Crash During Nonprecision Instrument Approach to Landing
Execuflight Flight 1526
British Aerospace HS 125-700A, N237WR
Akron, Ohio
November 10, 2015

Accident Report

NTSB/AAR-16/03
PB2016-104168

National Transportation Safety Board

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National
Transportation
Safety Board

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

National Transportation Safety Board. 2016. ***Crash During Nonprecision Instrument Approach to Landing, Execuflight Flight 1526, British Aerospace HS 125-700A, N237WR, Akron, Ohio, November 10, 2015*****. Aircraft Accident Report NTSB/AAR-16/03. Washington, DC.**

Abstract: This report discusses the November 10, 2015, accident in which a British Aerospace HS 125-700A, N237WR, registered to Rais Group International NC LLC and operated by Execuflight, departed controlled flight while on a nonprecision localizer approach to runway 25 at Akron Fulton International Airport and impacted a four-unit apartment building in Akron, Ohio. The captain, first officer, and seven passengers died; no one on the ground was injured. The airplane was destroyed by impact forces and postcrash fire. Safety issues discussed in this report relate to a lack of a requirement for flight data monitoring programs for 14 *Code of Federal Regulations* (*CFR*) Part 135 operators, a lack of a requirement for safety management system programs for 14 CFR Part 135 operators, a lack of a nonprecision approach procedure for Hawker 700- and 800-series airplanes that meets stabilized approach criteria and defines "landing assured," a lack of a requirement for flight crew training on the continuous descent final approach technique, inaccuracy of data entered into weight-and-balance software, inadequate Federal Aviation Administration (FAA) surveillance of Part 135 operators, and inadequate cockpit voice recorder maintenance procedures. Safety recommendations are addressed to the FAA, Textron Aviation, and Hawker 700- and 800-series training centers.

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Abbreviations

AC	advisory circular
agl	above ground level
AIRMET	airmen's meteorological information
AKR	Akron Fulton International Airport
AOA	angle of attack
APU	auxiliary power unit
ARTCC	air route traffic control center
ASAP	aviation safety action program
ASOS	automated surface observing system
ATC	air traffic control
CAK	Akron-Canton Regional Airport
CDFA	continuous descent final approach
CFIT	controlled flight into terrain
CFR	*Code of Federal Regulations*
CRM	crew resource management
CVR	cockpit voice recorder
DH	decision height
DME	distance measuring equipment
EST	eastern standard time
FAA	Federal Aviation Administration
FAF	final approach fix
FAR	Federal Aviation Regulations
FD	flight director

FDM	flight data monitoring
FDR	flight data recorder
fpm	feet per minute
FXE	Fort Lauderdale Executive Airport
GOM	general operations manual
GS	glideslope
HEMS	helicopter emergency medical service
Hg	mercury
ICAO	International Civil Aviation Organization
IFR	instrument flight rules
ILS	instrument landing system
IMC	instrument meteorological conditions
LOSA	line and air operational safety audit
LUK	Cincinnati Municipal Airport-Lunken Field
MDA	minimum descent altitude
MGY	Dayton-Wright Brothers Airport
mi	mile
min	minutes
msl	mean sea level
nm	nautical miles
NTSB	National Transportation Safety Board
NWS	National Weather Service
PAI	principal avionics inspector
PAPI	precision approach path indicator
PED	portable electronic device

PF	pilot flying
PIC	pilot-in-command
PM	pilot monitoring
PNF	pilot not flying
POI	principal operations inspector
PRIA	Pilot Records Improvement Act
RNAV	area navigation
SAFO	Safety Alert for Operators
SAS	Safety Assurance System
SIC	second-in-command
SMS	safety management system
SNPRM	supplemental notice of proposed rulemaking
SOP	standard operating procedure
SPI	Surveillance Priority Index
TAF	terminal aerodrome forecast
TDZE	touchdown zone elevation
USC	*United States Code*
VGSI	visual glide slope indication

Executive Summary

On November 10, 2015, about 1453 eastern standard time, Execuflight flight 1526, a British Aerospace HS 125-700A (Hawker 700A), N237WR, departed controlled flight while on a nonprecision localizer approach to runway 25 at Akron Fulton International Airport (AKR) and impacted a four-unit apartment building in Akron, Ohio. The captain, first officer, and seven passengers died; no one on the ground was injured. The airplane was destroyed by impact forces and postcrash fire. The airplane was registered to Rais Group International NC LLC and operated by Execuflight under the provisions of 14 *Code of Federal Regulations* (*CFR*) Part 135 as an on-demand charter flight. Instrument meteorological conditions prevailed, and an instrument flight rules flight plan was filed. The flight departed from Dayton-Wright Brothers Airport, Dayton, Ohio, about 1413 and was destined for AKR.

Contrary to Execuflight's informal practice of the captain acting as pilot flying on flights carrying revenue passengers, the first officer was the pilot flying, and the captain was the pilot monitoring. While en route, the flight crew began preparing for the approach into AKR. Although company standard operating procedures (SOPs) specified that the pilot flying was to brief the approach, the captain agreed to the first officer's request that the captain brief the approach. The ensuing approach briefing was unstructured, inconsistent, and incomplete, and the approach checklist was not completed. As a result, the captain and first officer did not have a shared understanding of how the approach was to be conducted.

As the airplane neared AKR, the approach controller instructed the flight to reduce speed because it was following a slower airplane on the approach. To reduce speed, the first officer began configuring the airplane for landing, lowering the landing gear and likely extending the flaps to 25° (the airplane was not equipped with a flight data recorder, nor was it required to be). When the flight was about 4 nautical miles from the final approach fix (FAF), the approach controller cleared the flight for the localizer 25 approach and instructed the flight to maintain 3,000 ft mean sea level (msl) until established on the localizer. The airplane was already established on the localizer when the approach clearance was issued and could have descended to the FAF minimum crossing altitude of 2,300 ft msl. However, the first officer did not initiate a descent, the captain failed to notice, and the airplane remained level at 3,000 ft msl.

As the first officer continued to slow the airplane from about 150 to 125 knots, the captain made several comments about the decaying speed, which was well below the proper approach speed with 25° flaps of 144 knots. The first officer's speed reduction placed the airplane in danger of an aerodynamic stall if the speed continued to decay, but the first officer apparently did not realize it. The first officer's lack of awareness and his difficulty flying the airplane to standards should have prompted the captain to take control of the airplane or call for a missed approach, but he did not do so.

Before the airplane reached the FAF, the first officer requested 45° flaps and reduced power, and the airplane began to descend. The first officer's use of flaps 45° was contrary to Execuflight's Hawker 700A nonprecision approach profile, which required the airplane to be flown at flaps 25° until after descending to the minimum descent altitude (MDA) and landing was assured; however, the captain did not question the first officer's decision to conduct the approach

with flaps 45°. The airplane crossed the FAF at an altitude of about 2,700 ft msl, which was 400 ft higher than the published minimum crossing altitude of 2,300 ft msl. Because the airplane was high on the approach, it was out of position to use a normal descent rate of 1,000 feet per minute (fpm) to the MDA. The airplane's rate of descent quickly increased to 2,000 fpm, likely due to the first officer attempting to salvage the approach by increasing the rate of descent, exacerbated by the increased drag resulting from the improper flaps 45° configuration.

The captain instructed the first officer not to descend so rapidly but did not attempt to take control of the airplane even though he was responsible for safety of the flight. As the airplane continued to descend on the approach, the captain did not make the required callouts regarding approaching and reaching the MDA, and the first officer did not arrest the descent at the MDA. When the airplane reached the MDA, which was about 500 ft above the touchdown zone elevation, the point at which Execuflight's procedures dictated that the approach must be stabilized, the airspeed was 11 knots below the minimum required airspeed of 124 knots, and the airplane was improperly configured with 45° flaps. The captain should have determined that the approach was unstabilized and initiated a missed approach, but he did not do so.

About 14 seconds after the airplane descended below the MDA, the captain instructed the first officer to level off. As a result of the increased drag due to the improper flaps 45° configuration and the low airspeed, the airplane entered a stalled condition when the first officer attempted to arrest the descent. About 7 seconds after the captain's instruction to level off, the cockpit voice recorder (CVR) recorded the first sounds of impact.

The National Transportation Safety Board (NTSB) identified the following safety issues as a result of this accident investigation:

- **Lack of a requirement for flight data monitoring programs for 14 *CFR* Part 135 operators.** Execuflight had no means to monitor the daily operation of its airplanes, identify operational deficiencies (such as noncompliance with SOPs), and correct those deficiencies before an accident occurred. In addition to this accident, the NTSB has investigated many other Part 135 accidents in which operators lacked the means to monitor routine flight operations. Absent continual surveillance of an operation through en route inspections by company check airmen, the only means an operator can use to consistently and proactively monitor its line operations is through comprehensive data collection over the entirety of its operation, which can be accomplished through flight data monitoring.
- **Lack of a requirement for safety management system (SMS) programs for 14 *CFR* Part 135 operators.** Execuflight lacked an SMS, which has been recognized in the industry as an effective way to establish and reinforce a positive safety culture and identify deviations from SOPs so that they can be corrected. This accident is one of many Part 135 accidents and incidents in which the NTSB has determined that inadequate operational safety oversight played a role. These accidents may have been prevented if an SMS had been in place.
- **Lack of a Hawker 700- and 800-series nonprecision approach procedure that meets stabilized approach criteria and defines "landing assured."** The step-down

technique for executing nonprecision approaches taught to the flight crew required leveling off at the MDA and a flap configuration change at the point of "landing assured." Since many nonprecision approaches, such as the AKR localizer 25 approach, have MDAs about 400 to 500 ft above ground level (agl), the step-down technique entails a configuration change below 1,000 ft agl. Configuration changes below 1,000 ft agl are contrary to one of the criteria for a stabilized approach provided in Federal Aviation Administration (FAA) Advisory Circular (AC) 120-71A, "Standard Operating Procedures for Flight Deck Crewmembers." Additionally, there is no definition of "landing assured," and Hawker simulator instructors provided varying definitions, some of which appeared to conflict with the federal regulation regarding descending below the MDA.

- **Lack of a requirement for flight crew training on the continuous descent final approach technique.** FAA AC 120-108, "Continuous Descent Final Approach [CDFA]," describes and recommends the use of the CDFA technique in lieu of the step-down type of nonprecision approach that Execuflight pilots were trained to conduct, which can lead to unstabilized approaches because of multiple thrust, pitch, and altitude adjustments inside the FAF. While the FAA has indicated that it favors the use of CDFA, the technique is only in guidance material (AC 120-108), and operators are not required to incorporate the information into their manuals. Execuflight training guidance did not specify the use of CDFA on nonprecision approaches. Although several CAE Simuflite instructors indicated that they may teach CDFA as a technique, there was no formal instruction on CDFA, and no formal instruction on using the CDFA technique was provided to Execuflight pilots before the accident.

- **Inaccuracy of data entered into weight-and-balance software.** At the time of the accident, Execuflight pilots primarily computed their airplanes' weight and balance with a software program, which required that the airplanes' basic operating weight first be entered as a default weight. Because an incorrect basic operating weight was entered into the program, the accident flight crew underestimated the airplane's takeoff weight. Although the incorrect information did not adversely affect the airplane's performance, this error highlights the importance of ensuring that software program data are current and accurate.

- **Inadequate FAA surveillance of 14 *CFR* Part 135 operators.** The FAA principal operations inspector assigned to Execuflight relied primarily on Part 135 pilot-in-command line checks flown locally to conduct his operational oversight. However, line checks flown locally do not constitute the same evaluation of the operator within the total operational environment of the air transportation system as en route inspections during normal line operations. The FAA considers en route inspections its most effective method of accomplishing its air transportation surveillance objectives and responsibilities but does not require inspectors of Part 135 operators to accomplish this critical surveillance activity.

- **Inadequate CVR maintenance procedures.** The 30-minute tape recovered from the airplane's CVR was not damaged; however, the quality of all recorded channels was poor, due in large part to electrical interference, likely from the aircraft's alternating current generator. Had an adequate functional test of the CVR been performed with the engines running or by downloading and reviewing CVR content from an actual flight, the CVR quality issue may have been detected and corrected.

The NTSB determines that the probable cause of this accident was the flight crew's mismanagement of the approach and multiple deviations from company standard operating procedures, which placed the airplane in an unsafe situation and led to an unstabilized approach, a descent below minimum descent altitude without visual contact with the runway environment, and an aerodynamic stall. Contributing to the accident were Execuflight's casual attitude toward compliance with standards; its inadequate hiring, training, and operational oversight of the flight crew; the company's lack of a formal safety program; and the Federal Aviation Administration's insufficient oversight of the company's training program and flight operations.

As a result of this investigation, the NTSB makes safety recommendations to the FAA, Textron Aviation, and Hawker 700- and 800-series training centers.

1. Factual Information

1.1 History of the Flight

On November 10, 2015, about 1453 eastern standard time (EST), Execuflight flight 1526, a British Aerospace HS 125-700A (Hawker 700A), N237WR, departed controlled flight while on a nonprecision localizer approach to runway 25 at Akron Fulton International Airport (AKR) and impacted a four-unit apartment building in Akron, Ohio.[1] The captain, first officer, and seven passengers died; no one on the ground was injured. The airplane was destroyed by impact forces and postcrash fire. The airplane was registered to Rais Group International NC LLC and operated by Execuflight under the provisions of 14 *Code of Federal Regulations* (*CFR*) Part 135 as an on-demand charter flight. Instrument meteorological conditions (IMC) prevailed, and an instrument flight rules (IFR) flight plan was filed. The flight departed from Dayton-Wright Brothers Airport (MGY), Dayton, Ohio, about 1413 and was destined for AKR.

The accident flight was the crewmembers' second flight of the day and occurred on the second day of a planned 2-day, 7-leg trip with the same crew and passengers on board for each leg. The trip began on November 9, 2015, about 0650 from the company's base of operations at Fort Lauderdale Executive Airport (FXE), Fort Lauderdale, Florida. After stops in St. Paul, Minnesota; Moline, Illinois; and St. Louis, Missouri, the first day of the trip ended about 1955 at Cincinnati Municipal Airport-Lunken Field (LUK), Cincinnati, Ohio. The second day of the trip was planned for flights from LUK to MGY, then to AKR, and finally a return to FXE.

On the day of the accident, the first flight of the day departed LUK about 1103 and arrived at MGY about 1133. While at MGY, the captain filed an IFR flight plan for flight 1526 to AKR, planning a 34-minute flight at a cruise altitude of 17,000 ft above mean sea level (msl), with a cruise speed of 382 knots and a departure time of 1330. According to the fueling service at MGY, the pilots requested that both wing tanks be filled to their capacity, and the airplane was fueled with 410 gallons (2,788 lbs) of Jet A fuel about 1145.

About 1349, the captain sent a "doors closed" text message from his cell phone to company management, and one of the pilots then contacted flight service to obtain their IFR clearance to AKR. Air traffic control (ATC) issued the flight an IFR clearance to AKR with a hold for release awaiting another inbound IFR aircraft into MGY. About 1409, the flight was given its release, and about 1413, the flight departed runway 20 at MGY.

About 1416, the flight contacted the Indianapolis Air Route Traffic Control Center (ARTCC), and the controller cleared the flight to climb to 17,000 ft msl and, 2 minutes later, cleared it to AKR via direct to the HUUVR intersection and then direct to the airport.[2] A review

[1] Unless otherwise noted, all times in this report are EST based on a 24-hour clock.

[2] The HUUVR intersection is a waypoint used for IFR navigation.

of cockpit voice recorder (CVR) audio, which began at 1420:52, indicated that the first officer was acting as the pilot flying (PF) and the captain was acting as the pilot monitoring (PM).[3]

About 1426, the flight crew began preparing for the approach into AKR by attempting to obtain the weather at AKR via the automated surface observing system (ASOS) broadcast. They did not correctly tune the radio and received the 1426 automated weather observation for Fairfield County Airport, Lancaster, Ohio, located about 108 miles (mi) southwest of AKR, which indicated a visibility of 10 mi, a broken ceiling of 1,100 ft above ground level (agl), and an overcast cloud layer at 1,800 ft agl.[4] At 1427:27.8, the first officer said, "I'll let you brief it to me," and the flight crew then began discussing the localizer 25 approach at AKR (see figure 1, which shows a copy of the approach chart used by the flight crew).

At 1429:30.2, the controller cleared the flight to cross the HUUVR intersection at 9,000 ft msl, and at 1432:17.6, the flight was issued a frequency change from Indianapolis ARTCC to Cleveland ARTCC. After checking in with Cleveland ARTCC, the flight crew returned to their discussion of the localizer 25 approach, which was interrupted at 1433:16.5 when a passenger came forward from the cabin and spoke to the crew. About this time, the airplane was descending through 13,500 ft msl, and the first officer told the passenger that he could stay a couple of minutes but then had to leave because "we cannot be distracted." At 1433:38.8, the first officer said, "okay. so we go down twenty three. then down to (what's the minimums?)," and the captain responded, "four seventy three."[5] The localizer approach to runway 25 had a final approach fix (FAF) minimum crossing altitude of 2,300 ft msl, a minimum descent altitude (MDA) of 1,540 ft msl, and the height of the MDA above the runway 25 touchdown zone elevation (TDZE) was 473 ft.

The flight crew then discussed the missed approach procedure, followed by a discussion of the overcast height above the ground. At 1436:26.9, the first officer said, "the minima for this approach [is] fifteen twenty," and at 1436:36.2, he said, "which is ground. where is the ground. five oh one right?" The approach chart for the AKR area navigation (RNAV) GPS approach to runway 25 listed 1,520 ft msl as the MDA for one version of the approach and 501 ft agl as the height above the ground of the MDA for another version of the approach.[6] At 1436:40, radar data recorded the flight descending through 10,000 ft msl with an estimated airspeed of about 298 knots.[7]

The flight crew continued to discuss the overcast height above the ground. At 1437:09.7, the first officer stated, "yeah I understand. but we can shoot it. we can shoot because the overcast

[3] The airplane was equipped with a CVR but was not equipped with a flight data recorder (FDR).

[4] At 1425, the AKR ASOS was reporting a visibility of 1 3/4 mi in mist and an overcast ceiling of 700 ft agl. The AKR ASOS broadcast on a frequency of 126.825, and the Fairfield County Airport ASOS broadcast on a frequency of 118.375, which was the same frequency as the MGY ASOS.

[5] The use of parentheses around a word or phrase in a CVR transcript indicates a questionable insertion.

[6] The MDA for the localizer performance version of the AKR RNAV GPS 25 approach was 1,520 ft msl, and the height of the MDA above the TDZE for the lateral navigation version of the approach was 501 ft.

[7] Title 14 *CFR* 91.117 restricts operation of an aircraft below 10,000 feet msl to 250 knots indicated airspeed. The airplane's airspeed was estimated from the radar-recorded ground speed and the reported winds aloft.

* reporting * eight hundred."[8] At 1437:32.7, he stated, "the cloud base is from the ground. from the ground do we get minimums for us."

