining directional control…and maintained the use of the thrust reversers on the second deployment below the normal stow speed of 60 knots as advised for an emergency…The [behavior] of the aircraft in these circumstances was consistent with…expectation.

Bombardier's memorandum concluded, in part, the following:

> …above 60 knots…the aircraft can generally be controlled with aerodynamic controls [vertical fin and rudder] alone. Below 60 knots the rudder alone is generally insufficient for directional control and some differential braking is normally required for steering. The current aircraft limitations and advice to flight crews are based upon these characteristics, and when these are followed no handling difficulties are expected.

According to the Safety Board's airplane performance study, an airplane similarly configured and landing with conditions, touchdown point, and deceleration efforts similar to those of the accident flight would have required an additional 1,146 feet of unobstructed runway to stop.

Pinnacle's CRJ company flight manual (CFM) contained contaminated landing runway length charts that are based on Bombardier-provided landing data for four types/levels of runway contaminants: compacted snow, loose snow, standing water/slush, and

ice. For these charts, the landing distance was considered the distance from crossing the runway threshold at 50 feet agl to the point at which the airplane comes to a full stop under the given conditions. These conditions included the airplane's weight and speed and wind conditions and assumed that both thrust reversers are operating normally. The Pinnacle CRJ CFM stated that the landing distance charts were based on a standard touchdown point within the first 1,500 feet of the runway and incorporated the 15-percent safety margin recommended in Safety Alert For Operators (SAFO) 06012, "Landing Performance Assessments at the Time of Arrival (Turbojets)" (issued August 31, 2006).

Based on the contaminated landing runway length charts in Pinnacle's CRJ CFM, the Safety Board calculated the distances required for the accident airplane to come to a complete stop with an added 15-percent safety margin and runway contamination conditions of compacted snow, loose snow, standing water/slush, or ice. (Pinnacle Operations Specification [OpSpec] C382 requires pilots to perform a landing distance assessment incorporating a 15-percent safety margin when landing on a contaminated runway. These issues are further discussed in section 1.17.1.) Table 2 shows the calculated stopping margins for a Vref of 140 knots plus an 8-knot speed additive,[39] a 3-knot tailwind, and a 15-percent safety margin, for the following runway surface contaminants: compacted snow, loose snow, standing water/slush, and ice.

Table 2. Calculated stopping margins for a V_{ref} of 140 knots plus an 8-knot speed additive, a 3-knot tailwind, and an 15 percent safety margin, for the following runway surface contaminants: compacted snow, loose snow, standing water/slush, and ice.

Type of Contaminant	Stopping margin relative to the runway end, with added 15-percent safety margin
Compacted snow	257 feet
Loose snow	-851 feet
Standing water/slush	-966 feet
Ice	-3,003 feet

Note: negative numbers = distance beyond the end of the runway.

The airplane performance study calculations indicated that the accident flight would have had a positive stopping margin with the added 15-percent safety margin for only the compacted snow conditions.

1.16.2 Airplane Simulations for Various V_{ref} Speed Additives and Thrust Reverser Landing Scenarios

The Safety Board conducted additional simulations to calculate hypothetical landing distances for alternative landing scenarios involving various Vref speed additives

[39] The contaminated runway length charts for various runway contaminants (that is, slush, compacted snow, etc.) allow pilots to add a landing distance penalty to increase the landing runway length required for each knot over the V_{ref} speed. Each chart's speed additive is unique. For the accident flight, the chart V_{ref} was 142 knots (with up to 5 knots added for gusty winds), and the airplane's actual speed was 148 knots.

and thrust reverser usage.[40] All test cases assumed that directional control was maintained throughout the landing roll and assumed the accident runway conditions.[41]

The simulations showed that if the pilots landed using normal flight operations manual (FOM) procedures at the accident touchdown point and using deceleration devices as recorded by the accident FDR, the airplane would run off the departure end of the runway for all tested landing speeds. The simulations also showed that, if the airplane touched down within the 1,500-foot, company-designated standard touchdown zone, it would likely have not stopped before the end of the runway for the accident conditions. Likewise, the simulations showed that, if the pilots had applied and maintained full thrust reverser (at least 80 percent engine fan speed) deployment from touchdown until the airplane came to a stop (a practice permitted by Pinnacle in an emergency situation), and maintained directional control, the airplane would likely have stopped before the end of the runway for all tested landing speeds.

1.16.3 Use of Braking Systems During Landing Roll

The Safety Board examined FDR data from the accident landing and the previous landing (at MSP) to determine whether the accident pilots applied adequate brake pedal forces to obtain optimal braking pressures from the airplane's braking/antiskid systems. The data showed that the pilots applied similar brake pedal forces during both landings. However, the resultant brake pressures were higher on the previous landing, which was made on an uncontaminated runway, than on the accident landing. Further, when the first officer applied additional force to the brake pedals late in the accident landing roll, the brake pressures did not increase. As previously discussed, the brake/antiskid system is designed such that the system modulates pressure to the wheel brakes in response to adverse runway conditions to ensure maximum braking effectiveness.

1.17 Organizational and Management Information

Pinnacle Airlines, Inc., is based in Memphis, Tennessee. The airline was established in 1985 as Express Airlines I. Between 1985 and 2000, Express Airlines I operated turboprop airplanes only. In 2001, Express Airlines I began integrating CRJ turbojet airplanes into its fleet and, in 2002, changed its name to Pinnacle Airlines. By 2003, Pinnacle had phased out turboprop airplanes from its operations and operated CRJ turbojet airplanes only. At the time of the accident, Pinnacle, operating as Northwest Airlink,[42] flew more than 700 flights daily to more than 100 cities in the United States and Canada; the company operated a fleet of 139 CRJs and employed more than 3,700 personnel.

[40] For specific information regarding these scenarios, see "Addendum 1 to Aircraft Performance Study" in the docket for this accident.

[41] Examination of the airplane's FDR data and the accident runway conditions indicated that directional control was not assured during the accident landing.

[42] At the time of the accident, Pinnacle had an agreement with NWA to operate 123 CRJs as a Northwest Airlink carrier. Pinnacle was also gearing up for an agreement with Delta Airlines (announced April 30, 2007) to operate 16 CRJs as a Delta Connection carrier.

1.17.1 Pinnacle Airlines' Landing Distance Assessment Guidance (Operations Specification C382)

On August 31, 2006, the FAA issued SAFO 06012, which urged operators of turbojet airplanes to develop procedures for flight crews to assess landing distances based on the actual conditions at the time of arrival, and to add a safety margin of at least 15 percent to that distance. The nonmandatory SAFO was issued as a result of an urgent recommendation issued by the Safety Board in January 2006,[43] and was intended to ensure adequate safety margins for landings on contaminated runways while the FAA pursued formal rulemaking addressing these areas. (These issues are further discussed in section 1.18.2.)

In December 2006, Pinnacle incorporated procedures consistent with the FAA's SAFO guidance on contaminated runway calculations into its OpSpec C382.[44] The procedures outlined in OpSpec C382 stated that Pinnacle pilots were to "assess the landing performance at time of arrival" accounting for, among other things, the "most adverse expected conditions" for the landing runway. OpSpec C382 specified that this landing distance assessment must be accomplished "…as close as practicable to the time of arrival consistent with the ability to obtain the most current meteorological and runway conditions considering pilot workload and traffic surveillance, but no later than the commencement of the approach procedure or visual approach pattern" and that all arrival landing distances will be increased by at least an additional 15 percent for all runway conditions.

SAFO 06012, Section 3g also provides the following guidance for training flight crews on landing distance assessment procedures, stating that all flight crewmembers should be made aware of the procedures:

> …in a manner consistent with the operator's methods for conveying similar knowledge to flight operations personnel. It may be conducted via operations/training bulletins or extended learning systems…all flight crewmembers should have hands on training and validate proficiency in these procedures during their next flight training event.

According to Pinnacle's CRJ program manager, in conjunction with the incorporation of OpSpec C382, the company provided its CRJ pilots with landing distance calculation charts in revisions to the CRJ CFM and guidance regarding the use of those

[43] SAFO 06012 was issued in response to Safety Recommendation A-06-16, which was issued as a result of the Safety Board's investigation of the December 2005 accident involving Southwest Airlines flight 1248, a 737 that ran off the end of a snow-contaminated runway. For additional information, see National Transportation Safety Board, *Runway Overrun and Collision, Southwest Airlines Flight 1248, Boeing 737-7H4, N471WN, Chicago, Illinois, December 8, 2005,* Aircraft Accident Report NTSB/AAR-07/06 (Washington, DC: NTSB, 2007).

[44] Pinnacle's OpSpec C382 is attached in appendix C to this report.

charts. In response to postaccident questions from the Safety Board, the CRJ program manager stated the following, in part:

> Pinnacle Airlines crews perform a runway assessment prior to every landing. Runway landing numbers for the conditions expected are always requested before initiating an approach. Crews are taught to use the SAFO charts provided as a tool in [their] decision process whenever there is a contaminant on a runway. The presence of a MU value reinforces the fact that there is some [contaminant] on a runway. The MU value given will give a crew additional information on which to base [a] landing decision. I have recently been made aware of a belief among some pilots/dispatchers that 40+ MU equates to a clean runway. This is not taught….pilots are taught to evaluate all available information and use the charts accordingly.
>
> …Pilots must always apply their experience and judgment to their surroundings. The type of contaminant and any braking action reports will play into the pilot-in-command's decision.

Although Pinnacle had incorporated an arrival landing distance assessment requirement consistent with SAFO 06012 into its procedures about 4 months before the accident, the accident pilots did not perform an arrival landing distance assessment before the accident landing. The captain told investigators that he reviewed Pinnacle's landing distance assessment procedures with the first officer during an earlier leg of the trip sequence but did not perform landing distance calculations before the approach to TVC.

During postaccident interviews, the captain told investigators that he obtained landing data from the company but did not refer to the landing distance charts to do a landing distance calculation.[45] He stated that he believed the runway conditions were okay based on the contamination depth, and he indicated that because he had been based at MSP for 3 1/2 years, he had landed on snowy runways many times. The captain estimated that, based on a planned touchdown zone of 1,000 to 1,500 feet down the runway and an expected 2,500-to-3,000-foot stopping distance on the runway, the airplane could be stopped using about 3,500 to 4,500 feet of the available 6,501-foot-long runway. The first officer stated that he thought that pilots were required to (and should) check landing distances with a contaminated runway. He said that he believed 4,000 feet was the required landing distance, but he stated that they did not check the landing distance charts before the approach to TVC.

[45] The captain told investigators that Pinnacle's policies called for both ACARS transmission of landing data based on expected field conditions and pilot performance of manual chart calculations "when you receive a contaminated report." He stated that during the flight between DSM and MSP on the day of the accident he showed the first officer how to use the contaminated landing and takeoff charts. However, he indicated that they did not perform pertinent landing distance calculations because "all legs [that day] had very light snow and all braking action reports made that day, including TVC, were 40 MU or better."

1.17.2 Pinnacle Airlines Guidance for Landing and Thrust Reverser Usage

According to Pinnacle's CRJ CFM, chapter 10, "Maneuvers and Profiles," the CRJ should be configured with 45° of flaps and landing gear extended as the airplane approaches the runway. The airplane should cross the runway's approach threshold at 50 feet agl at the appropriate V_{ref} for its weight (based on charts) and touchdown within 1,000 to 1,500 feet of that threshold. Chapter 8 of Pinnacle's FOM, "Flight Operations," further states, "Normally, all landings touch down within the first 1,500 feet of available runway…[i]f a touchdown cannot be made within the Runway Touchdown Zone" (first 3,000 feet or first third of available runway, whichever is less) a go-around is normally executed." In the event of gusty winds, company guidance allowed pilots to add up to 5 knots of additional airspeed to the V_{ref} speed. Chapter 10 of the CFM further states:

> At touchdown, the ground spoilers should deploy automatically…The nose wheel is gently lowered onto the runway and thrust reversers are deployed. Wheel braking is to be smoothly applied by steadily increasing pedal pressure, adjusting for runway conditions and length available.
>
> Note: Do not wait for thrust reverser deployment before braking.
>
> Reverse thrust reduces the airplane stopping distance more efficiently than using brakes alone and is most effective at high speeds.
>
> Raise the thrust levers to the interlock/deploy position…after reverser interlocks release…the reverse levers can be raised as required.
>
> At 80 knots, start reducing reverse thrust. Idle reverse power is established by 60 knots.
>
> Note: During landing, application of maximum reverse thrust is not permitted…below 60 knots indicated airspeed (KIAS). Below 60 KIAS, reverse thrust must be reduced to idle (not above 30 [percent] N_1). If reverse thrust above idle reverse is used at speeds less than 60 KIAS, foreign object damage to the engines may occur.

Pinnacle's CRJ CFM, chapter 7, "Adverse Weather," states that thrust reversers are most effective at high speed; however, when landing in a crosswind, directional control may be degraded when using full thrust reversers especially on a contaminated runway. (Bombardier, the CRJ manufacturer, also cautions about thrust reverser use on contaminated runways and/or in crosswind conditions.[46]) Pinnacle's guidance also states that skidding and hydroplaning should be anticipated and pilots should be prepared to "reduce reverse thrust to idle reverse and, if necessary…to idle forward thrust" to recover

[46] Similar thrust reverser information was included in McDonnell Douglas DC-9/MD-82 manuals, as discussed in the Safety Board's report on the June 1999 accident at Little Rock, Arkansas. For additional information, see National Transportation Safety Board, *Runway Overrun During Landing, American Airlines Flight 1420, McDonnell Douglas MD-82, N215AA, Little Rock, Arkansas, June 1, 1999*, Aircraft Accident Report NTSB/AAR-01/02 (Washington, DC: NTSB, 2001).

from a skid. Pinnacle's CRJ CFM further states that maximum reverse thrust may be used to a complete stop in an emergency situation.

According to Pinnacle's CRJ CFM, chapter 3, "Limitations," the maximum depth of contaminant for landing on a runway with wet snow covering an appreciable part of the runway surface is 1 1/2 inches. Also, Pinnacle's CRJ CFM states that the maximum tailwind component approved for landing is 10 knots and the maximum allowable crosswind component for landings on a contaminated runway is 15 knots.

Pinnacle's guidance further states that pilots should request a current runway or braking action report any time the weather conditions might be conducive to deteriorated braking performance/runway surface conditions, allowing at least 15 minutes for airport/ground officials to gather and report the requested information. Further, according to Pinnacle's guidance, whenever braking action is reported as nil by a 14 CFR Part 121 air carrier, airport operations vehicle, or company vehicle, all operations should be suspended on that surface (unless a greater emergency exists).[47]

1.17.3 Pinnacle Airlines Expeditious Deplaning Guidance

Pinnacle's FOM and flight attendant manuals contain guidance regarding a procedural alternative to emergency evacuation known as "expeditious deplaning." This guidance states the following:

> Some emergencies or abnormal situations may arise that are not time-critical, "life-or-death" in nature….In these situations, an "expeditious deplaning" is conducted. Passengers and crew would exit the aircraft in an orderly manner through the normal cabin exit. In this case, the pilot-in-command would do the normal shutdown checklist. An emergency evacuation checklist would not be accomplished since you are not "evacuating." After deplaning, gather the passengers together at a common location away from the aircraft.
>
> In considering if an expeditious deplaning is warranted, the crews evaluate all aspects including weather, outside temperature, location on the airfield, etc. Remember, removing the passengers from the aircraft may impose greater hazards on them than allowing them to remain on board.

1.17.4 Recent Pinnacle Airlines Safety-Related Actions

In 2004, Pinnacle Airlines experienced a fatal accident for which the Safety Board determined that the probable cause included "the pilots' unprofessional behavior,

[47] This guidance was consistent with information contained in SAFO 06012. For example, one SAFO note stated, "[c]onditions specified as 'nil' braking action are not considered safe, therefore operations under conditions specified as such should not be conducted. Do not attempt to operate on surfaces reported or expected to have nil braking action." Also, one table in the SAFO indicates that "landing is prohibited" when nil braking action is evident.

deviation from standard operating procedures, and poor airmanship, which resulted in an in-flight emergency from which they were unable to recover, in part because of the pilots' inadequate training."[48] In partial response to that accident (and consistent with Safety Board recommendations), Pinnacle subsequently instituted an aviation safety action program (ASAP) and flight operational quality assurance (FOQA) program to monitor and address in-flight safety issues. According to the company vice president of safety, Pinnacle Airlines was one of only two regional carriers in the United States to have implemented both ASAP and FOQA programs at the time of the TVC accident.

Pinnacle Airlines had also hired a new senior management team in the 2 years before this accident that had instituted programs to increase safety and improve pilot morale. The company safety department, whose director reported directly to the company chief executive officer, had recently instituted FOQA, ASAP, internal evaluation programs, and risk management processes. The FAA principal operations inspector (POI) assigned to Pinnacle indicated that relations between the company and the FAA were positive and had improved dramatically with the hiring of the new management team.

1.17.4.1 Postaccident Procedural/Operational Changes

As a result of the TVC accident, Pinnacle revised its operational procedures, guidance, and training for pilots and dispatchers as follows:

- Amended the landing technique outlined in the CFM to specify that pilots should fly the approach from a point at least 3 miles out to the runway threshold at V_{ref}. Pinnacle's FOM requires all airplanes to be fully configured for landing, at the proper speed, and on the required flight track for landing by 1,000 feet agl.
- Retained existing FOM guidance reflecting Pinnacle's standard touchdown zone (within the first 1,000 to 1,500 feet of the runway) and added FOM guidance indicating that if a touchdown cannot be made within the first 1,000 to 1,500 feet of the runway, pilots should go-around.
- Increased pilot training regarding landing distance assessments, use of performance charts incorporating an extra 15-percent safety margin, and most effective use of brakes and thrust reversers for stopping the CRJ.
- Established a policy limiting check airmen performing OE training to 14-hour duty days.
- Developed new winter airport operations procedures to mitigate the risks involved in landing at airports that were identified by the company as having more potential hazards during winter operations (based on runway length, climate, snowfall amount, airport elevation, and accident/incident history).

[48] For more information, see National Transportation Safety Board, *Aviation Accident Report, Crash of Pinnacle Airlines Flight 3701, Bombardier CL-600-2B19, N8396A, Jefferson City, Missouri, October 14, 2004,* Aircraft Accident Report NTSB/AAR-07/01 (Washington, DC: NTSB, 2007).

The new procedures established the following constraints for landings on contaminated runways:

No tailwind landings allowed;

Vertical guidance required for the approach;

Thrust reversers and other ground lift dumping devices must be operational;

Captains perform all landings;

Crew must have runway friction or braking action reports that reflect existing conditions; and

Reports must reflect at least fair braking action.

1.17.4.2 Postaccident Staffing/Scheduling/Training Changes

Pinnacle representatives indicated that, at the time of the TVC accident, the company was experiencing difficulties related to pilot turnover and staffing issues. They reported that the company was losing about one pilot per day and was hiring younger pilots with less experience than in the past. Pinnacle was addressing these difficulties by: 1) developing cooperative programs with pilot training centers; 2) adapting the company's training procedures to less experienced pilots; and 3) initiating procedures to help address scheduling pressure.

Additionally, Pinnacle representatives told investigators that the company was evaluating methods of reducing the potential for pilot fatigue[49] and for providing food to pilots who miss regular meals because of operational issues. In addition, Pinnacle's subsequent submission on this accident stated, "Pinnacle continues to look for ways to help reduce the possibility of fatigue" and reemphasized that check airmen performing OE are limited to 14-hour duty days. Subsequent correspondence from Pinnacle representatives indicates that check airmen performing OE are now also limited to 8 hours of "actual," not "scheduled," flight time per day.

1.18 Additional Information

1.18.1 Fatigue-Related Information[50]

Research has shown that long duty days can be associated with pilot fatigue and degraded performance. Aviation accident data show that human-performance-related

[49] When asked whether pilot fatigue was a problem at Pinnacle, the FAA POI estimated that 60 to 70 percent of Pinnacle pilots who voluntarily submitted event reports through the company's ASAP cited fatigue as a factor in the events. In addition, several of the company pilots interviewed during this investigation indicated that company schedules could be exhausting.

[50] The Safety Board has long been concerned about operator fatigue in transportation and has issued 115 human fatigue-related safety recommendations for all modes of transportation since 1972. Additionally, the Board has included human fatigue in transport operations on its annual Most Wanted List of Transportation Safety Improvements since the list's inception in 1990.

airline accidents are more likely to happen when pilots work long days. The Board's 1994 study of flight-crew-related major aviation accidents[51] found that captains who had been awake for more than about 12 hours made significantly more errors than those who had been awake for fewer than 12 hours. Such errors included failing to recognize and discontinue a flawed approach; pilots often exhibited a tendency to continue the approach despite increasing evidence that it should be discontinued. Additionally, accident data showed that pilots flying schedules that involved 13 or more hours of duty time had accident rates several times higher than pilots flying schedules with shorter duty days.[52] Research and accident history also show that fatigue can cause pilots to make risky, impulsive decisions; become fixated on one aspect of a situation; and react slowly to warnings or signs—any of which can result in an approach being continued despite evidence that it should be discontinued.[53] Additionally, research shows that people who are fatigued become less able to consider options and are more likely to become fixated on a course of action or a desired outcome.[54]

According to current FAA regulations, a two-person flight crew engaged in scheduled, domestic operations (such as the accident flight crew) would be limited to 8 scheduled flight hours between required rest periods. (At the time of the accident, the pilots had flown 8.35 hours; however, Federal regulations permit, within limits, flight times that exceed the flight hour cap because of "circumstances beyond the [operator's] control…such as adverse weather conditions.") However, these regulations do not take into consideration the starting time of day, the length of the duty day, the number of flight segments, weather conditions, or other factors that might affect a pilot's workload or the pilot's fatigue.

The Safety Board has previously noted that the aviation regulatory authorities of Great Britain have adopted flight and duty time regulations that take into consideration a pilot's starting time and number of flight legs, as well as the total duty time.[55] Despite the

[51] For additional information, see 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).

[52] See J.H. Goode, 2003, "Are Pilots at Risk of Accidents Due to Fatigue?" *Journal of Safety Research*, 34, pp. 309-313.

[53] See M. R. Rosekind, K. B. Gregory, D. L. Miller, E. L. Co, J. V. Lebacqz, M. Brenner paper. 2005. *Evaluating Fatigue Factors in Accident Investigations: Description and Application of a Structured Approach.* Special Supplement of *Aviation, Space Environmental Medicine*, in preparation. For additional fatigue-related information, see a) National Transportation Safety Board, *Evaluation of U.S. Department of Transportation Efforts in the 1990s to Address Operator Fatigue,* Safety Report NTSB/SR-99/01 (Washington, DC: NTSB, 1999); b) National Transportation Safety Board, *Uncontrolled Collision With Terrain, American International Airways Flight 808, Douglas DC-8-61, N814CK, U.S. Naval Air Station, Guantanamo Bay, Cuba, August 18, 1993*, Aircraft Accident Report NTSB/AAR-94/04 (Washington, DC: NTSB, 1994); c) National Transportation Safety Board, *Controlled Flight into Terrain, Korean Air Flight 801, Boeing 747-300, HL7468, Nimitz Hill, Guam, August 6, 1997*, Aircraft Accident Report NTSB/AAR-00/01 (Washington, DC: NTSB, 2000); and d) National Transportation Safety Board, *Runway Overrun During Landing, American Airlines Flight 1420, McDonnell Douglas MD-82, N215AA, Little Rock, Arkansas, June 1, 1999,* Aircraft Accident Report NTSB/AAR-01/02 (Washington, DC: NTSB, 2001).