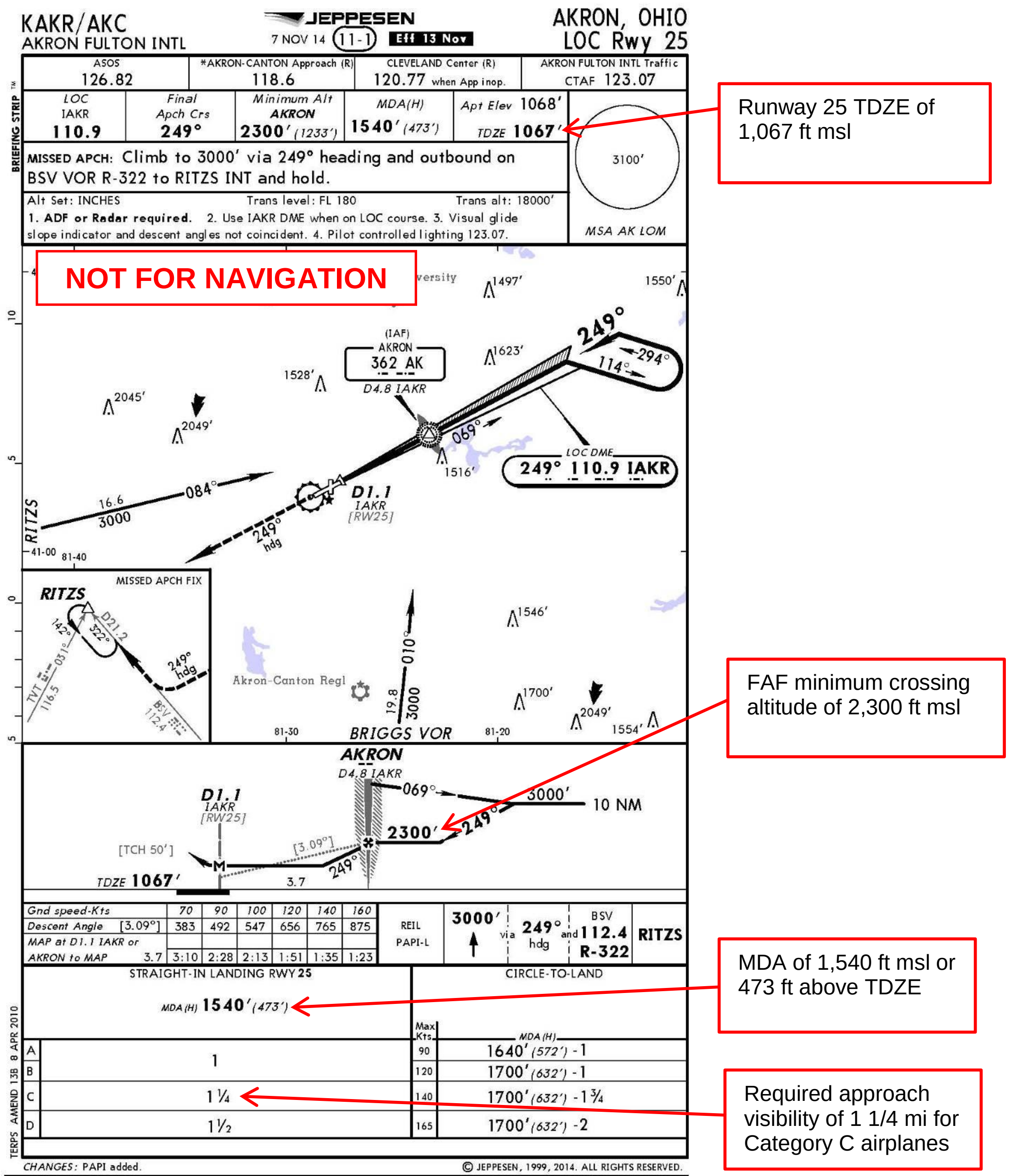

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Figure 1. Instrument approach chart for the localizer approach to runway 25 at Akron Fulton International Airport at the time of the accident.

[8] The use of the * symbol in a CVR transcript indicates an unintelligible word or syllable.

At 1437:39.2, the CVR recorded the 1438 automated weather at AKR, which was reporting an overcast ceiling of 600 ft agl, a visibility of 1 1/2 mi in mist, and wind from 240° at 8 knots. At 1437:44.6, the Cleveland ARTCC controller instructed the flight to change frequencies to Akron approach. The first officer checked in with Akron approach and reported that the flight was level at 9,000 ft msl over HUUVR. The approach controller gave the flight a 65° heading, told the pilots to expect the localizer 25 approach at AKR, and asked the pilots to advise when they had the weather at AKR. The first officer replied, "we are in the process of copying the weather." The controller then cleared the flight to descend at the pilots' discretion to 5,000 ft msl.

At 1439:22.4, the captain repeated the current AKR weather conditions, stating, "one and half mile visibility. overcast at six hundred." The captain and first officer then discussed the visibility, and, at 1439:40.7, the captain commented, "alright we are visibility we got it."[9] At 1440:25.0, the captain said, "did you do my approach (brief). *** (we gotta go somewhere else right). ***," and at 1440:34.2, the captain continued saying, "* if you say that. I might be wrong. I'm not sure." The first officer's response was unintelligible.

At 1441:08.8, the first officer said, "***. the minima is five hundred and ten. ***minima," followed by the captain questioning "localizer?" At 1441:19.4, the captain said, "four eighty. four eighty." At 1441:24.9, the first officer said, "four seventy three," which was the height above the TDZE of the MDA for the localizer 25 approach.

At 1443:59.8, the approach controller instructed the flight to reduce speed to 200 knots and descend to 4,000 ft msl. About 2 minutes later, at 1446:05.5, the approach controller notified the flight that they were following a slower airplane on the approach and issued a further speed reduction to 170 knots and a descent to 3,000 ft msl.[10] At 1447:09.1, the approach controller gave the flight a 280° heading and instructions to join the localizer course for runway 25. At 1447:40, the airplane reached an altitude of about 3,000 ft msl and leveled off. At 1447:47.4, the first officer said, "…I will…try to. drag every (thing)," indicating he planned to begin configuring the airplane for landing by extending the flaps and landing gear.

At 1448:14.3, the captain said, with emphasis, "oh we got. we got. we got nine degrees pitch up. *," indicating that he noticed the first officer flying with a high pitch attitude. At 1448:21.6, the CVR recorded increased noise consistent with a power increase, and at 1448:27.0, the CVR recorded the sound of a thump followed by increased noise similar to landing gear extension.[11] At 1448:33.9, the captain said, with emphasis, "did you hear what he say? there is an airplane on the approach. (he is) slower than us. he hasn't cancelled. we don't know if he's on the ground." At 1448:44.6, the captain again commented on the pitch attitude, saying, "you need to (look). you need to. I mean we were-were flying like (one thirty nine). nine degrees pitch up." The

[9] Based on the estimated landing weight and interviews with Execuflight pilots and CAE Simuflite Hawker 700A instructors, the airplane's approach category was C, and the required visibility minimum for the AKR localizer 25 approach was 1 1/4 mi. See section 2.2.1 for more information about the context of the flight crew's conversation.

[10] The slower airplane was a single-engine airplane flown by an instrument student and flight instructor who were conducting a training flight.

[11] After this point and until the end of the CVR recording, the increased noise from the gear obscured portions of the recording, most notably, ATC communications. The ATC recording that the Federal Aviation Administration (FAA) provided was used to verify radio communications.

National Transportation Safety Board's (NTSB) radar performance study determined that, between 1448:30 and 1449:30, the pitch of the airplane increased from about 5° to 12° nose up, and the airspeed slowed from about 150 to 125 knots.[12]

At 1449:22.9, when the flight was about 4 nautical miles (nm) from the FAF for the localizer 25 approach at AKR, the approach controller advised that the pilots of the slower airplane ahead had cancelled their IFR flight plan and cleared the Execuflight airplane for the localizer approach. The captain acknowledged the clearance and advised that they were established on the localizer. Once established on the localizer approach, the flight was no longer required to remain at the previous ATC-assigned altitude of 3,000 ft msl and could descend to the FAF minimum crossing altitude of 2,300 ft msl. Radar data indicated that the airplane remained level at 3,000 ft msl for about 2 minutes before it began to descend (see figure 2, which shows the airplane's descent path).

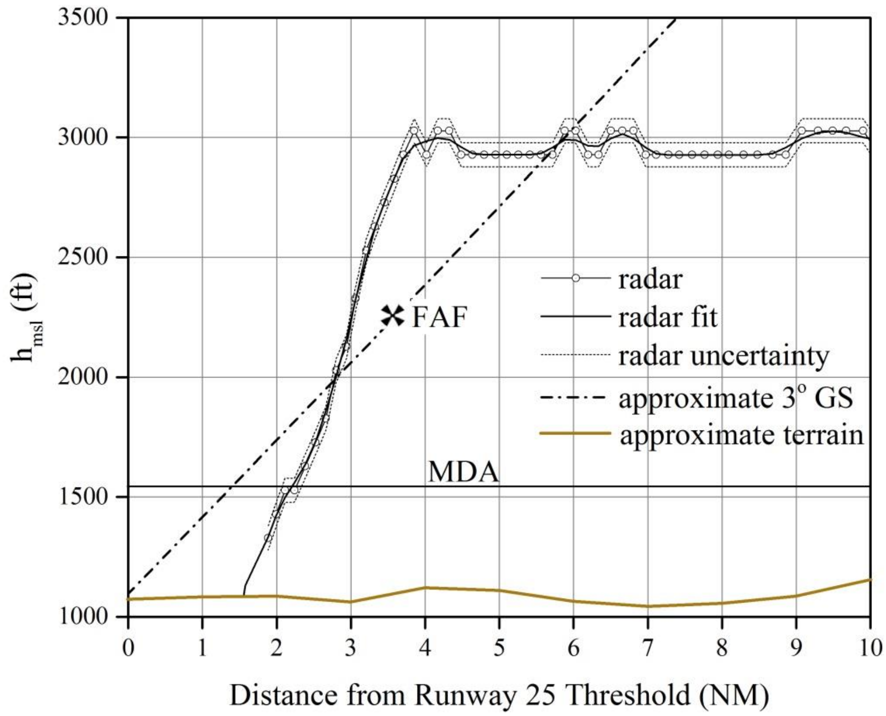


Figure 2. Profile view of the airplane's approach to runway 25 at Akron Fulton International Airport based on radar data.

Note: The 3° glideslope [GS] depicted is for reference only; the localizer approach to runway 25 does not include vertical guidance.

[12] The study estimated the airplane's pitch attitude from airplane angle of attack (AOA), which was derived from lift coefficient data provided by the airplane manufacturer, and flightpath angle, which was derived from radar data. Airspeed was estimated from the radar data using wind information from an aircraft meteorological data relay sounding from an aircraft that departed Cleveland-Hopkins International Airport, Cleveland, Ohio, at 1443. The study assumes steady, coordinated flight. See section 1.10.1 for more information about the study.

At 1449.41.3, the captain said, "look you're going one twenty. you can't keep decreasing your speed**." The first officer responded, "no. one tw--. how do you get one twenty?" At 1449:56.1, the captain said, "that's what I'm saying. if you keep decreasing your speed--," and the first officer interrupted, "but why?" to which the captain replied, "*because we gonna stall. I don't want to sta--."

At 1450:21.6, the approach controller instructed the flight to change to the local advisory frequency, and, at 1450:39.8, the captain made a position report on the local advisory frequency. At 1450:53.9, one of the pilots of the preceding slower airplane that had just landed at AKR said, "hey guys. ah we just landed on the loc. and uh broke out right at minimums (right at a) mile," and the captain responded, "appreciate it."

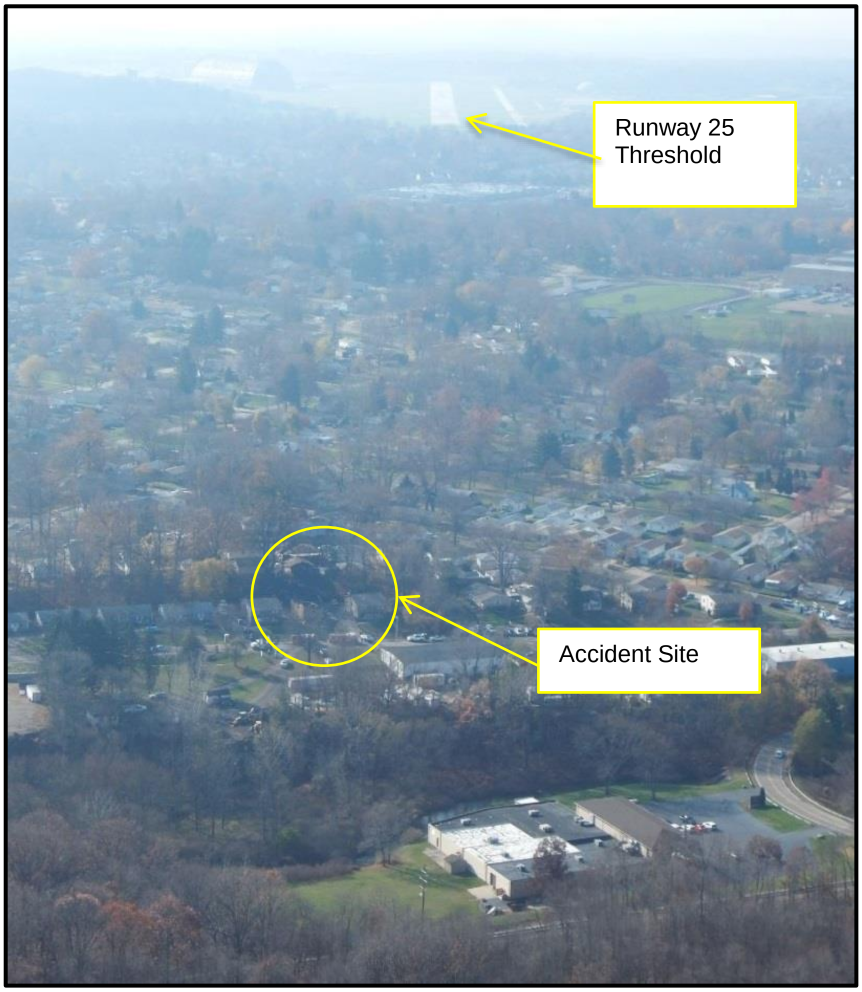
At 1451:00.9, the first officer requested "full flaps" (45° flaps). The captain began to recite the Landing checklist at 1451:06.7, stating, "gear down. before landing. three lights. one. and." At 1451:08, the airplane's airspeed, which had stabilized about 130 knots, began to decrease. At 1451:13.6, the first officer reduced the power, and the airplane, which had been level about 3,000 ft msl, began to descend. At 1451:31.3, the first officer said, "alright we go to minimums," indicating that the airplane was crossing the FAF and could now descend to the MDA.

Radar data indicated that the airplane reached the FAF at 1451:33, at an airspeed of about 109 knots and an altitude of about 2,700 ft msl, which was about 400 ft above the FAF minimum crossing altitude of 2,300 ft specified in the approach procedure. The airplane's rate of descent increased rapidly, and, at 1451:43, when the airplane reached an altitude of about 2,300 ft, the descent rate was about 2,000 feet per minute (fpm), and the airspeed was about 118 knots.

At 1451:56.6, the captain said, with emphasis, "on localizer. you're diving. you're diving. don't dive. two thousand feet per minute buddy." The first officer interjected, "yeah," and the captain continued at 1452:02.5 by saying, "two thousand feet per minu-- don't go two thousand feet per minute." At 1452:07.3, the captain again said, "don't go two thousand feet per minute" and, at 1452:10.2, "when you are fifteen hundred feet above the ground. or minimums."

Radar data indicated that the airplane reached the MDA about 1452:13 and continued to descend; when it reached the MDA, the airplane's airspeed was about 113 knots, and its rate of descent had decreased to about 830 fpm. At 1452:17.0, the captain stated, "ground," and, at 1452:20.5, he stated, "keep going." At 1452:27.3, the captain said, "okay level off guy," and, at 1452:27.4, the CVR recorded a rattling sound consistent with the activation of the stick shaker. At 1452:30.1, the CVR again recorded sound consistent with the stick shaker, and at 1452:32.8, the airplane's ground proximity warning system announced, "pull up." At 1452:34.7, the CVR recorded the first sounds of impact.

A motion-activated security camera located about 900 ft to the southeast of the accident site captured the airplane as it came in over the surrounding trees in a left-wing-down attitude about 1.8 nm from the approach end of runway 25 at AKR. An explosion and postcrash fire were observed on the video just after the airplane flew out of the security camera's view. Multiple witnesses observed the airplane descend in a left banked turn, impact an apartment building, and burst into flames. Figure 3 is an aerial view of the location of the accident site.



Source: Ohio State Highway Patrol.

Figure 3. Aerial photograph showing the location of the accident site relative to the runway 25 threshold.

The apartment building that the airplane struck and two cars parked behind the building were destroyed as a result of the airplane's impact and the postcrash fire. The apartment buildings on either side of the destroyed building sustained damage due to debris impact, and the detached garages of two houses behind the destroyed building were damaged by the postcrash fire.

1.2 Flight Crew Information

The flight crew consisted of a captain acting as pilot-in-command (PIC) and a first officer acting as second-in-command (SIC). The captain occupied the left pilot seat, and the first officer occupied the right seat. Both pilots were hired by Execuflight in June 2015.[13] Execuflight records showed that they had flown together on three occasions within the 90 days before the accident for

[13] See section 1.2.3 for information about the hiring of the pilots.

a total of about 32.5 flight hours. Neither pilot had previously flown into AKR while employed at Execuflight.

Both pilots were foreign nationals (the captain was from Colombia, and the first officer was from Italy), and each held an English proficiency declaration on his FAA pilot certificate. According to the CAE Simuflite instructors who provided the pilots with their most recent simulator training, neither pilot exhibited difficulties communicating in English. Further, according to Execuflight personnel and the FAA principal operations inspector (POI) for Execuflight (who administered the oral portion of each pilot's initial Part 135 Hawker 700A competency check at Execuflight), neither pilot had difficulty understanding or communicating in English.

1.2.1 Captain

The captain, age 40, held an FAA airline transport pilot certificate with a multiengine airplane rating and a type rating for the HS-125.[14] He had commercial privileges in single-engine airplanes. In addition, he held air transport and commercial pilot certificates issued by the Civil Aviation Authority of Colombia. The captain's most recent FAA first-class medical certificate was dated June 23, 2015, with no restrictions or limitations.

The captain was current and qualified under Execuflight and FAA requirements. A review of his FAA records found no prior accidents or incidents. The captain was the subject of an enforcement action for operating an aircraft contrary to an ATC instruction in violation of 14 *CFR* 91.123(b) on June 21, 2014.[15] The FAA issued a letter of correction with a recommendation for remedial training; the captain completed the remedial training, and the FAA closed the enforcement action on December 24, 2014.

The captain was hired by Execuflight on June 4, 2015, as a Hawker captain. Before joining Execuflight, the captain was employed as a Hawker 800A captain by Heralpin USA, Inc., a Part 91 operator, from May 1, 2014, until April 30, 2015, when his employment was terminated.[16] According to his resume, he was a pilot for Helicol-Avianca from April 2011 until April 2014 in Bogota, Colombia, and a first officer with Avianca Cargo from January 2010 until April 2011 in Rionegro, Colombia.

A review of Execuflight and FAA records indicated that the captain had about 6,170 hours total flight time, of which 3,414 hours were as PIC. He had about 1,020 hours of HS-125 flight time, of which about 670 hours were as PIC. He had flown about 167 hours since joining Execuflight. In the 90 days, 30 days, and 7 days before the accident, the captain accumulated about 118, 43, and 10 flight hours, respectively.

The captain attended Execuflight's initial new-hire Hawker 700A simulator training at the CAE Simuflite training facility in Dallas, Texas, from May 19, 2015, to June 2, 2015. According

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[14] An HS-125 type rating includes the Hawker 700- and 800-series airplanes.

[15] Title 14 *CFR* 91.123(b) states that "Except in an emergency, no person may operate an aircraft contrary to an ATC instruction in an area in which air traffic control is exercised."

[16] For additional details about the captain's previous employment, see section 1.2.3.1.

to CAE Simuflite records, the captain received 48 hours of ground school training on the Hawker 700A and 8 hours of ground school differences training on the Hawker 800. The captain flew in the simulator with a pilot from another Part 135 operator and received a total of 24.3 hours of Hawker 700A simulator training (12.3 hours as PF and 12.0 hours as PM) during 7 simulator sessions. During the course of his simulator training, he conducted 13 instrument landing system (ILS) approaches, 15 nonprecision approaches, 4 circling approaches, and 3 visual approaches. On June 1, 2015, he completed the flight portion of his Part 135 Hawker 700A competency check and an instrument proficiency check in the simulator.[17]

The captain attended basic indoctrination training at the company from June 22, 2015, to June 25, 2015. The in-house training consisted of 32 hours of ground school that included basic company indoctrination and hazardous material, security, and general emergency training. On June 26, 2015, the captain completed the oral portion of his Part 135 Hawker 700A competency check, which the FAA POI assigned to Execuflight administered, and on August 6, 2015, he completed his Part 135 line check, which Execuflight's chief pilot administered.[18]

1.2.2 First Officer

The first officer, age 50, held an FAA airline transport pilot certificate with a multiengine airplane rating and type ratings for the HS-125, Boeing 737 (circling approaches in visual meteorological conditions only), and Lear Jet (SIC privileges only). He had commercial privileges in single-engine airplanes. The first officer's most recent FAA first-class medical certificate was dated September 3, 2015, with no restrictions or limitations.

The first officer was hired by Execuflight on June 1, 2015, as a Hawker first officer. Before joining Execuflight, the first officer had been unemployed since February 27, 2015. He was previously employed by Sky King, Inc., a supplemental Part 121 operator, as a first officer on the Boeing 737 from September 16, 2014, to February 27, 2015, when his employment was terminated.[19] According to his resume, from 2012 to 2014, he was a first officer for Chauff Air, a Part 91 operator, and, from 2007 to 2011, he was a first officer on the Hawker and Learjet for Personal Jet, Inc.

The first officer was current and qualified under Execuflight and FAA requirements. A review of FAA records found no prior accidents, incidents, or enforcement actions. A review of Execuflight and FAA records indicated that the first officer had about 4,382 hours total flight time, of which 3,200 hours were as PIC. He had about 482 hours of HS-125 flight time, all of which were as SIC. He had flown about 82 hours since joining Execuflight. In the 90 days, 30 days, and

[17] According to 14 *CFR* 135.293, no certificate holder may use a pilot unless, since the beginning of the 12th calendar month before that service, that pilot passes a written or oral knowledge test and a flight competency check. According to 14 *CFR* 135.297, no certificate holder may use a pilot as PIC unless, since the beginning of the 6th calendar month before that service, that pilot has passed an instrument proficiency check.

[18] According to 14 *CFR* 135.299, no certificate holder may use a pilot as PIC unless, since the beginning of the 12th calendar month before that service, the pilot has passed a flight check consisting of at least one flight over one route segment and including takeoffs and landing at one or more representative airports.

[19] For additional details on the first officer's previous employment, see section 1.2.3.2.

7 days before the accident, the first officer accumulated about 78, 38, and 21 flight hours, respectively.

The first officer attended Execuflight's initial new-hire Hawker 700A simulator training at the CAE Simuflite training facility in Dallas, Texas, from June 9, 2015, to June 22, 2015. According to CAE Simuflite records, he received 48 hours of Hawker 700A ground school training. The first officer flew in the simulator with a CAE instructor and received a total of 22.6 hours of simulator training (20.3 hours as PF and 2.3 hours as PM) during 7 simulator sessions. During the course of his simulator training, he conducted 16 ILS approaches, 19 nonprecision approaches, 6 circling approaches, and 2 visual approaches. On June 22, 2015, he completed the flight portion of his Part 135 Hawker 700A competency check and an instrument proficiency check in the simulator.

The first officer attended basic indoctrination training at the company from June 24, 2015, to July 1, 2015. On July 23, 2015, the first officer completed the oral portion of his Part 135 Hawker 700A competency check, which the POI administered.

1.2.3 The Flight Crew's Hiring

The Pilot Records Improvement Act of 1996 as amended (PRIA) was enacted to ensure that air carriers and air operators adequately investigate a pilot's background before allowing that pilot to conduct commercial air carrier flights.[20] Under PRIA, a hiring employer cannot place a pilot into service until that employer obtains and reviews the last 5 years of the pilot's background and other safety-related records as specified in PRIA. For an air carrier that previously employed a pilot, PRIA requires that air carrier to provide to the hiring employer records "pertaining to the individual's performance as a pilot" that concern the pilot's "training, qualifications, proficiency, and professional competence, including any comments or evaluations by check airmen; any disciplinary actions that the previous employer did not overturn; and any release from employment or resignation, termination, or disqualification from employment."[21]

As previously mentioned, Execuflight hired both pilots in June 2015. According to the Execuflight General Operations Manual (GOM), the president was responsible for recruiting and terminating all company personnel and could delegate the responsibility to other persons with management responsibilities. The GOM also stated that the director of operations had specific duties that included conducting personnel interviews and recommending personnel actions to the president. In an interview, Execuflight's president stated that he hired both pilots and delegated the review of PRIA records to the chief pilot. The former director of operations (who was with Execuflight at the time the accident captain and first officer were hired) was asked if he was involved in the hiring of either of the two pilots, and he answered that he was not. According to Execuflight's chief pilot, the hiring was done by the president.

[20] Relevant PRIA requirements are codified at 49 *United States Code* (*USC*) 44703(h), (i), and (j).

[21] For more information, see 49 *USC* § 44703(h)(i)(B)(ii)(I-III).

1.2.3.1 Captain's Pilot Records Improvement Act Background Check

The captain's PRIA documentation that Execuflight provided to the NTSB itemized records that were obtained from his previous employer, Heralpin USA, but the documentation did not include copies of those records.[22] Documentation that the NTSB requested and obtained directly from Heralpin USA showed that the captain was scheduled for recurrent training on the Hawker 800A at CAE Simuflite on April 20, 2015, but did not attend the training. According to Heralpin USA's records, the captain received an employment termination notice on April 30, 2015, which stated the following:

> [Your] employment with Heralpin USA will be officially terminated on April 30, 2015. You have been terminated for the following reasons:
>
> Failure to present [your]self for Hawker 800A Recurrent Training on April 20, 2015 at CAE Simuflite.

According to Execuflight's president, he hired the captain based on his background, including his previous experience in the Hawker and three or four Part 91 flights he made with the captain. When asked about the captain's PRIA background check, the president stated that it showed an "administrative issue" related to a communication course, which was corrected. According to the president, Execuflight did not contact Heralpin USA to obtain additional background information about the captain. The president stated that the captain's separation from Heralpin USA was voluntary. He further stated that he relied on the PRIA background check, the captain's interview, and recommendations from other pilots when hiring the captain.

1.2.3.2 First Officer's Pilot Records Improvement Act Background Check

The first officer's PRIA documentation that Execuflight provided to the NTSB included detailed records concerning the pilot's performance from his most recent previous employer, Sky King.[23] The documentation included a letter from a Sky King check airman that detailed difficulties experienced by the first officer during 737 ground school and simulator training for Sky King. The letter stated that in ground school, the first officer "started to fall behind" and "struggled" with memory items and weight-and-balance problems, and in the simulator, he continued to struggle with weight-and-balance problems and did not know memory items, callouts, profiles, or flows. The letter further stated that because of the first officer's "lack of acceptable progression," he was given the opportunity to fly as a jumpseat observer for 7 days and obtained over 16 hours of observation experience. However, upon completion of his time as an observer, the first officer's performance remained "significantly below acceptable standards."

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[22] The captain's PRIA documentation indicated that the agent Execuflight contracted to perform the background check attempted to contact the Colombian companies listed on the captain's resume as previous employers but received no responses.

[23] The first officer's PRIA documentation indicated that the agent Execuflight contracted to perform the background check attempted to contact the other companies listed on the first officer's resume as previous employers but received no responses.

On February 27, 2015, his employment with Sky King was terminated due to "unsatisfactory work performance."

Execuflight's president stated that he hired the first officer based on a recommendation from another pilot and a Part 91 flight that he made with the first officer. When asked about the first officer's PRIA background check, the president stated that he was "not too familiar" with the PRIA records because the chief pilot was the one who "does all the due diligence in that respect." He further stated that he did not "really home in on" the first officer as he was hiring him as an SIC and "didn't get in deep into his file."

According to the chief pilot, he was aware that the first officer was "terminated involuntarily" from Sky King. According to the Sky King check airman who wrote the letter detailing the first officer's training difficulties, the first officer's performance in the simulator was "ridiculously weak," and no one from Execuflight contacted him for additional background information on the first officer.

1.2.4 The Flight Crew's Preaccident Activities

According to Execuflight flight logs, the captain was off duty on November 6 and 7, 2015. He flew a day trip on November 8, 2015, and was on duty from 0750 to 1305.

According to Execuflight flight logs, the first officer flew a 2-day roundtrip from FXE to Teterboro, New Jersey, on November 6 and 7, 2015, and he was on duty from 0800 to 1300 on November 6. Hotel records showed that the first officer and the captain of the 2-day trip both checked out of their hotel in Teterboro about 1210 on November 7. During sworn testimony, the captain of the 2-day trip stated that he and the first officer took a shuttle from the hotel to the airport, and, upon reaching the airport between about 1400 and 1430, the first officer began work and conducted all preflight preparation for the return leg of the trip.[24] According to a text message sent by the captain of the 2-day trip to the dispatcher, the airplane's door was closed at 1653 for the flight to FXE.

The flight logs indicated that the first officer and the captain of the 2-day trip both came on duty at 1500 on November 7 and flew the return leg, departing Teterboro at 1720 and arriving at FXE at 2006. The first officer then immediately began an overnight trip to Mexico with Execuflight's chief pilot, departing FXE at 2040. The first officer's last Part 135 flight for the November 7 to 8 duty period ended at 0715 on November 8. The flight logs showed that upon completion of this flight, the first officer had 7 hours 45 minutes (min) of consecutive rest in the preceding 24 hours. In an e-mail sent to NTSB investigators on August 3, 2016, Execuflight's president wrote that the first officer did not come on duty at 1500 on November 7 as the flight logs indicated, rather he came on duty at 1715, and, therefore, the first officer had 10 hours of consecutive rest in the preceding 24 hours when his last Part 135 flight ended on November 8.

Regarding the first officer's November 7 and 8 overnight trip, the captain of the 2-day trip stated that he and the first officer were asked to fly the overnight trip, but he told the dispatcher

[24] During the course of the investigation, this captain and the company president provided conflicting information. The NTSB subsequently deposed each of them to obtain sworn testimony concerning the conflicting accounts.

who made the request that they could not fly the trip as it would cause both of them to exceed duty time. The captain of the 2-day trip further stated that the first officer was not aware he was scheduled for the overnight trip to Mexico until they landed at FXE, where the chief pilot met them and informed the first officer that he would be flying the overnight trip. According to sworn testimony by the captain of the 2-day trip, the first officer told him on the evening of November 8 that he was tired from the overnight trip and had expected to stay overnight in Mexico, but “they ended up flying all night and coming back.”

Title 14 *CFR* 135.267(d) and Execuflight’s GOM state that a flight crewmember assignment “must provide for at least 10 consecutive hours of rest during the 24-hour period that precedes the planned completion time of the assignment.” According to the GOM, before a flight departed, the operations management person on duty was required to “review the flight and duty time status of each crewmember selected to accomplish the flight, and ascertain that the crewmember can complete the flight assignment pursuant to the requirements of FAR [Federal Aviation Regulation] 135.263 and 135.267.” During sworn testimony, Execuflight’s president stated that he was the operations management person on duty for the first officer’s November 7 and 8 overnight trip. Execuflight’s president further stated that he called the first officer on the night of November 6 and instructed him not to go to the airport on November 7 until shortly before the flight from Teterboro to FXE. When asked if anyone checked with the first officer to find out what time he left Teterboro in order to calculate whether the first officer could complete the overnight trip within the limitations of Title 14 *CFR* 135.267(d), Execuflight’s president stated that the chief pilot and the first officer “discussed their duty time” and “whether it would [be] okay or not okay” for the first officer to make the trip. According to Execuflight’s president, “they always had the option of, if they were to be breaking duty time, to stay in Mexico.”

According to Execuflight flight logs recovered from the airplane, on November 9, 2015, the accident pilots were on duty from 0550 to 2030, a total of 14 hours 40 min. The pilots’ maximum sleep opportunities on the 4 days before the accident as determined by reviewing portable electronic device (PED) records and Execuflight flight logs for both pilots are shown in the following table.[25] All the sleep opportunities began during the evening after 1900 with the exception of the first officer’s maximum sleep opportunity for the November 7 to 8 period, which took place during the day on November 8 between 0917 and 1704 and was interrupted by an outgoing text message at 1253.

Table. The accident flight crew’s maximum sleep opportunities.

Time Period	Captain’s Maximum Sleep Opportunity	First Officer’s Maximum Sleep Opportunity
Nov 6 at 1900 to Nov 7 at 1859	0129 to 0718 5 hours 49 min	1957 to 1012 14 hours 15 min
Nov 7 at 1900 to Nov 8 at 1859	0125 to 0735 6 hours 10 min	0917 to 1704 7 hours 47 min
Nov 8 at 1900 to Nov 9 at 1859	0029 to 0520 4 hours 51 min	1915 to 0550 10 hours 35 min
Nov 9 at 1900 to Nov 10 at 1453	2317 to 0905 9 hours 48 min	2046 to 0903 12 hours 17 min

[25] A questionnaire was provided to the next of kin to gather information about each pilot’s normal sleep habits and preaccident activities; however, no responses were received.

1.3 Aircraft Information

The accident airplane was a British Aerospace HS 125-700A, registration number N237WR, serial number 257072, manufactured on August 16, 1979. The HS 125-700A type certificate is now owned by Textron Aviation, Inc.[26]

The airplane was powered by two Honeywell TFE-731-3 engines. At the time of the accident, the airplane had accumulated about 14,948 total hours and 11,075 cycles.[27] Postaccident examination of the airplane and engines did not reveal any preaccident anomalies that would have precluded normal operation.

1.3.1 Weight-and-Balance and Performance Information

1.3.1.1 Weight-and-Balance Records

According to weight-and-balance records for the airplane, at the time of its most recent weighing on May 30, 2014, the airplane's basic empty weight was 13,815 lbs, and its basic operating weight (which includes the weight of the required crew, their baggage, and other standard items such as meals and potable water) was documented as 14,276.92 lbs. An amended weight-and-balance record dated December 22, 2014, was recovered from the airplane; the amendment reduced the airplane's weight by 300 lbs due to the removal of the auxiliary power unit (APU), resulting in a basic operating weight of 13,976.92 lbs.

There was no entry in the airplane's maintenance records corresponding to the removal of the APU on December 22, 2014. A maintenance record dated February 9, 2015, indicated that an unserviceable APU was removed and replaced with a serviceable APU, and an APU was located in the wreckage at the accident site. However, no amended weight-and-balance record corresponding to the reinstallation of the APU was found.

1.3.1.2 Execuflight's Calculation of Weight and Balance

Execuflight's pilots primarily used a computer program called Ultra-Nav Aviation Aircraft Performance Software to perform weight-and-balance computations and derive performance information for a flight.[28] Before each flight, the PIC was to input the weights of the passengers, baggage, and fuel, and the program would calculate weight-and-balance and performance information. A review of the Ultra-Nav weight-and-balance printouts that Execuflight provided for the accident flight and each of the previous flights on the 2-day trip showed that the

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[26] Beechcraft Corporation acquired the type certificate in 1994 and produced more recent variants of the Hawker. In 2014, Beechcraft Corporation became part of Textron Aviation, Inc.

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

[28] According to Ultra-Nav, graphs and charts from the airplane's flight manual were digitized and mathematically transformed into equations that replicated the procedures and computations in the takeoff, landing, and weight-and-balance sections of the flight manual. Execuflight's use of the Ultra-Nav software program, which used the airplane's basic operating weight as a default setting, was authorized by its GOM.

weight-and-balance computations used the airplane's basic empty weight of 13,815 lbs instead of the basic operating weight of 14,276.92 lbs, which should have been used.

When Execuflight received its most recent renewal of the Ultra-Nav software for the accident airplane in September 2015, its current basic operating weight should have been entered into the program as a default setting. Execuflight's chief pilot stated that the company did not know what the actual Ultra-Nav default setting was for the airplane's basic operating weight since any crewmember who had access to the system could change the default. It is unknown who entered the basic empty weight instead of the basic operating weight.

Review of the Ultra-Nav weight-and-balance printouts that Execuflight provided for the accident flight and each of the previous flights on the 2-day trip indicated that a passenger weight of 200 lbs per passenger (total weight of 1,400 lbs) and a baggage weight of 250 lbs was used for each flight. Execuflight's FAA-issued operations specifications stated that the company was authorized to use actual weights of all passengers and bags or solicited ("asked") passenger weight plus 10 lbs and actual weight of bags. According to Execuflight personnel, the airplane was equipped with a portable scale for determining actual passenger and baggage weights.

According to the Ultra-Nav printout for the accident flight, the takeoff fuel weight used was 7,700 lbs. The fueling service at MGY reported that the airplane's wing tanks were filled to capacity before the flight to Akron, and, according to the manufacturer, the airplane's total wing tank fuel capacity was 8,160 lbs. Taxi fuel was not included in the Ultra-Nav printout. According to Ultra-Nav, pilots could account for taxi burn by subtracting the estimated taxi fuel weight from the takeoff fuel weight. Execuflight's chief pilot stated that 300 lbs of fuel would be considered a typical taxi fuel burn but could vary depending on ramp delays.