[54] J.A. Caldwell, 1997. "Fatigue in the aviation environment: an overview of the causes and effect as well as recommended countermeasures." *Aviation, Space, and Environmental Medicine,* 68, pp. 932-938.

[55] See Civil Aviation Authority of Great Britain (2004), *The Avoidance of Fatigue in Aircrews: Guide to Requirements*. Gatwick, England, CAP 371 (Section B, page 9).

Board's repeated efforts urging the FAA to revise and update the established Federal pilot flight and duty time regulations to reflect more recent research findings in fatigue and sleep issues, there have been no significant changes to those regulations since the Federal Aviation Regulations were recodified in 1964.

The FAA has participated with other transportation modal administrations in a Department of Transportation (DOT) Human Factors Coordinating Committee, which was established in 1991, which led the DOT's Operator Fatigue Management Program effort to develop practical tools for use by individuals and industries to better maintain vigilance and alertness on the job. This effort has resulted in several products that could potentially help companies and individuals to reduce fatigue-related problems in transportation, including: 1) a practical guide addressing fatigue management and countermeasure usage; 2) fatigue modeling software tailored for transportation applications; and 3) work schedule representation and analysis software to aid managers and schedulers in evaluating and designing work schedules. According to DOT and industry personnel, although the Federal Railroad Administration has tested and incorporated some of these tools in the railroad industry,[56] the FAA has not yet applied them in the aviation industry.

In its 2008 annual report to Congress regarding the Safety Board's Most Wanted List of Transportation Safety Improvements, the DOT indicated that the FAA is currently considering amendments to existing 14 CFR Part 135 pilot flight and duty time regulations. Additionally, the FAA is working with the International Civil Aviation Organization to develop a fatigue risk management system to regulate flight and duty time management to improve flight crew alertness.

Because the FAA had not taken acceptable action regarding this issue, the Safety Board issued Safety Recommendation A-06-10 in February 2006 in connection with its investigation of the October 19, 2004, accident involving Corporate Airlines flight 5966.[57] Safety Recommendation A-06-10 superseded Safety Recommendation A-99-45[58] (then classified, "Open—Unacceptable Response") and asked the FAA to do the following:

> Modify and simplify the flight crew hours-of-service regulations to take into consideration factors such as length of duty day, starting time, workload, and other factors shown by recent research, scientific evidence, and current industry experience to affect crew alertness.

[56] For additional information, see Federal Railroad Administration, *Validation and Calibration of a Fatigue Assessment Tool for Railroad Work Schedules,* Summary Report DOT/FRA/ORD-06/21 (Washington, DC: DOT, 2006).

[57] The Board also issued Safety Recommendation A-06-11 as a result of this accident. Safety Recommendation A-06-11 asked the FAA to require Part 121 and 135 operators to incorporate fatigue-related information similar to that being developed by the Department of Transportation Operator Fatigue Management Program into their initial and recurrent training programs; such training should address the detrimental effects of fatigue and include strategies for avoiding fatigue and countering its effects. For additional information, see National Transportation Safety Board, *Collision with Trees and Crash Short of the Runway, Corporate Airlines Flight 5966, BAE Systems BAE-J3201, N875JX, Kirksville, Missouri, October 19, 2004*, Aircraft Accident Report NTSB/AAR-06/01 (Washington, DC: NTSB, 2006).

[58] Safety Recommendation A-99-45 asked the FAA to "establish within 2 years scientifically based hours-of-service regulations that set limits on hours of service, provide predictable work and rest schedules, and consider circadian rhythms and human sleep and rest requirements."

The FAA's May 31, 2006, response to this recommendation did not describe any plans for addressing flight hours-of-service and fatigue issues in Part 121 operations; therefore, in November 2006, the Safety Board classified Safety Recommendation A-06-10 as "Open—Unacceptable Response."

Although the Safety Board considers hours-of-service regulations to be essential, the Board also recognizes that the development and implementation of fatigue risk management systems is useful in mitigating fatigue-related events. The Board issued two related safety recommendations on June 10, 2008. Safety Recommendations A-08-44 and -45 asked the FAA to do the following:

> Develop guidance, based on empirical and scientific evidence, for operators to establish fatigue management systems, including information about the content and implementation of these systems. (A-08-44)[59]
>
> Develop and use a methodology that will continually assess the effectiveness of fatigue management systems implemented by operators, including their ability to improve sleep and alertness, mitigate performance errors, and prevent incidents and accidents. (A-08-45)
>
> The FAA has scheduled a forum on the subject of fatigue for June 17 to 19, 2008.

1.18.2 Previously Issued Safety Recommendations

1.18.2.1 Landing Distance Assessment

Among the recommendations issued as a result of the Safety Board's investigation of the Southwest Airlines flight 1248 accident[60] were Safety Recommendations A-07-57 and -61. Safety Recommendation A-07-61 was issued on October 16, 2007, and asked the FAA to do the following:

> Require all 14 *Code of Federal Regulations* Part 121, 135, and 91 subpart K[61] 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.

[59] Safety Recommendation A-08-44 superseded Safety Recommendation A-06-11, which was classified "Closed—Acceptable Action/Superseded." For further information, see <http://www.ntsb.gov/Recs/letters/2008/A08_44_45.pdf> on the Safety Board's website.

[60] For additional information, see National Transportation Safety Board, *Runway Overrun and Collision, Southwest Airlines Flight 1248, Boeing 737-7H4, N471WN, Chicago, Illinois, December 8, 2005*, Aircraft Accident Report NTSB/AAR-07/06 (Washington, DC: NTSB, 2007).

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

The Safety Board recognized that the standardized methodology recommended in Safety Recommendation A-07-61 would take time to develop and issued Safety Recommendation A-07-57 as an urgent action, asking the FAA to do the following until such a 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)

Because the intent of this recommendation was to restore safety margins for landing on contaminated runways, similar to urgent Safety Recommendation A-06-16 (which was issued on January 27, 2006, and was classified "Open—Unacceptable Response" on May 8, 2007),[62] the Safety Board classified A-06-16 "Closed—Unacceptable Action/Superseded." Safety Recommendation A-07-57 maintained the previous recommendation's classification of "Open—Unacceptable Response" because the Safety Board believed that the FAA has had adequate time to require landing distance assessments and implement a landing distance safety margin but had not yet done so. In November 2007, the Safety Board added the need for landing distance assessments with an adequate safety margin for every landing to its Most Wanted List of Transportation Safety Improvements.

The FAA responded to Safety Recommendation A-07-57 on December 17, 2007, and A-07-61 on January 8, 2008. For both recommendations, the FAA stated that a survey of Part 121 operators indicated that 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. The FAA also stated that its POIs would continue to encourage their assigned air carriers to incorporate the SAFO elements in their procedures but did not describe the actions that it would take to encourage those operators that have not complied with the SAFO (as was noted during the investigation of the February 2007 Shuttle America accident at Cleveland, Ohio[63]) to do so. Because all 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 (Urgent) remains classified "Open—Unacceptable Response."

The FAA further indicated that, on December 6, 2007, it announced the formation of an aviation rulemaking committee (ARC) to review regulations affecting certification and operation of airplanes and airports for airplane takeoff and landing operations on contaminated runways. The ARC kickoff meetings occurred on March 27 to 28, 2008. ARC subgroups are to provide their recommendations to the FAA by March 1, 2009. Pending the prompt completion of the aviation rulemaking committee's work and the FAA's

[62] Urgent Safety Recommendation A-06-16 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."

[63] For additional information, see National Transportation Safety Board, *Runway Overrun During Landing, Shuttle America, Inc., doing business as Delta Connection Flight 6448, Embraer ERJ-170, N862RW, Cleveland, Ohio, February 18, 2007*, Aircraft Accident Report NTSB/AAR-08/01 (Washington, DC: NTSB, 2008).

timely action in response to the committee's recommendations, the Board classified Safety Recommendation A-07-61 "Open—Acceptable Response" in April 2008.

1.18.2.2 Standardized Phraseology

Also as a result of the Southwest Airlines flight 1248 accident, the Safety Board issued Safety Recommendation A-07-62, which asked the FAA to do the following:

> Develop and issue formal guidance regarding standards and guidelines for the development, delivery, and interpretation of runway surface condition reports.

The FAA responded to Safety Recommendation A-07-62 on January 8, 2008, stating that the ARC (development of which was announced by the FAA on December 6, 2007) would also provide the FAA with advice and recommendations regarding "establishment of standards for runway surface condition reporting and minimum surface conditions for continued operations." Pending the FAA taking the recommended actions, the Safety Board classified Safety Recommendation A-07-62 "Open—Acceptable Response" on June 12, 2008.

1.18.2.3 Crash Detection and Location Technology

As a result of the June 1, 1999, accident at Little Rock, Arkansas, the Safety Board issued Safety Recommendation A-01-66, which asked the FAA to do the following:

> Evaluate crash detection and location technologies, select the most promising candidate(s) for ensuring that emergency responders could expeditiously arrive at an accident scene, and implement a requirement to install and use the equipment.

The FAA's February 19, 2002, response letter to the Safety Board cited guidance contained in AC 150/5220-10B, "Guide Specification for Water/Foam Aircraft Rescue and Firefighting Vehicles," which dictates that "all new vehicles carrying 1,000 gallons or more of water and purchased with Federal funds" be equipped with FLIR equipment to allow ARFF vehicle drivers to maneuver in reduced visibility and "to locate, within certain limits, a specific object like an aircraft." The FAA Administrator further stated the following:

> …between the [FLIR] system capabilities and the emergency response coordination with tower controllers, emergency responders are able to respond quickly to virtually every recent on-airport accident or incident. I believe that the FAA has addressed the full intent of this safety recommendation, and I consider the FAA's action to be complete.

In its October 17, 2002, response, the Safety Board stated that the intent of its recommendation was broader than the FAA's interpretation, indicating that the recommendation asks the FAA to evaluate technology that would aid ARFF personnel

in "detecting and locating a crashed airplane in situations regardless of the weather or visibility." The Board acknowledged that installation of FLIR devices was a positive step; however, the Board cited several accidents in which it believed that "FLIR would have been of little value in speeding the emergency response." The Board again asked the FAA to evaluate crash detection and location technology; pending such an evaluation and implementation of a requirement for such equipment, the Board classified Safety Recommendation A-01-66 "Open—Unacceptable Response."

2. ANALYSIS

2.1 General

The pilots were properly certificated and qualified under Federal regulations and Pinnacle Airlines training requirements. No evidence indicated any medical conditions that might have adversely affected the pilots' performance during the accident flight.

The accident airplane was properly certificated and was equipped and maintained in accordance with industry practices and was within weight and center of gravity limits.

The investigation revealed no evidence of any failure or anomaly of the airplane's powerplants, structures, or systems (including the airplane's deceleration devices, such as brakes, antiskid devices, and thrust reversers) that would have affected the airplane's performance during the accident landing. Although the airplane performance study showed that the airplane's braking during the accident landing was less effective than during previous landings, the investigation indicated that the reduced effectiveness was likely the result of the antiskid system's normal modulation of the output brake force on the contaminated runway. Therefore, the Safety Board concludes that, based on the system designs and runway conditions, it is likely that the airplane's braking and antiskid systems were performing to their maximum effectiveness.

Although, at its original departure time, Pinnacle dispatchers could not dispatch the accident flight because of strong winds in the TVC forecast, an amended forecast issued by NWA's meteorology department (and reflected in a subsequent NWS-issued forecast) predicted more favorable wind conditions (as well as higher ceilings and improved visibility in light snow) at TVC and thus met the required criteria for the flight's dispatch.

The services provided by MSP ARTCC were in accordance with all FAA directives. Separation, instrument approach vectoring and clearance, and additional services were all complete and correct. The flight arrived after the TVC ATCT had closed for the night; however, the pilots required no ATC traffic information or separation services because there was no other traffic in the area at the time of arrival (records indicate that the most recent traffic in the area was about 3 hours earlier). The Safety Board concludes that the services provided by the ATC system did not affect the outcome of the flight. Information commonly provided by ATC (for example, weather and runway surface condition reports) was available to the flight crew, and its availability was unaffected by the ATCT's closure before the flight's arrival at TVC.

TVC airport operations personnel performed and completed snow removal and deicing operations based on the accident airplane's revised estimated arrival time of 0037. Friction measurements completed on runway 28 after those operations (about 15 minutes

before the airplane touched down, as prescribed in the airport snow removal plan) were better than .40 MU. However, moderate-to-heavy snow fell after the snow removal operations were completed, and the runway conditions deteriorated. Ground personnel estimated that the snow depth had increased to nearly 1/2 inch before the airplane landed. Based on the airport's snow and ice control plan, this depth of accumulation nearly, but did not quite, reach the 1/2-inch level needed to trigger additional snow removal activities. Therefore, the Safety Board concludes that TVC's snow removal operations and runway surface condition assessment activities were conducted in accordance with the airport's FAA-approved snow and ice control plan.

Postaccident interviews and documentation indicated that after the airplane came to a stop, the captain evaluated its condition and considered various methods of deplaning the passengers. The captain recognized that if he commanded an immediate emergency evacuation, the passengers would be safely away from the airplane; however, they would have been exposed to severe winter weather conditions at night. Because the pilots' postaccident evaluation of the airplane (which included an external inspection) revealed no indication of fire risk, the captain elected to follow Pinnacle's "expeditious deplaning" procedures. He kept the passengers on board the airplane until emergency response/transport personnel arrived at the airplane. Postaccident reports indicate that the resultant egress through the left front cabin door and stairs was orderly; there were no injuries reported. The Safety Board concludes that, considering the severe winter weather and the relatively intact condition of the airplane, the captain's decision to deplane the passengers using Pinnacle's "expeditious deplaning" procedures was appropriate.

2.1.1 Aircraft Rescue and Firefighting Crash Detection

The TVC ARFF responder reported that, although he heard that the accident site was somewhere along runway 10/28, he initially had difficulty determining the airplane's location along the length of that runway, despite his use of FLIR equipment, in part because of snow-restricted visibilities. Additionally, the ARFF vehicle radio was set to scan emergency radio frequencies, and transmissions about a concurrent, unrelated off-airport fire resulted in congestion on those radio frequencies, making it difficult for the ARFF responder to obtain clarifying information. (The investigation revealed that TVC personnel promptly addressed this frequency congestion issue after the accident.) The ARFF responder was able to drive directly to the accident site after he heard a radio transmission stating, "we're on the numbers of 10," and arrived at the site about 7 minutes after he was alerted to the accident. The Safety Board concludes that, although there were no reported injuries resulting from this accident, had a postaccident fire occurred, the delay in ARFF response could have adversely affected the safety of passengers after the accident. The Safety Board further concludes that the FLIR equipment installed in the ARFF vehicle did not help the firefighter locate the accident airplane; however, improved crash detection and location equipment would likely have facilitated a more timely ARFF response. Therefore, the Safety Board reiterates Safety Recommendation A-01-66.

2.1.2 Postaccident Alcohol Testing

Title 14 CFR Part 121 Appendix J, Section B1 states that a decision to forgo the administration of a postaccident alcohol test "shall be based on the employer's determination, using the best available information at the time of the determination, that the covered employee's performance could not have contributed to the accident." The Safety Board is not aware of any information at the time of the accident that would have precluded alcohol testing. Pinnacle did conduct drug tests for the pilots 3 hours after the accident and both pilots tested negative for illicit drugs, but the pilots were not tested for alcohol. Although there is no reason to believe their performance was affected by alcohol, the failure of the airline to perform required postaccident alcohol tests prevents a definitive statement on the issue. Even though there was some uncertainty as to whether the runway overrun was an accident or an incident, it would have been prudent for Pinnacle to comply with the drug and alcohol testing regulations as if the overrun were to be classified as an accident.

After another recent accident,[64] pilots tested negative for alcohol and drugs. However, the alcohol testing was delayed until about 3 hours after the accident and no records stating the reasons for the delay were prepared by the air carrier—Shuttle America—(as required by 14 CFR Part 121 Appendix J) nor were such records requested by an FAA representative.

Timely testing for alcohol after an accident is necessary to evaluate any safety factors related to alcohol impairment or to eliminate them from further consideration. Although there was no evidence that alcohol was a factor in either recent accident, it cannot be conclusively ruled out; further, there is evidence that administration of required testing was not conducted or enforced strictly. Therefore, the Safety Board believes that the FAA should emphasize with POIs the importance of conducting timely postaccident drug and alcohol testing.

The safety issues discussed in this analysis include the pilots' actions and decision-making during the approach, landing, and landing roll; pilot fatigue and line check airman duty time regulations; weather and field condition information and ground operations personnel communications; and criteria for runway closures in snow and ice conditions.

2.2 Pilot Performance, Actions, and Decision-Making During the Flight

During its investigation, the Safety Board evaluated the pilots' actions and decisions during the flight, including their decision to land at TVC, their awareness of/attention to the weather conditions at TVC, and their actions during the landing roll. The Safety Board's review of CVR evidence indicated that, consistent with the captain's performing

[64] National Transportation Safety Board, *Runway Overrun During Landing, Shuttle America, Inc., doing business as Delta Connection Flight 6448, Embraer ERJ-170, N862RW, Cleveland, Ohio, February 18, 2007,* Aircraft Accident Report NTSB/AAR-08/01 (Washington, DC: NTSB, 2008).

OE duties, the pilots' conversation during the flight largely focused on operational and procedural issues, including the inclement weather (snow and strong winds). Postaccident interviews and CVR evidence showed that the pilots had been operating in inclement weather conditions with snow, wind, and turbulence all day and expected to encounter similar weather conditions at TVC. The pilots received updated weather information from the company via ACARS about 45 minutes before landing. This updated information indicated that the winds at TVC were still favorable for landing, and the captain advised the passengers that "it looks like we're gonna have no problems gettin' in [to TVC] this evening."

2.2.1 Pilot Actions and Decision-Making During the Approach

2.2.1.1 Landing Distance Assessments

CVR and postaccident interview evidence indicated that the pilots' concerns during the flight appeared to be primarily related to the TVC wind conditions, perhaps because that was the critical factor in the airplane's dispatch. Although the CVR recorded the captain mentioning the possibility of diverting to DTW late in the approach (about 1 minute before touchdown), the pilots exhibited limited concern regarding the runway surface condition.

About 37 minutes before they landed, the pilots listened to the TVC ASOS broadcast for updated weather information and runway surface condition information. This ASOS information indicated winds out of 040° at 7 knots and visibilities of 1 1/2 miles in light snow. This was the only TVC ASOS broadcast the pilots listened to before their arrival at TVC. However, TVC ground operations personnel provided the pilots with updated weather and runway surface condition information on several occasions as the airplane neared the airport. Evidence indicates that the runway surface conditions at TVC deteriorated further because of increasing snowfall during the last 15 minutes of the accident flight. The TVC airport operations supervisor provided runway surface condition information to the accident pilots both before ("forty plus MU"[65] with "thin wet snow over patchy thin ice") and during the vectoring stages of the approach (for example, "it's comin' down pretty good," "this is fillin' in pretty quick," and "it's fillin' in real hard"). Consistent with this information, the CVR recorded the captain commenting that he expected to land on a contaminated runway. For example, the captain stated: "there's snow removal on the field yet they're showing forty or better sounds like a contaminated…runway to me" at 0029:10.5; "with contaminant, more than likely" at 0033:50.9; and "snowing hard" at 0034:09.3. (ASOS reports, which the pilots had not obtained, also showed that light snow increased to moderate snow about 0030; then, about 0040, increased to heavy snow with visibility of 1/4 mile.)

In December 2006, Pinnacle incorporated procedures into the company's OpSpecs requiring its pilots to perform landing distance assessment procedures consistent with guidance contained in the FAA's SAFO 06012. These procedures, which were in effect at

[65] Runway friction surveys are not conducted on uncontaminated runways; thus, no MU values would be obtained or reported for those surfaces.

the time of the accident, required Pinnacle pilots to obtain the most current meteorological and runway surface condition estimates as close to landing as possible and perform landing distance assessments to determine whether adequate runway length was available before beginning an approach to a contaminated runway.

However, CVR evidence revealed that the pilots did not perform such an assessment, and, during postaccident interviews, both pilots told investigators that they did not perform a landing distance assessment. The captain told investigators that he had landed on snowy runways many times and that he believed the runway conditions were okay based on the contamination depth. The first officer stated that he thought that pilots were required to (and should) check landing distances with a contaminated runway. He said that he believed 4,000 feet was the required landing distance but indicated that they did not check the landing distance charts.

The Safety Board's review of Pinnacle's landing distance charts, based on the accident conditions and reports indicating that wet snow was on the runway, indicated that the airplane's landing distance would exceed the available runway length. Further, the pilots had adequate information available to indicate that the runway was contaminated and that a landing distance assessment was required. To the company's credit, Pinnacle voluntarily incorporated the procedures outlined in SAFO 06012; yet the pilots still did not perform the required landing distance assessment before this accident. The captain stated that he believed the runway was freshly plowed and that the conditions were such that a landing distance assessment was not required. The Safety Board concludes that the pilots failed to perform the landing distance assessment that was required by Pinnacle's OpSpecs; had they done so, using current weather information, the results would have shown that the runway length was inadequate for the contaminated runway conditions described. This accident reinforces the need for pilots to perform landing distance assessments before every landing, taking into account conditions at the time of arrival and adding a safety margin of at least 15 percent to calculated landing distances. Therefore, the Safety Board reiterates Safety Recommendation A-07-57.

Later in the approach, when advised by the TVC airport operations supervisor that snow had accumulated to nearly 1/2 inch, the captain told the first officer, "[w]e're allowed 3 inches…half inch is nothing." The captain's comments indicated that he believed that company policies allowed them to land under any circumstances with up to 3 inches of contaminant on the runway.[66] However, the captain ignored the company requirement for performance of a landing distance assessment demonstrating that sufficient runway exists for a safe landing in contaminated runway conditions regardless of contaminant depth. The TVC ground operations supervisor's comments (including "it's filling in" and his estimate that the snow was 1/2 inch deep) provided the pilots with ample information to recognize at least that the runway was contaminated and that a landing distance assessment should have been performed. Nonetheless, on the basis of the information provided by the TVC ground operations supervisor, the captain appeared satisfied that the ground cover was within Pinnacle's limitations and continued the approach without performing a landing distance assessment. The Safety Board concludes that because the

[66] Pinnacle policies only permitted landings on runways with wet snow depths of 1 1/2 inches or less.

pilots had ample evidence that wet snow was accumulating rapidly on the runway at TVC, they should have anticipated a landing on a contaminated runway and performed a landing distance assessment as required by the company's OpSpec.

The Safety Board's review of ATC and CVR data and postaccident pilot statements indicated that as the approach continued, the pilots could have reassessed their decision and performed a landing distance assessment as they received additional information regarding TVC weather and runway conditions; their workload was relatively light during the approach to TVC. Further, if the pilots were concerned about the time and workload involved in conducting a landing distance assessment during the approach, they could have requested either a delayed turn-in for the approach or holding pattern instructions from MSP ARTCC.

2.2.1.1.1 Landing Distance Assessment Training

SAFO 06012, Section 3g also provides the following guidance for training flight crews on the landing distance assessment procedures, stating that all flight crewmembers should be made aware of the procedures:

> ….in a manner consistent with the operator's methods for conveying similar knowledge to flight operations personnel. It may be conducted via operations/training bulletins or extended learning systems…all flight crewmembers should have hands on training and validate proficiency in these procedures during their next flight training event.