The Ultra-Nav printout for the accident flight showed passenger weight (1,400 lbs), baggage weight (250 lbs), and fuel weight (7,700 lbs) added to the basic empty weight (13,815 lbs), resulting in a total takeoff weight of 23,165 lbs and a takeoff center of gravity of 26.9 inches. It showed an estimated fuel burn en route of 1,500 lbs subtracted from the takeoff weight, resulting in a landing weight of 21,665 lbs and a landing center of gravity of 25.9 inches. The printout also showed a V_{REF} for the approach of 124 knots at flaps 45°.[29] According to the manufacturer, the airplane's weight and center of gravity as shown on the Ultra-Nav printout were within published limitations for both takeoff and landing.

According to the Execuflight GOM, before each departure, the flight crew was required to complete a Turbine Daily Record Sheet/Manifest form or flight log that included the following items:

1. The number of passengers
2. The total weight of the loaded aircraft
3. The maximum allowable takeoff weight for that flight

[29] V_{REF} is 1.3 times the airplane's stalling speed in the landing configuration and is the speed required on crossing the landing runway threshold at a 50-ft height to achieve calculated aircraft performance.

4. The center of gravity limits

5. The center of gravity of the loaded aircraft

6. The registration number of the aircraft

7. The origin and destination

8. Identification of crewmembers and their crew position assignments

The GOM stated that the PIC was to carry either in paper or electronic format one copy of the completed flight log on board the airplane to the destination, and a duplicate copy was to be "emailed or uploaded to the Chief Pilot and to the aircraft account for future storage prior to any departure." NTSB investigators found that, in practice, the Ultra-Nav printouts, not the completed flight logs, were sent to the chief pilot. A comparison of the Ultra-Nav printouts that Execuflight provided with the flight logs for November 9 and 10, 2015, which were found at the accident site, revealed that the weight-and-balance numbers entered on the flight logs did not match the numbers on the Ultra-Nav printouts for the flights before the accident flight. There were no entries on the flight log dated November 10 for the accident flight. According to Execuflight's chief pilot, a pilot could populate the flight log with numbers different than those produced by the Ultra-Nav program if the Ultra-Nav computations were made well before the estimated takeoff time and then recalculated right before the departure due to a change in conditions, passengers, or fuel.

1.3.1.3 Estimated Weight and Balance

NTSB investigators used the airplane's basic operating weight of 14,276.92 lbs, the flight crew's passenger weight (1,400 lbs) and baggage weight (250 lbs), and the fuel weight with full wing tanks (8,160 lbs) to estimate a total ramp weight of about 24,086 lbs. Subtracting an estimated fuel burn during taxi of 300 lbs resulted in a total takeoff weight of about 23,786 lbs (the airplane's maximum structural takeoff weight was 25,500 lbs). Subtracting the flight crew's estimated fuel burn en route (1,500 lbs) from the takeoff weight resulted in a landing weight of about 22,286 lbs, which exceeded the airplane's maximum landing weight of 22,000 lbs. Based on these estimated takeoff and landing weights, the flight's maximum takeoff weight, as limited by landing weight, was 23,500 lbs.[30] The software calculations made by Ultra-Nav, which could extrapolate reference landing speeds above maximum landing weight, indicated that, for an overweight landing at 22,286 lbs, V_{REF} was 125 knots at flaps 45°.

1.4 Meteorological Information

1.4.1 Weather Information Available Before Departure

According to Execuflight's chief pilot, Execuflight pilots conducted their own flight planning and filed their own flight plans via an account with the website Fltplan.com. According

[30] The maximum takeoff weight was landing limited based on the estimated fuel burn en route of 1,500 lbs (22,000 lbs maximum landing weight + 1,500 lbs fuel burn en route = 23,500 lbs maximum takeoff weight).

to Fltplan.com, the weather data provided on the website was from the National Weather Service (NWS). A review of the Fltplan.com website records for the Execuflight account indicated that, at 0928 on November 10, 2015, the weather page for a flight from MGY to AKR with a planned departure time of 1330 was accessed. Access to the website account was via a common user name, so the specific person who accessed the website was not recorded.

The NWS does not issue a terminal aerodrome forecast (TAF) for AKR; the closest TAF is issued for Akron-Canton Regional Airport (CAK), located approximately 8 mi south of AKR. TAFs are valid for a 5 mi radius around an airport's center. When planning a flight to an airport that does not have a TAF, pilots typically refer to the closest available TAFs to supplement the information in weather forecast products that cover large areas, such as the area forecast, airmen's meteorological information (AIRMET) bulletins, and graphical products. The amended TAF for CAK issued at 0900 was displayed when the Fltplan.com weather page was accessed, and, for the flight's estimated time of arrival at AKR, it called for IMC to prevail with surface wind from 280° at 8 knots, visibility 4 mi in light drizzle and mist, and an overcast ceiling at 700 ft agl. In addition to the CAK TAF, the Fltplan.com weather page listed the most recent weather observations at AKR, CAK, and other nearby airports, all of which reported IMC with ceilings less than 1,000 ft agl.

Although it was not displayed on the Fltplan.com weather page, the NWS area forecast for northern Ohio issued at 0445 expected overcast clouds at 2,000 ft agl, tops to 8,000 ft, widely scattered light rain showers, and visibility 3 to 5 mi in mist. The area forecast was amended by AIRMET Sierra update 3, issued at 0945, for IMC, which extended over Ohio, and called for IMC with ceilings less than 1,000 ft agl and visibility below 3 mi in mist and light precipitation.

The next scheduled TAF for CAK was issued at 1231 and lowered the visibility and cloud height and continued to predict IMC. The forecast current at the time of the accident expected a wind from 250° at 6 knots, visibility 3 mi in light rain and mist, ceiling overcast at 400 ft agl, with a temporary period of visibility 1 1/2 mi in light drizzle and mist, and ceiling overcast at 600 ft.

About 1358, one of the pilots obtained an IFR clearance for the flight by calling flight service. Review of a transcript of the pilot's conversation with the flight service briefer indicated that the pilot did not request any weather information during the call.

1.4.1.1 Alternate Airport Requirements

Fltpln.com website records indicated that an IFR flight plan was filed for the flight from MGY to AKR at 1133, which was shortly after the airplane arrived at MGY. An alternate airport was not listed for the flight.

Title 14 *CFR* 135.223, "IFR: Alternate Airport Requirements," states the following:

> (a) Except as provided in paragraph (b) of this section, no person may operate an aircraft in IFR conditions unless it carries enough fuel (considering weather reports or forecasts or any combination of them) to—

(1) Complete the flight to the first airport of intended landing;

(2) Fly from that airport to the alternate airport; and

(3) Fly after that for 45 minutes at normal cruising speed or, for helicopters, fly after that for 30 minutes at normal cruising speed.

(b) Paragraph (a)(2) of this section does not apply if part 97 of this chapter prescribes a standard instrument approach procedure for the first airport of intended landing and, for at least one hour before and after the estimated time of arrival, the appropriate weather reports or forecasts, or any combination of them, indicate that—

(1) The ceiling will be at least 1,500 feet above the lowest circling approach MDA; or

(2) If a circling instrument approach is not authorized for the airport, the ceiling will be at least 1,500 feet above the lowest published minimum or 2,000 feet above the airport elevation, whichever is higher; and

(3) Visibility for that airport is forecast to be at least three miles, or two miles more than the lowest applicable visibility minimums, whichever is the greater, for the instrument approach procedure to be used at the destination airport.

Review of the instrument approach chart for the localizer 25 approach at AKR (figure 1) indicated that an AKR weather forecast that called for a ceiling lower than 2,132 ft or a visibility lower than 3 1/4 mi for at least 1 hour before and after the estimated time of arrival at AKR required that an alternate airport be filed for the flight.[31] Based on the TAF for CAK issued at 0900 and the AIRMET Sierra issued at 0945, an alternate airport was required by 14 *CFR* 135.223.

1.4.2 Weather During the Approach

AKR has a federally owned and operated ASOS that reported the following conditions surrounding the time of the accident:

At 1431, wind from 250° at 8 knots, visibility 1 1/2 mi in mist, ceiling overcast at 500 ft agl, temperature 11°C, dew point 9°C, altimeter 29.95 inches of mercury (Hg). Remarks: automated observation system, ceiling 300 ft variable 900 ft agl, temperature 11.1°C, dew point 9.4°C.

[31] According to the instrument approach chart for the localizer 25 approach at AKR, a circling approach was authorized; the lowest circling MDA for a category C airplane was 632 ft agl, and the lowest visibility minimum for a category C airplane was 1 1/4 mi. Approach categories group airplanes based on the speed at which they approach a runway for landing. Category C airplanes have a V_{REF} between 121 and 140 knots. Based on the Ultra-Nav calculated V_{REF} for the approach of 124 knots, the accident airplane was a category C airplane.

> At 1454, wind from 240° at 7 knots, visibility 1 1/2 mi in mist, ceiling broken at 400 ft agl, overcast at 900 ft agl, temperature 11°C, dew point 9°C, altimeter 29.95 inches of Hg. Remarks: automated observation system, sea level pressure 1014.2 hectopascals, temperature 10.6°C, dew point 9.4°C.
>
> At 1505, wind from 240° at 11 knots, visibility 1 1/4 mi in light rain and mist, ceiling overcast at 600 ft agl, temperature 11°C, dew point 9°C, altimeter 29.95 inches of Hg. Remarks: automated observation system, rain began at 1505, ceiling 300 ft agl variable 900 ft agl, hourly precipitation less than 0.01 inch or a trace, temperature 10.6°C, dew point 9.4°C.

Pilots could receive a recorded message of the most current AKR ASOS weather by tuning a radio to 126.82 MHz. At 1438:41.6, the CVR recording indicated that the pilots listened to the AKR ASOS broadcast and received the following information: time 1438, wind from 240° at 8 knots, visibility 1 1/2 mi in mist, ceiling overcast at 600 ft agl, temperature 11°C, dew point 9°C, altimeter 29.95 inches of Hg, and density altitude 900 ft.

According to interviews with the instructor and instrument student on the training flight that completed the approach ahead of the accident flight, they broke out of the clouds about 40 ft above the MDA of 1,540 ft msl and leveled at the MDA about 3 nm as indicated on their distance measuring equipment (DME). They reported having visual contact with the ground and forward visibility at 3.0 nm DME; however, they could not see the runway environment until about 2.3 nm DME, and their first visual reference was the precision approach path indicator (PAPI). Review of the instrument approach chart for the localizer 25 approach at AKR showed that the FAF was located at 4.8 nm DME, and the missed approach point was at 1.1 nm DME.

1.5 Aids to Navigation

No problems with any navigational aids were reported. FAA postaccident testing of the runway 25 localizer and DME on November 11, 2015, found both to be in tolerance on normal transmitter readings.

1.6 Airport Information

AKR is located about 4 mi southeast of Akron, Ohio, at a field elevation of 1,068 ft. Runway 7/25 is 6,336 ft long and 150 ft wide and is equipped for nonprecision approaches. Runway 25 is equipped with high-intensity runway lights and a four-light PAPI located on the left side of the runway. The PAPI for runway 25 has a 4.0° glidepath angle that results in a threshold crossing height of 45 ft agl.[32] According to the FAA's *Aeronautical Information Manual*, PAPI lights are visible from about 5 mi during the day and up to 20 mi at night.

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[32] A PAPI provides pilots with a visual glide slope indication (VGSI) to provide guidance for a safe descent. The 4.0° VGSI for runway 25 provided obstacle clearance for nearby trees. As specified in the published instrument approach procedures for runway 25, the VGSI and the instrument vertical descent angle (3.09° from the final approach fix) are not coincident.

The runway lights and the PAPI are activated by pilot-controlled lighting with three clicks from a radio tuned to the common traffic advisory frequency. The runway lights illuminate to low intensity with the three clicks, medium intensity with five clicks, and high intensity with seven clicks. The PAPI and runway lights are on a 15-minute timer that starts when they are first turned on. The timer resets every time the radio is clicked three times within a 30-second time frame.

According to interviews with the instructor and instrument student on the training flight that completed the approach ahead of the accident flight, they activated the PAPI and the runway lights to high intensity before their landing and observed normal illumination and indications during flight and after landing. According to an AKR maintenance technician, the PAPI was visually checked postaccident and found operational.

1.7 Flight Recorders

The airplane was not equipped with an FDR nor was it required to be by federal regulations.[33] The airplane was equipped with a Fairchild GA-100 CVR designed to record a minimum of 30 minutes of analog audio on a continuous loop tape in a four-channel format: one channel for each flight crewmember, one channel for a cockpit observer, and one channel for the cockpit area microphone.[34] The magnetic tape was not damaged or affected by impact forces or postcrash heat exposure; it was successfully read, and a transcript was prepared covering the period from 1420:52 to 1452:35 (see appendix B).

The audio quality of all channels was degraded by a loud tone of about 400 Hz and associated harmonics. As a result, the quality of all recorded channels was rated as poor.[35]

A study was conducted to determine engine speeds from the sound spectrum of the CVR recording because an FDR was not installed and no other data sources existed for this information. Although the study suggested that both engines were likely producing nearly equal power throughout the recording, the poor quality of the recording precluded the study from reaching definitive conclusions.

1.7.1 Cockpit Voice Recorder Maintenance and Operational Checks

The CVR was overhauled on July 16, 2009, and had operated about 2,701.8 hours since overhaul when the accident occurred.[36] According to the CVR manufacturer, the CVR overhaul

[33] According to 14 *CFR* 135.152, an approved flight recorder is not required for multiengine, turbine-powered airplanes and rotorcraft that have a passenger seating configuration of fewer than 10 seats. The accident airplane was configured with eight passenger seats.

[34] According to 14 *CFR* 135.151(a), an approved CVR is required for multiengine, turbine-powered airplanes and rotorcraft that have a passenger seating configuration of six or more seats and for which two pilots are required by certification or operating rules. The accident airplane required two pilots by certification.

[35] The NTSB rates recording quality as excellent, good, fair, poor, or unusable. For a complete description of each rating level, see the CVR Quality Rating Scale in appendix B of this report.

[36] At the time of the accident, the airplane had operated about 1,589.3 hours since the CVR was overhauled. According to the CVR manufacturer, the CVR is expected to operate 1.7 hours for every 1 hour of airplane operation because the CVR is typically powered by ground power when the airplane's engines are not operating.

interval is currently 4,000 CVR operating hours. CVR overhaul intervals were originally 8,000 hours but had to be shortened to 4,000 hours due the obsolescence of the replacement tapes necessary to meet the original 8,000-hour requirement. According to the airplane's maintenance records, the most recent maintenance on the CVR was a "functional check per manufacturer's procedures" performed on May 13, 2015, by an avionics facility that Execuflight contracted.

The flight crew was required to check the CVR before the engines were started as part of the Before Starting Engines checklist. The checklist item was to be read by the PM and performed by the PF. According to Execuflight's chief pilot, Execuflight pilots performed the CVR test in accordance with the CVR manufacturer's guidance for a preflight functional check. The guidance stated, in part, the following:

> To conduct the Pre-flight Functional Check, push and hold the remote green "TEST" switch or "TEST" switch on the Control Unit for a minimum of 5 seconds. The green test "OK" annunciator will remain illuminated until the button is released. If the test annunciator does not illuminate within 6 seconds, the recorder must be removed from the aircraft for servicing.

1.7.2 Federal Aviation Administration Oversight Related to Cockpit Voice Recorder

Maintenance oversight of the CVR was primarily conducted by the FAA principal avionics inspector (PAI) assigned to Execuflight. In a postaccident interview, the PAI stated that he had checked the airplane on the ramp about 4 months before the accident; however, at that time, no power was available to power the aircraft, so he could not check the CVR. The PAI indicated that FAA policy regarding maintenance inspections was that inspections should not create additional work or level of risk to the operator. For example, checking the CVR with the engines running was not the kind of test the FAA would perform; further, the PAI indicated that he would not expect an operator to perform a maintenance inspection of the CVR with the engines running.

The PAI commented that when he has the opportunity to check a CVR, he prefers to plug a headset into the CVR test jack to hear the quality of the recording as opposed to using the CVR test pushbutton. The PAI noted that most CVR maintenance checks are "go/no-go" operational checks rather than an in-depth check that follows the CVR manufacturer's maintenance manual.[37]

The PAI commented generally on his experiences with tape-based recorders, including the following: (a) he was aware that tape-based recorders have quality issues, so when possible, he tries to hear the quality of CVR recordings through the CVR headset test jack; (b) he believed that the replacement tape overhaul interval was 1,500 hours; (c) there was an industry issue tracking CVR time-in-service when CVRs were swapped between aircraft; and (d) he was concerned that as older aircraft were retired, the tape-based CVRs would be sold and reinstalled in operating aircraft, perpetuating quality issues related to tape-based CVRs.

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[37] For example, the "Complete Audio System Test" section of the Fairchild GA-100 maintenance manual stated, in part, that "To accomplish this test, the Pilot's, Co-pilot's, Cockpit Area Microphone, and Third Crewmember or Public Address System inputs must be individually checked for their operational integrity with the Cockpit Voice Recorder."

In a postaccident interview, the FAA POI for Execuflight said that he had no responsibility for oversight of the CVR. He stated that any training of flight crews regarding CVR operational test procedures would occur during initial and recurrent training events. Asked if he was familiar with FAA Safety Alert for Operators (SAFO) 06019, "Functional Test of the Cockpit Voice Recorder (CVR) Prior to the First Flight of the Day," issued November 8, 2006, the POI indicated he was not familiar with the SAFO and that a SAFO was a recommended action only.[38]

1.8 Wreckage and Impact Information

Examination of the accident site indicated that the airplane struck tree branches and power lines before impacting terrain in the front yard of a four-unit apartment building. Pieces of the left aileron and an outboard portion of the left wing were located in an area of ground scarring in the front yard. The airplane traveled through the building and came to rest on an embankment located behind the building (see figure 4 for an aerial photograph of the accident site). While most of the wreckage was consumed by fire, all major components of the airplane were located between the front yard and the airplane's final location on the embankment. No airplane structure was located along the flightpath before the first pieces of structure identified in the front yard.

Source: Ohio State Highway Patrol.

Figure 4. Aerial photograph of the accident site showing the destroyed apartment building.

[38] The "Recommended Action" section in SAFO 06019 stated, "All Directors of Operations and Chief Pilots should ensure that all training requirements for testing of CVRs are emphasized during initial and recurrent training. All pilots of aircraft equipped with a CVR should test the function of the CVR before the first flight of each day as part of an approved aircraft checklist."

The left main landing gear and associated mating wing structure were found in the remains of the apartment building. The right main landing gear and associated mating wing structure were located between the rear of the building and the embankment. The burned remains of the entire fuselage and the empennage were located on the embankment (see figure 5 for a view of the fuselage and engines). Inboard and outboard portions of the right wing, the nose landing gear, both engines, and the APU were also located on the embankment. Examination indicated that, at impact, all landing gear were down and locked, and the flaps were extended to about 45°.