Pinnacle Airlines voluntarily adopted the guidance in SAFO 06012 and incorporated mandatory landing distance assessments for contaminated runways into both its flight manual and operations specifications, informing pilots via a revision to the flight manual, and teaching the procedure in ground school. The FAA POI indicated that he was satisfied with the company's adoption of this SAFO. However, provisions for hands-on training and validation of proficiency were not put into place.

Although both the captain and the first officer were familiar with the landing distance assessment procedure (in fact, as part of the first officer's operating experience, the captain reviewed the landing distance assessment procedures during a previous flight), neither recognized the need to accomplish this procedure when they were briefed on the contaminated runway conditions at TVC. This deficiency may be explained by fatigue impairment, but more thorough training on the rationale behind conducting a landing distance assessment may have made the crew more cognizant of the need for such an assessment and of the benefits of conducting the assessment for contaminated runways before landing. After the accident, Pinnacle voluntarily increased its training on the landing distance assessment by providing pilots with an additional review of the charts and their proper use during semiannual training events, annual ground school training, and annual pilot check flights.

When adopting new operational procedures, it is important to ensure that those who will be using the procedures have a thorough understanding of not only how to perform

the procedure, but when to perform it. Because dispatch must perform a landing distance calculation before departure to ensure that the airplane can land at the destination airport within weight limits and in the available landing distance, pilots may not recognize the criticality of performing a landing distance assessment just before landing. The assessment is particularly critical when runway conditions may have changed over the length of the flight, as was the case at TVC. The primary purpose of conducting a landing distance assessment is to account for current runway conditions. The Safety Board is concerned that the introduction of a landing distance assessment in a manner similar to other, possibly less essential procedures followed by training up to 6 months later may not sufficiently communicate to pilots the importance of conducting a landing distance assessment before landing on a contaminated runway.

The Safety Board supports the guidance of SAFO 06012 and recognizes that Pinnacle Airlines voluntarily adopted this procedure and enhanced its training after the accident. The Safety Board concludes that initial training for pilots on the rationale for and criticality of conducting a landing distance assessment before landing on a contaminated runway would reinforce the need to conduct such an assessment. The FAA's Takeoff/ Landing Performance Assessment Aviation Rulemaking Committee, convened to discuss the landing distance assessment methods provided in SAFO 06012, provides an ideal forum to address the training that is necessary for the implementation of landing distance assessment procedures. Therefore, the Safety Board believes that the FAA should, as part of the Takeoff/Landing Performance Assessment Aviation Rulemaking Committee, address the need for initial training on the rationale for and criticality of conducting landing distance assessments before landing on contaminated runways.

2.2.1.2 "Nil" Braking Reports

During the last 15 minutes of the flight, the TVC airport operations supervisor used the term "nil" twice describing the runway braking action in radio transmissions to the accident pilots. Review of ATC and CVR evidence indicated that the TVC airport operations supervisor's first "nil" braking report ("…I'm gonna call braking action nil now…'cause it's fillin' in real hard") was issued about the same time that the controller assigned the pilots a new heading and approved a frequency change to the TVC CTAF. The radio transmissions began about 0038:03 and 0038:04, respectively, and the pilots were monitoring both the TVC CTAF and MSP ARTCC radio frequencies as they neared TVC. CVR evidence shows that the first officer turned down the volume on the TVC CTAF to hear the heading and frequency instructions provided by the controller. The captain's subsequent comment about the TVC airport operations supervisor's transmission ("I mean, what kind of report's that, 'it's filling in'…doesn't tell me good bad fair poor") indicated that he had not heard the nil braking report portion of that transmission. Therefore, the Safety Board concludes that it is likely that neither pilot heard the TVC airport operations supervisor's first nil braking report because that transmission occurred simultaneously with critical approach instructions issued by the controller.

The TVC airport operations supervisor used the term "nil" a second time in a transmission less than 3 minutes later (about 0040:53), when he stated, "…again…brakin' action's probably nil on the runway." This "probably nil" statement from the TVC airport

operations supervisor was not definitive, nor was it standard phraseology for reporting runway conditions. The captain promptly requested clarification, asking, "are you saying it's nil?" The TVC airport supervisor's response to this question, however, was even more ambiguous than his "probably nil" statement; he stated that he had not been "out there to do a field report and it's been 5, 10 minutes, so I don't know what it's doin' now." (The TVC airport operations supervisor stated during postaccident interviews that this assessment of the runway condition was based on tests he conducted in his vehicle on runway 28, during which he perceived "minimal to nonexistent" braking action and "uncertain" directional control; however, he did not provide the pilots with this detailed description of conditions.) The Safety Board concludes that, although Pinnacle procedures prohibit landing when runway braking action is reported as "nil," the TVC airport operations supervisor's description of "probably nil" (a term that has no clearly defined meaning with regard to runway braking action) and his subsequent failure to confirm a nil braking report when questioned further by the pilots likely led the pilots to believe that the runway braking action was not actually nil and therefore did not directly prohibit the landing.

During subsequent communications, the captain further queried the airport operations supervisor about runway conditions, specifically asking about the depth of snow covering the runway, and the airport operations supervisor responded, estimating nearly 1/2 inch of snow. When presented with ambiguous information, it is not unreasonable to expect the captain to request more information so that he can make a decision whether or not to land; that decision is ultimately the captain's. While the subsequent information the captain received indicated that the snow depth was within the limits established by the company, he still did not perform a landing distance assessment, which was required for landing with the contamination on the runway.

2.2.2 Pilot Actions During the Landing and Landing Roll

The Safety Board evaluated the pilots' actions during the touchdown and landing roll to determine whether those actions were a factor in the overrun. FDR data showed that the pilots flew the approach and crossed the runway 28 threshold at an airspeed of about 148 knots. This was consistent with existing Pinnacle guidance indicating that an airplane at the accident airplane's landing weight and configuration should have flown the approach and crossed the threshold at the reference landing speed (V_{ref}) plus up to 5 additional knots for gusty wind conditions. FDR data showed that the airplane was decelerating as it crossed the runway's approach threshold and touched down on the landing runway at a speed of 123 knots, about 2,400 feet beyond that threshold. Pinnacle guidance dictates that the normal touchdown zone on a runway is 1,000 to 1,500 feet beyond the runway's approach threshold and calls for a go-around if an airplane cannot land in the first 3,000 feet or the first third of the runway, whichever is less. Therefore, based on its review of FDR data and Pinnacle landing guidance, the Safety Board concludes that the accident airplane landed farther down the runway than the 1,500-foot touchdown point assumed by the landing distance calculations; however, even if the airplane had touched down within the 1,500-foot, company-designated standard touchdown zone, it would likely not have stopped before the end of the runway given the accident conditions.

An airplane's deceleration during the landing roll is a function of the runway surface condition and the application/use of deceleration mechanisms, including spoiler and thrust reverser deployment and associated engine fan speed setting and wheel brake/antiskid systems. According to the Safety Board's airplane performance study and review of the FDR data, immediately after the airplane touched down, brake pressure was applied and the spoilers and thrust reversers were deployed. (The thrust reversers were deployed and then stowed twice during the landing roll.) The FDR recorded airplane heading changes during each thrust reverser deployment. During the first thrust reverser deployment, FDR data showed a 3° nose-right heading change that the pilots were able to compensate for with left rudder input. During the second thrust reverser deployment (which was initiated at a slower speed), FDR data showed a 7° nose-right heading change, followed by a left rudder input. The airplane heading then veered left to a maximum 25° nose-left-of-runway heading, despite the pilots' attempts to counter with right rudder input, as the airplane ran off the end of the runway.

These heading changes, which were simultaneous with thrust reverser deployment, were apparently consistent with Pinnacle and Bombardier guidance indicating that directional control/rudder effectiveness might be compromised when using thrust reversers while landing on contaminated runways and/or in crosswind conditions. (Pinnacle procedures prohibited the use of reverse thrust on contaminated surfaces at speeds of less than 60 knots, although company pilots were permitted to use maximum reverse thrust to a complete stop in emergency situations.) During postaccident interviews, the captain indicated that he did not immediately recognize the need for more aggressive thrust reverser application because the reduced visibility and the contaminated runway made it difficult to determine the airplane's location along the runway. However, he stated that he was concerned about keeping the airplane aligned with the runway centerline during the landing roll. Therefore, the Safety Board concludes that the pilots' use of the thrust reversers during the landing roll was not inconsistent with company and manufacturer guidance related to thrust reverser usage in adverse weather conditions and company policies prohibiting thrust reverser use at speeds less than 60 knots except in emergency circumstances.

2.3 Pilot Fatigue Issues

When asked whether pilot fatigue was a problem at Pinnacle, the FAA POI estimated that 60 to 70 percent of Pinnacle pilots who voluntarily submitted event reports through the company's ASAP cited fatigue as a factor in the event. In addition, several of the company pilots interviewed during this investigation indicated that company schedules could be exhausting. The Safety Board examined the pilots' hours of rest, waking time, length of duty day, workload, personal sleep histories, and performance deficiencies to determine whether fatigue was a factor in the pilots' performance and decision-making during the accident flight. In addition, the Board examined line check airman issues.

2.3.1 Accident Pilot Fatigue

The accident occurred well after midnight at the end of a demanding day during which the pilots had flown 8.35 hours,[67] made five landings, been on duty more than 14 hours, and been awake more than 16 hours.[68] During the accident flight, the CVR recorded numerous yawns and comments that indicate that the pilots were fatigued. Specifically, the accident CVR recorded the captain yawning four times (at 2340:00.3, 0001:06.6, 0004:00.4, and 0009:47.1). Additionally, the captain made references to being tired at 2332:12, 2341:53, and 0018:43, and the first officer stated, "jeez, I'm tired" at 0020:41. Additionally, the pilots' high workload (flying in inclement weather conditions, and in the captain's case, providing OE for the first officer) during their long day likely increased their fatigue.

The Safety Board's 1994 study of flight crew-related major aviation accidents indicated that fatigue related to lengthy periods of wakefulness can contribute to accidents. Specifically, the Board's study found that captains who had been awake for more than about 12 hours made significantly more errors (including failure to recognize and discontinue an ill-advised or flawed approach) than those who had been awake for less than 12 hours.

Accident data further show that long duty days significantly increase the likelihood of human factors-related accidents. Pilots who flew schedules involving 13 or more hours of duty time had accident rates several times higher than pilots who flew shorter schedules. In its investigations of two accidents in which fatigue was cited and the pilots continued an ill-advised and/or flawed approach (the June 1999 accident at Little Rock, Arkansas, and the October 2004 accident at Kirksville, Missouri),[69] the Safety Board noted that the pilots had been continuously awake for at least 15 to 16 hours (as had the pilots in this accident). In addition, several other accidents have involved fatigued pilots, subject to long continuous wakefulness and late hours, who attempted to land despite evidence

[67] Although the pilots' 8.35 hours of flight time exceeded the flight time cap, Federal regulations do allow for such exceedences when they are the result of "circumstances beyond the [operator's] control…such as adverse weather conditions."

[68] The captain stated that although he was off duty during the days before the accident, his sleep during that time was interrupted, in part because of a newborn child. He awoke about 0700 CDT on the day of the accident. The first officer was also off duty in the days before the accident, during which he made a personal trip to California. He awoke about 0630 CDT on the day of the accident.

[69] See National Transportation Safety Board, *Runway Overrun During Landing, American Airlines Flight 1420, McDonnell Douglas MD-82, N215AA, Little Rock, Arkansas, June 1, 1999,* Aircraft Accident Report NTSB/AAR-01/02 (Washington, DC: NTSB, 2001) and National Transportation Safety Board, *Collision with Trees and Crash Short of the Runway, Corporate Airlines Flight 5966, BAE Systems BAE-J3201, N875JX, Kirksville, Missouri, October 19, 2004*, Aircraft Accident Report NTSB/AAR-06/01 (Washington, DC: NTSB, 2006).

that the approach should be discontinued.[70] Research also indicates that alertness suffers when a working day exceeds 14 to 16 hours.[71]

Fatigue especially affects decision-making, and people who are fatigued become less likely to consider options and more likely to become fixated on a desired outcome. Among pilots, this may appear as errors such as failing to discontinue an ill-advised approach. In this case, the accident occurred during an instrument approach to a snow- and ice-contaminated runway in a snowstorm after the fifth flight segment of the day. The pilots had performed four previous landings and flown in challenging (windy, turbulent, snowy) weather conditions throughout the day, and it is unlikely that they wanted to extend their day further by diverting to an alternate airport. In this case, it is likely that fatigue and a desire to end the trip (and their day) influenced the pilots' continuation of the approach despite evidence that they should either delay the approach or divert to an alternate airport.

The Safety Board concludes that the poor decision-making shown by the accident pilots, including their failure to account for the changing weather and runway conditions during the approach; their failure to perform a landing distance calculation; and their failure to reassess or discontinue the approach accordingly, likely reflected the effects of fatigue.

Scientific literature indicates that people typically underestimate their level of fatigue,[72] especially when they are busy, as the pilots would have been when preparing for and departing on the accident flight. During postaccident interviews, both pilots indicated that they did not realize how tired they were until they reached cruise altitude during the accident flight. This is consistent with CVR evidence, which shows that complaints of fatigue and yawning began during this relatively low workload phase of the flight. Because the accident trip involved a series of delays because of dispatch, maintenance, and deicing issues, the pilots may have felt alert when they committed to the trip but found that they were tired as they set up for the approach into TVC (which occurred almost 2 hours later than scheduled). Pinnacle had a policy that allowed pilots to remove themselves from trips because of fatigue; however, the accident pilots did not elect to do so, possibly because they did not recognize their level of fatigue until they were en route.

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[70] See a) National Transportation Safety Board, *Uncontrolled Collision With Terrain, American International Airways Flight 808, Douglas DC-8-61, N814CK, U. S. Naval Air Station, Guantanamo Bay, Cuba, August 18, 1993*, Aircraft Accident Report NTSB/AAR-94/04 (Washington, DC; NTSB, 1994); b) National Transportation Safety Board, *Controlled Flight into Terrain, Korean Air Flight 801, Boeing 747-300, HL7468, Nimitz Hill, Guam, August 6, 1997*, Aircraft Accident Report NTSB/AAR-00/01 (Washington, DC: NTSB, 2000); and c) 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).

[71] G.P. Kruger (1989). "Sustained work, fatigue, sleep loss, and performance: a review of the issues." *Work and Stress*, vol. 3, pp. 129-141.

[72] A. Itoi, R. Cilveti, M. Voth, B. Dantz, P. Hyde, A. Gupta, and W. Dement (1993). "Can Drivers Avoid Falling Asleep at the Wheel?" Washington, DC: AAA Foundation for Traffic Safety. For more information, see <http://www.aaafoundatoin.org/resources/index.cfm?button=asleep>.

The pilots' schedule for the accident sequence was consistent with existing FAA flight and duty time regulations. The Safety Board has long urged the FAA to review and update the hours-of-service regulations based on current scientific evidence. For example, in 2006, the Board issued Safety Recommendation A-06-10, which recommended that the FAA "modify and simplify the flight crew hours-of-service regulations to take into consideration factors such as length of duty day, starting time, workload, and other factors shown by recent research, scientific evidence, and current industry experience to affect crew alertness." Despite this and other fatigue-related recommendations, the FAA has not updated or revised its pilot flight and duty time regulations. On the basis of the FAA's continued inaction, in November 2006, the Safety Board classified Safety Recommendation A-06-10, "Open—Unacceptable Response."

This accident demonstrates again that fatigue-related issues continue to affect the safety of airline operations and that the airline industry could greatly benefit from hours-of-service rules that reflect current scientific understanding and industry experience to minimize the effects of fatigue on safety. The Safety Board concludes that existing FAA pilot flight and duty time regulations permitted the long and demanding day experienced by the accident pilots, which resulted in their fatigued condition and degraded pilot decision-making. Therefore, the Safety Board reiterates Safety Recommendation A-06-10.

2.3.2 Line Check Airman Fatigue Issues

Because the accident captain was serving as a line check airman during the accident flight, issues related to scheduling of check airmen were addressed in this investigation. In addition to regular line pilot duties, check airmen have the added responsibilities of providing OE to new hires[73] while shouldering additional cockpit duties as needed, depending on the experience and competency of the new hire. In this case, the accident captain was subject to significant additional workload because of his check airman duties. Throughout the day, the captain was flying in challenging conditions without the assistance of an experienced colleague, continually monitoring the first officer's actions and performance as the nonflying pilot, and providing guidance to the first officer. (CVR evidence showed that the captain actively provided instruction and monitoring of the first officer's actions in support of his initial OE throughout the accident flight.)

These additional responsibilities can result in a workload that is substantially more demanding and fatiguing than regular line flying and, in this case, would have almost certainly exacerbated the development of fatigue for the captain. Especially during a time of pilot shortages and high turnover rates, increased training demands could force line check airmen to spend the bulk of their flying time providing OE and flying with new pilots with less experience, resulting in greater demands on the check airmen. The captain indicated that most of his flying during the weeks before the accident involved OE and performing other check airman duties. Federal regulations do not address check airman hours of service apart from general flight and duty time limitations, and Pinnacle did not apply special duty-time limits to its line check airmen at the time of the accident.

[73] Other check airman duties include performing line and proficiency checks.

Subsequent correspondence from Pinnacle representatives indicates that check airmen performing OE are now limited to 14 hours of duty and 8 hours of "actual" (rather than "scheduled") flight time per day.

The Safety Board concludes that the additional responsibilities and task demands involved in providing OE and performing related check airman functions likely aggravated the effects of fatigue for the captain/check airman. The Board recognizes that previously reiterated Safety Recommendation A-06-10 encompasses numerous factors that the FAA should consider in modifying flight crew flight and duty times and other limitations for pilots, including workload. The increased workload involved when a line check airman is providing OE and performing related check airman functions is another aspect of flight and duty time regulations and other limitations that need to be addressed as part of Safety Recommendation A-06-10. Further, on June 10, 2008, the Safety Board issued Safety Recommendations A-08-44 and -45 recommending the development and evaluation of fatigue management systems; the breadth of issues potentially addressed by these systems could include specific factors addressing check airman functions and the Safety Board urges the FAA to consider check airman workload in fatigue management system development and guidance.

2.4 Dissemination of Weather and Field Condition Reports

The Safety Board evaluated whether critical information regarding local weather and airport conditions was available to the flight crew during the approach. Because the flight arrived after the scheduled operating hours of the TVC ATCT, information was not relayed by the ATCT controller or available through controller-recorded (ATIS) transmissions. However, other sources of weather and field condition information, such as airport operations equipment and personnel and ASOS transmissions, provided information consistent with that which would be provided by ATCT controllers and the ATIS during operating hours. The Board evaluated the flight crew's use of the weather information and the pilot/airport operations personnel communications during the flight's approach to TVC.

2.4.1 Weather Information Available to the Flight Crew

Per standard operating procedure, when the TVC ATCT closed on the night of the accident, controllers selected the TVC ASOS weather information for continuous broadcast on the airport's ATIS frequency. This information was updated at 1-minute intervals and was available to the pilots continuously—upon access—during the descent, approach, and landing. (During tower operating hours, the same ASOS observations were the source of weather data for the recorded ATIS broadcast or direct controller-pilot weather advisories.) The Safety Board's review of the ASOS observations indicated that they reflected the rapidly deteriorating conditions and increased snowfall at the time of the accident. Review of the ASOS data indicated no interruption in the system's weather observation broadcasts during the accident airplane's approach to TVC.

Published reference information regarding TVC weather observations in FAA and Pinnacle documents clearly indicated that the pilots were required to obtain weather information through the ASOS broadcast. Further, postaccident interviews and CVR evidence indicated that the pilots were aware of these required procedures. Among other OE procedural and operations issues discussed during the flight from MSP to TVC, the captain specifically reviewed uncontrolled airport operations and procedures with the first officer. However, CVR data showed that the crew monitored the TVC ASOS weather information on only one occasion, about 30 minutes before they landed. They did not obtain a more current observation as they neared the airport and heard transmissions from the airport operations supervisor indicating that the conditions were deteriorating. Therefore, the Safety Board concludes that the pilots could have made a more informed landing decision if they had monitored the current (updated every minute) and unambiguous TVC weather information that was continuously available to them through the TVC ASOS broadcast.

2.4.2 Airport and Runway Condition Reports and Ground Personnel Phraseology

In accordance with published procedures, after tower closing time the pilots communicated directly with TVC airport operations personnel on the CTAF regarding the timing of their arrival, snow removal activities, and the airport/runway conditions. The airport operations personnel are the source of runway and field condition reports issued by the control tower during operating hours, which are distributed via NOTAMs; therefore, the accident flight crew had direct access to equivalent runway and field condition information.

The Safety Board notes that early in the airplane's descent, the TVC airport operations supervisor provided the following precise runway condition report to the accident captain, "I've [.40+ on] runway two eight. I've got thin, wet snow [over] patchy thin ice." However, subsequent phraseology used by the TVC airport operations supervisor during radio transmissions to the accident pilots was conversational and imprecise (for example, the phrases "comin' down good," "fillin' in real hard," and "probably nil") and therefore subject to possible misinterpretation.

During the last 20 minutes of the accident flight, the TVC airport operations supervisor made several radio transmissions to the accident pilots regarding snow removal operations, subsequent snowfall, and accumulation of snow on the landing runway. Additionally, about 0040:53, the pilots clearly heard the second of two transmissions issued by the TVC airport operations supervisor that described the braking action on runway 28 as "probably nil."[74] However, when the captain immediately asked, "are you saying it's nil?" to confirm the nil braking report, the TVC airport operations supervisor vacillated and eventually downplayed his nil report, saying he had not performed a field report and did not know "what it's doin' now." When queried by the captain, the TVC

[74] As previously stated, the pilots likely did not hear the first nil braking report because of a simultaneous radio transmission.

airport operations supervisor estimated the runway snow depth to be "close to" 1/2 inch. CVR-recorded communications between the pilots indicated that the captain was initially concerned about the TVC airport operations supervisor's "probably nil" braking report but felt more confident about landing after hearing the contaminant depth estimate of 1/2 inch.

The FAA recommends that airports use the AIM chapter titled, "Radio Communications, Phraseology, and Techniques" as a source for related airport training materials and procedures. This AIM chapter emphasizes the importance of precision, conciseness, and proper radio technique in successfully communicating by radio and includes examples of proper phraseology and radio techniques. A review of TVC training materials for operations personnel regarding communications and airport familiarity indicated that the materials were consistent with and referenced the AIM information. Further, TVC records indicate that all ground personnel on duty the night of the accident, including the airport operations supervisor, had successfully completed the required training.

Because the airport operations supervisor had completed the required training and was also familiar with appropriate phraseology from his pilot training, it is not clear why he failed to provide specific and decisive information at all times on the night of the accident. However, it is likely that TVC airport operations supervisor's reticence to confirm his "probably nil" braking report when the captain tried to confirm it was a factor in the pilots' decision to continue the approach. The Safety Board concludes that the TVC airport operations supervisor's use of ambiguous and unspecific radio phraseology when providing braking action information likely affected the captain's decision to continue the approach; an unambiguous runway surface condition report would have provided the pilots with more accurate and useful information to factor into their landing decision. Therefore, the Safety Board believes that the FAA should issue a CertAlert to all 14 CFR Part 139 certificated airports that describes the circumstances of this accident, emphasizes the importance of specific and decisive radio communications, and urges airports to ensure that those criteria are being met in all airfield radio communications.

In its report on the Southwest Airlines flight 1248 accident, the Safety Board issued Safety Recommendation A-07-62, asking the FAA to do the following:

> Develop and issue formal guidance regarding standards and guidelines for the development, delivery, and interpretation of runway surface condition reports.

The FAA responded to Safety Recommendation A-07-62 on January 8, 2008, stating that the ARC (development of which was announced by the FAA on December 6, 2007) would also provide the FAA with advice and recommendations regarding "establishment of standards for runway surface condition reporting and minimum surface conditions for continued operations." On June 12, 2008, the Safety Board classified Safety Recommendation A-07-62 "Open—Acceptable Response."

2.4.3 Runway Closure Procedures in Snow and Ice Conditions

In 2005, the FAA Great Lakes Region sent correspondence to all Part 139 airport operators in the region regarding operations during snow and ice conditions. This letter stated that airports must implement procedures for closing any pavement available to air carriers when braking action/friction values reach an unsafe value (the equivalent of nil braking action). TVC airport personnel discussed this issue at a snow plan meeting held September 22, 2006. However, at the time of the accident, TVC's snow and ice control plan did not specify criteria that would result in airport personnel closing a runway and/or the airport. If TVC's snow and ice control plan had incorporated such criteria, it is likely that the TVC airport operations supervisor would have, given his determination that the braking action was nil, closed the runway to air carrier operations before the accident flight arrived, forcing the pilots to take alternate action. (After the accident, TVC received operational criteria information from the air carriers, and the airport now restricts air carrier operations when MU values of .27 or less are measured or when nil braking action is reported by pilots or TVC ground operations personnel.)

Therefore, the Safety Board concludes that incorporation of minimum safe operating limits for runway surface conditions into an airport's snow and ice control plan would ensure that airport operations personnel prohibit air carrier operations on any runway if, in their estimation, the braking action on that runway is unsafe. Therefore, the Safety Board believes that the FAA should require all 14 CFR Part 139 certificated airport operators to include in their airport's snow and ice control plan absolute criteria for type and depth of contamination and runway friction assessments that, when met, would trigger immediate closure of the affected runway to air carrier operations. Friction assessments should be based on pilot braking action reports, values obtained from ground friction measuring equipment, or estimates provided by airport ground personnel.

3. CONCLUSIONS

3.1 Findings

1. The pilots were properly certificated and qualified under Federal regulations and Pinnacle Airlines training requirements. No evidence indicated any medical conditions that might have adversely affected the pilots' performance during the accident flight.

2. The accident airplane was properly certificated and was equipped and maintained in accordance with industry practices and was within weight and center of gravity limits.

3. The investigation revealed no evidence of any failure or anomaly of the airplane's powerplants, structures, or systems (including the airplane's deceleration devices, such as brakes, antiskid devices, and thrust reversers) that would have affected the airplane's performance during the accident landing.

4. Based on the system designs and runway conditions, it is likely that the airplane's braking and antiskid systems were performing to their maximum effectiveness.

5. Although, at its original departure, time Pinnacle dispatchers could not dispatch the accident flight because of strong winds in the Cherry Capital Airport (TVC) forecast, an amended forecast issued by Northwest Airline's meteorology department (and reflected in a subsequent National Weather Service-issued forecast) predicted more favorable wind conditions (as well as higher ceilings and improved visibility in light snow) at TVC and thus met the required criteria for the flight's dispatch.

6. The services provided by the air traffic control (ATC) system did not affect the outcome of the flight. Information commonly provided by ATC (for example, weather and runway surface condition reports) was available to the flight crew, and its availability was unaffected by the air traffic control tower's closure before the flight's arrival at Cherry Capital Airport.

7. Cherry Capital Airport's snow removal operations and runway surface condition assessment activities were conducted in accordance with the airport's Federal Aviation Administration-approved snow and ice control plan.

8. Considering the severe winter weather and the relatively intact condition of the airplane, the captain's decision to deplane the passengers using Pinnacle's "expeditious deplaning" procedures was appropriate.

9. Although there were no reported injuries resulting from this accident, had a postaccident fire occurred, the delay in aircraft rescue and firefighting response could have adversely affected the safety of passengers after the accident.

10. The forward-looking infrared equipment installed in the aircraft rescue and firefighting (ARFF) vehicle did not help the firefighter locate the accident airplane; however, improved crash detection and location equipment would likely have facilitated a more timely ARFF response.

11. Although there is no reason to believe the pilots' performance was affected by alcohol, the failure of the airline to perform required postaccident alcohol tests prevents a definitive statement on the issue.

12. Even though there was initially some uncertainty as to whether the Cherry Capital Airport runway overrun was an accident or an incident, it would have been prudent for Pinnacle to comply with the drug and alcohol testing regulations as if the overrun were to be classified as an accident.

13. The pilots failed to perform the landing distance assessment that was required by Pinnacle's Operations Specifications; had they done so, using current weather information, the results would have shown that the runway length was inadequate for the contaminated runway conditions described.

14. Because the pilots had ample evidence that wet snow was accumulating rapidly on the runway at Cherry Capital Airport, they should have anticipated a landing on a contaminated runway and performed a landing distance assessment as required by the company's Operations Specifications.

15. Initial training for pilots on the rationale for and criticality of conducting a landing distance assessment before landing on a contaminated runway would reinforce the need to conduct such an assessment.

16. It is likely that neither pilot heard the Cherry Capital Airport operations supervisor's first "nil" braking report because that transmission occurred simultaneously with critical approach instructions issued by the controller.

17. Although Pinnacle procedures prohibit landing when runway braking action is reported as "nil," the Cherry Capital Airport operations supervisor's description of "probably nil" (a term that has no clearly defined meaning with regard to runway braking action) and his subsequent failure to confirm a nil braking report when questioned further by the pilots likely led the pilots to believe that the runway braking action was not actually nil and therefore did not directly prohibit the landing.

18. The accident airplane landed farther down the runway than the 1,500-foot touchdown point assumed by the landing distance calculations; however, even if the airplane had touched down within the 1,500-foot, company-designated standard touchdown zone, it would likely not have stopped before the end of the runway given the accident conditions.

19. The pilots' use of the thrust reversers during the landing roll was not inconsistent with company and manufacturer guidance related to thrust reverser usage in adverse

weather conditions and company policies prohibiting thrust reverser use at speeds less than 60 knots except in emergency circumstances.

20. The poor decision-making shown by the accident pilots, including their failure to account for the changing weather and runway conditions during the approach; their failure to perform a landing distance calculation; and their failure to reassess or discontinue the approach accordingly, likely reflected the effects of fatigue.

21. Existing Federal Aviation Administration pilot flight and duty time regulations permitted the long and demanding day experienced by the accident pilots, which resulted in their fatigued condition and degraded pilot decision-making.

22. The additional responsibilities and task demands involved in providing operating experience and performing related check airman functions likely aggravated the effects of fatigue for the captain/check airman.

23. The pilots could have made a more informed landing decision if they had monitored the current (updated every minute) and unambiguous Cherry Capital Airport (TVC) weather information that was continuously available to them through the TVC automated surface observing system broadcast.

24. The Cherry Capital Airport operations supervisor's use of ambiguous and unspecific radio phraseology when providing braking action information likely affected the captain's decision to continue the approach; an unambiguous runway surface condition report would have provided the pilots with more accurate and useful information to factor into their landing decision.

25. Incorporation of minimum safe operating limits for runway surface conditions into an airport's snow and ice control plan would ensure that airport operations personnel prohibit air carrier operations on any runway if, in their estimation, the braking action on that runway is unsafe.

3.2 Probable Cause

The National Transportation Safety Board determines that the probable cause of this accident was the pilots' decision to land at Cherry Capital Airport (TVC), Traverse City, Michigan, without performing a landing distance assessment, which was required by company policy because of runway contamination initially reported by TVC ground operations personnel and continuing reports of deteriorating weather and runway conditions during the approach. This poor decision-making likely reflected the effects of fatigue produced by a long, demanding duty day and, for the captain, the duties associated with check airman functions. Contributing to the accident were 1) the Federal Aviation Administration pilot flight and duty time regulations that permitted the pilots' long, demanding duty day and 2) the TVC operations supervisor's use of ambiguous and unspecific radio phraseology in providing runway braking information.

4. RECOMMENDATIONS

4.1 New Recommendations

As a result of this investigation, the National Transportation Safety Board makes the following recommendations to the Federal Aviation Administration:

> Emphasize with principal operations inspectors the importance of conducting timely postaccident drug and alcohol testing. (A-08-40)
>
> As part of the Takeoff/Landing Performance Assessment Aviation Rulemaking Committee, address the need for initial training on the rationale for and criticality of conducting landing distance assessments before landing on contaminated runways. (A-08-41)
>
> Issue a CertAlert to all 14 *Code of Federal Regulations* Part 139 certificated airports that describes the circumstances of this accident, emphasizes the importance of specific and decisive radio communications, and urges airports to ensure that those criteria are being met in all airfield radio communications. (A-08-42)
>
> Require all 14 *Code of Federal Regulations* Part 139 certificated airport operators to include in their airport's snow and ice control plan absolute criteria for type and depth of contamination and runway friction assessments that, when met, would trigger immediate closure of the affected runway to air carrier operations. Friction assessments should be based on pilot braking action reports, values obtained from ground friction measuring equipment, or estimates provided by airport ground personnel. (A-08-43)

4.2 Previously Issued Recommendations Reiterated in This Report

The Safety Board reiterates the following recommendations to the Federal Aviation Administration:

> Evaluate crash detection and location technologies, select the most promising candidate(s) for ensuring that emergency responders could expeditiously arrive at an accident scene, and implement a requirement to install and use the equipment. (A-01-66)

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

Modify and simplify the flight crew hours-of-service regulations to take into consideration factors such as length of duty day, starting time, workload, and other factors shown by recent research, scientific evidence, and current industry experience to affect crew alertness. (A-06-10)

BY THE NATIONAL TRANSPORTATION SAFETY BOARD

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Chairman

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Vice Chairman

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STEVEN R. CHEALANDER
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Adopted: June 10, 2008

5. APPENDIXES

APPENDIX A

INVESTIGATION AND PUBLIC HEARING

Investigation

The National Transportation Safety Board was notified about the accident on April 12, 2007, shortly after it occurred. A partial go-team was launched from headquarters with an Investigator-in-Charge and specialists in Operations, Human Performance, and Airworthiness.

The following investigative groups were formed during the course of this investigation: Airworthiness, Air Traffic Control, Meteorology, Operations, Human Performance, Airport/Survival Factors, Airplane Performance, Flight Data Recorder, and Cockpit Voice Recorder.

In accordance with Annex 13 to the Convention on International Civil Aviation, an accredited representative from the Transportation Safety Board of Canada and advisors from Transport Canada and Bombardier Aerospace participated in this investigation.

Parties to the investigation were the Federal Aviation Administration; Pinnacle Airlines (Pinnacle); Airline Pilots Association (ALPA); Northwest Airlines (NWA); Northwest Regional Airport Commission/Cherry Capital Airport, Traverse City, Michigan; and General Electric Aviation (GE). The Safety Board received submissions on this accident from Pinnacle, ALPA, NWA, Cherry Capital Airport (Traverse City, Michigan), and GE.

Public Hearing

No public hearing was held for this accident.

APPENDIX B

COCKPIT VOICE RECORDER TRANSCRIPT

The following is a transcript of the L-3 Communications model FA 2100-1020 cockpit voice recorder (CVR) installed on Pinnacle Airlines flight 4712, a Bombardier Regional Jet CL600-2B19, N8905F, which ran off the departure end of runway 28 after landing at Cherry Capital Airport, Traverse City, Michigan, on April 12, 2007.

LEGEND

APT-5	Radio transmission from airport fire/rescue
CAM	Cockpit area microphone voice or sound source
CTR	Radio transmission from Minneapolis center controller
HOT	Flight crew audio panel voice or sound source
INT	Intercom audio panel voice or sound source
OPS	Radio transmission from Traverse City Airport Operations Supervisor
PA	Public address system audio panel voice or sound source
RDO	Radio transmissions from
-1	Voice identified as the captain (CAPT)
-2	Voice identified as the first officer (FO)
-3	Voice identified as the flight attendant (FA)
-4	Voice identified as ground personnel
-?	Voice unidentified
*	Unintelligible word
#	Expletive
@	Non-pertinent word
&	Proper name
( )	Questionable insertion
[ ]	Editorial insertion

Note 1: Times are expressed in universal coordinated time (UTC).

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 and SOURCE	CONTENT	TIME and SOURCE	CONTENT
02:52:01.3 [start of recording]			
Start of Transcript			
03:31:54.1 HOT-1	ah what kinda winds are we poppin' I can't even remember any more. they're not light (weight) either I can't find a sock with a light on it. ahh there's one.		
03:32:01.6 HOT-2	and there's over- I can't tell where that's goin' thought.		
03:32:03.4 HOT-1	I can tell yeah.		
03:32:07.4 HOT-1	fun #.		
03:32:10.9 HOT-2	you you all right?		
03:32:12.3 HOT-1	yeah just tired. too late for this #. act of & to get this airplane outta here. you know what I mean?		
03:32:23.6 HOT-2	yeah.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
03:32:24.3 HOT-1	#.		
03:32:26.4 HOT-1	by the time you get done doin' everyone else's job you don't have time to do your own. that' a problem with this airline. when I power up ah turn the wings on.		
03:32:35.9 HOT-2	okay.		
03:32:38.5 HOT-1	when I start doin' missed just go click, and I'll say set thrust you need * * * *.		
03:32:43.8 HOT-2	okay.		
03:32:46.1 HOT-1	we're waiting for parallel traffic that's why he said nobody on final position and hold clear.		
03:32:51.8 HOT-2	okay.		
03:32:52.4 HOT-1	get yeah we're at thirteen minutes right now * *. if I went to very light which this is very light now we'd be legal. yeah.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
03:33:00.4 HOT-2	okay.		
03:33:00.8 HOT-1	on type one *.		
03:33:02.7 HOT-2	I see what you're sayin'.		
03:33:03.9 HOT-1	if we were empty like we were the other night I'd done type one 'cause we were number one for departure.		
03:33:14.6 HOT-1	this really a short runway for a major airport.		
03:33:16.9 HOT-2	this one?		
03:33:17.5 HOT-1	yeah you know for one of the long ones.		
03:33:18.4 HOT-2	* (well how long is it?) it's nine thousand feet long?		
03:33:21.4 HOT-1	eight thousand.		
03:33:22.1 HOT-2	eight thousand.		

TIME and SOURCE	INTRA-COCKPIT COMMUNICATION CONTENT	TIME and SOURCE	AIR-GROUND COMMUNICATION CONTENT
03:33:22.8 HOT-1	yeah.		
03:33:25.9 HOT-1	you know for bein'-.		
		03:33:26.3 TWR	and forty seven twelve caution wake turbulence have a DC eight departed off of runway four two minutes ago wind three six zero at one two runway three zero right heading of three one zero cleared for takeoff.
03:33:32.0 CAM	[sound of increasing background noise].		
		03:33:36.7 RDO-2	alright three one zero cleared for takeoff Flagship ah forty seven twelve.
03:33:39.7 HOT-1	set thrust.		
03:33:42.6 HOT-2	thrust set.		
03:33:43.4 HOT-1	alright.		
03:33:45.1 HOT-1	three one zero on the heading.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
03:33:46.3 HOT-2	three one zero		
03:33:47.3 HOT-1	thanks.		
03:33:48.2 HOT-1	ha ha (I'm gonna) * (all these up).		
03:33:51.0 HOT-2	eighty knots.		
03:33:51.5 HOT-1	checks.		
03:34:01.1 HOT-2	V one, rotate.		
03:34:04.2 HOT-2	V two.		
03:34:06.1 HOT-2	positive rate.		
03:34:07.2 HOT-1	gear up.		
03:34:09.7 HOT-1	speed mode.		
03:34:16.9 CAM	[sound of decreasing background noise].		

TIME and SOURCE	INTRA-COCKPIT COMMUNICATION CONTENT	TIME and SOURCE	AIR-GROUND COMMUNICATION CONTENT
03:34:19.4 HOT-1	heading mode.		
03:34:22.9 HOT-1	heading's active.		
03:34:24.1 HOT-2	okay.		
		03:34:26.2 TWR	Flagship forty seven twelve turn right heading of three six zero and contact departure good night.
		03:34:31.3 RDO-2	roger three six zero (over to) departure Flagship forty seven twelve.
03:34:34.5 HOT-1	bug two hundred flaps up.		
03:34:41.3 HOT-1	excellent * *.		
		03:34:55.3 RDO-2	and Minneapolis departure Flagship forty seven twelve is turning heading three six zero through two thousand seven hundred for seven thousand.
		03:35:02.0 DEP	Flagship forty seven twelve Minneapolis departure radar contact.

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
		03:35:05.5 RDO-2	roger.
03:35:06.1 HOT-1	hah. yeah. great.		
03:35:07.3 HOT-2	#.		
		03:35:07.9 RDO-2	thanks.
03:35:10.6 HOT-1	this plane didn't want to speed up, did it?		
03:35:16.7 HOT-1	took (that) long to get to two hundred knots. and being way below the flight director, don't know what the deal is with that.		
03:35:24.0 HOT-2	(I don't know).		
03:35:26.5 HOT-1	alright two fifty go ahead and thrust climb checks.		
03:35:27.1 HOT-2	* *.		
03:35:31.2 HOT-1	alright two fifty.		

TIME and SOURCE	INTRA-COCKPIT COMMUNICATION CONTENT	TIME and SOURCE	AIR-GROUND COMMUNICATION CONTENT
		03:35:32.1 DEP	Flagship forty seven twelve climb maintain one seven thousand.
03:35:34.0 HOT-2	no. oh two fifty.		
03:35:35.5 HOT-1	one seven seventeen thousand.		
		03:35:38.3 RDO-1	one seven seventeen thousand Flagship forty seven twelve.
03:35:42.5 HOT-2	#.		
03:35:45.2 HOT-1	*.		
03:35:49.4 HOT-1	you keep (going) into this box trying to get climb thrust and you won't get # for flying (though) seventeen because the APUs runnin'.		
03:35:55.9 HOT-2	okay.		
03:35:56.6 HOT-1	alright.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
03:35:59.1 HOT-2	ignition off. or actually never mind. continuous ignition.		
03:36:00.9 HOT-1	yeah do your flow.		
03:36:02.6 HOT-2	*?		
03:36:02.6 HOT-1	sure do your flow.		
03:36:04.0 HOT-2	okay.		
03:36:05.8 HOT-1	probably turn the autopilot on so I can (watch) check this. good much better # I'm not gonna turn it on.		
03:36:10.9 HOT-2	'kay continuous ignition off.		
03:36:12.6 HOT-1	yeah.		
03:36:13.2 HOT-2	'kay.		
03:36:13.6 HOT-1	alright.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
03:36:15.1 HOT-1	don't stop up here, right here? over here.		
03:36:17.9 HOT-2	n'kay.		
03:36:18.3 HOT-1	down here.		
03:36:20.8 HOT-1	alright? I don't know what flow you were doin' in the sim but it's.		
03:36:21.7 HOT-2	alright.		
03:36:26.9 HOT-1	fuel.		
03:36:28.3 HOT-1	APU. lights. thrust reversers. box. check your ECS pages. and (box) it up * * * you know what I'm sayin' just do it. you can turn my wing off if you would we're good.		
03:36:43.1 HOT-2	alright. * Think so?		
03:36:49.5 HOT-?	* * * * (armed) .		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
03:36:53.1 HOT-2	okay climb check complete.		
03:36:54.3 HOT-1	alright.		
03:36:57.6 HOT-1	better you're not depressurizing the airplane, you know so.		
03:37:02.8 HOT-1	it's partially my fault 'cause I make you guys fly so much.		
03:37:06.0 HOT-1	you haven't done non-flying but like two times. (in the airplane). from takeoff, you know.		
03:37:12.1 HOT-2	yeah right okay.		
03:37:12.9 HOT-1	right.		
03:37:18.2 HOT-1	(havin' trouble) piece a #.		
03:37:39.4 HOT-1	this is the hardest day, rest days are cake, you know, easier. tomorrow's four legs and we got two legs and three legs.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
03:37:47.9 HOT-2	alright.		
03:37:48.4 HOT-1	you you know what I mean?		
03:37:50.0 HOT-1	alright.		
03:37:51.1 HOT-2	ten thousand.		
03:37:51.5 HOT-1	bug two ninety. box (items).		
03:37:55.0 HOT-2	* *.		
03:37:57.1 HOT-1	you keep spinnin' those knobs the wrong way when did that start?		
03:37:59.8 HOT-2	aho *.		
03:38:00.3 HOT-1	aha every # knob you grab today is like goin' the wrong way. [sound of chuckle]. that's why my flight director went # jerked up on the speed (mode) trying to get me to V two.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
03:38:10.2 HOT-2	[sound of chuckle].		
		03:38:11.0 DEP	Flagship forty seven twelve cleared direct STEIN resume Wellstone One departure.
		03:38:14.6 RDO-2	alright direct SNINE ah WLSTN One Flagship forty seven twelve.
03:38:16.4 HOT-1	Wellstone One.		
		03:38:19.2 DEP	roger.
03:38:20.1 HOT-?	* * * * * *.		
03:38:24.3 HOT-1	legs page, legs page, legs, (SNINE).		
03:38:30.1 HOT-2	*.		
03:38:31.2 HOT-1	execute, execute.		
03:38:31.5 HOT-2	*? (execute).		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
03:38:34.0 HOT-1	nav mode. [sound of chuckle]. * * *. [sound of chuckle]. * * *.		
03:38:34.8 HOT-2	*.		
03:38:44.8 HOT-2	and seatbelt sign.		
03:38:51.0 HOT-1	no * no I don't wanna turn it off. * let 'em sleep.		
03:38:54.7 HOT-2	alright.		
03:38:55.2 HOT-1	check see if we're still in the clouds yeah a little bit.		
03:39:01.0 HOT-1	ah there's-.		
		03:39:01.5 DEP	Flagship forty seven twelve contact Minneapolis center one three three point seven.
		03:39:06.0 RDO-2	one three three point seven for F- Flagship forty seven twelve.