Source: Honeywell International.

Figure 5. Photograph of the fuselage and engines at the accident site.

The remnants of the left (captain's), center, and right (first officer's) instrument panels were identified in the wreckage. All instruments exhibited postcrash fire and impact damage. Examination of the angle-of-attack (AOA) indicator from the captain's instrument panel revealed that the indicator needle was in about the 2 o'clock position, which was within the indicator's red (stall) band.

Disassembly examinations of the engines found evidence that both were operating during impact. Gas producer compressor blades in both engines exhibited severe leading-edge impact damage consistent with the ingestion of foreign objects while the engines continued to operate during the impact sequence. Aluminide particles were found fused to turbine airfoil surfaces in both engines, showing that combustion was occurring during impact. In addition, the fans of both engines exhibited severe rotational damage, and fibrous debris consistent with building insulation material mixed with soil was found inside the air passages of both engines.

1.9 Medical and Pathological Information

The Summit County Medical Examiner's Office performed autopsies on the captain, the first officer, and the seven passengers. The medical examiner determined that the cause of death for both pilots was "inhalation of products of combustion and thermal injury." According to the autopsy reports no significant natural disease was identified in either pilot. Review of FAA medical certification records showed that neither pilot had reported any significant medical conditions or the use of any medications.

The FAA's Civil Aerospace Medical Institute performed toxicology testing on samples from the captain and the first officer. The testing did not identify ethanol, drugs of abuse, or medications. The toxicology tests indicated that the captain's blood carboxyhemoglobin saturation was 19%, and the first officer's was 37%.[39] Additionally, cyanide was identified in the captain's blood (1.51 ug/ml) and the first officer's blood (2.37 ug/ml).[40]

The medical examiner determined that the cause of death for five passengers was "blunt force trauma," and the cause of death for two passengers was "blunt force trauma…with inhalation of products of combustion."

1.10 Tests and Research

1.10.1 Radar Performance Study

The NTSB conducted a radar performance study using radar and meteorological data to derive the airplane's altitude, descent rate, and airspeed and to estimate its attitude, AOA, and load factor. As shown in figure 6, between 1438 and 1449:30 as the airplane descended from 9,000 ft to 3,000 ft and leveled off, the airspeed decreased from about 280 knots to 130 knots, and the AOA increased from about 1° to about 10°. For about the next 90 seconds, airspeed and AOA remained near 130 knots and 10°, respectively. A few seconds after the first officer requested full flaps at 1451:00.9, the airplane began to descend, airspeed began to decrease, and AOA began to increase. About the time the radar data ended at 1452:26, the estimated AOA exceeded 15°. According to the manufacturer, the critical AOA (or the stalling AOA) for flaps 45° is 15.5°.

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[39] Carboxyhemoglobin is the compound that is formed when inhaled carbon monoxide combines with hemoglobin in the blood. Carboxyhemoglobin levels reflect carbon monoxide exposure, which increases in fires.

[40] Cyanide is a toxic substance often produced in high concentration when nitrogen-containing plastics are burned.

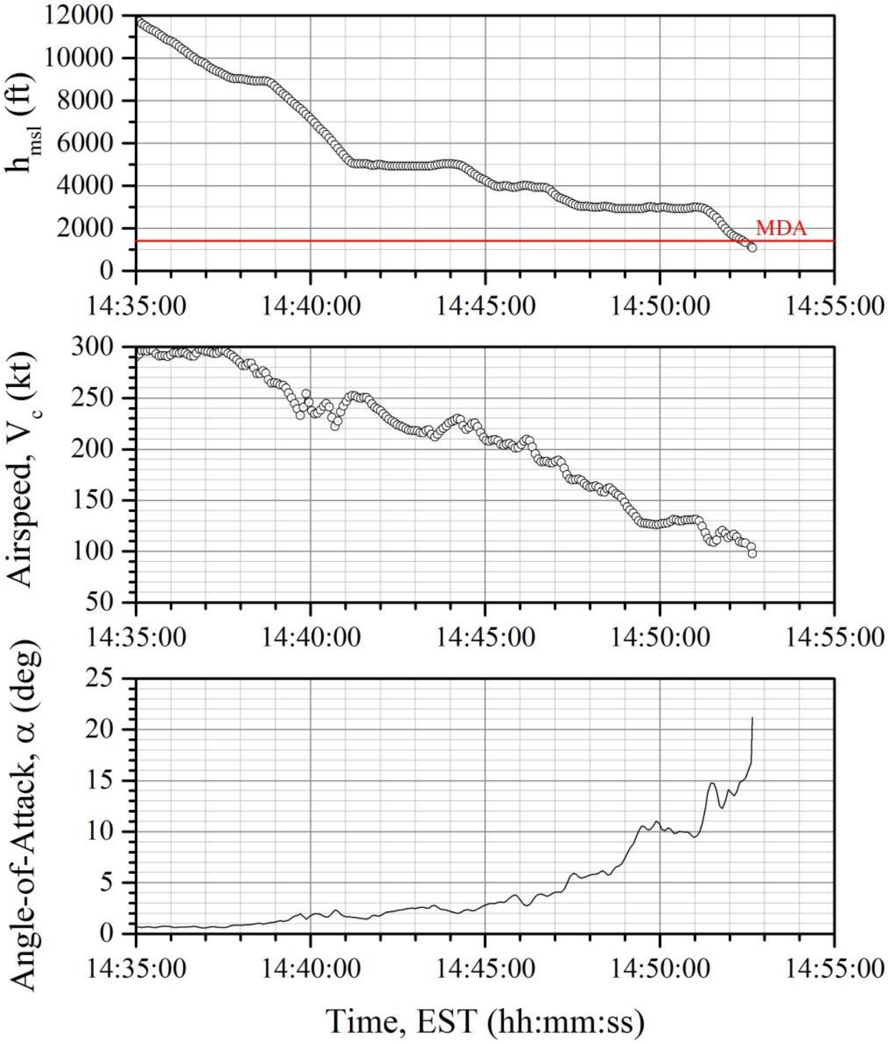

Figure 6. Altitude, estimated airspeed, and estimated angle of attack for the final minutes of the flight based on radar data.

1.10.2 Flight Simulation

The NTSB conducted simulator testing in a Hawker 700A simulator at CAE Simuflite in Dallas, Texas, on January 19 and 20, 2016. The testing showed that to maintain level flight with flaps 25°, gear down, and airspeed V_{REF} + 20 knots, a pitch of 7.5° to 8° nose up and a fuel flow of 850 lbs per hour per engine was required. To maintain level flight with flaps 45°, gear down, and airspeed V_{REF} + 20 knots, a pitch of 8° nose up and a fuel flow of 1,150 lbs per hour per engine was required.

1.10.3 Previous Flight Plans

The NTSB reviewed the available past flight plans that the captain filed while operating as PIC for Execuflight between August 28, 2015, and November 10, 2015. Of the 17 available flight plans, there were 5 flights for which an alternate airport was required but not filed, including the accident flight and the flight before it from LUK to MGY. There were 9 flights for which an alternate airport was filed when the weather forecast did not require it and 3 flights for which an alternate airport was filed when the weather forecast did require it.

1.11 Organizational and Management Information

At the time of the accident, Execuflight was a privately held company based at FXE. The company was authorized to conduct both passenger and cargo operations under the provisions of 14 *CFR* Part 135. Execuflight operated 6 airplanes and employed 11 pilots, including the chief pilot. The Execuflight fleet consisted of two Gulfstream III airplanes, one Hawker 800 airplane, two Hawker 700A airplanes (including the accident airplane), and one Westwind II airplane.

Pilots for Execuflight were based at FXE. Each newly hired pilot signed a 2-year employment contract in exchange for which Execuflight paid for the pilot's training. Termination or cancellation of the contract required pilots to reimburse the company for the costs associated with their training.

Execuflight did not have a safety management system (SMS), an aviation safety action program (ASAP), or a nonpunitive company reporting system.[41] According to interviews with company personnel, safety issues and complaints were expected to be brought directly to Execuflight management. At the time of the accident, the position of director of operations was vacant; the previous director of operations left the company in February 2015.[42] The Execuflight GOM also listed a director of safety position as part of the company organization, but it was not part of the "management hierarchy" and was not required under 14 *CFR* 119.69. During an interview, the company president stated that the chief pilot was acting as the director of safety; however, during an interview on the previous day, the chief pilot stated that the company did not have a director of safety.

1.11.1 Standard Operating Procedures

Execuflight policy and procedures were outlined in the Execuflight GOM, revision 53, dated May 21, 2014. In addition, the company had defined standard operating procedures (SOPs) for the Hawker 700A in the Execuflight Part 135 Training Program Manual, dated February 1, 2012. According to the Execuflight SOPs, pilot tasks were defined by the PF and the pilot not flying (PNF). (For purposes of this report, the terms PNF and PM are considered synonymous.)

[41] According to FAA Advisory Circular (AC) 120-66B, "Aviation Safety Action Program (ASAP)," the objective of an ASAP is to encourage air carrier and repair station employees to voluntarily report safety information that may be critical to identifying potential precursors to accidents. Under an ASAP, safety issues are resolved through corrective action rather than through punishment or discipline.

[42] The chief pilot and director of operations positions, which are defined by 14 *CFR* 119.69, are management personnel required for operations conducted under Part 135.

1.11.1.1 Operational Control

Execuflight used the services of employees called "dispatchers." However, according to interviews, their function was primarily to act as sales agents tasked with arranging Execuflight charters, and they did not perform traditional dispatch functions, such as preflight planning and filing of flight plans, obtaining and evaluating required weather information, and calculating weight and balance.[43] Execuflight pilots were responsible for these activities.

Execuflight used text messages as a flight-following method. Pilots would text a "door closed" time to indicate an impending departure and a "doors open" time to indicate an arrival. Various Execuflight management personnel, including the president, director of operations, chief pilot, and the flight's sales agent, received the messages.

The "Flight Locating Procedures" section of the GOM stated, in part, the following:

> INITIATING FLIGHT: Prior to initiating a FAR 135 flight for the company, the operations management person on duty authorized to exercise operational control shall proceed as follows:
>
> 1. Review the flight and duty time status of each crewmember selected to accomplish the flight, and ascertain that the crewmember can complete the flight assignment pursuant to the requirements of FAR 135.263 and 135.267.
>
> 2. Contact Flight Service or the National Weather Service and determine from the weather briefing the flight can be conducted safely and within the limitations, authorizations and weather criteria stipulated in the Company Operations Specifications and applicable FARs.
>
> 3. Review fuel requirements and weight and balance information for the flight to determine compliance with applicable FARs.
>
> 4. Verify an appropriate Flight Plan has been filed and the weather briefing received by the Pilot in Command prior to departure.

Execuflight's chief pilot, when asked if he, as the operations management person on duty on the day of the accident, reviewed the weather, fuel requirements, and weight-and-balance information and verified that an appropriate flight plan was filed for the accident flight before departure, stated that he "was kept abreast of the aircraft movements through the text messages received from the crew, i.e. 'doors open,' 'doors closed.'"

1.11.1.2 Checklists

For normal operations, Execuflight Hawker 700A pilots were required to use the checklists found in the Execuflight Hawker HS-125-700 Normal checklist, which the FAA accepted on December 15, 2010. A copy of the Normal checklist was recovered from the accident scene.

[43] The FAA does not require Part 135 operators to have flight dispatchers.

Execuflight's GOM stated that during airborne operations, the PF will call for the checklist, and "checklist items will be read in a loud, clear voice and the proper response will be equally clear and understandable." The GOM also stated that upon completion of each individual checklist, the crewmember completing the checklist was to announce, "(Checklist Name) CHECKLIST COMPLETE." Execuflight SOPs called for checklists to be accomplished as challenge and response. After the PF initiated the checklist, the PM was to read each checklist item aloud and confirm the accomplishment of the checklist item verbally. After completion of any checklist, the PM was to state "___ checklist is complete."

According to interviews with Execuflight management, Execuflight pilots, and CAE Simuflite instructors familiar with Execuflight procedures, none of the Execuflight normal checklists were considered "silent" checklists, and typically all Execuflight normal checklists were considered "challenge and response" or otherwise always ended with a verbal "checklist complete."

1.11.1.3 Approach Briefing

Execuflight Hawker 700A pilots were required to conduct an approach briefing during the descent before each landing. The approach briefing was the first checklist item in the Hawker 700A Approach checklist; the checklist called for the PM to state "approach brief" and the PF to respond "complete." According to the Execuflight GOM, before starting an approach, the PF was to brief the PM. The GOM stated, "crew briefings help to standardize an operation and stimulate planning, supervision, teamwork, integrity, and redundancy. They are also a mechanical means of requiring a pilot to consider factors that might otherwise be overlooked." According to the Execuflight SOPs, pilots were required to include the following items when briefing an instrument approach:

- approach to be executed
- field elevation
- appropriate minimum sector altitude(s)
- inbound leg to FAF, procedure turn direction and altitude
- final approach course heading and intercept altitude
- timing required
- DH [decision height]/MDA
- MAP [missed approach point] (non-precision)
- VDP [visual descent point]
- special procedures (DME step-down, arc, etc.)
- type of approach lights in use (and radio keying procedures, if required)
- missed approach procedures
- runway information and conditions.

1.11.1.4 Stabilized Approach

Execuflight SOPs for a stabilized approach called for the airplane to be within an "approach window" when within 500 ft above the TDZE. If the airplane was not within the approach window, a missed approach was required to be executed. The SOPs listed the following parameters for the approach window:

- Within one dot CDI [course deviation indicator] deflection or 5° bearing;
- IVSI [instantaneous vertical speed indicator] less than 1,000 fpm;
- Indicated airspeed within V_{AP} +/-10 kts (no less than V_{REF} or 0.6 [indicated] AOA whichever is less);
- No instrument flags with the landing runway or visual references not in sight; and
- Landing configuration, except for full flaps (nonprecision or single-engine approaches).

The Execuflight president stated that stable approach meant the airplane was descending less than 1,000 fpm below 1,000 ft agl. The chief pilot said that stable approach meant the airplane was descending no more than 1,000 fpm when inside the FAF.

When asked what their stable approach criteria were, one CAE Simuflite instructor said he was not sure what CAE's stable approach criteria were and that the FAA told him that descending at more than 1,200 fpm on the approach was unstable. Another instructor said it was "3° per 100 ft,"[44] and the airspeed was also defined from the FAF as V_{REF} + 10 knots minimum; over the threshold, they must be at V_{REF} with the wings level. A third instructor said that a stable approach was within 10 knots, with a rate of descent no more than 1,000 fpm, maybe heading aligned, and the airplane had to be within a "box."

1.11.1.5 Nonprecision Approach

Execuflight SOPs defined callouts to be made by the PM during performance of a nonprecision approach. These callouts included stating "final fix" when the airplane reached the FAF, "1000/500/200/100 ft to minimums" as the airplane reached these altitudes relative to the MDA, and "minimums" when the airplane reached the MDA. There were also callouts specified for all landing gear and flap configuration changes, including stating "flaps selected 15°/25°/45°" and "flaps indicate 15°/25°/45°" as the flap setting was changed.

The Execuflight Part 135 Training Program Manual contained the standard nonprecision approach profile for the Hawker 700A, which called for the airplane to enter the terminal area at a speed of V_{REF} + 50 knots with flaps up and landing gear retracted. During the initial stages of the approach, the airplane should be at a speed of V_{REF} + 25 knots with flaps 15° and gear retracted. At a point 1 nm from the FAF inbound to the airport, the airplane should be at a speed of V_{REF} + 20 knots with flaps 25° and gear extended. Once landing on the runway was assured, the pilot

[44] It is unclear what the instructor meant by this answer; however, it illustrates just one of the variety of responses received.

should select flaps 45°, slow to a speed of V_{REF} + 10 knots, and begin descent to cross the runway threshold at a speed of V_{REF}.

According to interviews with Execuflight pilots and CAE Simuflite instructors, the descent from the FAF on a nonprecision approach in the Hawker 700A entailed a step-down procedure. Descent to the MDA was initiated at the FAF, and upon arrival at the MDA, the airplane was leveled off until in a position to descend to the runway. Level flight at the MDA was conducted at flaps 25°, and the flaps were lowered to 45° when landing was assured.

When asked about level flight at flaps 45°, one CAE Simuflite instructor stated that the Hawker 700A had a "lot of drag" when the flaps were extended beyond 20°, and it would take "quite a bit of power" to maintain straight and level flight at V_{REF} + 10 knots approach speed with the gear down at flaps 45°. Another instructor stated that he did not know of any situation in the training program where a pilot was taught to fly with flaps 45° in level flight. He stated that he would never do that and was not even sure what the power setting would be. He further stated that it would be "nuts" to do that since it would involve a lot of power, with a lot of drag, and if the pilot was not paying attention to his speed, the airplane could slow and stall.

1.11.1.6 Landing Flap Settings

Regarding landing flap settings, the "Landing Procedures" section of the HS 125-700A Flight Manual stated that flaps "may be lowered to 25° and 45° as required." The section further stated that "lowering the flaps to 45° causes a nose-down change of attitude and, because of the extra drag, rate of descent will be increased unless power is added."

As previously described, for nonprecision approaches, Execuflight procedures called for the airplane to be flown at flaps 25° until landing on the runway was assured when the pilot would select flaps 45° and begin descent from the MDA. Many nonprecision approaches, such as the AKR localizer 25 approach, have MDAs about 400 to 500 ft agl, and, thus, the Hawker 700A nonprecision approach procedure requires a configuration change, accompanied by changes in pitch and power, when the airplane is below 1,000 ft agl.

For precision approaches, such as an ILS approach, Execuflight Hawker 700A procedures called for the pilot to select flaps 45° at "glideslope intercept" and fly the remainder of the approach at flaps 45° to landing. Glideslope intercept typically occurs when the airplane is above 1,000 ft agl, and, thus, the Hawker 700A precision approach procedure does not require a flap configuration change when the airplane is below 1,000 ft agl.

1.11.1.7 Runway Assured

No definition exists in the HS 125-700A Flight Manual, Execuflight GOM, Execuflight Training Manual, or Execuflight SOPs of "runway assured" or "landing assured" for selection of flaps 45° and descent from the MDA on a nonprecision approach, nor does the FAA provide a definition.[45] Regarding descent below the MDA, 14 *CFR* 91.175(c)(1) states that no pilot may operate an aircraft below the authorized MDA unless:

> the aircraft is continuously in a position from which a descent to a landing on the intended runway can be made at a normal rate of descent using normal maneuvers, and for operations conducted under part 121 or part 135 unless that descent rate will allow touchdown to occur within the touchdown zone of the runway of intended landing.

Execuflight's chief pilot stated that "runway assured" meant the pilot would not select flaps 45° and descend from the MDA until the runway was in sight.