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
		03:39:26.0 RDO-2	Minneapolis departure Flagship forty seven twelve through ah twelve thousand for seventeen.
		03:39:31.6 CTR	Flagship forty seven twelve Minneapolis center roger climb and maintain flight level two three zero.
		03:39:36.0 RDO-2	roger two three zero Flagship forty seven twelve.
03:39:41.6 HOT-1	(truly) gonna kick your #.		
03:39:41.8 HOT-2	& I did it again.		
03:39:44.1 HOT-1	that's (gonna) # somebody up, spin it aggressively when you're below the altitude that this guys climbin' too.		
03:39:49.5 HOT-2	okay.		
03:39:50.0 HOT-1	[sound of chuckle].		
03:39:51.2 HOT-1	twenty three yeah twenty three.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
03:39:51.4 HOT-2	(I) two three zero. two three zero.		
03:40:00.3 HOT-1	[sounds similar to sigh and yawn] ah #.		
03:40:05.2 HOT-2	heading bug.		
03:40:06.8 HOT-1	you can set it again if you'd like, yeah.		
03:40:11.8 HOT-1	this plane smells like # # I'll bet she's got like old lady # or something you smell that? comes in from up here you can feel the air. so you know when the stink stays it wasn't the pilot that # you 'cause the pilots farts come up underneath and go out of the way.		
03:40:25.8 HOT-2	[sound of chuckle].		
03:40:34.6 HOT-1	* just started today, I don't know what your doing there, all you knobs are goin' the wrong way, time to go to sleep when.		
03:40:39.3 HOT-2	[sound of chuckle].		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
03:40:51.9 HOT-1	* * * (can't tell what she get?)		
		03:40:53.3 CTR	Flagship forty seven twelve cleared direct Traverse City.
		03:40:56.5 RDO-1	roger direct Traverse City Flagship forty seven twelve.
03:40:59.9 HOT-2	Traverse City the VOR?		
03:41:02.6 HOT-1	I usually ask we we got both but ah what's the distance difference?		
03:41:04.6 HOT-2	ahhh.		
03:41:08.1 HOT-1	five miles why don't we the tr- VOR, when in doubt do the VOR, so, the VOR, oh you got okay execute.		
03:41:11.9 HOT-2	alright there it is, (that's right?), confirm?		
03:41:19.1 HOT-1	(let's) say what vertical speed autopilot on.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
03:41:20.0 HOT-2	*.		
03:41:21.8 HOT-2	"kay vertical speed. autopilot on.		
03:41:23.0 HOT-1	fishin' all over the place * *. alright		
03:41:23.8 HOT-2	autopilot on.		
03:41:26.2 HOT-1	and autopliot engaged your side. that's what I usually say when I kick *.		
03:41:29.4 HOT-2	oh yeah okay.		
03:41:30.3 HOT-1	you see it go green? your side is (red).		
03:41:30.6 HOT-2	* autopilot on your side alright.		
03:41:33.8 HOT-1	most guys *. alright if I keep it in speed mode and say autopilot on it'd say two ninety five right now [sound of chuckle] 'cause I'm not on speed. know what I mean?		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
03:41:41.4 HOT-2	okay.		
03:41:43.4 HOT-1	and it might do some of that #. we're out of the clouds right now, still not. alright.		
03:41:52.5 HOT-1	aw I'm tired dude, just # worn out.		
03:41:57.4 HOT-1	(just) not in the mood to have the the # match that that coulda turned into with dispatch. ya know?		
03:42:02.7 HOT-2	yeah.		
03:42:03.9 HOT-1	I'm gonna find out about the legalities of peak wind versus base wind.		
03:42:09.0 HOT-2	yeah ah what is that is it peak wind or the base wind, (like gust)?		
03:42:09.4 HOT-1	I'm gonna check in the *.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
03:42:13.9 HOT-1	yeah I I think he's gonna be right 'cause that's just too out there for them to come up with on their own, I think it's Northwest engineering that gave that to 'em.		
03:42:20.7 HOT-2	yeah I mean what.		
03:42:21.5 HOT-1	so.		
03:42:22.0 HOT-2	you would think it would be gust.		
03:42:23.6 HOT-1	ahh well it's kinda like main body and temporary. you know what I mean but.		
03:42:28.0 HOT-2	yeah.		
03:42:28.5 HOT-1	I can't legally start the approach 'cause a gust would exceed my tailwind component.		
03:42:32.6 HOT-2	right but if at the main body-		

TIME and SOURCE	CONTENT
	AIR-GROUND COMMUNICATION
03:42:33.3 CTR	Flagship forty seven twelve contact Minneapolis center one three three point seven five have a good night.
03:42:38.6 RDO-2	alright three three seven five you too Flagship forty seven twelve.
03:42:45.7 RDO-2	Minneapolis center Flagship forty seven twelve through flight level one eight zero for flight level two three zero.
03:42:51.5 CTR	Flagship forty seven twelve Minneapolis center climb and maintain flight level two seven zero.
03:42:55.7 RDO-2	ah flight level two seven zero Flagship forty seven twelve.
	INTRA-COCKPIT COMMUNICATION
03:42:59.2 HOT-2	two seven zero.
03:43:02.6 HOT-1	*.
03:43:07.4 HOT-2	two seven zero?

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
03:43:08.1 HOT-1	two seven zero.		
03:43:08.9 HOT-2	okay and a eighteen hundred transition.		
03:43:12.1 HOT-1	eighteen transition when you're callin' through eighteen.		
03:43:13.8 HOT-2	right yeah.		
03:43:15.6 HOT-1	and altitude. should be a big clue to hit the.		
03:43:18.5 HOT-2	oh okay.		
03:43:18.9 HOT-1	so that you can get on the right altitude.		
03:43:21.4 HOT-1	[sound of laughter] the eight hundred or a thousand foot different altitude. you know what I mean?		
03:43:24.8 HOT-2	okay.		
03:43:26.4 HOT-1	they know why your altitude's not matchin'.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
03:43:35.9 HOT-1	[sound of inhalation] oh #.		
03:43:41.2 HOT-1	tomorrow your gonna be thrown into a more stressful situation with Detroit 'cause you just haven't been there before. but I want you to be more relaxed in the airplane.		
03:43:49.9 HOT-2	alright.		
03:43:50.1 HOT-1	It's another five leg day so now it's been a third of your flyin' today.		
03:43:53.6 HOT-2	tomorrow's a five leg?		
03:43:54.6 HOT-1	no today was.		
03:43:56.0 HOT-1	so this is been a third of all the flying you've done in the airplane. you should feel more comfortable with all this crap on the ground.		
03:44:02.7 HOT-2	alright.		
03:44:03.3 HOT-1	good to you?		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
03:44:05.5 HOT-2	there're something's that don't (know).		
03:44:07.2 HOT-1	* * you you get a list of question * tomorrow morning *.		
03:44:08.7 HOT-2	(right).		
03:44:12.0 HOT-1	the ah.		
03:44:13.9 HOT-1	like what?		
03:44:16.4 HOT-2	ah like ah when you have to amend it. a little bit, like.		
03:44:19.7 HOT-1	okay, we do that on the ground.		
03:44:21.3 HOT-2	okay.		
03:44:21.9 HOT-1	we'll talk about it it. see that MCDU?		
03:44:25.3 HOT-1	little message? hit MCDU see what pops up.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
03:44:25.3 HOT-2	yes.		
03:44:27.9 HOT-2	do MCDU?		
03:44:29.6 HOT-1	yeah then watch what happens.		
03:44:30.6 HOT-2	yeah?		
03:44:30.9 HOT-1	yeah.		
03:44:31.8 HOT-2	'kay.		
03:44:32.7 HOT-1	now hit ACARS.		
03:44:35.4 HOT-1	check it out it popped right up to you en-route page. pretty cool, eh?		
03:44:40.5 HOT-2	that is cool.		
03:44:44.1 HOT-1	now the MCDU went away [sound of chuckle].		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
03:44:56.2 HOT-1	probably gonna do a DME arc to this approach, the arcs are built funny in the box, it's built off the radial so it pretty much says.		
03:45:07.8 HOT-1	X Y Z radial I'll show you how to build it, if you instead of taking vectors you have to take the r- you know DME arc.		
03:45:14.4 HOT-2	what's her name?		
03:45:15.6 HOT-1	&.		
03:45:16.3 HOT-2	&?		
03:45:16.6 HOT-1	aw # I don't know it's on the carbon copy of the one before.		
03:45:20.0 HOT-2	okay.		
03:45:20.9 HOT-1	[sound of chuckle].		
03:45:21.8 HOT-2	oh alright.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
03:45:24.6 HOT-1	I couldn't think of that # mechanics name I think it's &.		
03:45:27.5 HOT-2	K O V A R (F).		
03:45:30.1 HOT-1	[sound of chuckle].		
03:45:40.5 HOT-1	so you and I need to sit down at about noon for a two o'clock shuttle. you know? * maybe we should eat breakfast together like nine or ten in the morning you know?		
03:45:49.6 HOT-2	alright.		
03:45:50.2 HOT-1	we'll find out when their breakfast stops, we'll go down there and we'll eat breakfast. I'm gonna try to work out if they got a workout room sometime, then we'll meet at noon.		
03:46:00.6 HOT-1	then we'll go through amendments. if they're gonna go through this flow # ('cause it's still) you still doin' goofy #. you know.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
03:46:10.2 HOT-1	I just don't want you to # a guy by setting the wrong altitude and you guys are * off of (five) and, towers trying to call you for ten # minutes while your sittin' on ground and ground comes up and goes Flagship blah blah you still with me? you know what I mean. you miss four or five departure slots. [sound of chuckle].		
03:46:25.7 HOT-2	yeah.		
03:46:30.2 HOT-1	ah. I don't want you trying to start an engine we got an (ITT) of two hundred C, # like that.		
03:47:02.6 HOT-2	it took us forty five minutes to get off.		
03:47:05.7 HOT-1	** (it) * take, ('cause we got a) [sound of chuckle].		
03:47:07.4 HOT-2	yeah.		
03:47:14.6 HOT-1	so on that page besides the (book) what else do we do?		
03:47:20.8 HOT-2	(do) * an in range.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
03:47:22.6 HOT-1	no on on just this page we're still en-route here, we got some things to do on that page, what are they? ah read it see if there is anything you wanna put in there.		
03:47:34.2 HOT-2	* gate return, gate hold, gate request, ah estimated.		
03:47:39.3 HOT-1	gate request. and you can just.		
03:47:42.1 HOT-2	just hit edit?		
03:47:43.0 HOT-1	yeah.		
03:47:43.8 HOT-2	alright.		
03:47:44.4 HOT-1	gives you the gate, flags yes or no, and you're good to takeoff * * *. so *. those are the three things your doing and actually four if you count the book. takeoff landing ID.		
03:47:53.9 HOT-2	okay.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
03:47:56.7 HOT-2	alright.		
03:47:57.5 HOT-1	select it.		
03:47:59.4 HOT-1	*, cool.		
03:47:59.4 HOT-2	alright.		
03:48:03.2 HOT-1	'* * gate two you got a new terminal building in Traverse City, I remember watchin' it get built so I have an idea where it is, but I've never parked at and they say on their NOTAMS that all the ah markings for the parking spots aren't there so we have to line-up with the guys hips.		
03:48:17.5 HOT-2	okay.		
03:48:18.8 HOT-1	so my understanding is we used to park here under the control tower and that's the new terminal over there.		
03:48:29.5 HOT-1	and so two eight be a left turn off probably at the complete # end.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
03:48:38.0 HOT-1	well we know what runway we're doin. [sound of chuckle].		
03:48:39.8 HOT-2	[sound of chuckle].		
03:48:40.5 HOT-1	where we're goin' missed so you can go ahead prepare for twenty eight.		
03:48:43.2 HOT-2	alright.		
03:48:44.3 HOT-1	[sound of chuckle].		
03:48:46.8 HOT-2	twenty five minutes out, okay.		
03:48:52.1 HOT-2	ILS two eight.		
03:48:53.2 HOT-1	yup.		
03:48:54.9 HOT-1	when you select it I would do.		
03:48:56.7 HOT-2	vectors?		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
03:48:58.0 HOT-1	ah # I wonder what arc we're gonna do. we're gonna have to re-select that why don't keep it on vectors right now.		
03:49:03.9 HOT-2	what's the what's the ah?		
03:49:06.6 HOT-1	alright?		
03:49:07.0 HOT-2	hours you think?		
03:49:07.9 HOT-1	we're so late that the tower's not open I guarantee it.		
03:49:11.2 HOT-2	alright.		
03:49:11.6 HOT-1	alright.		
03:49:12.6 HOT-1	so without a tower center's gonna transition us either on the north arc or south arc.		
		03:49:15.8 CTR	(Flagship) forty seven twelve contact Minneapolis center one two three point seven two.

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
		03:49:21.0 RDO-2	Minneapolis center one two three point seven two forty seven twelve. *.
03:49:25.6 HOT-2	two three.		
		03:49:32.1 AWOS	[Hartwell AWOS report].
03:49:36.5 HOT-1	well that's obviously the wrong frequency. that's obviously the, well we'll leave it up.		
03:49:43.9 HOT-2	it was *.		
03:49:51.4 HOT-1	maybe he was readin' it to a pilot, sounded like AWOS but.		
03:49:54.7 HOT-2	yeah it did.		
03:49:55.5 HOT-1	s' give 'em a shot.		
		03:49:56.3 RDO-2	and Minneapolis center Flagship forty seven twelve through ah flight level two five zero to ah flight level two seven zero.

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
03:50:02.5 HOT-1	it's drivin' me nuts.		
		03:50:02.9 CTR	Flagship forty seven twelve Minneapolis center roger.
03:50:06.2 HOT-1	alright your at seven hundred feet above two five oh.		
03:50:09.2 HOT-2	okay.		
03:50:10.1 HOT-1	two five eight two six oh but not two five.		
03:50:12.3 HOT-2	okay.		
03:50:13.2 HOT-2	two five sev- alright.		
03:50:13.7 HOT-1	so flight level two five eight for two seven zero.		
03:50:16.6 HOT-2	alright.		
03:50:17.4 HOT-1	*.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
03:50:20.0 HOT-1	so if you gonna round it to the next thousand round it to one that your closest too, I been doin' that alot but I like, everyone out here * two six oh. two six one two six two for two seven oh.		
03:50:30.1 HOT-2	* * two seven zero. *.		
03:50:30.5 HOT-1	two seven zero * alright.		
03:50:32.8 HOT-2	alright.		
03:50:34.2 CAM	[sound of altitude warning tone].		
03:50:34.3 HOT-1	so that's the radio etiquette. twenty six for twenty seven.		
03:50:37.9 HOT-2	twenty six for twenty seven.		
03:50:41.4 HOT-2	alright you wanna do vectors or you just don't know-		
03:50:43.7 HOT-1	let's do vectors.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
03:50:44.5 HOT-1	ahm I'm trying to show you something though if they give us- * ah you selected it so # it [sound of chuckle].		
03:50:51.4 HOT-2	(I thought you said vector) *.		
03:50:52.4 HOT-1	yeah but I a don't you don't have to select vectors.		
03:50:54.8 HOT-2	alright. *.		
03:50:55.2 HOT-1	* * *, a you don't have to select it 'cause it automatically does it. but.		
03:50:58.7 HOT-2	alright.		
03:50:59.7 HOT-1	here's twenty eight. I was trying to show you that's the arc for the ah the * south arc 'cause it's arcin' off the one eight zero radial. see that?		
03:51:00.8 HOT-2	alright.		
03:51:12.2 HOT-2	*. alright wait where is it?		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
03:51:17.0 HOT-1	alright ** alright why don't we do this I'm I'll do this I'm gonna go to plane view alright.		
03:51:22.2 HOT-2	okay.		
03:51:23.1 HOT-1	if I can get the right, alright. alright. ahh if I if I can get down to a scale that alright check this out, I'm gonna select this arc.		
03:51:35.6 HOT-2	okay.		
03:51:35.9 HOT-1	see the south arc the one eighty eight zero radial?		
03:51:37.1 HOT-2	oh wow yes.		
03:51:39.0 HOT-1	okay I'm gonna cancel mod. we go ILS two eight and I'm gonna do this arc. that's not the arc that's the procedure turn. see the procedure turn pop up?		
03:51:49.7 HOT-2	procedure turn.		

INTRA-COCKPIT COMMUNICATION

TIME and SOURCE	CONTENT
03:51:50.4 HOT-1	so guess what if we get the fifteen DME arc, the north arc, that is not in this database.
03:51:56.9 HOT-1	you see that okay so if he gives the north arc we're goin' green needles. or I'm building an arc in the database
03:51:56.9 HOT-2	got 'em yes.
03:52:03.6 HOT-2	'kay.
03:52:04.1 HOT-1	I can zero three five zero two five. I'm sorry zero four five zero five five. zero six five very short arc isn't it?
03:52:10.2 HOT-2	okay.
03:52:13.9 HOT-1	shorter'n it looks 'cause that's the lead-in radial at zero six five.
03:52:17.0 HOT-2	thirty five * five.

AIR-GROUND COMMUNICATION

TIME and SOURCE	CONTENT

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
03:52:17.6 HOT-1	well I'm just showin' ya but since we don't know what we're gettin'.		
03:52:20.8 HOT-2	fifteen DME.		
03:52:21.5 HOT-1	just select two eight you don't have to select vectors, when you selected vectors all this went away, it's already selected.		
03:52:21.6 HOT-2	okay.		
03:52:29.4 HOT-1	so if I go into legs right now Traverse City I gotta put my airport back in 'cause it always drops it when you have a runway that you pass the airport come back.		
03:52:39.9 HOT-2	okay.		
03:52:40.3 HOT-2	alright my airports back in two eight's there it is vectors right?		
03:52:44.2 HOT-2	alright.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
03:52:44.8 HOT-1	I didn't have to select it and confirm and execute. see it on my plane view.		
03:52:48.8 HOT-2	alright.		
03:52:49.7 HOT-1	cool, okay. but that's how a DME arc works. Helena Montana, doesn't have a ah database for the arc that we always use.		
03:52:55.0 HOT-2	* *.		
03:53:00.5 HOT-2	okay.		
03:53:01.1 HOT-1	so you have to either build it or fly it green needles and when gettin' checked out the first time as a captain.		
03:53:06.5 HOT-2	right.		
03:53:07.0 HOT-1	ah you have to do it ah green needles we have to check you out green needles. * *.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
03:53:11.9 HOT-1	so I to teach you how to do the white needles let your FO watch how good your doin' development I'm not gonna make guys do green needles that's the place I refuse to go in and give an (OE) to or do a check out till I've been there the other day last week.		
03:53:16.3 HOT-2	[sound of chuckle] *.		
03:53:26.6 HOT-1	okay.		
03:53:27.3 HOT-2	alright.		
03:53:28.2 HOT-1	so we're done with that and we got two eight in there.		
03:53:30.6 HOT-2	thirty minutes out so we can do a.		
03:53:32.3 HOT-1	we're forty four still (no it not) so we got some time.		
03:53:33.5 HOT-2	alright. alright.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
03:53:35.6 HOT-1	chill out relax shoot something if you want to eat you # doughnut whatever [sound of chuckle] I'm gonna eat this bad #.		
03:53:35.7 HOT-2	* *.		
03:53:41.9 HOT-2	I totally forgot about my doughnut man.		
03:53:43.7 HOT-1	aww.		
03:53:56.0 HOT-1	eh turned my cowls off finally.		
03:53:57.7 HOT-2	(name at) last meal.		
03:54:03.6 HOT-1	I'm getting nine E weather.		
03:54:06.3 HOT-2	okay alright.		
03:54:18.3 HOT-1	this is funny since towers closed.		
03:54:24.0 HOT-2	alright.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
03:54:24.5 HOT-1	the weather that we get won't be from tower It'll be from Northwest so I guarantee ya the weathers gonna be legal.		
03:54:28.9 HOT-2	[sound of chuckle] oh my &.		
03:54:32.0 HOT-1	that's # up.		
03:54:32.9 HOT-2	isn't that?		
03:54:35.1 HOT-1	that is so # up. on a sixty five hundred foot runway dude no less.		
03:54:39.2 HOT-2	who request weather?		
03:54:40.3 HOT-1	I just did (messages) comin'.		
03:54:42.1 HOT-2	is that Northwest weather or is that METAR?		
03:54:44.0 HOT-2	yea a METAR.		
03:54:45.0 HOT-1	It's a METAR but Northwest generates it.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
03:54:47.5 HOT-2	okay.		
03:54:48.6 HOT-1	yeah the weather observer over at Traverse City it's a Northwest meteorological station, keeps the government from having to pay for it let's Northwest do # like this.		
03:54:53.2 HOT	selcal, selcal. [electronic voice].		
03:54:59.4 HOT-1	(it's at) zero four zero at eight. less of a tailwind 'cause they got ten more degrees off.		
03:55:04.9 HOT-2	alright.		
03:55:06.0 HOT-1	or actually we'll see.		
03:55:08.5 HOT-2	zero four zero?		
03:55:10.9 HOT	[sound of single short electronic tone].		
03:55:12.6 HOT-2	check it real quick?		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
03:55:13.7 HOT-1	yeah I'm trying to think of degrees (does) **.		
03:55:21.7 HOT-2	or.		
03:55:28.6 HOT-1	I don't know, I can't do my math. well two eight zero is only ten off of # west so hah that'd be a one hundred runway, right? so.		
03:55:33.3 HOT-2	see what it is.		
03:55:39.4 HOT-1	sixty degree instead of a fifty degree now it's sixty degrees which lowers * the tailwind component also.		
03:55:41.9 HOT-2	right. right.		
03:55:46.0 HOT-1	so mile and a half light snow eighteen hundred so we're gettin' in there.		
03:55:51.8 HOT-1	I'll let the flight attendant know.		
03:55:56.4 HOT-1	so she d' have to worry 'bout it anymore.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
03:55:59.9 HOT-2	eighty, eighty plus forty. it's a hundred twenty degrees.		
03:56:07.3 FA	yeah.		
03:56:07.7 INT-1	hey hey.		
03:56:08.7 FA	hey hey.		
03:56:09.0 INT-1	how ya doin' ah the weather the winds have dyin' down a little bit the later we get here so we're good to get into Traverse City I just wanted to let you know so you didn't have to worry about it.		
03:56:17.7 FA	terrific.		
03:56:18.6 INT-1	alright we're about ah forty minutes out.		
03:56:21.3 FA	okay good.		
03:56:22.3 INT-1	awesome.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
03:56:23.1 FA	thank you very much.		
03:56:23.5 INT-1	alright talk to you little bit. alright.		
03:56:24.8 FA	yup.		
03:56:38.5 HOT-2	* in the runway forty.		
03:56:40.3 HOT-1	tell ya what I hate wakin' people up but, I'm gonna talk to these people we've already # delayed the # out of 'em, it's a smooth ride, I want them to know that we're gettin' into Traverse City 'cause alot of them overheard us talkin' about Detroit, ya know?		
03:56:53.9 HOT-2	alright just yeah make it like short sweet.		
03:56:55.1 HOT	[sound of single short electronic tone].		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
03:56:56.7 PA-1	a ladies and gentlemen from the ah flight deck welcome once again we do apologize for the delays gettin' out and the delays on the ground ah good news is the winds are dying down significantly in ah Traverse City so it's looks like we're gonna have no problems gettin' in this evening. ah weather right now is mile and a half visibility light snow overcast skies, ah winds out of the northeast at ten miles per hour right now, turned the seatbelt sign off remain seated * seatbelt fasted we're showing about ah thirty minutes left en-route * * *.		
03:57:02.9 HOT-2	* * * * * * *.		
03:57:40.1 HOT-2	like twenty degrees.		
03:57:42.1 HOT-1	well its only off the tail, it's a one hundred runway it's a zero four zero so that's sixty degrees.		
03:57:50.1 HOT-2	alright I though it was a hundred twenty degrees.		
03:57:51.9 HOT-1	well from the other way it is, but it's a from tail.		
03:57:54.1 HOT-2	alright.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
03:57:56.7 HOT-2	right.		
03:57:57.1 HOT-1	your relative wind is forty degrees this angle right here is forty degrees.		
03:58:00.8 HOT-2	okay		
03:58:01.3 HOT-1	see what I mean?		
03:58:02.2 HOT-2	right.		
03:58:02.6 HOT-1	er I'm a sorry sixty not forty sixty.		
03:58:04.6 HOT-2	alright so you'd go you'd go to sixty degrees?		
03:58:06.6 HOT-1	so I'd come yeah its says come out and then wind velocity.		
03:58:09.1 HOT-2	* right here? and it's eight knots?		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
03:58:11.1 HOT-1	it's only eight which obviously can't have a ten knot tailwind component. so it's like six knot tailwind.		
03:58:17.1 HOT-2	alright.		
03:58:18.0 HOT-1	that's (funny) so I'll be on the bottom of the (bug).		
03:58:22.6 HOT-2	it's not too *.		
03:58:22.8 HOT-1	yeah it won't be too bumpy down there, there's a pretty good hill out there man there's a pretty good a piece a terrain. hah.		
03:58:29.5 HOT-2	terrain is not good?		
03:58:30.9 HOT-1	it's not bad it just when your on a visual if you out far enough.		
03:58:34.7 HOT-2	yeah.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
03:58:35.6 HOT-1	airport eleven's ah six forty but look at that tower out there two thousand feet. that's fourteen hundred foot difference on the arc you see on the arc highest terrain?		
03:58:37.3 HOT-2	oh shoot **?		
03:58:47.2 HOT-1	there you gonna see that arrow look how high the highest terrain is right there, fourteen hundred feet above airport elevation so if your doing a base to final on a visual at night into Traverse City you become very familiar with that hah tower 'cause pattern altitude if you just add fifteen hundred feet, to airport elevation's only twenty one hundred, fifty feet higher than that tower so you you wanna pick a different pattern altitude when you come in here at night, doing base to final #.		
03:58:58.6 HOT-2	yeah.		
03:59:15.6 HOT-2	alright.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
03:59:16.2 HOT-1	ah non-controlled environment we'll probably do the south arc, he'll give us a heading to join the ah * fly heading one five zero join the fifteen DME arc cleared ILS runway two eight change to advisory frequency approved notify me on the ground this frequency or missed approach blah blah blah, yeah. and on CTAF give him some iams- IFR to joint the fifteen DME arc but also tell 'em that we're east south east of the field we're a regional jet they don't know what a Flagship is we'll be landing runway two eight any other traffic in the area please advise, so we'll have CA- CTAF on one and we'll listening to center on two when he hands us over so that we always have radio contact whenever the # hits the fan.		
04:00:06.0 HOT-2	where the where this yeah I'm looking for the CTAF right now.		
04:00:06.2 HOT-2	where at.		
04:00:09.0 HOT-1	tower frequency.		
04:00:10.6 HOT-2	alright.		
04:00:13.9 HOT-1	says CTAF.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
04:00:15.3 HOT-2	yeah.		
04:00:15.5 HOT-1	twenty four two.		
04:00:23.4 HOT-1	alright dude. * you have the radios just have fun with nobodies listening to you (anyhow it's too) late at night they're on eastern time so it's twelve o'clock there already and we're.		
04:00:38.2 HOT-1	* two eight but that's what were doin' weather we like it or not, ahm there's no arrival procedure we'll plan our descent (on and on) so I'd like to have thirty out at the VOR ah eleven thousand feet when you get a chance.		
04:00:51.6 HOT-2	okay.		
04:00:52.5 HOT-1	ah I'll tell ya what you do it now and we'll just drag (it out) the VOR * thirty out at eleven.		
04:01:00.0 HOT-2	okay.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
04:01:06.6 HOT-1	[sound similar to yawn] your back's gonna be sore from being in that seat leaning over to type hah shorter you are the worse it is.		
04:01:14.6 HOT-2	confir- ah confirm?		
04:01:15.4 HOT-1	ah put put my eleven thousand in there then we'll execute it. put your eleven thousand over.		
04:01:21.1 HOT-2	oh eleven thousand.		
04:01:22.3 HOT-1	yup that how I get my descent planning.		
04:01:24.4 HOT-2	alright.		
04:01:25.4 HOT-1	without that I got no VNAV.		
04:01:30.8 HOT-1	execute.		
04:01:31.5 HOT-2	alright * execute.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
04:01:34.3 HOT-1	alright so that's our descent ah two Jan oh June oh six what do you have on your chart? It's eleven dash one.		
04:01:43.8 HOT-2	*.		
04:01:46.9 HOT-2	eleven dash one t- January second, yup. I concur.		
04:01:50.1 HOT-1	alright ah good, ILS two eight (ten) seven almost set twice. set twice. two seventy nine's inbound twenty five forty nine over GWENN. you wanna pop that in there also? twenty five forty nine over GWENN. eight twenty is decision height ah eight seventeen sorry eight twenty in the window.		
04:02:03.7 HOT-2	alright * * * twenty nine forty nine.		
04:02:15.4 HOT-1	if we have to go missed its climb to eleven hundred before we turn then we turn left to three thousand direct to the VOR so that's cake. alright it'll be white needles auto tune you know what I mean? so heading sync heading mode * to four hundred feet autopilot on.		
04:02:29.6 HOT-2	alright.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
04:02:30.3 HOT-1	yada yada yada. alright and that's a teardrop entry. that requires half mile visibility right now we have it. not by much but we have it.		
04:02:41.1 HOT-2	alright.		
04:02:41.5 HOT-1	alright any equipment goes out we're lookin' at three quarters of a mile anything else goes bad we're goin' to # Detroit.		
04:02:47.7 HOT-2	[sound of chuckle].		
04:02:49.3 HOT-1	ah we'll take one look at it if it's nasty we're you know if we go missed we're going Detroit unless it's my fault and we got fuel for it.		
04:02:55.6 HOT-2	alright.		
04:02:56.5 HOT-1	ah it's a left turn off at the end sixty five hundred feet * gonna tell ya what better look at what I got on that. I got ah HIRLS MASLR and no VASI at all that is some #.		
04:03:11.6 HOT-2	no # VASI?		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
04:03:12.5 HOT-1	no just HIRL MASLR that's great. just gets better.		
04:03:16.9 HOT-2	got MALSR though.		
04:03:18.3 HOT-1	yeah ya got MALSR.		
04:03:19.9 HOT-2	no VASI though.		
04:03:20.9 HOT-1	no VASI so hundred and fifty feet wide sixty five hundred feet long. cha ching. any questions?		
04:03:30.8 HOT-2	[sound similar to sigh] no questions.		
04:03:33.3 HOT-1	* approach ah complete you can execute that I don't know what well what'd ya do wait a minute.		
04:03:34.9 HOT-2	(off) okay.		
04:03:40.6 HOT-1	yeah okay that’s right execute, and I'll tell ya what you ah execute.		
04:03:42.4 HOT-2	*.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
04:03:44.4 HOT-2	eh ah twenty five forty nine?		
04:03:46.2 HOT-1	yeah something's not right on that.		
04:03:47.4 HOT-2	twenty five forty nine.		
04:03:48.4 HOT-1	yeah twenty five forty nine.		
04:03:51.6 HOT-1	[sound of chuckle] * * * * *.		
04:03:55.9 HOT-2	and alright and ah let's se I'm gonna get the landing weight and the numbers.		
04:04:00.4 HOT-1	'kay you go ahead and execute that though so we don't get another caution * so twenty eight ten twenty five forty nine execute. [sound similar to prolonged yawn while speaking].		
04:04:05.3 HOT-2	'kay.		
04:04:06.2 HOT-1	yep.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
04:04:06.6 HOT-2	alright. execute. alright.		
04:04:07.8 HOT-1	'kay. now you can figure out your weights.		
04:04:09.8 HOT-2	alright.		
04:04:16.5 HOT-1	yeah we give up four hundred pounds # around with that. good thing he gave me all that gas.		
04:04:22.3 HOT-2	let see * forty one.		
04:04:28.7 HOT-2	let's how much gas we gonna land with here.		
04:04:33.8 HOT-1	your not guessin' you know.		
04:04:35.6 HOT-2	alright.		
04:04:36.0 HOT-1	forty one six is your (zero) fuel weight.		
04:04:38.6 HOT-2	okay.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
04:04:39.6 HOT-1	forty six six. I'm comin' up with forty six two if you round their way it's forty six three.		
04:04:46.4 HOT-2	forty six three it's not forty seven (thou-)?		
04:04:48.3 HOT-1	yup.		
04:04:49.0 HOT-2	'kay		
04:04:51.4 HOT-1	good, short runway night snow tailwind heavy airplane, love it. [sound of laughter] ya know?		
04:05:02.8 HOT-1	the public's in good hands with Allstate you know what I mean?		
04:05:07.2 HOT-2	the way it's always is.		
04:05:08.5 HOT-1	it is. it is by the time you get done doin' everyone else's job you don't have time for your own. and you'll f- know what I'm talkin' about when you get goin' you know what I mean?		
04:05:09.1 HOT-2	one forty seven [sound of chuckle].		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
04:05:17.3 HOT-1	you'll make a stupid # mistake that almost cost you your life and when you look at it it's gonna be because you were doin' somebody else's fixin' somebody else's mistake.		
04:05:27.5 HOT-1	I'm not talkin' about as a check airmen I'm talkin' about dispatches mistake, load controls mistake, rampers not showin' up. you know?		
04:05:37.2 HOT-1	temperature drops like five to ten degrees below zero at Mini and they have a forty percent sick call rate. hah. so.		
04:05:50.4 HOT-2	alright speeds are set.		
04:05:51.9 HOT-1	alright.		
04:05:53.2 HOT-2	alright do an in-range?		
04:05:54.2 HOT-1	alright so what'd you edit out there?		
04:05:56.8 HOT-2	one forty.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
04:05:58.4 HOT-1	alright * * display hanging like this *. * * set it on the runway * *.		
04:05:59.8 HOT-2	*.		
04:06:02.4 HOT-2	alright forty seven on the runway?		
04:06:04.0 HOT-1	execute.		
04:06:04.6 HOT-2	alright.		
04:06:05.2 HOT-1	don't leave the box hanging guys look down and go what the # d'ya do?		
04:06:07.9 HOT-2	okay.		
04:06:08.4 HOT-1	[sound of chuckle] and then he won't believe that you did what you did so hit cancel mod make you do it again. you know what I mean?		
04:06:14.4 HOT-1	alright so ATIS is we tried to get ATIS its ah.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
		04:06:18.3 CTR	Flagship forty seven twelve change to my frequency one three two point niner.
04:06:22.3 HOT-1	watch this don't answer.		
04:06:25.4 HOT-1	now answer we're on your frequency thirty two niner.		
		04:06:28.6 RDO-2	roger forty seven twelve with you forty ah thirty two niner.
04:06:32.2 HOT-1	theyup.		
		04:06:32.7 CTR	Flagship forty seven twelve Minneapolis center Traverse City altimeter is two niner five five. descend pilots discretion maintain one one thousand.
04:06:38.5 HOT-1	(excellent).		
04:06:44.0 HOT-1	PD eleven.		
04:06:44.7 HOT-2	two niner niner five?		

TIME and SOURCE	INTRA-COCKPIT COMMUNICATION CONTENT	TIME and SOURCE	AIR-GROUND COMMUNICATION CONTENT
04:06:45.8 HOT-1	yup.		
		04:06:47.1 RDO-2	alright pilots discretion down to ah one one thousand two niner niner five for Flagship ah forty seven twelve.
		04:06:52.6 CTR	roger.
04:06:54.2 HOT-1	alright so PD to eleven right?		
04:06:55.9 HOT-2	alright.		
04:06:56.3 HOT-1	pilots discretion.		
04:06:57.6 HOT-2	so.		
04:06:59.9 HOT-2	okay.		
04:07:00.6 HOT-1	thank you, * * * (choice) till you set it.		
04:07:03.4 HOT-2	alright.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
04:07:04.1 HOT-1	so I'm * * my top of descent. that's why I set it.		
04:07:06.1 HOT-2	okay.		
04:07:08.0 HOT-1	see why we do that thirty out? awesome. eleven.		
04:07:14.6 HOT-1	say it when you set it.		
04:07:15.5 HOT-2	oh ahw eleven thousand (set confirm).		
04:07:15.8 HOT-1	eleven, set checks.		
04:07:18.2 HOT-2	*.		
04:07:18.9 HOT-1	(that it?)		
04:07:20.0 HOT-2	alright.		
04:07:22.1 HOT-1	might wanna rock and roll * we'll be on the ground in about.		
04:07:25.2 HOT-2	have to get landing data and all that but.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
04:07:26.8 HOT-1	yup.		
04:07:28.8 HOT-2	my *.		
04:07:32.4 HOT-1	love that arrival page it's not it's not active till the door opens but you love to look at it.		
04:07:38.6 HOT-1	[sound of chuckle].		
04:07:42.0 HOT-1	ah we do need to do that so we we need something in there yeah. alright.		
04:07:42.5 HOT-2	* * * * er range.		
04:07:47.3 HOT-1	shouldn't have any specials but we.		
04:07:48.6 HOT-2	and the time is gonna be?		
04:07:51.4 HOT-1	thirty eight oh four thirty eight.		
04:07:53.0 HOT-2	(four is ah) * * *?		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
04:07:54.2 HOT-1	I'll talk to * about that but right now I just want you to throw a number in it you know what I mean? I'm happy if you remember to do it.		
04:08:00.7 HOT-1	alright.		
04:08:01.0 HOT-1	then we'll talk about what & was talkin' about * * *.		
04:08:02.8 HOT-2	any any no we're not doin' that. (ah I missed the night page). * * *? no.		
04:08:05.2 HOT-1	no we're not doin' any more flyin' today. no.		
04:08:10.1 HOT-2	any wheelchairs anything?		
04:08:11.4 HOT-1	not a thing. just hit send.		
04:08:14.3 HOT-2	alright. * *.		
04:08:22.7 HOT	selcal, selcal [electronic voice].		

INTRA-COCKPIT COMMUNICATION

TIME and SOURCE	CONTENT
04:08:23.8 HOT-1	'kay wait on that don't even look at (so doesn't) * * * go (9E) request.
04:08:28.2 HOT-2	alright.
04:08:29.2 HOT-1	landing two eight. that way we don't have to (listen to) the selcal twice now hit send. you can actually watch it (in) message come in, see here's our in-range watch's it pop up and then you'll know. see how we didn't get a selcal your ears don't hurt.
04:08:45.0 HOT-2	ahuh.
04:08:50.0 HOT-1	* * would take this # out. and it was gate two forty seven max landing flaps eight go around.
04:08:57.3 HOT-2	alright.
04:08:57.8 HOT-1	thirty two degrees OPS forty seven (card) that's what they said that agreed agreed with us right?
04:09:04.4 HOT-1	so he told me PD to eleven when I start this descent you need to report that descent * * two seven zero for eleven.

AIR-GROUND COMMUNICATION

TIME and SOURCE	CONTENT

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
04:09:12.8 HOT-2	okay.		
04:09:13.5 HOT-1	alright. it's.		
04:09:16.5 HOT-2	two seven zero for eleven.		
04:09:17.7 HOT-1	yup say we're s- starting down whatever you wanna say leavin' two seven zero for eleven. hey thanks. keeps 'em heads up a what we're doin' how we doin' our descent planning.		
04:09:25.7 HOT-2	alright.		
04:09:26.6 HOT-1	alright alright so, we've got ATIS kinda, almost.		
04:09:31.6 HOT-2	alright.		
04:09:32.4 HOT-1	we gettin' it? see what's our ATIS it's a nineteen seventeen.		
04:09:37.5 HOT-2	nineteen seventeen. alright. want me to get it over here?		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
04:09:47.1 HOT-1	[sound similar to yawn] oh shyot.		
		04:09:52.0 AWOS	Traverse City (Cherry Capital) airport automated weather observation-
04:09:52.9 HOT-1	* * * log overnight to a average overnight [sound of chuckle]		
		04:09:56.8 AWOS	zero four zero-
04:09:58.0 HOT-2	* * .		
		04:09:58.4 AWOS	* *-
04:09:59.0 HOT-1	no.		
		04:09:59.2 AWOS	wind zero four zero at zero seven, visibility-
04:10:03.8 HOT-1	*.		

TIME and SOURCE	INTRA-COCKPIT COMMUNICATION CONTENT	TIME and SOURCE	AIR-GROUND COMMUNICATION CONTENT
		04:10:04.3 AWOS	one and one half light snow sky condition (two) niner hundred broken one thousand five hundred overcast two thousand two hundred temperature zero zero Celsius dewpoint minus zero one Celsius altimeter two niner five four remarks.
04:10:28.5 HOT-1	two niner five four?		
		04:10:29.8 AWOS	hours of operation are seven AM local time till ten PM local time the frequency for * * *-
04:10:34.1 HOT-1	way off what he gave us.		
		04:10:35.2 AWOS	one niner point one seven five common * advisory frequency is one two four point two pilot operator approach lighting is available on one two four point two for IFR services contact Minneapolis center on one three two point niner for additional services contact (Lansing) radio on one two two point (two) or one two two point six five.
04:10:54.4 HOT-1	alright, good?		
04:10:55.6 HOT-2	yup.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
04:10:56.2 HOT-1	okay couple things that are different about this airport, nobody's gonna tell you cleared to land.		
04:11:02.1 HOT-2	right.		
04:11:02.5 HOT-1	so these need to come on when you know your gonna land.		
04:11:06.0 HOT-2	alright.		
04:11:06.3 HOT-1	alright.		
04:11:07.2 HOT-1	if it's nasty gnarly out don't turn 'em on you'll just blind yourself in the clouds.		
04:11:12.4 HOT-2	alright.		
04:11:12.9 HOT-1	you know use just your recog maybe just your nose light. you know. just these no nose feel out see what you see better with.		
04:11:19.5 HOT-2	alright.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
04:11:19.7 HOT-1	they reflect right back in your face.		
04:11:21.3 HOT-2	alright.		
04:11:21.9 HOT-1	alright.		
04:11:22.7 HOT-1	ahm CTAF controlled lighting it's just like Hot Spring if we don't key up the lights. we're not seein' the runway 'cause they're gonna be on at all.		
04:11:30.0 HOT-2	shh really? oh my &.		
04:11:31.9 HOT-1	alright?		
04:11:32.0 HOT-2	got it, yeah.		
04:11:33.6 HOT-1	CTAF calls we already talked about tell 'em who you are where you are what you are they don't know what a Flagship is. big difference between an CRJ comin' around an arc and a one fifty. one fifty take ten minutes do it we'll it about a minute and a half. [sound of chuckle] ** you know.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
04:11:48.5 HOT-2	okay.		
04:11:49.0 HOT-1	so.		
04:11:49.9 HOT-2	why don't why we have the arc up?		
04:11:54.8 HOT-1	I don't know if we're gonna get it yet I know what kinda * coverage he has but I'm gonna ask him some things here in a second 'cause he reported what we read back we read back two niner seven five for an altimeter and they're reporting two niner five five. somebody else is two niner five six so I think the current's two niner five six. but he he'll give us another one when he gives us lower. if he gives us anything that diff- grossly different we want to check it again right now I'm gonna set five five 'cause that's what ATIS has and I've heard give some other ones that were five six five five.		
04:12:27.0 HOT-2	alright.		
04:12:29.8 HOT-1	oh I'm gonna say goodbye to the folks then we'll start descending.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
04:12:36.5 PA-1	ah ladies and gentlemen from the ah flight deck short flight as promised once airborne we gonna be a begin our descent here in about two minutes seatbelt signs comin' back on be on the ground about fifteen minutes and we do apologize once again for the delays today ah park at gate two the weather hasn't changed must since talked to you last ah winds still out of the northeast tens miles per hour temperatures ah just above freezing right now thirty ah three degrees Fahrenheit thank you once again for choosing Northwest Northwest Airlink as your carrier have a good night.		
04:12:44.2 HOT	[sound of single electronic chime].		
04:13:10.3 HOT-1	ya ya, alright.		
04:13:14.6 HOT-1	couldn't remember the # temperature, told 'em it was just above freezing.		
04:13:23.8 HOT-2	ah since we have radar why can't they they can vector onto the approach can't they?		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
04:13:28.5 HOT-1	I don't that they have radar coverage if the tower is a visual tower anyhow. I don't know where their radar coverage stops they got terrain at two thousand feet and arc at thirty somethin' hundred feet. thirty five hundred foot arc and terrain at two thousand I doubt they have very good radar coverage.		
04:13:45.0 HOT-2	okay.		
04:13:45.3 HOT-1	so I don't know that's why I'm puttin' in if he can vector us and ha- we don't get below his minimum vectoring altitude then he can give us the clearance, ya know?		
04:13:54.8 HOT-2	ya right.		
04:13:55.1 HOT-1	he may even be able to give us the fifteen DME fix.		
04:14:00.9 HOT-1	yeah.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
04:14:05.0 HOT-1	but we'll see or he may say ah a procedure turn [sound of chuckle]. we may * have do the Traverse City and go do the GWENN go out and do a procedure turn.		
04:14:18.8 HOT-2	alright.		
04:14:19.5 HOT-1	you know if we do that we'll be we'll at two hundred knots when we hit Traverse City VOR so it keeps the radius close and tight.		
04:14:26.9 HOT-2	okay.		
04:14:28.6 HOT-1	it fly's actual map it doesn't do timing like when we used to hack timing out it fly's an actual map so you don't get outside of your protected airspace.		
04:14:38.1 HOT-2	okay.		
04:14:49.2 HOT-1	but yeah be ready to have to build the box no big deal.		
04:14:53.4 HOT-2	see we got all the data for everything?		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
04:14:56.1 HOT-1	we're ready to rock.		
04:14:57.1 HOT-2	* ready to rock.		
04:14:57.8 HOT-1	yeah we've already briefed it.		
04:14:59.6 HOT-2	'kay.		
04:15:01.2 HOT-1	you still you got forty seven (cards) and that speeds are all set.		
04:15:06.0 HOT-2	alright.		
04:15:08.0 HOT-1	I'm gonna start down.		
04:15:10.4 HOT-2	okay.		
04:15:16.3 HOT-1	just go ahead and tell 'em we're leav-		
04:15:16.5 HOT-2	*.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
04:15:17.4 HOT-1	naw just tell 'em we're leavin' two seven zero for eleven.		
04:15:22.1 HOT-1	ah give 'em a second aw he just went missed hah.		
04:15:25.4 HOT-2	outta where?		
04:15:26.0 HOT-1	I don't know he said say intentions so he just went missed.		
04:15:30.2 HOT-1	(that's great) * give 'em give 'em a second.		
04:15:37.2 HOT-1	[sound of chuckle].		
04:15:39.1 HOT-1	guess his intentions were to go back shoot another approach [sound of laughter]. ouch.		
04:15:46.4 HOT-1	oh a thirty seven.		
04:15:46.7 HOT-2	ah yeah.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
04:15:49.6 HOT-1	just tell 'em hey for- center Flagship forty seven twelve's starting down.		
		04:15:54.1 RDO-2	and Minneapolis center forty seven twelve starting down.
04:15:59.0 HOT-1	* *.		
04:16:04.6 HOT-1	ah so we'll transition to two ninety 'cause we're descendin'.		
04:16:08.1 HOT-2	'kay.		
04:16:18.4 HOT-2	your right my back does hurt man.		
04:16:20.4 HOT-1	yup. throwin' bags around bendin' over for ACARS doin' walkarounds lookin' up in wheel wells and pullin' hatches and. so it * a wonder how (&) and some of these * these old FOs do it.		
		04:16:32.8 CTR	Flagship forty seven twelve descend pilot's discretion maintain five thousand.