During interviews, CAE Simuflite instructors gave multiple meanings for the term "landing assured" or "runway assured." One instructor described that his personal meaning of "landing assured" was if the airplane lost thrust in both engines and could still make it to the runway. Another instructor stated that the pilots would select flaps 45° on a nonprecision approach when the landing was assured, which would occur when they broke out of the clouds on a stabilized approach with the runway in sight, and it was based on "pilot's discretion based on a number of variables." Another instructor stated that "landing assured" was based on visibility and runway conditions, and, in his opinion, there was no set definition for "landing assured."

Another instructor stated that "landing assured" meant when the wheels touched the runway and added that he trained Hawker 700A pilots to remain at flaps 25° until they touched down on the runway and could bring the thrust levers to idle. They would then select flaps 45° during the landing rollout, raise the lift dump, and use maximum braking. This instructor also said that on a nonprecision approach, there was no time that the pilot would have flaps 45°, and that was how they were supposed to be trained.

1.11.1.8 Approach Power Management

According to interviews with CAE Simuflite instructors, because the Hawker 700A did not have autothrottles, pilots were required to adjust the thrust of the engines manually during an approach, and pilots were generally taught the technique of targeting certain engine fuel flows to manage their descents. Target fuel flows were provided in an energy management chart used at CAE Simuflite. According to the chart, for a nonprecision approach with flaps 25°, speed at V_{REF} + 20 knots, and the gear extended, a fuel flow of 900 lbs per hour per engine and a pitch up of 3° were required to maintain level flight. The chart did not list the fuel flow and pitch required for level flight with flaps 45°.

1.11.1.9 Second-in-Command Acting as Pilot Flying

According to Execuflight management personnel and pilots, Execuflight captains would typically act as PF on all revenue legs with passengers on board, and first officers would act as PF on "empty" legs that did not have revenue passengers on board. A review of Execuflight

[45] Based on interviews and multiple descriptions, the terms "runway assured" and "landing assured" are considered synonymous.

documentation did not find a formal policy delineating PF and PM roles based on whether passengers were on board.

In an interview, the former director of operations stated that he considered the practice of having first officers fly empty legs a "safety proposal" in place at Execuflight and that the first officer would fly the empty legs until they built up the confidence to fly the revenue legs. He added that he considered each first officer's ability on a "one-on-one basis" and stated:

> No way would I allow a First Officer that's just out of school with just [a fresh] type rating [to] go out there and fly in a full-blown IFR approach, down to minimums, you know, on his first couple of weeks, even without passengers.

When interviewed, the president of Execuflight said first officers flying revenue legs was considered on a "case-by-case" basis, and the chief pilot said it was the "captain's discretion" to decide if the first officer was competent to fly an instrument approach.

1.11.2 Pilot Training

1.11.2.1 Use of CAE Simuflite

Execuflight's operations specifications authorized the company to use the CAE Simuflite training center in Dallas, Texas, which was certified under 14 *CFR* Part 142, as part of its approved training program. Execuflight was required by the FAA to ensure that all contract training met company and regulatory requirements; the contract training center had adequate facilities and equipment, competent personnel, and organizational structure to support the training of Execuflight pilots; and the instruction and evaluation of its pilots were conducted in accordance with its operations specifications. As part of that assurance, Execuflight was required by the FAA to conduct initial and recurring audits of each training agreement. The recurring audits were to be conducted at least once every 24 months, and each audit was to be presented to Execuflight's POI for review and acceptance. The most recent audit date listed in the company's operations specifications for the HS-125-700A training agreement was September 2014, and the most recent date for the Beech Hawker-800XP was November 2012. A review of Execuflight records showed that the two CAE Simuflite Hawker evaluators authorized to conduct checkrides for Execuflight conducted nine pilot checkrides in 2015 and six in 2014, and each indicated "Pass" for the results.[46]

1.11.2.2 Crew Resource Management Training

Title 14 *CFR* 135.330, "Crew Resource Management [CRM] Training," requires each certificate holder to have an approved CRM training program that includes initial and recurrent training. The former Execuflight director of operations created a CRM manual, approved by the FAA on March 22, 2013, and the Execuflight chief pilot provided in-house instruction on CRM to Execuflight pilots via lecture and PowerPoint presentation. Review of Execuflight's CRM training

[46] The evaluators were employed by CAE Simuflite. When conducting checkrides, the evaluators were acting as designees of the FAA.

program revealed that the content consisted of a review of the topics required by 14 *CFR* 135.330(a).[47] The content was largely copied and pasted from Appendix 1 of AC 120-51E, "Crew Resource Management Training." Appendix 1 discusses crew performance marker clusters and states that "these behavioral markers are provided to assist organizations in program and curriculum development and to serve as guidelines for feedback."

According to the Execuflight CRM manual, upon completion of the training, each pilot was required to take a 10-question test and "have a non-corrected passing grade of 80%." A pilot scoring below 80% was to "review each missed question and have a corrected grade to 100%." The CRM test questions and answers were provided in the CRM manual.

According to documentation that Execuflight provided, the captain and first officer completed CRM training on June 25, 2015, and July 1, 2015, respectively. The captain's CRM test answer sheet had 100% written in the box for an uncorrected grade; the box for a corrected grade was blank. The Execuflight chief pilot had initialed the test score results. According to the answers provided in the CRM manual, the captain's uncorrected grade should have been 40%. The first officer's CRM test answer sheet had 80% written in the box for an uncorrected grade and 100% written in the box for a corrected grade. The Execuflight chief pilot had initialed the test score results. According to the answers provided in the CRM manual, the first officer's uncorrected grade should have been 70%, and his corrected grade should have been 90%. Areas of CRM in which the crewmembers were deficient according to their CRM test results included responsibilities of the PIC, flight deck management, and aeronautical decision-making.

1.11.3 Federal Aviation Administration Oversight

The FAA flight standards district office in Miramar, Florida, was responsible for oversight of Execuflight. The POI for Execuflight had been responsible for the certificate's oversight since May 24, 2004, when he first certified the operator. The POI oversaw 16 certificates, 14 of which were Part 135 operators (including Execuflight), and characterized his workload as "very busy." The POI did not have an assistant at the time of the accident.

The POI stated that he visited Execuflight about four to five times a year. He periodically conducted line and ramp checks and would "sample" flight manifest and training records. He said that he did not conduct en route checks with Execuflight or any of his other Part 135 operators. He said that he typically conducted the Part 135 line checks of Execuflight pilots and that he did not know what pilots did in normal operations because he only got to see them during their line checks, which were not performed on revenue flights. When the captain received his line check in June 2015, the POI did not directly administer it. Rather, he observed Execuflight's chief pilot, who was acting as a check airman, conduct the captain's line check. The POI stated that his only

[47] Title 14 *CFR* 135.330(a) states, "each certificate holder must have an approved crew resource management training program that includes initial and recurrent training. The training program must include at least the following: (1) Authority of the pilot in command; (2) Communication processes, decisions, and coordination, to include communication with Air Traffic Control, personnel performing flight locating and other operational functions, and passengers; (3) Building and maintenance of a flight team; (4) Workload and time management; (5) Situational awareness; (6) Effects of fatigue on performance, avoidance strategies and countermeasures; (7) Effects of stress and stress reduction strategies; and (8) Aeronautical decision-making and judgment training tailored to the operator's flight operations and aviation environment."

interactions with the captain and the first officer were when he conducted the oral portions of their Part 135 Hawker 700A competency checks in June and July of 2015, respectively.

The POI had not had the opportunity to go to CAE Simuflite in Dallas to observe Execuflight simulator training because of funding limitations and did not always know when the pilots went for training until after they completed their training. The POI stated that he had never had the opportunity to "sit through" ground school training at Execuflight. The POI considered Execuflight to be a "very good operator," and, in general, he felt Execuflight did a "pretty good job." According to the POI, he was aware that the position of director of operations was vacant at the time of the accident and that Execuflight was in the process of trying to fill it. The POI stated that the chief pilot temporarily took over some of the duties and did an "excellent" job.

1.12 Additional Information

1.12.1 Recent Investigations with Cockpit Voice Recorder Issues

On August 16, 2015, a Cessna 172M, N1285U, and a North American Rockwell NA265-60SC (Sabreliner), N442RM, collided in midair about 1 mi northeast of Brown Field Municipal Airport, San Diego, California.[48] The pilot (and sole occupant) of the Cessna and the two pilots and two mission specialists aboard the Sabreliner died; both airplanes were destroyed. The Cessna was operating under the provisions of 14 *CFR* Part 91, and the Sabreliner was operated as a public aircraft in support of the US Navy. The Sabreliner's tape-based Fairchild GA-100 CVR had fair to poor quality; specifically, old content was not fully erased before new content was written to the tape, causing audio "shadows" of prior flights that confounded usability of the most recent recording.

On March 13, 2014, US Airways flight 1702, an Airbus A320, N113UW, experienced a nose landing gear collapse after the captain aborted the takeoff at Philadelphia International Airport, Philadelphia, Pennsylvania.[49] Of the 149 passengers, two reported minor injuries; the airplane sustained substantial damage. US Airways was operating the airplane under the provisions of 14 *CFR* Part 121 as a regularly scheduled passenger flight. The investigation determined that the CVR's cockpit area microphone channel was not working before the accident.

On February 5, 2014, Trans States Airlines flight 3395, an Embraer 145EP, N802HK, landed hard at Memphis International Airport, Memphis, Tennessee.[50] There were no injuries, and the airplane sustained substantial damage. Trans State Airlines was operating the airplane under the provisions of 14 *CFR* Part 121 as a regularly scheduled passenger flight. The investigation determined that the CVR's cockpit area microphone channel was not working before the accident.

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[48] More information about this accident, NTSB case number WPR15MA243A/B, can be found by accessing the Aviation Accident Database at www.ntsb.gov.

[49] More information about this accident, NTSB case number DCA14MA081, can be found by accessing the Aviation Accident Database at www.ntsb.gov.

[50] More information about this accident, NTSB case number DCA14FA058, can be found by accessing the Aviation Accident Database at www.ntsb.gov.

On January 7, 2013, a Japan Airlines Boeing 787, JA829J, that was parked at a gate at Logan International Airport, Boston, Massachusetts, experienced an APU battery fire (NTSB 2014a). There were no injuries, and the airplane sustained minor damage. The airplane had arrived from Narita International Airport, Narita, Japan, as a regularly scheduled passenger flight conducted under the provisions of 14 *CFR* Part 129. Due to design and installation issues, the audio obtained from the enhanced airborne flight recorder was poor quality. Although the poor quality of the audio recording did not impact the investigation, the NTSB concluded that it could impede future investigations. Therefore, the NTSB issued Safety Recommendations A-14-126 and -127 to the FAA; these recommendations are currently classified "Open—Acceptable Response."[51]

On March 4, 2008, a Cessna 500, N113SH, struck large birds, causing it to enter a steep descent and crash about 2 minutes after takeoff from Wiley Post Airport, Oklahoma City, Oklahoma (NTSB 2009b). The two pilots and three passengers died, and the airplane was destroyed by impact forces and postcrash fire. The airplane was operated under the provisions of 14 *CFR* Part 91. The investigation determined that the CVR was inoperative before the accident.

On February 1, 2008, a North American Rockwell NA-265-80, N3RP, was substantially damaged when it collided with three other airplanes while taxiing for departure at FXE.[52] An airport tug driver received minor injuries. The airplane was being operated under the provisions of 14 *CFR* Part 91. The investigation determined that the CVR was inoperative before the accident.

1.12.2 Continuous Descent Final Approach Technique and Stabilized Approach

According to FAA AC 120-71A, "Standard Operating Procedures For Flight Deck Crewmembers," dated February 27, 2003, a nonprecision IFR approach is stabilized when all of the following criteria are maintained from 1,000 ft height above touchdown to landing in the touchdown zone:

1. The airplane is on the correct track.
2. The airplane is in the proper landing configuration.
3. After the FAF, the pilot flying requires no more than normal bracketing corrections to maintain the correct track and desired profile (3° descent angle, nominal) to

[51] Safety Recommendation A-14-126 asked the FAA to require Boeing to improve the quality of (1) the enhanced airborne flight recorder radio/hot microphone channels by using the maximum available dynamic range of the individual channels and (2) the cockpit area microphone airborne recordings by increasing the crew conversation signals over the ambient background noise. Safety Recommendation A-14-127 asked the FAA to either remove the current exception to European Organization for Civil Aviation Equipment ED-112A, "Minimum Operational Performance Specification for Crash Protected Airborne Recording Systems," chapter I-6 in Technical Standard Order 123B, "Cockpit Voice Recorder Equipment," or provide installers and certifiers with specific guidance to determine whether a cockpit voice recorder installation would be acceptable.

[52] More information about this accident, NTSB case number NYC08LA091, can be found by accessing the Aviation Accident Database at www.ntsb.gov.

landing within the touchdown zone. Level-off below 1,000 ft height above touchdown is not recommended.

4. The airplane speed is within the acceptable range specified in the approved operating manual used by the pilot.

5. The rate of descent is no greater than 1,000 fpm.

   - If an expected rate of descent greater than 1,000 fpm is planned, a special approach briefing should be performed.
   - If an unexpected, sustained rate of descent greater than 1,000 fpm is encountered during the approach, a missed approach should be performed. A second approach may be attempted after a special approach briefing, if conditions permit.

6. Power setting is appropriate for the landing configuration selected and is within the permissible power range for approach specified in the approved manual used by the pilot.

On January 20, 2011, the FAA issued AC 120-108, "Continuous Descent Final Approach [CDFA]," to promote the technique of a stable continuous descent path to the MDA in lieu of the traditional step-down or "dive and drive" type of nonprecision approach. The CDFA technique (or constant-angle-of-descent technique) is consistent with the stabilized approach procedures in AC 120-71A and entails flying the final approach as a continuous descent, without level-off, from an altitude at or above the FAF minimum crossing altitude to a point about 50 ft above the landing runway threshold. According to the AC, "stepdowns flown without a constant descent will require multiple thrust, pitch, and altitude adjustments inside the…FAF. These adjustments increase pilot workload and potential errors during a critical phase of flight." The AC stated that the advantages of the CDFA technique included the following:

1. Increased safety by employing the concepts of stabilized approach criteria and procedure standardization

2. Improved pilot situational awareness and reduced pilot workload

3. Improved fuel efficiency by minimizing the low-altitude level flight time

4. Reduced noise level by minimizing the level flight time at high thrust settings

5. Procedural similarities to APV [approach procedure with vertical guidance] and precision approach operations

6. Reduced probability of infringement on required obstacle clearance during the final approach segment

Execuflight training guidance did not incorporate the use of the CDFA technique on nonprecision approaches. While several CAE Simuflite instructors indicated that they may teach CDFA as a technique, there was no formal instruction on CDFA.

Execuflight stated in a July 20, 2016, letter to the NTSB that it notified the FAA on January 21, 2016, of its intent to require the use of CDFA on all nonprecision approaches conducted in Hawker 700- and 800-series airplanes and include CDFA in its approved training program for these airplanes. The letter also stated that CDFA will be required on all of its fleets and that Execuflight will audit its contract training facilities to verify that the training is provided.

2. Analysis

2.1 General

The flight crew was properly certificated and qualified in accordance with federal regulations and company requirements. No evidence was found indicating that the flight crew's performance was affected by toxins, alcohol or other drugs, or medical conditions. Postaccident examination of the airplane found no evidence of any preimpact structural, engine, or system failures.

When the flight contacted Akron approach control, the approach controller asked the pilot to advise when he had the automated weather for AKR. The pilot responded that they were "in the process of copying the weather." According to FAA procedures, the controller should have followed up and verified that the pilot received the weather information, but he did not do so. However, the controller's omission was inconsequential because the CVR recording confirmed that the flight crew listened to the AKR ASOS and received the weather information. The NTSB concludes that the air traffic controller's handling of the flight was not a factor in this accident.

The security video shows that fire erupted immediately upon impact. The autopsy and toxicological reports indicate that the pilots and two of the passengers survived the initial impact. However, they did not exit the airplane. The NTSB concludes that the impact forces of the accident were survivable for some occupants, but the immediate and rapidly spreading postcrash fire likely precluded the possibility of escape.

2.2 Accident Sequence

2.2.1 Preapproach

The CVR recording indicated that during the flight, the first officer was the PF. This was contrary to Execuflight's informal practice of the captain acting as the PF on all revenue legs with passengers on board and the first officer acting as PF on legs that did not have revenue passengers on board. According to the former director of operations, he considered the practice a "safety proposal" in place at Execuflight and considered each first officer's ability on a "one-on-one basis." According to the chief pilot, it was "captain's discretion" to decide if the first officer was competent to fly an instrument approach. Thus, although the captain's decision to allow the first officer to act as PF on the accident leg was contrary to Execuflight's informal safety practice, the decision was at the captain's discretion.

The flight departed MGY about 1413, and at 1426:09, the flight crew began preparing for the approach into AKR by attempting to receive the weather at AKR via the ASOS broadcast. However, the flight crew received the automated weather observation for Fairfield County Airport, Lancaster, Ohio, located about 108 mi southwest of AKR, which indicated a visibility of 10 mi and a ceiling of 1,100 ft overcast, considerably better than the current AKR visibility of 1 3/4 mi in mist and overcast ceiling of 700 ft agl. It is likely that the flight crew had previously listened to the MGY ASOS, which had the same frequency as Fairfield County Airport's ASOS, and failed to change frequencies before they attempted to listen to the AKR weather. The flight crew did not immediately recognize their error, and the correct weather for AKR was not recorded on the CVR until 1437:39.2, about 11 min 30 seconds later.

At 1427:27.8, the first officer said, "I'll let you brief it [the approach] to me," and, contrary to Execuflight GOM guidance, which specified that before starting an approach, the PF will brief the PM, the captain responded, "okay" and began the approach briefing. For the PF, briefing the approach to be conducted reinforces the approach requirements and procedures to perform as the pilot flying the approach. As stated in the Execuflight GOM, "crew briefings help to standardize an operation and stimulate planning, supervision, teamwork, integrity, and redundancy. They are also a mechanical means of requiring a pilot to consider factors that might otherwise be overlooked."

At 1433:38.8, the first officer said, "okay. so we go down twenty three. then down to (what's the minimums?)," and the captain responded, "four seventy three." The localizer approach to runway 25 had an MDA of 1,540 ft msl, and the height of the MDA above the runway 25 TDZE was 473 ft. Thus, these statements indicated that both pilots were referring to the AKR localizer 25 approach chart at this time. The flight crew then discussed the missed approach procedure, followed by a discussion of the overcast height above the ground.

At 1436:26.9, the first officer said, "the minima for this approach [is] fifteen twenty," followed by, "which is ground. where is the ground. five oh one right?" A review of the AKR RNAV GPS 25 approach chart showed that it listed 1,520 ft msl as the MDA for one version of the approach and 501 ft agl as the height above the ground of the MDA for another version of the approach. Thus, the first officer's comments indicated that at this time, he was using the RNAV 25 approach chart for reference during the approach briefing instead of the localizer 25 chart. The captain did not correct the first officer, and the correct height above the ground of the MDA for the localizer 25 approach was not verbalized again until 1441:24.9, about 5 minutes later.

At 1436:40, while the first officer was discussing the MDA with the captain, radar data recorded the flight at 10,000 ft msl with an estimated airspeed of about 298 knots. This speed was 48 knots higher than the maximum speed of 250 knots required by 14 *CFR* 91.117 below 10,000 ft msl. No comments were recorded by the CVR at this time about airspeed, and it is likely that both pilots failed to recognize their lack of compliance with the 250-knot speed restriction as they descended below 10,000 ft msl.

The first officer made several statements that indicated he had an incorrect understanding of the weather minimums required to begin an instrument approach; he referred to the ceiling height as the controlling weather minimum, rather than the visibility.[53] At 1437:09.7, the first officer stated, "yeah I understand. but we can shoot it. we can shoot because the overcast reporting * eight hundred." At 1437:32.7, he stated, "the cloud base is from the ground. from the ground do we get minimums for us."

[53] Title 14 *CFR* 91.175(c)(2) prohibits operation below the DH or MDA unless the flight visibility is not less than the visibility prescribed in the standard instrument approach being used. Title 14 *CFR* 135.225 requires that the latest weather report issued by a weather reporting facility at an airport must indicate that weather conditions are at or above the authorized IFR landing minimums for that airport before a pilot may begin an instrument approach.

After listening to the AKR ASOS, at 1439:22.4, the captain stated that the ceiling was 600 ft overcast and the visibility was 1 1/2 mi (which was greater than the required visibility of 1 1/4 mi for the Hawker 700A). The captain and first officer then discussed the visibility and determined that they had the required minimum visibility to start the approach as indicated by the captain's comment at 1439:40.7, "alright we are visibility we got it."

The captain became confused as to whether the approach briefing had been completed as indicated by his comment to the first officer at 1440:25.0, "did you do my approach (brief)?" This was likely because the captain did not enforce the SOP that required the PF, in this case the first officer, to brief the approach.

At 1441:08.8, almost 5 minutes after the initial erroneous reference to the RNAV 25 approach chart, the first officer said, "the minima is five hundred and ten," followed by the captain questioning "localizer?" At this point the first officer apparently realized that he was referencing the RNAV approach chart and not the localizer approach chart because, at 1441:24.9, he correctly stated the height above the ground of the MDA for the localizer 25 approach as "four seventy three."

The flight crew's approach briefing was unstructured, inconsistent, and began before the crew had the most current weather at AKR on which to base the approach brief. Further, the flight crew never completed the approach briefing, and critical items required by the Execuflight GOM, such as the field elevation, minimum sector altitude, missed approach point, type of approach (step-down), and runway lighting, were never reviewed. This resulted in confusion about the expected weather and when the airplane would break out of the clouds on the approach. While determining when the airplane is expected to break out of the clouds can assist in managing the expectations of the approach, visibility is the controlling element of an approach, and the conversation between the two pilots led to an ambiguous expectation of when they would acquire visual contact with the ground and the runway environment.

The first item in Execuflight's Hawker 700A Approach checklist called for the PM to state "approach brief" and the PF to respond, "complete." The purpose of an Approach checklist is to ensure that the approach briefing has been completed and the cockpit is set up for the anticipated approach. Execuflight's GOM stated that during airborne operations, the PF will call for the checklist; however, the CVR never recorded the first officer requesting the Approach checklist. The GOM further stated that "checklist items will be read in a loud, clear voice and the proper response will be equally clear and understandable," and upon completion of each individual checklist, the crewmember completing the checklist was to announce that the checklist is complete. However, the CVR did not record the crew conducting the Approach checklist or announcing it was complete.

In summary, the flight crew failed to conduct a complete approach briefing and to accomplish the Approach checklist as required by Execuflight SOPs. The NTSB concludes that as a result of the flight crew's failure to complete the approach briefing and the Approach checklist as per SOPs, the captain and first officer did not have a shared understanding of how the approach was to be conducted.

2.2.2 Localizer Approach

About 1444, the approach controller instructed the flight crew to reduce speed to 200 knots and descend to 4,000 ft msl. About 2 minutes later, the controller notified the flight crew that they were following a slower airplane on the approach and issued a further speed reduction to 170 knots and a descent to 3,000 ft msl. At 1447:09.1, the controller gave the flight a heading of 280° to intercept the localizer course for runway 25. At 1447:47.4, the first officer told the captain that he was going to "drag every (thing)," indicating he planned to begin configuring the airplane for landing, likely in an attempt to reduce speed as they followed the slower airplane to the airport. Based on the first officer's statement, it is likely that, at this time, the flaps were set to 25°; however, the change in flap setting was not accompanied by a callout from either crewmember.

At 1448:14.3, the captain said, "we got nine degrees pitch up," indicating that he noticed the first officer flying with a high pitch attitude, which was likely a further attempt by the first officer to reduce speed. At 1448:27.0, the CVR recorded the sound of the landing gear extending. Extension of the landing gear was not accompanied by a callout from either crewmember. Execuflight SOPs allowed the PF to make configuration changes such as lowering the landing gear or flaps; however, the SOPs specified that, before making a configuration change, the PF was to make a callout to alert the PM to the forthcoming change. The NTSB notes that given the poor quality of the CVR recording, it is possible that the flight crew made some of the required callouts, but they were unintelligible.

At 1448:33.9, the captain said, with emphasis, "did you hear what he say? there is an airplane on the approach. (he is) slower than us. he hasn't cancelled. we don't know if he's on the ground." The captain was clearly concerned that they would need additional spacing on the approach, and the first officer responded by slowing the airplane. Radar data indicated that between 1448:30 and 1449:30, the airplane's estimated airspeed decreased from about 150 to 125 knots.

At 1449:22.9, when the flight was about 4 nm from the FAF, the approach controller advised the flight crew that the pilots of the slower airplane ahead had cancelled their IFR flight plan, cleared the flight for the localizer 25 approach, and instructed the flight to maintain 3,000 ft msl until established on the localizer. According to radar data, the airplane was already established on the localizer when the approach clearance was issued and, consistent with the minimum altitude for that segment of the approach, could have descended to the FAF minimum crossing altitude of 2,300 ft msl. However, the first officer did not initiate a descent, the captain failed to notice, and the airplane remained level at 3,000 ft msl.

As the first officer continued to slow the airplane, the captain made several comments about the airplane's decaying speed. At 1449.41.3, the captain said "look you're going one twenty. you can't keep decreasing your speed**--." The first officer was apparently unaware of his speed because he responded "no. one tw--. how do you get one twenty?" The first officer may have believed that he was allowed to slow to V_{REF} or 124 knots, but, at that moment, the airplane was still at flaps 25°, and according to Execuflight SOPs, should have been flying no slower than V_{REF} + 20 knots or 144 knots. The first officer's speed reduction placed the airplane in danger of an aerodynamic stall if the speed continued to decay, but the first officer apparently did not realize it.[54] At 1449:56.1, the captain said "that's what I'm saying. if you keep decreasing your speed--," the first officer interrupted "but why?" and the captain continued "because we gonna stall. I don't want to sta--." The first officer's lack of awareness of his configuration and speed should have been an indication to the captain that the first officer was having difficulty flying the airplane in IMC and was not sufficiently familiar with the nonprecision approach procedures on the Hawker 700A to execute the approach safely. It was apparent that the first officer had lost situational awareness of the approach, and the circumstances were demanding more than his capabilities; however, the captain allowed the first officer to continue flying the approach. The NTSB concludes that before the airplane reached the FAF, when the first officer reduced airspeed and placed the airplane in danger of encountering a stall, the captain should have taken control of the airplane or called for a missed approach, but he did not do so.

At 1450:21.6, the approach controller instructed the flight to change to the local advisory frequency. At 1450:39.8, the captain made a position report on the local advisory frequency, and at 1450:53.9, one of the pilots of the preceding slower airplane stated, "hey guys. ah we just landed on the loc. and uh broke out right at minimums (right at a) mile." This voluntary pilot report indicated that the ceiling was near the MDA of 1,540 ft msl or 473 ft agl, and the visibility was possibly below the 1 1/4 mi visibility required for the approach. Since this visibility report was not an official observation, the accident flight was authorized to continue the approach. The captain acknowledged the transmission, but the flight crew did not discuss the weather that was reported; such a transmission should have heightened the crew's awareness that they needed to execute the approach flawlessly or consider executing a missed approach.

At 1451:00.9, the first officer requested "full flaps" (45°). The first officer's decision to use flaps 45° was contrary to Execuflight's Hawker 700A nonprecision approach profile that required the airplane to be flown at flaps 25° until after descending to the MDA and landing was assured. It was also contrary to the training both pilots received on nonprecision approaches at CAE Simuflite. However, the captain did not question the first officer's decision to conduct the approach with flaps 45°. Also, the captain failed to make the "flaps selected 45°" and "flaps indicate 45°" callouts as required by Execuflight SOPs. Further, after configuring the airplane for landing, the flight crew was required to accomplish the Landing checklist per Execuflight SOPs, and, although the captain began to recite the checklist at 1451:06.7, the flight crew never completed it.

At 1451:13.6, the first officer reduced the power, and the airplane, which had been level about 3,000 ft msl, began to descend. At 1451:20, the airplane reached an altitude of about 2,900 ft, an airspeed of 115 knots, and a descent rate of about 1,000 fpm, which is the maximum descent rate for an approach to be considered stabilized according to FAA AC 120-71A. At 1451:31.3, the first officer said, "alright we go to minimums," indicating the airplane was crossing the FAF and could now descend to the MDA. The captain did not make a "final fix" callout as required by Execuflight SOPs. According to radar data, the airplane crossed the FAF at 1451:33 at an airspeed of 109 knots and an altitude of about 2,700 ft, which was about 400 ft above the minimum crossing

[54] According to the manufacturer, at a gross weight of 22,286 lbs, the airplane's stall speed with flaps 25° and gear extended was about 102 knots.

altitude. Because the airplane was high on the approach, it was out of position to use a normal descent rate of 1,000 fpm to the MDA.

The airplane's rate of descent increased rapidly, and at 1451:43, the airplane reached a descent rate of about 2,000 fpm, at an altitude of about 2,300 ft, and an airspeed of 118 knots. The high descent rate was likely due to the first officer's attempt to salvage the approach by increasing the rate of descent, exacerbated by the increased drag resulting from the improper flaps 45° configuration. At 1451:56.6, the captain said, "on localizer. you're diving. you're diving. don't dive. two thousand feet per minute buddy." The first officer interjected, "yeah," and the captain continued, saying "two thousand feet per minu- don't go two thousand feet per minute," and again at 1452:07.3, "don't go two thousand feet per minute." At no time did he attempt to take control of the airplane even though he was responsible for safety of the flight. As the airplane continued to descend on the approach, the captain failed to make the required 1,000 ft, 500 ft, 200 ft, and 100 ft to minimums callouts required by Execuflight SOPs, which would have alerted the first officer to his altitude relative to the MDA, and he likely also failed to notice that the airspeed was below V_{REF} as he made no comment about it.

Radar data indicated that the airplane reached the MDA about 1452:13; at that time, the airplane's airspeed was about 113 knots, and its rate of descent had decreased to about 830 fpm. Upon reaching the MDA, the captain did not call out "minimums" as required by Execuflight SOPs. At 1452:17.0, the captain reported that he saw the ground, and, at 1452:20.5, he said, "keep going," although he made no reference to visually acquiring the PAPI or runway environment as required by 14 *CFR* 91.175(c)(1) for descent below the MDA. The first officer did not verbally respond to the captain's command to "keep going" when arriving at the MDA, yet he complied with it and continued the descent, indicating his continued loss of situational awareness on the approach and his sole reliance on the captain's instructions.

Execuflight SOPs for a stabilized approach required that a missed approach be executed if the airplane was not within a defined approach window when within 500 ft above the TDZE. The approach window parameters included a descent rate less than 1,000 fpm, an airspeed no less than V_{REF} (124 knots), and the appropriate flap configuration (25°). Although the descent rate had decreased to about 830 fpm, the airspeed was too slow at 113 knots, and the airplane was improperly configured with full flaps. Thus, upon reaching the MDA (which was 473 ft above the TDZE), the airplane was not within the defined approach window, and the flight crew should have executed a missed approach. The NTSB concludes that when the airplane reached the MDA, the approach was not stabilized, and the captain should have called for a missed approach according to SOPs, but he did not do so.

Rather than calling for a missed approach, at 1452:27.3, about 14 seconds after the airplane descended below the MDA, the captain said "okay level off guy," indicating that he wanted the first officer to stop his descent. The captain's instruction to level off was followed immediately by the sound of the stick shaker, indicating that the airplane was nearing an aerodynamic stall.[55] Analysis of radar data indicated that just before radar contact was lost at an altitude of about

[55] According to the airplane's flight manual, the stick shaker is set to operate at an indicated airspeed of 7% to 9% above stalling speed.

1,300 ft msl, the airplane was likely in a stalled condition as indicated by an estimated airspeed of 98 knots and an estimated AOA of 21°, which exceeded the critical AOA of 15.5°.[56] About 7 seconds after the captain's instruction to level off, the CVR recorded the first sounds of impact. Further evidence that the airplane was in a stalled condition at impact was provided by the AOA indicator that was found postaccident with its indicator needle within the stall band.

Leveling off required an increase in pitch and power to arrest the descent rate while maintaining airspeed. Because the flight crew had lost awareness of airspeed and allowed the airspeed to decay below V_{REF}, there was little margin for error. Also, because the airplane was at flaps 45° instead of flaps 25°, the first officer needed to increase the power substantially more than he had during his training on nonprecision approaches to compensate for the additional drag due to the higher flap setting. Maintaining altitude and airspeed at flaps 45° required a fuel flow of about 1,150 lbs per hour per engine, which was significantly more than the 800 lbs per hour per engine that Execuflight pilots were trained to apply to level the airplane at the MDA when conducting nonprecision approaches at flaps 25°. Additionally, depending on the descent power setting, there could have been some delay between the first officer's movement of the thrust levers and an engine power increase. The NTSB concludes that, when attempting to arrest the airplane's descent, the first officer did not appropriately manage pitch and thrust control inputs to counter the increased drag from the 45° flap setting, which resulted in an aerodynamic stall.

Throughout the approach, both pilots repeatedly failed to follow SOPs, which are intended to minimize operational errors; however, the captain was ultimately responsible for demanding a more professional and disciplined tone in the cockpit and ensuring the safety of the flight. Although the captain clearly recognized that the first officer was having difficulty flying the approach, he did not intervene either before the airplane reached the FAF when he noted the first officer was not maintaining the proper airspeed or after the airplane passed the FAF when he noted that the first officer was exceeding the proper vertical speed. Rather, the captain inappropriately adopted the duties of a flight instructor and did so ineffectively as demonstrated by his failure to ensure the safety of flight as he coached the first officer through the approach. The NTSB concludes that the captain's failure to enforce adherence to SOPs and his mismanagement of the approach placed the airplane in an unsafe situation that ultimately resulted in the loss of control.

2.3 Standard Operating Procedures and Flight Data Monitoring

As previously discussed, the flight crew failed to adhere to company policy and neglected numerous SOPs in performing the approach. The crew's deficiencies included the following:

- The captain (the PM) agreed to brief the approach to the first officer (the PF), as opposed to the PF briefing the PM as specified in the GOM.
- The approach briefing was not completed.
- The Approach checklist was not completed.

[56] According to the manufacturer, at a gross weight of 22,286 lbs, the airplane's stall speed with flaps 45° and gear extended was about 98 knots.

- Aircraft configuration changes were made without the required callouts.
- Instead of remaining at flaps 25° until after reaching the MDA and landing was assured, the flight crew prematurely set flaps 45°.
- The captain did not make numerous required callouts, including the "checklist complete" callout for the landing checklist; the "final fix" callout when the airplane reached the FAF; the 1,000 ft, 500 ft, 200 ft, and 100 ft to minimums callouts; and the "minimums" callout when the airplane reached the MDA.
- Upon reaching the MDA, the approach was unstabilized, which mandated a missed approach, but the flight crew continued the approach.
- The captain instructed the first officer to continue to descend below the MDA without the runway environment in sight and landing assured.

SOPs are widely recognized as a basic element of safe aviation operations. Well designed cockpit procedures are an effective countermeasure against operational errors, and disciplined compliance with SOPs, including strict checklist discipline, provides the basis for effective crew coordination and performance. The NTSB has repeatedly cited casual cockpit discipline and inadequate compliance with SOPs as contributing factors to accidents (NTSB 2003, NTSB 2006a, NTSB 2006c, NTSB 2006d, NTSB 2007a, NTSB 2007b, NTSB 2009a, NTSB 2010a, NTSB 2011a, NTSB 2011b, and NTSB 2015). Operational data confirm the importance of strict compliance with SOPs for safe operations. For example, industry data show that pilots who intentionally deviated from SOPs were three times more likely to commit other types of errors, mismanage errors, and find themselves in undesired situations compared with pilots who did not intentionally deviate from procedures.[57]

The NTSB's investigation of the crash of East Coast Jets flight 81, a Hawker 800A, N818MV, on July 31, 2008, in Owatonna, Minnesota, found that, if East Coast Jets, as a Part 135 operator, had been required to develop SOPs and its pilots had been required to adhere to them, many of the deficiencies demonstrated by the pilots during the accident flight (which included inadequate checklist discipline and failure to conduct an approach briefing) might have been corrected. Therefore, the NTSB issued Safety Recommendation A-11-20, which asked the FAA to require 14 *CFR* Part 135 and 91 subpart K operators to establish, and ensure that their pilots adhere to, SOPs (NTSB 2011a).

In a November 18, 2013, response, the FAA agreed that there was no explicit regulatory requirement that Part 135 or Part 91 subpart K operators develop and employ formalized SOPs. However, the FAA stated that its policy and guidance repeatedly emphasized the use of SOPs and required all Part 135 and Part 91 subpart K operators to either develop their own SOPs or to use SOPs found in the manufacturers' operating manuals. As a result, the FAA believed that little could be gained by developing further guidance or other materials about SOPs for Part 135 and Part 91 subpart K operators. However, to remind these operators of the importance of adhering to SOPs, the FAA developed and, on July 9, 2012, issued SAFO 12003, which reminded all Part 135

[57] The data came from the LOSA Collaborative, a network of researchers, safety professionals, pilots, and line representatives collaborating to provide, among other things, oversight and implementation of line and air operational safety audits (LOSA) and a forum of information exchange regarding these audits. More information is available at http://losacollaborative.org/.

certificate holders and Part 91 subpart K program managers of the criticality of using SOPs during all phases of flight. The FAA believed that it had fully addressed Safety Recommendation A-11-20 and planned no further action.

On March 21, 2014, the NTSB replied that, despite the guidance that had been issued, some Part 135 operators still were not establishing and requiring their pilots to adhere to SOPs. However, because the FAA regarded its action as complete, the NTSB classified Safety Recommendation A-11-20 "Closed—Unacceptable Action." Nevertheless, procedural noncompliance continues to concern the NTSB, and the NTSB included the issue of "Strengthen Procedural Compliance" on its 2015 Most Wanted List.