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
		04:16:38.0 RDO-2	pilot's discretion down to five thousand Flagship forty seven twelve.
		04:16:43.1 RDO-1	ah I knew you gave it to us once could you ah re-check our altimeter to Traverse City for forty seven twelve.
		04:16:48.5 CTR	certainly can the Traverse City altimeter is, two niner five five.
		04:16:54.6 RDO-1	I appreciate it two niner five five for forty seven twelve.
04:16:57.7 HOT-2	five thousand set.		
04:16:59.0 HOT-1	five thousand set.		
04:17:04.8 HOT-1	alright, so as a flying pilot right now you gotta be real careful you don't blow through ten thousand doin' two hundred ninety knots. right.		
04:17:13.5 HOT-2	right		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
04:17:13.6 HOT-1	with the altitude set we're in a vertical mode this is when guys do it. now I think we're back in the clouds and we're below forty again.		
04:17:21.3 HOT-2	'kay.		
04:17:21.9 HOT-1	piece of crap. [sound of chuckle] it's hard at night you know all these reflections look like stars so it's hard to tell. eleven hundred left turn three thousand to the VOR that's easy enough.		
04:17:33.5 HOT-2	alright left turn direct to the VOR.		
04:17:35.3 HOT-1	yeah. after eleven hundred feet which eleven hundred feet's about five hundred AGL so right after (having gone) we'll start turning.		
04:17:44.1 HOT-1	* *.		
		04:17:58.4 CTR	and Flagship forty seven twelve do you have the current weather for Traverse City?
		04:18:02.1 RDO-2	that's affirmative Flagship forty seven twelve.

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
04:18:14.3 HOT-1	I usually tell 'em then you know that's affirmative we * like to land two eight? you know there's no it's a VOR Alpha we could do but (our assured to land) a thousand and three, I don't think last time we checked we had that right what's the ceiling at?		
04:18:29.1 HOT-2	it's a broken at ah		
04:18:32.2 HOT-1	we don't have a three.		
04:18:33.1 HOT-2	nine hundred.		
04:18:34.1 HOT-1	okay yeah we don't have that either. alright. but he knows, he's (further near) Traverse City * * # it.		
04:18:42.4 HOT-2	alright.		
04:18:43.4 HOT-1	'kay these are pieces of #. I * * a wet dog ready to go to sleep tonight dude. (I'm ready).		
04:18:56.4 HOT-2	not bad.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
04:19:05.0 HOT-1	you're not gonna be a rock star when you get on line that's what six hundred eight hundred hours of flyin's for. know what I mean?		
04:19:11.7 HOT-2	alright.		
04:19:12.7 HOT-1	you're not gonna be a rock star.		
04:19:17.8 HOT-1	but I just wanna make sure your Jackin' people you know. so you're gettin' closer and closer to that. I don't like this trend of flyin' worse instead of flyin' better. you know what I mean. and we'll, eh tomorrow we'll have you hand flyin' I'm not gonna fly any more legs. so * Detroit's got big runways and it's gonna be a little windy 'cause this'll still be pushin' out * * shorts * kick your #. * descent check.		
04:19:48.9 HOT-2	descent check.		
04:20:09.2 HOT-2	alright seatbelt signs?		
04:20:10.7 HOT-1	on.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
04:20:11.7 HOT-2	alright pressurization?		
04:20:12.7 HOT-1	set.		
04:20:13.4 HOT-2	fuel?		
04:20:13.8 HOT-1	check.		
04:20:14.9 HOT-2	and check.		
04:20:15.9 HOT-2	altimeters?		
04:20:17.6 HOT-1	ah two niner five five left is there showin' seventeen two.		
04:20:20.9 HOT-2	and two niner five five seventeen two * * landing data?		
04:20:25.7 HOT-2	set right.		
04:20:26.4 HOT-1	set left.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
04:20:28.2 HOT-2	CAS check.		
04:20:30.2 HOT-1	clear.		
04:20:41.1 HOT-2	# I'm tired. approach briefing.		
04:20:43.4 HOT-1	complete.		
04:20:44.0 HOT-2	descent check complete.		
04:20:45.1 HOT-1	ah I just looked in here for somethin' whaddya think I was lookin' for?		
04:20:52.4 HOT-1	thirty fifty five, OPS frequency.		
04:20:55.2 HOT-2	alright.		
04:20:55.2 HOT-1	ah reason I'm doin' this * is I'm gonna get ah field conditions from 'em 'cause they're actually legally responsible for it.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
		04:21:04.2 RDO-1	ah Traverse City operations Flagship forty seven twelve.
04:21:18.9 HOT-1	nobodies home nobodies home [in a singsong voice]. make sure I read it right. * * read * our alternates or somethin'. nope.		
04:21:32.3 HOT-1	probably not even there * decided to go home.		
04:21:36.4 HOT-2	*.		
		04:21:36.9 RDO-1	Traverse City operations Flagship forty seven twelve.
		04:22:04.0 CTR	Flagship forty seven twelve I'm sorry did you say you had the weather at Traverse City?
04:22:08.5 HOT-1	yeah. landing two eight, like to land.		
		04:22:09.8 RDO-2	that's affirmative ah F- Flagship a twenty or forty seven twelve landing two eight.

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
		04:22:16.1 CTR	Flagship forty seven twelve roger fly present heading radar vectors ILS final approach course Traverse City say the heading.
04:22:21.4 HOT-?	*.		
04:22:22.9 HOT-1	heading's is now one oh five or one hundred.		
		04:22:25.0 RDO-2	roger heading's one oh five radar vectors ah for the ILS ah two eight for Flagship forty seven twelve.
		04:22:30.2 CTR	roger.
04:22:31.2 HOT-2	alright.		
04:22:31.7 HOT-1	alright.		
04:22:33.4 HOT-1	ah present heading so final heading so final NAV is set up this side this side.		
04:22:34.3 HOT-2	sweet.		

TIME and SOURCE	INTRA-COCKPIT COMMUNICATION CONTENT	TIME and SOURCE	AIR-GROUND COMMUNICATION CONTENT
04:22:36.8 HOT-2	alright.		
04:22:40.1 HOT-2	I can drive 'em over though. drive 'em over [in a singsong voice]. put in the pink and make it big?		
04:22:46.0 HOT-1	okay let's do that. just don't go green till ya have it in final NAV.		
04:22:47.3 HOT-2	alright, alright.		
04:22:50.5 HOT-1	alright.		
04:22:53.2 HOT-2	alright CF two eight? what's a CF two eight? I'm s-		
04:22:58.8 HOT-1	twenty eight mile centerline fix.		
04:23:00.4 HOT-2	alright should I hit this?		
04:23:01.2 HOT-1	for runway two eight centerline fix, well you drove it right?		
04:23:04.1 HOT-2	no I haven't driven it yet.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
04:23:04.7 HOT-1	okay don't hit that.		
04:23:05.8 HOT-1	centerline fix for two eight it's not a twenty eight mile final it would be if it was on visual.		
04:23:08.0 HOT-2	alright (this).		
04:23:13.3 HOT-1	* page *.		
04:23:14.3 HOT-2	there ya go.		
04:23:16.1 HOT-2	*?		
04:23:17.5 HOT-1	make it big.		
04:23:18.4 HOT-2	alright.		
04:23:20.0 HOT-1	execute.		
04:23:20.0 HOT-2	confirm?		

TIME and SOURCE	INTRA-COCKPIT COMMUNICATION CONTENT	TIME and SOURCE	AIR-GROUND COMMUNICATION CONTENT
04:23:22.4 HOT-1	good he does have coverage and we're * over ten seven.		
04:23:25.8 HOT-2	ten seven?		
04:23:26.8 HOT-1	alright.		
04:23:28.2 HOT-2	okay.		
04:23:28.8 HOT-1	just to # and giggle me go ahead and put ah Traverse City fourteen six in the standby.		
04:23:34.4 HOT-1	you gotta no let's set both of ours * * *. that's alright.		
04:23:34.6 HOT-1	selcal, selcal [electronic voice].		
04:23:38.2 HOT-2	got it.		
04:23:40.7 HOT-1	* *.		
04:24:00.1 HOT-1	good work champ.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
04:24:07.7 HOT-1	you can go ahead and do an approach check give her a little extra time.		
04:24:12.5 HOT-2	okay.		
04:24:13.0 HOT-1	blue green.		
04:24:16.9 HOT-1	and we'll do that with a APU also 'cause of the conditions.		
04:24:24.2 CAM	[sound of electronic double chime].		
04:24:28.0 HOT-2	turn APU on?		
04:24:28.9 HOT-1	yeah.		
04:24:29.5 HOT-2	alright.		
04:24:47.2 HOT-1	alright and here's what I would do right now I'm gonna try OPS one more time but.		
04:24:50.1 HOT-2	'kay.		

TIME and SOURCE	INTRA-COCKPIT COMMUNICATION CONTENT	AIR-GROUND COMMUNICATION CONTENT
04:24:51.8 RDO-1		operations Traverse City Flagship forty seven twelve ya up?
04:24:56.2 HOT-2	approach check complete.	
04:25:00.3 HOT-1	ahh last time we'll try that, alright.	
04:25:02.7 HOT-1	CTAF is what twenty four two?	
04:25:05.4 HOT-1	yeah.	
04:25:05.6 HOT-2	twenty four two.	
04:25:07.1 HOT-1	(yeah).	
04:25:07.5 HOT-2	I have it set.	
04:25:08.4 HOT-2	yeah.	

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
		04:25:09.4 RDO-1	Traverse City traffic ah Flagship forty seven twelve's regional jet we're ah to the west about twenty five miles be landing runway two eight any other traffic in please the area please advise Traverse City.
04:25:14.3 HOT-2	got blue needles.		
		04:25:22.3 OPS	hey fla- Flagship forty seven twelve this is airport operations how do you copy.
		04:25:26.6 RDO-1	copy loud and clear.
04:25:28.8 HOT-2	I don't hear anybody. nobody's in the pattern today.		
		04:25:28.8 OPS	I've got multiple pieces of equipment on the airfield here on two eight and I'm running numbers for you as we speak I'll call you back in two minutes.
04:25:32.3 HOT-1	*.		
04:25:36.8 HOT-1	okay we're about a ahh probably thirteen minutes out ah at ah -		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
04:25:43.6 HOT-1	he's got equipment on the runway this gets better.		
		04:25:45.1 OPS	(other) that standby for my number I got 'em up for ya just just second here.
04:25:49.0 HOT-1	thank you sir.		
04:25:50.1 HOT-2	numbers? what what I'm I'm not - alright. what numbers is he talkin' 'bout?		
		04:25:51.3 RDO-1	thank you sir.
04:25:55.6 HOT-1	ah runway conditions mu they mu readings I don't know if you * that in in your FOM. ah so he's got a truck driving up down the # taxiways see how our braking's gonna be.		
04:25:56.4 HOT-2	never mind.		
04:25:59.7 HOT-2	okay.		
04:26:08.8 HOT-2	alright. sound good.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
04:26:09.3 HOT-1	that works for me.		
04:26:15.2 HOT-1	hey they could be out there with # wind meters. [sound similar to chuckle.].		
04:26:17.6 HOT-2	[sound similar to chuckle.].		
04:26:18.6 HOT-1	just to keep Northwest from lyin'.		
04:26:22.0 HOT-1	alright well it's been two two minutes so you go transfer bleeds.		
04:26:24.8 HOT-2	alright.		
04:26:28.8 HOT-1	cool. I didn't expect OPS to call up but that's why we do that I guess.		
04:26:33.3 HOT-2	n' alright.		
04:26:33.8 HOT-1	sure suck to land on a backhoe or some #. [sound of chuckle] check this out, star wars.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
04:26:38.9 HOT-2	boy better- * * alright doesn't even feel like we're movin'.		
04:26:44.9 HOT-1	yeah heh well look look sideways. hey you should (flip) the strobes (on).		
		04:26:49.9 OPS	Flagship forty seven twelve airport operations
04:26:52.9 HOT-1	now on two.		
04:26:53.8 HOT-2	'kay.		
		04:26:54.6 RDO-1	yeah forty seven twelve go.
		04:26:56.5 OPS	yeah I've forty plus runway two eight I've got thin wet snow or patchy thin ice ah give us about ah five eight minutes to clear the runway ah when you're ready to land here give us a call.
04:26:58.6 HOT-1	that's mu.		

TIME and SOURCE	INTRA-COCKPIT COMMUNICATION CONTENT	AIR-GROUND COMMUNICATION CONTENT
04:27:09.8 RDO-1		ah you need five to eight minutes ah we're twelve minutes out we copied the ah forty mu or better on two eight thank you.
04:27:17.7 OPS		yeah okay we're gonna have these ah vehicles cleared off the second pass here and ah just keep us advised where you're at.
04:27:19.5 CTR		(the) SAAB *** turn left heading one one zero.
04:27:23.8 RDO-1		ah right now we're ah fifteen miles west of the field at ah *.
04:27:26.8 RDO-2		forty seven twelve one one zero.
04:27:30.1 OPS		okay and ah just a we'll we'll I'll call you when we're clear.
04:27:30.2 CTR		ah Flagship forty seven twelve negative that's for another aircraft.
04:27:35.7 HOT-1	[sound of chuckle] alright.	

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
04:27:37.3 HOT-2	I got.		
		04:27:45.4 RDO-1	ah Center's forty seven twelve do you kinda keep contact with a airport ops in ah Traverse City when we come in here?
		04:27:52.3 CTR	ahhh no I do not keep ah in contact with airport ops.
		04:27:56.7 RDO-1	alright we just called in range and apparently they've got some mu equipment on the runway for the next five to eight minutes so anywhere you wanna put us?
		04:28:04.8 CTR	okay we'll just vector you out ah long here on the ILS and ah when you feel comfortable you let me know we'll turn you back in.
		04:28:11.6 RDO-1	okay we'll do that thank you.
04:28:15.1 HOT-2	alright.		
04:28:15.7 HOT-1	Ahh I don't wanna be stuck (in this) go around just 'cause there's equipment on the runway, ya know?		

TIME and SOURCE	INTRA-COCKPIT COMMUNICATION CONTENT	TIME and SOURCE	AIR-GROUND COMMUNICATION CONTENT
04:28:20.9 HOT-2	approach-		
		04:28:21.6 OPS	Traverse City Traffic snow removal equipment on all surfaces any aircraft in the area please advise Traverse City.
		04:28:29.1 RDO-1	and ah as previously reported Flagship forty seven twelve's regional jet ah we're still about ten miles west of the field we're plannin' on a long downwind to ah give you guys some time just advise when clear.
04:28:32.9 CAM	[sound similar to altitude alert chime].		
		04:28:42.1 OPS	roger that forty seven twelve I'll call when we're clear here.
		04:28:44.7 RDO-1	thank you sirra.
04:28:47.5 HOT-1	alright six for five.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
		04:28:48.9 CTR	and Flagship forty seven twelve show light ahhh precipitation 'bout ah twelve o'clock and three miles. and extending out to about fifty miles east of the field.
04:28:49.9 HOT-1	* (quit).		
04:28:56.0 HOT-1	yup.		
04:29:00.6 HOT-1	thanks.		
		04:29:01.3 RDO-2	ah roger that thanks for for Flagship forty seven twelve.
04:29:05.9 HOT-1	alright.		
04:29:09.7 HOT-2	'kay.		
04:29:10.5 HOT-1	there's snow removal on the field yet they're showing forty or better sounds like a contaminated # runway to me.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
04:29:17.1 HOT-1	you don't put snow equipment on a runway, this the same place that drove one # snow truck down centerline, they took it off so we could land. sounds alot that that gettin' ready to go on again.		
04:29:26.2 HOT-1	ALTs cap.		
04:29:26.3 HOT-2	ahuh.		
04:29:27.9 HOT-1	so I'll tell what I'll do is ah we'll bug two hundred, we'll just slow 'cause all we're trying to do is buy time right now.		
04:29:28.7 HOT-2	ALTs cap.		
04:29:33.7 HOT-2	sure.		
04:29:35.4 HOT-1	ahh fuel's good at four point seven. gonna' turn the wing on here a second.		
04:29:40.9 HOT-2	check.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
04:29:47.5 HOT-1	I mean if they're running a full gauntlet it's gonna take them ten minutes to just go down to the (mile), 'cause they got s- they got trucks that -		
04:30:02.2 HOT-1	alright wings on please.		
04:30:09.4 HOT-1	let's put GWENN in there too.		
		04:30:11.1 CTR	and Flagship forty seven twelve what's the current heading?
04:30:15.0 HOT-1	one oh five.		
		04:30:16.0 OPS	and ah Flagship forty seven twelve airport ops how out are you now?
		04:30:16.1 RDO-2	ah heading one oh five Flagship forty seven twelve.
		04:30:18.4 CTR	Flagship forty seven twelve let's turn right to a heading of one one five.
		04:30:23.2 RDO-2	turn to right one one five * Flagship forty seven twelve.

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
		04:30:24.6 RDO-1	we could be on the ground in ah five minutes or ah we can extend this out for a ah ten or fifteen minutes. what do you need?
		04:30:32.7 OPS	'kay I'm gonna get my va- vehicles off the runway right now and then ah then I can you can land at your discretion here I just got call get my plows off.
		04:30:40.7 RDO-1	okay ah no hurries.
04:30:45.6 HOT-1	I don't like that #.		
04:30:50.3 HOT-1	one one five on the heading (SWEARIG) is that all; *		
04:30:52.4 HOT-2	yep one one one one five.		
04:30:54.3 HOT-1	it's getting dicey on the radio. it's not you're fault that's this is weird as #. this is what happened to me at Pinnacle (&). but instead of our APU start he was savin' 'em money and trying to start it at the marker close and then failed. [sound of chuckle]. oh we had a lot of # goin' on.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
04:30:55.9 HOT-2	I know.		
04:31:16.5 HOT-1	I was goin' off your heading. because we first reported one oh five off of your heading and we never changed our heading.		
04:31:23.4 HOT-2	alright.		
		04:31:24.0 OPS	and forty seven twelve just second here I gotta get my last plow off the runway for ya.
04:31:24.3 HOT-1	* *.		
		04:31:28.3 RDO-1	Wilco appreciate the help forty seven twelve.
04:31:32.3 HOT-1	alright. I'm gonna talk to them * *.		
04:31:44.1 HOT-1	I wanna hear him say the truck's off before we actually get a (clearance) but.		
04:31:49.0 HOT-1	I'm thinkin' two to three miles past GWENN come back in let these boys do their thing.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
04:31:54.2 HOT-2	alright.		
04:31:55.4 HOT-1	at the speed we're doin'. you know I hope they didn't leave trail marks. s' ya know.		
04:32:04.6 HOT-1	# me once shame on you # me twice shame on me. right?		
04:32:09.0 HOT-2	right.		
04:32:09.9 HOT-1	this same airport same # I bet we get down there and see a three foot snow bank go off-road.		
		04:32:16.4 OPS	and forty seven twelve all vehicles are clear of a runway two eight Traverse City.
		04:32:20.9 RDO-1	excellent thank you very much ah we'll go ahead and turn in and Traverse City traffic Flagship forty seven twelve's regional jet I'll be doing the ILS 'bout two miles short of (CLINT) any traffic in the area please advise thanks guys.
		04:32:34.0 RDO-1	ah forty seven twelve OPS advises all the vehicles are cleared.

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
04:32:51.2 HOT-1	hoh. we just flagged the localizer off and on see how that goes.		
		04:32:58.7 CTR	and Flagship forty seven twelve say again.
		04:33:02.1 RDO-1	yeah operations advises all vehicle clear of the runway we'll be ready for an approach when you are.
		04:33:07.2 CTR	okay be about another ahh two minutes 'till I get you out far enough to turn you back in onto the ILS.
		04:33:12.4 RDO-1	excellent thanks for the help.
04:33:14.9 HOT-1	ahhh.		
04:33:15.1 HOT-2	sweet.		
04:33:18.5 HOT-1	[sound similar to sigh].		
04:33:20.5 HOT-1	dude * * can't win from losing today.		

	INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
04:33:24.4 HOT-2	jeeze.		
04:33:24.8 HOT-1	you know?		
04:33:25.3 HOT-2	yeah.		
04:33:25.7 HOT-1	just wanted a little somewhat standard flight for ya kinda let ya get your # up.		
04:33:35.1 HOT-1	feel like it was stopping on a dime have we done any short runways I guess Pensacola was sixty five for ya?		
04:33:40.4 HOT-2	lets go with * * * *.		
04:33:40.5 HOT-1	or seven thousand what was it seven or eight seven I guess.		
04:33:40.5 HOT-2	Pensacola sixty five.		
04:33:45.3 HOT-2	yeah this is gonna be short. (I don't care).		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
04:33:46.5 HOT-1	yeah and at night it'll feel short too.		
04:33:50.9 HOT-1	with contaminant. more than likely.		
		04:33:53.1 OPS	* forty seven twelve you guys * * yet?
		04:33:56.7 RDO-1	I'm sorry the other radio's going what's that?
		04:33:59.3 OPS	you guys inside GWENN yet?
		04:34:01.5 RDO-1	ahh the Center wouldn't let us turn yet so we're about one minute prior to the turn.
		04:34:06.7 OPS	okay roger that it's comin' down pretty good here so ahhh (guess) I'll see you on the ground here.
04:34:09.5 HOT-1	hah snowing hard.		
		04:34:11.7 RDO-1	excellent thanks for the help tonight.
		04:34:15.3 CTR	Flagship forty seven twelve descend pilot's discretion maintain three thousand five hundred.

TIME and SOURCE	INTRA-COCKPIT COMMUNICATION CONTENT	TIME and SOURCE	AIR-GROUND COMMUNICATION CONTENT
		04:34:21.3 RDO-2	three thousand five hundred Flagship forty seven twelve.
04:34:23.3 HOT-1	I'll set it for you thirty five alright.		
04:34:24.3 HOT-2	alright thirty five set alright.		
04:34:29.5 HOT-1	ah go double chime her to set her down.		
04:34:31.8 HOT-2	double chime her.		
04:34:32.4 HOT-1	thanks.		
04:34:34.8 CAM	[sound of single warning chime].		
04:34:34.9 HOT	[sound of electronic chime].		
04:34:35.5 HOT-1	flaps eight.		
04:34:39.2 HOT-2	'kay.		
04:34:47.2 HOT-2	why is the PA on?		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
04:34:48.3 HOT-1	(cause) she's telling them to sit the # down we've been cleared for the approach. put you seat backs in the upright position tray tables.		
04:34:50.0 CAM	[sound of single warning chime].		
04:34:55.8 HOT-2	what you want me to do that?		
04:34:57.4 HOT-1	no that's what she's doing you asked why the PA light's on. she's making her announcement which when you double chime her she has to do it.		
04:34:59.6 HOT-2	oh she's doing that.		
04:35:03.8 HOT-1	pretty cool huh?		
		04:35:07.6 RDO-1	Traverse City traffic Flagship forty seven twelve regional jet be turnin' about a ah fifteen mile final any other traffic please advise Traverse City.
04:35:17.9 HOT-1	alt's cap.		
04:35:19.6 HOT-2	alt's cap.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
04:35:20.5 HOT-1	he's about (to) turn us is why I made that call.		
		04:35:22.4 OPS	forty seven twelve how many minutes is that? fifteen miles out?
		04:35:26.7 RDO-1	I wish he'd a turned us sooner but we're about five minutes from ah touchdown.
		04:35:30.9 OPS	okay I'll stay clear it's comin' down pretty good guys just to give ya a heads up.
		04:35:35.1 RDO-1	ah how are the winds doin' fine?
		04:35:38.0 OPS	I'm not sure what the winds are doing I know they're out of the east.
		04:35:40.7 RDO-1	thank you.
		04:35:42.7 CTR	Flagship forty seven twelve turn left to a heading of zero seven zero.
		04:35:46.3 RDO-2	zero seven zero Flagship forty seven twelve.

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
04:35:49.4 HOT-1	I guess that's all he's gonna give me eh? why don't we go ah flaps twenty bug one eighty.		
04:35:59.3 HOT-1	got a forty eight knot tailwind on this approach, see that?		
04:36:05.3 HOT-2	that's not good.		
04:36:06.5 HOT-1	that's gonna be fun. that's why I'm slowin' the # down. our groundspeed gonna be like I'm doin' two fifty at the marker.		
04:36:19.7 HOT-1	says it comin' down good which means its snowing like a # and we probably won't see the runway. so be ready for the missed if it is we're going to Detroit that's all we got.		
04:36:24.2 HOT-2	alright.		
04:36:30.1 HOT-1	come on center lets roll with this shot. (who knows) what these winds are doin' turns us turns us too sharp we'll miss the course. we'll miss the final approach fix.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
04:36:51.9 HOT-1	I don't know what his concern is about the.		
04:36:54.0 HOT-2	did (I) do final nav? yea well I am sure we did.		
04:36:57.2 HOT-1	you did.		
04:36:58.2 HOT-2	we did? yeah we did.		
04:36:58.8 HOT-1	we did. * green needles (auto) tune.		
04:37:01.2 HOT-2	(okay).		
04:37:02.0 HOT-1	don't touch a nothin'.		
04:37:02.9 HOT-2	no I'm not.		
04:37:05.0 HOT-1	come on dude I don't wanna go out into lala land let's go.		
04:37:23.2 HOT-1	ahhh # eh.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
		04:37:25.4 CTR	Flagship forty seven twelve turn left to ah heading of three four five.
		04:37:27.7 OPS	forty seven twelve airport ops.
		04:37:30.7 RDO-2	say heading one more time forty seven twelve.
		04:37:32.6 CTR	Flagship forty seven twelve turn left heading three five five.
		04:37:33.4 RDO-1	standby.
		04:37:36.1 RDO-2	three five five Flagship forty seven twelve.
		04:37:39.1 RDO-1	ah what's ya got guys.
		04:37:40.5 OPS	I need to know if guys are gonna be landing soon 'cause I gotta this its fillin' n pretty quick down here so ah how far are you guys out?
		04:37:49.3 RDO-1	yeah we're intercepting the localizer right now so ah four and a half five minutes at the most.

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
		04:37:54.4 OPS	who's that?
		04:37:55.9 RDO-1	got some funky winds up here it's ah tailwind of fifty knots on the approach and we're supposed to be shearing to an east wind so.
		04:38:03.2 OPS	yeah I'm gonna I don't know what the ah conditions like * down the runway but I'm gonna call braking action NIL now. cause' it's fillin in real hard.
		04:38:04.3 CTR	Flagship forty seven twelve turn left to a heading of three one zero.
		04:38:08.4 RDO-2	three one zero Flagship forty seven twelve.
		04:38:10.3 RDO-1	okay, (thanks).
04:38:12.7 HOT-1	three one zero. so he sayin' it's a # runway's what he's tellin' me.		
04:38:13.6 HOT-2	three one zero.		
04:38:16.0 HOT-2	alright.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
04:38:16.7 HOT-1	(yeah).		
04:38:18.0 HOT-1	no our approach clearance yet?		
04:38:19.5 HOT-2	no approach clearance.		
04:38:21.4 HOT-1	see it will be like four minutes feel that groundspeed? feel that groundspeed go #.		
04:38:25.8 HOT-2	*.		
04:38:27.4 HOT-2	forty five knots.		
04:38:28.5 HOT-1	yeah. GWENNs the marker.		
		04:38:29.7 CTR	Flagship forty seven twelve maintain two thousand seven hundred until established on the localizer you're eight miles east of GWENN cleared ILS approach to the Traverse City airport fly heading three one zero to join the localizer.

TIME and SOURCE	INTRA-COCKPIT COMMUNICATION CONTENT	TIME and SOURCE	AIR-GROUND COMMUNICATION CONTENT
		04:38:43.0 RDO-2	cleared and maintain two thousand feet and turn heading ah three one zero join localizer Flagship forty seven twelve.
04:38:48.9 HOT-1	two thousand seven hundred.		
		04:38:49.8 CTR	Flagship forty seven twelve I misheard the readback three ah two thousand seven hundred until established on the ah localizer.
		04:38:55.6 RDO-2	(under) two thousand seven hundred until established ah Flagship forty seven twelve
04:38:58.8 HOT-1	ah loc one glideslope armed twenty seven hundred set she's seated.		
04:39:05.5 HOT-2	alright.		
04:39:08.8 HOT-1	he's saying it's fillin' in so his runway's a foot deep of snow is what's he's tellin' me. so we're gonna be very careful on the thrust reversers we're gonna keep this # straight.		
04:39:18.8 HOT-2	'kay.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
04:39:21.7 HOT-1	I mean what kind of report's that it's filling in ya know doesn't tell me good bad fair poor.		
04:39:31.6 HOT-1	I went down so that we'd be below the glideslope when we catch. alt's cap.		
04:39:36.6 HOT-2	alt's cap.		
04:39:37.6 HOT-1	localizer's alive.		
04:39:39.8 HOT-2	loc two's armed. yeah.		
04:39:41.3 HOT-1	loc's alive it's comin' in.		
04:39:43.0 HOT-2	'kay.		
04:39:44.3 HOT-1	lo- ah eh.		
		04:39:44.9 CTR	Flagship forty seven twelve show you joining the localizer radar services terminated change to advisory frequency approved cancellation arrival time this frequency.

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
		04:39:54.8 RDO-2	roger cancel with you ah Flagship forty seven twelve.
04:39:57.5 HOT-1	change to advisory approved.		
		04:39:58.6 RDO-2	and change to advisory approved Flagship forty seven twelve.
04:40:00.8 HOT-1	so lets put thirty two nine on two and we'll put twenty four two on one I got you cleared to land lights.		
04:40:06.6 HOT-2	thirty two nine on two.		
04:40:08.5 HOT-1	yeah.		
04:40:09.4 HOT-1	that's center so we can listen to 'em. put CTAF on one.		
04:40:16.2 HOT-2	alright on one.		
04:40:18.7 HOT-1	eh gear down flaps thirty bug one sixty.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
04:40:19.4 HOT-2	gear down.		
04:40:21.9 CAM	[sound of increased background noise].		
04:40:23.6 HOT	[sound similar to flap overspeed clacker].		
04:40:24.4 HOT-1	that's alright it's within five knots makes it does it do it. bug one sixty.		
04:40:25.4 HOT-2	flaps thirty.		
04:40:29.5 HOT-1	glideslope's alive I don't know if I said that or not.		
04:40:34.9 HOT-1	eleven hundred feet first then left turn to three thousand is what we're gonna be doin'. flaps forty five ref plus factor before landing checklist. glideslope's active.		
04:40:43.8 HOT-2	'kay flaps forty five.		
		04:40:46.1 RDO-1	Traverse City traffic forty seven twelve's GWENN inbound.

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
		04:40:51.2 RDO-1	it's about two minutes for you guys.
		04:40:53.1 OPS	yeah we're all clear of the runway for ya and again ah brakin' actions probably NIL on the runway.
		04:40:57.4 RDO-1	are you saying it's NIL?
		04:40:59.3 OPS	(oh I) haven't been out there to do a field report and it's been ah five ten minutes so I don't know what it's doin' now.
		04:41:04.7 RDO-1	okay.
04:41:07.3 HOT-1	he's not reporting it NIL he's like he's sayin' its NIL. heh.		
04:41:14.8 HOT-2	all right landing gear down three green?		
04:41:16.1 HOT-1	down three green.		
04:41:16.8 HOT-2	alright flaps?		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
04:41:18.3 HOT-1	ahh forty five indicated.		
04:41:19.8 HOT-2	forty five indicated. thrust reversers?		
04:41:20.5 HOT-1	that's you.		
04:41:21.2 HOT-1	alright.		
04:41:21.9 HOT-2	(now).		
04:41:23.1 HOT-2	are armed.		
04:41:24.4 HOT-2	flight attendant is notified we already dinged her before landing check complete.		
		04:41:31.3 RDO-1	about how deep of a contaminate would you say it is?
04:41:33.9 HOT	one thousand [electronic voice].		
		04:41:34.7 OPS	I'd ah forty seven twelve I'd say it's probably close to half inch now.

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
		04:41:38.9 RDO-1	okay that's not bad thank you.
04:41:39.0 HOT-2	'kay.		
04:41:40.8 HOT-2	good.		
04:41:41.2 HOT-1	* we're allowed three inches. alright. and set my missed please three thousand we might need it if it looks ugly when we're comin' in I'll go around. (you know what I mean). made this mistake before. as long as there's no shovel you know marks and # half inch is nothin'. alright our decision height's eight twenty call me at nine twenty a hundred above.		
04:41:42.6 HOT-2	'kay.		
04:41:50.0 HOT-2	alright.		
04:41:54.8 HOT-2	alright.		
04:42:04.2 HOT-2	alright.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
04:42:05.2 HOT-1	if we go around just listen to what I'm sayin' what I'm callin' for 'cause there's a hill right off the twelve o'clock nose see that?		
04:42:12.4 HOT-2	okay.		
04:42:12.8 HOT-1	alright kinda a little hilly around here so don't forget to call my positive rate don't forget to get my gear up when I call for it flaps will go to eight not flaps twenty.		
04:42:15.3 HOT	five hundred [electronic voice].		
04:42:19.1 HOT-2	alright.		
04:42:22.1 HOT-2	gotcha.		
04:42:24.3 HOT-1	and definitely not flaps up. let's heading sync that #. alright here we go. (now to get) this runway.		
04:42:29.5 HOT-2	okay.		
04:42:31.7 HOT-2	alright.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
04:42:35.2 HOT-2	got a hundred feet.		
04:42:36.7 HOT-1	alright.		
04:42:39.2 HOT-1	approach lights in sight.		
04:42:42.0 HOT-1	continuing. (runway) in sight. landing.		
04:42:42.9 HOT	[sound of autopilot disconnect cavalry charge] minimums [electronic voice].		
04:42:44.7 HOT-2	run ah runway in sight.		
04:42:49.1 HOT	one hundred [electronic voice].		
04:42:52.5 HOT	fifty [electronic voice].		
04:42:53.5 HOT	forty [electronic voice].		
04:42:54.3 HOT	thirty [electronic voice].		
04:42:55.5 HOT	twenty [electronic voice].		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
04:42:57.4 HOT	ten [electronic voice].		
04:43:02.3 CAM	[sound of muted thump].		
04:43:03.7 CAM	[sound of muted thump followed by increased background noise consistent with an aircraft on landing rollout].		
04:43:04.4 HOT-1	#. [sotto voce].		
04:43:05.7 HOT-2	spoilers green.		
04:43:06.6 HOT	[sound of click].		
04:43:06.9 HOT-1	very easy very easy. [sotto voce].		
04:43:12.6 HOT-2	#. [sotto voce].		
04:43:12.8 HOT	[sound of click].		
04:43:14.2 HOT-1	alright [sotto voce].		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
04:43:15.8 HOT-2	eighty knots.		
04:43:16.4 HOT-1	checks [sotto voce].		
04:43:17.7 HOT-1	very easy. #. #. #. #. #. #. #. #. [sotto voce].		
04:43:24.4 HOT-2	# sixty knots.		
04:43:27.6 HOT-1	ahh we're goin' off.		
		04:43:27.7 OPS	* * he's off the runway guys holy # he's off.
04:43:33.8 HOT	[sound of banging].		
04:43:35.2 HOT	[sound of repeating single chime].		
04:43:35.7 HOT-1	alright.		
04:43:37.2 HOT	gear disagree [repeating electronic voice].		
04:43:38.9 HOT-2	#. [sotto voce].		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
04:43:40.6 HOT-1	evacuation checklist.		
04:43:44.1 HOT-1	my checklist.		
04:43:44.8 HOT-1	call the flight attendant. call the flight attendant. call the flight attendant.		
04:43:49.0 HOT-2	call.		
04:43:49.8 HOT-1	'kay get out and help her.		
04:43:58.1 CAM-1	get out and help her get out of the (checklist).		
04:44:06.3 CAM	[sound similar to cockpit door banging].		
04:44:07.3 CAM-3	(you in) there.		
04:44:08.1 CAM-2	alright?		
04:44:14.0 CAM-2	everyone okay?		
04:44:16.3 CAM-3	are you okay?		

	INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
04:44:17.1 CAM-2	* okay **?		
04:44:18.5 CAM-3	yeah ***.		
04:44:19.9 CAM	[sound of two single chimes].		
04:44:21.8 CAM-1	alright hey a uhm & start evacuate the aircraft. alright?		
04:44:27.2 CAM-3	okay.		
04:44:31.9 CAM	[sound of triple chime].		
04:44:34.0 CAM	config the brakes [repeating electronic voice]		
		04:44:40.9 RDO-1	and center forty seven twelve.
		04:44:47.4 RDO-1	center forty seven twelve.
04:45:33.8 CAM	[sound similar to complex single 600 Hz tone].		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
04:45:45.5 CAM-1	okay I don't want shut all this off to be honest with you. so.		
04:46:32.3 PA-1	well ladies and gentlemen from the ah flight deck obviously the ah runway conditions are ah not the best. the aircraft ah overran the runway ahm and we're gonna have to coordinate with ground try to get you guys off the aircraft so please ah leave your personal items on-board and ah just give us about a minute or two figure out how we'll figure out how we pull everybody off.		
		04:47:00.1 RDO-1	operations forty seven twelve are you there?
04:47:03.6 CAM-2	contact clearance wanna tell 'em?		
		04:47:06.9 RDO-1	operations forty seven twelve are you there?
		04:47:15.2 RDO-1	operations forty seven twelve are you here?
		04:47:18.4 OPS	yeah I I'm with ya forty seven twelve I'm comin' right for ya.
		04:47:21.6 RDO-1	thank ya.

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
		04:47:28.2 OPS	I dialed nine one one guys.
04:47:39.1 CAM-2	APU still on.		
04:48:02.9 CAM-4	everybody's been doin' alright no one no one's injured?		
04:48:06.7 CAM-4	okay.		
04:49:35.0 CAM-1	* *.		
04:49:36.2 CAM-2	ah #.		
04:49:37.1 CAM-1	there goes my career.		
04:49:38.4 CAM-?	folks I know the weather's bad but (we want to get you) off the plane okay (we're going to) go outside and got vehicles coming ****.		
04:49:47.8 CAM	[ground crew discussion concerning vehicle positioning].		

TIME and SOURCE	INTRA-COCKPIT COMMUNICATION CONTENT	TIME and SOURCE	AIR-GROUND COMMUNICATION CONTENT
04:50:01.1 CAM	[sound similar to cell phone chime].		
		04:50:08.7 RDO-1	Minneapolis center forty seven twelve.
		04:50:12.1 CTR	Flagship forty seven twelve go.
		04:50:14.0 RDO-1	yeah we overran the runway here in Traverse City we're off the end.
		04:50:18.4 CTR	you overran the runway at Traverse City ahh roger.
		04:50:22.3 RDO-1	local OPS is ah notified we just need to get some assistance out here.
		04:50:26.5 CTR	okay I'll tell my supervisor.
04:50:35.8 CAM-1	I'm happy with the configuration right now.		
04:50:37.7 CAM-2	you're happy okay.		
04:50:38.6 CAM-1	okay but I'd you to **.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
04:50:39.6 CAM-2	whaddya want me to do?		
04:50:41.9 CAM-1	I wanna get everybody off and into a vehicle of some kind.		
04:50:45.0 CAM-2	**.		
04:50:46.3 CAM-1	'cause I don't know * we're leakin' fuel. I don't know if we have any other problems.		
04:50:47.8 CAM-2	(sure).		
04:50:50.8 CAM-2	alright then we need to get these people off.		
04:50:51.2 CAM-1	* *.		
04:50:52.5 CAM-2	'kay you wanna get the babies off first? on this van right here?		
04:50:56.9 CAM-1	ah yeah get the BIA's.		
04:50:58.5 CAM-2	the BIA's?		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
04:50:59.3 CAM-1	one at a time get 'em in the vehicle.		
04:51:02.8 CAM-?	[conversation about off loading the babies from the aircraft].		
04:51:11.4 CAM-1	&, & & forty seven twelve.		
04:51:14.2 CAM-1	we just ran off the end of the runway in Traverse City.		
04:51:14.3 CAM-?	***.		
04:51:18.4 CAM-1	there's no braking action at all on two eight and the airplane just didn't stop, so. everybody on the airplane's okay but we're sittin' off about a hundred feet off the end of the runway.		
04:51:31.8 CAM-1	yeah we got OPS out here and we're trying to coordinate with everybody. yeah.		
		04:51:35.2 APT-5	airport five to CFR on frequency.
04:51:38.4 CAM-?	[unintelligible conversation].		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
		04:52:08.9 CTR	ah Flagship forty seven twelve understand you notified OPS you don't need us notify anybody?
		04:52:09.4 APT-5	airport five to CFR on frequency.
04:52:30.3 CAM-1	hello oh yeah, yeah, yeah it's, it's, and ** (left) one of the mains is off the ground it's by it's right wheel er a right wing and ah we've got the air stairs we got a lot of operations out here to help us there's no injuries to the passengers, ahm I'm just trying to ah manage gettin' everybody off the aircraft right now. yeah I mean we're at a a pretty good we're about a now at twenty degree angle to the end to the runway heading off the end of the runway. ah yeah but I'm gonna have to get goin' here a second to keep assisting with this. thank you.		
04:53:20.6 CAM-1	hey & come here. & come here can you do me a favor.		
04:53:24.3 CAM-2	yeah.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
04:53:29.3 CAM-1	sorry. everybody's okay but the aircraft is definitely a loss you know I mean it's ah I don't know what else to do, I'm trying to get everybody off the plane as safely as possible 'cause right now I'm not sure of the configuration of the airplane you know what I mean? so I'm trying to get everybody, it's snowin' like crazy but I'd like to get 'em off the aircraft on to some type of transportation. they weren't answering on the in-range and ahm I got OPS on it I've notified ATC when to give them the buzz real quick and see if they answer no. standby.		
		04:53:47.6 CTR	Flagship forty seven twelve Minneapolis.
		04:54:05.0 RDO-1	operations forty seven twelve you up?
04:54:08.3 CAM-?	okay.		
		04:54:09.4 OPS	forty seven twelve go ahead.
		04:54:11.6 RDO-1	yeah we don- went off the end of the runway we're gonna need assistance off the end here to help offload ah passengers.

TIME and SOURCE	INTRA-COCKPIT COMMUNICATION CONTENT	TIME and SOURCE	AIR-GROUND COMMUNICATION CONTENT
		04:54:16.9 OPS	ah guys we are ah in ah the works on on try to figure that at this ah moment we'll get right back with ya.
		04:54:23.4 RDO-1	alright thanks.
04:54:24.1 CAM-1	ah I guess ah yeah my cell phone's [pilot recites a ten digit number] and I guess I I'm gonna want some advice on from you right now * are you more comfortable keeping people on this aircraft or do you want me to get 'em off away from the aircraft?		
04:54:46.2 CAM-1	I get 'em out it's snowing like crazy it's cold but I don't know the condition of the aircraft as far as from the outside, ya know what I mean? we have the door open I've kinda done a walkaround it appears to be safe.		
04:55:00.9 CAM-1	doesn't appear to be but like I said you know we're off the runway so and the main's not (on) the aircraft.		
04:55:15.6 CAM-1	okay hey I gotta go I gotta go alright alright.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
04:55:20.6 CAM-?	*** still got five thousand pounds of fuel on (on board).		
04:55:25.5 CAM-1	okay, alright.		
04:55:28.0 CAM-?	* want me to power down * * *?		
04:55:31.9 CAM	[sound similar to clanking].		
04:55:43.7 CAM	[sound of single chime].		

End of Transcript

04:55:44.8

[end of recording]

APPENDIX C

PINNACLE'S OPERATIONS SPECIFICATION C382 (LANDING DISTANCE ASSESSMENT)

U.S. Department of Transportation
Federal Aviation Administration

Operations Specifications

C382. Landing Performance Assessment At Time Of Arrival For Turbojet Operations — **HQ Control:** 09/06/06 **HQ Revision:** 000

a. The certificate holder is authorized to conduct turbojet airplane operations using landing performance assessment procedures at time of arrival and shall conduct all such operations in accordance with the provisions of this operations specification.

b. To assess the landing performance at time of arrival for its turbojet airplane operations the approved assessment procedures must account for at least the following:

(1) Runway to be used,
(2) Metrological conditions affecting landing performance,
(3) Runway conditions,
NOTE: Runway conditions specified as "nil" braking action are not considered safe, therefore operations under conditions specified as such must not be conducted.
(4) Airplane weight and configuration,
(5) Approach speed,
(6) Planned touchdown point,
(7) Planned use of airplane ground deceleration devices, and
(8) Most adverse reliable braking action report or runway condition report, or most adverse expected conditions for the runway, or portion of the runway, that will be used for landing.

c. All landing distances at time of arrival calculated in accordance with subparagraph b above will be increased by at least an additional 15% for all runway conditions.

d. For landing performance assessments, the certificate holder must use;

(1) The manufacturer's approved and/or advisory landing performance data as applicable, or
(2) If the airplane manufacturer has not provided data for a specific airplane make, model, and series, the certificate holder must use the guidance provided by Flight Standards to develop its own data for landing operations on contaminated runways.

e. This assessment is required to be accomplished as close as practicable to the time of arrival consistent with the ability to obtain the most current meteorological and runway conditions considering pilot workload and traffic surveillance, but no later than the commencement of the approach procedure or visual approach pattern.

f. This assessment must include adjustments for landing flare distance consistent with the certificate holder's normal landing operations and head-up-guidance systems (HGS) or autoland air distances as applicable.

g. The approved assessment procedures described or referenced below are used by the certificate holder for the landing performance assessment at time of arrival.

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h. Required Training. Before conducting any turbojet operations authorized by this operations specification the flightcrew and dispatchers (if applicable) must be qualified in accordance with the certificate holder's FAA approved training program for the procedures being used.

i. Other Limitations and Provisions.

Print Date: 4/13/2007 — C382-1 Pinnacle Airlines, Inc. — Certificate No.: REXA257A

U.S. Department of Transportation
Federal Aviation Administration

Operations Specifications

(1) The certificate holder must comply with all the provisions of 14 CFR Section 121.195 for landing performance calculations required before takeoff.

(2) Except in an emergency situation, no pilot may land a turbojet airplane unless the useable runway available is equal to or longer than the sum of the landing performance assessments specified above in subparagraph b and the safety margin specified in subparagraph c.

(3) This operations specification requirement is independent of other operations specifications. The longer of the landing distance determined by compliance with this operation specification, and that determined in compliance with other applicable operations specifications will be the minimum landing distance required.

(4) This authorization requires concurrence with Flight Standards headquarters prior to its issuance.

1. The Certificate Holder applies for the Operations in this paragraph.
2. Support information reference:
3. These Operations Specifications are approved by direction of the Administrator.

DIGITALLY FAA SIGNED 12/6/2006 11:38:31 AM
Zindell, Raymond C
Principal Operations Inspector

4. Date Approval is effective: 12/06/2006 Amendment Number: 1
5. I hereby accept and receive the Operations Specifications in this paragraph.

DIGITALLY INDUSTRY SIGNED 11/27/2006 12:47:28
Garvin, Michael R. ,Jr.
Director of Operations Date: 11/27/2006