In this case, Execuflight had established SOPs, but the flight crew consistently failed to follow them. As noted in FAA AC 120-71A, a lack of firm implementation of SOPs by management poses a danger in that flight crews "too easily become participants in an undesirable double standard condoned by instructors, check airmen, and managers. Flight crews may end up doing things one way to satisfy training requirements and checkrides but doing them another way in 'real life' during line operations." Although the accident pilots had recently successfully completed Execuflight's initial pilot training program, their performance during the accident flight appears to represent an example of the risk described by the AC.

Execuflight had no means to monitor the daily operation of its airplanes, identify operational deficiencies (such as noncompliance with SOPs), and correct those deficiencies before an accident occurred. Absent continual surveillance of an operation through en route inspections by company check airmen, the only means an operator can use to consistently and proactively monitor its line operations is through comprehensive data collection over the entirety of its operation, which can be accomplished through a flight data monitoring (FDM) program.

In Part 121 operations, many airlines voluntarily have FDM programs known as flight operations quality assurance programs, as described in FAA AC 120-82, "Flight Operational Quality Assurance." FDM programs consist of a system or combination of systems that record an aircraft's flight performance and operational data. These data are downloaded, evaluated, and used to identify and mitigate risks by modifying operational and maintenance procedures, providing feedback to pilots in training, and highlighting areas in which additional training may be needed.

The accident airplane was equipped with a CVR as required by 14 *CFR* 135.151 but was not required to and did not have an FDR. CVR review is typically restricted to accident investigations and is not used for FDM programs. In addition to this accident, the NTSB has investigated other Part 135 accidents in which operators lacked the means to monitor routine flight operations (NTSB 2003, NTSB 2006c, NTSB 2009b, NTSB 2009c, NTSB 2010b, and NTSB 2011a).

As a result of an increase in fatal helicopter emergency medical service (HEMS) accidents in 2008, on September 24, 2009, the NTSB issued Safety Recommendation A-09-90, which asked the FAA to require HEMS operators to install flight data recording devices and establish a structured FDM program that reviews all available data sources to identify deviations from established norms and procedures and other potential safety issues.[58] On February 21, 2014, the FAA published a comprehensive final rule addressing many aspects of HEMS operations (NARA 2014). The final rule included 14 *CFR* 135.607, "Flight Data Monitoring System," which requires that a helicopter used in air ambulance operations conducted under Part 135 be equipped with an approved FDM system capable of recording flight performance data. However, the final rule did not require that all HEMS operators establish an FDM program. Pending such a requirement, on September 11, 2014, the NTSB classified Safety Recommendation A-09-90 "Open—Acceptable Response."

The NTSB believes that, as demonstrated by this and many other accidents, all Part 135 operators have the same need for FDM programs as Part 135 HEMS operators. Had an FDM program been in place at Execuflight, failure of either pilot to follow SOPs on earlier flights might have provided Execuflight the opportunity to take corrective action that could have avoided the accident. The NTSB concludes that operational FDM programs could provide Part 135 operators with objective information regarding the manner in which their pilots conduct flights and that a periodic review of such information could assist operators in detecting and correcting unsafe deviations from company SOPs. Therefore, the NTSB recommends that the FAA require all 14 *CFR* Part 135 operators to install flight data recording devices capable of supporting an FDM program. The NTSB further recommends that the FAA, after the action in Safety Recommendation A-16-34 is completed, require all 14 *CFR* Part 135 operators to establish a structured FDM program that reviews all available data sources to identify deviations from established norms and procedures and other potential safety issues.

2.4 Organizational Factors

The operator is the first line of defense against procedural noncompliance by setting a positive safety attitude for pilots to follow and establishing organizational protections. In this accident, Execuflight had defined protections in place, including reviewing the background of its incoming pilots, providing CRM training, and overseeing flight operations. However, as discussed in the following sections, these barriers were undermined by Execuflight's lack of compliance and inappropriate implementation.

2.4.1 Pilot Hiring

PRIA requires that, before allowing an individual to begin service as a pilot, a hiring air carrier must request, receive, and evaluate records from previous employers pertaining to that individual's performance as a pilot.[59] The purpose of a PRIA background check is to ensure that

[58] More information about Safety Recommendation A-09-90 can be found by accessing the Safety Recommendations link at www.ntsb.gov.

[59] According to the FAA, records related to pilot performance encompass those records of an activity or event specifically related to an individual's completion of the core duties and responsibilities of a pilot, as assigned by the employer and established by the FAA, to maintain safe aircraft operations. Records of disciplinary action arising out of the pilot's noncompliance with company policies unrelated to safe aircraft operations (for example, attendance, company dress codes, and other morality or behavior-based policies) are not the type contemplated by PRIA.

an air carrier has the information needed to make an informed decision about a pilot's professional competence before hiring that individual.

According to the president of Execuflight, who was responsible for hiring all company personnel, the captain's PRIA background check showed an "administrative issue" at his previous employer that was corrected, and his separation from the company was voluntary. However, this information was contrary to information that the captain's previous employer provided to the NTSB, which indicated that he was terminated due to his failure to attend scheduled recurrent training. Although PRIA did not require Execuflight to evaluate the captain's employment termination (because the reason did not pertain to his performance as a pilot), the conflicting information about the circumstances of the captain's termination suggests that Execuflight management did not conduct a thorough review of the captain's background.

The first officer's PRIA background check records that Execuflight provided indicated that the first officer was terminated by his previous employer due to "unsatisfactory work performance." The records included a letter from a check airman that detailed training difficulties that the first officer encountered during Boeing 737 ground school and simulator training. The president of Execuflight stated that he hired the first officer based on a recommendation from another pilot and a single flight he made with him. Regarding the first officer's PRIA records, the president stated that he did not "really home in on him" as he was hiring him as SIC.

The first officer's recent and extensive training difficulties were well documented by his previous employer, and this documentation was included in the PRIA records and should have alerted Execuflight to conduct a thorough evaluation of the first officer's abilities to operate as a pilot on their certificate. However, although Execuflight's chief pilot stated that he was aware of the first officer's training difficulties and that he was "terminated involuntarily" from his previous employer, no one from Execuflight contacted the previous employer to discuss the training issues identified by the check airman.

Since the FAA has left the responsibility of determining a pilot's professional competence solely with the operator hiring the pilot, it is important that the operator conduct a thorough examination of a pilot's background to ensure the pilot is prepared and qualified to safely operate an airplane under the operator's certificate. This is the primary reason PRIA was enacted. However, in this case, Execuflight's evaluation of the PRIA records it obtained for both the captain and the first officer was cursory. Although the captain's termination for failing to attend training was not related to his competence as a pilot, the first officer's recent training difficulties were substantial and should have raised concerns with Execuflight management about the first officer's competence. The NTSB concludes that because Execuflight did not fully evaluate the information it had concerning the first officer's significant training difficulties at his previous employer, the company missed an opportunity to determine if the first officer was fully capable of operating its airplanes safely.

2.4.2 Crew Resource Management Training

AC 120-51E details methods and characteristics of effective CRM training. According to the AC, the components of effective CRM include initial indoctrination/awareness, recurrent practice and feedback, and continual reinforcement. While Execuflight addressed CRM in the flight crew's initial training, no evidence exists that recurrent practice and feedback or continual reinforcement were part of the company's organizational practices.

Review of Execuflight's CRM training program, which the captain and first officer completed separately about 4 months before the accident, revealed that the content consisted of a cursory review of the topics required by 14 *CFR* 135.330(a). Much of the content was largely copied and pasted from AC 120-51E's Appendix 1, which discusses crew performance marker clusters. This appendix was provided to assist organizations with program and curriculum development; it was not designed as curriculum itself. In addition, the performance of the flight crewmembers on the CRM test was not appropriately assessed.

Upon completion of the training, each pilot was required to pass a 10-question test with an uncorrected score of 80%. The uncorrected grades recorded on the captain's and first officer's answer sheets were 100% and 80%, respectively. However, according to the answers provided in the CRM manual, the captain's and first officer's actual uncorrected scores were 40% and 70%, respectively. The chief pilot initialed both answer sheets, and a corrected grade was recorded on the first officer's answer sheet, indicating that the first officer received a review of the questions missed. However, no evidence exists that the captain received a review of the questions missed. The Execuflight chief pilot's apparent dismissal of the captain's CRM test results indicates a "check the box" approach by Execuflight to CRM training and minimizes the importance that CRM has in teamwork, communication, and safety. Areas of CRM in which the crewmembers were deficient according to their CRM test results included responsibilities of the PIC, flight deck management, and aeronautical decision-making. Significantly, the captain's errors during the flight were in these deficient areas, demonstrating that the CRM training the crewmembers received was ineffective.

Also, AC 120-51E emphasizes the importance of crewmembers training together; however, during simulator training, the captain was paired with a pilot from a different operator, and the first officer was paired with an instructor. As a result, neither pilot had the opportunity to practice CRM with another Execuflight pilot before flying revenue flights. Further, Execuflight did not use scenario-based training and line-oriented flight training, which are noted in the AC as effective ways to train and reinforce CRM. Finally, the company had no method of evaluating and providing feedback to improve CRM skills. The NTSB concludes that deficiencies in Execuflight's CRM training program, including the cursory review of CRM topics, the lack of appropriate evaluation of CRM examinations, and the lack of continual reinforcement of CRM principles, resulted in the flight crew receiving inadequate CRM training.

Although both pilots had recently completed Execuflight's CRM training program, their performance during the accident flight was inconsistent with the skills and knowledge associated with effective CRM. Effective CRM incorporates elements of communication, decision-making, team-building, workload management, and situation awareness skills that can be used to operate the aircraft appropriately and adhere to SOPs, including checklists and callouts. As previously described, both the captain and the first officer neglected numerous SOPs throughout the accident flight. Their actions revealed ineffective coordination and division of responsibility, failure to execute checklists and make callouts as required, and inadequate pilot briefings, all of which are indicative of poor CRM. In addition, neither the captain nor the first officer challenged the other on his noncompliance with SOPs, which is inconsistent with appropriate CRM practice. Therefore, the NTSB concludes that the flight crew did not demonstrate effective CRM during the accident flight.

2.4.3 Flight Operations Oversight

Not only did the flight crew consistently fail to follow SOPs during the accident flight, they also deviated from SOPs regarding preflight planning on the accident flight and all prior flights of the 2-day trip. Examples of these deviations include the lack of adherence to procedures on calculating passenger and baggage weights, filing alternate airports, and recording flight log information.

To ensure accuracy and verify that preflight planning was conducted properly by its pilots, the flight-locating procedures in the Execuflight GOM required that, before a flight was initiated, the operations management person on duty was to review weather, fuel, weight and balance, and verify that an appropriate flight plan was filed. When asked if he reviewed these items before the accident flight departed, Execuflight's chief pilot, who was the operations management person on duty at the time of the accident, stated that he was kept abreast of the airplane's movements through the "doors open" and "doors closed" text messages that he received from the crew. His answer implies that the chief pilot did not review the weather, fuel, weight and balance, and flight plan for the accident flight as required by company procedures; thus, there was no verification of the preflight planning for the accident flight or opportunity to correct mistakes made by the flight crew. Further, the NTSB found evidence indicating that Execuflight management's disregard for the preflight planning requirements in its flight-locating procedures was not limited to the accident flight.

A review of the Fltplan.com website records for the Execuflight account indicated that the weather page listing the MGY and AKR weather reports and forecasts was accessed at 0928 on the day of the accident. Because access to the website account was via a common user name, it is unknown who reviewed the weather page, but it was likely one of the accident pilots. When the Fltplan.com weather page was accessed, the TAF for CAK, located 8 mi south of AKR, called for 4 mi visibility in light drizzle and mist and an overcast ceiling of 700 ft agl at the estimated time of arrival into AKR. Further, the area forecast for northern Ohio as amended by AIRMET Sierra update 3, issued at 0945, called for ceilings less than 1,000 ft agl and visibility below 3 mi in mist and light precipitation.

Based on the CAK TAF and the AIRMET Sierra, an alternate airport was required to be filed on the flight plan for the accident flight. However, when the flight plan was filed at 1133, the captain did not file an alternate airport for the flight contrary to 14 *CFR* 135.223 requirements. Although it is not known what alternate airport the flight crew would have chosen had they complied with the requirements, even the most conservative fuel load estimate for the accident airplane (using the flight crew's planned fuel of 7,700 lbs) would have provided ample fuel for flight to multiple possible alternates (including a return to the departure airport, MGY) with the appropriate fuel reserves.

A review of the available past flight plans filed by the captain while operating as PIC for Execuflight between August 28, 2015, and November 10, 2015, revealed four other flights for which an alternate airport was required but not filed, including the flight before the accident flight from LUK to MGY. This indicated a recent history on the part of the captain of failing to file an alternate airport on a flight plan as required by federal regulations. In addition, the captain's history of failing to file an alternate airport when one was required indicates that Execuflight management had a history of failing to verify that an appropriate flight plan was filed before departure of each flight as required by company procedures.

Review of the Ultra-Nav printouts and the manifest forms for all the flights of the 2-day trip revealed multiple deviations from SOPs in the flight crew's preflight procedures, including the following:

- Instead of using actual weights when calculating weight and balance, the flight crew used a weight of 200 lbs for each passenger and a weight of 250 lbs for baggage on all flights of the 2-day trip, including the accident flight.
- The flight crew used a fuel weight of 7,700 lbs for the accident flight, but if the airplane's wing tanks were filled to capacity at MGY as the flight crew requested, the fuel weight used should have been 8,160 lbs.
- For all five legs of the 2-day trip before the accident flight, the weight-and-balance information on the Ultra-Nav printout did not match the weight-and-balance information entered on the flight log.
- The flight crew did not complete the flight log before departing on the accident flight.

Without the actual weights of each passenger and the baggage, it was not possible to accurately determine the weight of the airplane at takeoff from MGY. Estimates of the airplane's takeoff and landing weights were calculated using the correct basic empty weight, the same passenger and baggage weights used by the flight crew, a takeoff fuel weight of 7,860 lbs (8,160 lbs less 300 lbs taxi burn), and the same en route fuel burn used by the flight crew (1,500 lbs). The estimated takeoff weight of 23,786 lbs exceeded the flight's maximum takeoff weight (as limited by landing weight) of 23,500 lbs by 286 lbs, and the estimated landing weight of 22,286 lbs exceeded the airplane's maximum landing weight of 22,000 lbs by 286 lbs. An exceedance of this magnitude likely would not have had a significant effect on aircraft performance. The NTSB concludes that although the flight crew's multiple deviations from SOPs concerning weight and balance on each flight of the 2-day trip likely did not directly contribute to the accident, these deviations represent a pattern of routine disregard for SOPs.

The pattern of routine disregard for SOPs regarding preflight planning extended to Execuflight management. The flight crew's consistent use of 200 lbs for the weight of each passenger and 250 lbs for the weight of the baggage on all previous flights of the 2-day trip provided five opportunities before the accident flight for a manager reviewing the weight-and-balance calculations as required by company procedures to recognize that actual weights were not being used. However, no evidence exists that Execuflight management recognized or took any action to remedy this repeated disregard of company SOPs, just as they did not address the captain's multiple failures to file an alternate airport when one was required. The NTSB concludes that Execuflight's management had multiple opportunities to identify and correct the flight crew's routine disregard for SOPs regarding preflight planning but failed to do so.

A further instance of Execuflight's management neglecting to properly oversee its flight operations occurred during the first officer's last duty period before the accident trip. According to flight logs covering this duty period, on November 7 (3 days before the accident flight), the first officer came on duty at 1500 and flew the return leg of a 2-day trip, arriving at FXE at 2006. The first officer then immediately began an overnight trip, departing FXE at 2040. His last Part 135 flight on the overnight trip ended at 0715 on November 8. Upon completion of the flight at 0715, the first officer had only 7 hours 45 min of consecutive rest in the preceding 24 hours, which was below the 10 hours minimum consecutive rest required by both 14 *CFR* 135.267(d) and Execuflight's GOM. Although Execuflight's president asserted in sworn testimony that the first officer came on duty after the captain of the 2-day trip (at 1715 on November 7) and actually had 10 hours rest, the sworn testimony of the captain of the 2-day trip, hotel records, and a "doors closed" text message support the 7 hours 45 min of rest calculated from the flight logs.

Further, the captain of the overnight trip was Execuflight's chief pilot, and the operations management person on duty for the overnight trip was Execuflight's president. According to the sworn testimony of Execuflight's president, both the chief pilot and the president were aware of the potential failure to meet rest requirements if the first officer completed the overnight trip. Although the operations management person on duty was required by company procedures to ensure that each assigned pilot met rest requirements before the flight departed, the evidence suggests that neither the chief pilot nor Execuflight's president ensured that the first officer met the rest requirements of 14 *CFR* 135.267(d) before assigning him to fly the overnight trip.

The repeated deviations from sound operational practices identified in this investigation indicate a culture of complacency and disregard for rules, signifying the need for strong leadership and positive role models to reinforce a positive safety culture. SOPs were implemented as a countermeasure against human error; however, the efficacy of these initiatives is dependent on compliance (Helmreich 2000; Helmreich et al. 2001). A strong organizational safety culture embeds the importance of compliance with SOPs as a countermeasure against the occurrence of consequential human error that tends "to reduce the margin of safety and increase the probability of accidents or incidents" (ICAO 2002). Therefore, the NTSB concludes that Execuflight's casual attitude towards compliance with standards illustrates a disregard for operational safety, an attitude that likely led its pilots to believe that strict adherence to SOPs was not required.

2.4.4 Safety Management System

In addition to not rigorously following its own SOPs, Execuflight lacked an SMS, which has been recognized in the industry as an effective way to establish and reinforce a positive safety culture and identify deviations from SOPs so that they can be corrected. According to the FAA's website, "SMS is the formal, top-down business-like approach to managing safety risk, which includes a systemic approach to managing safety, including the necessary organizational structures, accountabilities, policies and procedures."[60] Although the FAA requires only

[60] More information can be found at www.faa.gov/about/initiatives/sms/faq.

14 *CFR* Part 121 air carriers to have an SMS, other sectors of the aviation industry are increasingly implementing SMS voluntarily.

The NTSB has investigated other recent Part 135 accidents where failures of organizational safety played a role. On February 14, 2014, a Cessna 210L, N732EJ, operated by Southern Seaplane, Inc., impacted terrain near Clay, Alabama, after the pilot lost control in night IMC.[61] The pilot and the passenger died, and the airplane was destroyed. The NTSB determined that contributing to the accident were the operator's inadequate dispatch procedures, which did not prevent the pilot from flying beyond his duty day, flying at night for which he was not current, or flying in IMC for which he was not qualified by the company.

On November 29, 2013, the pilot of a Cessna 208B, N12373, operated by Hageland Aviation, lost situational awareness in night IMC, resulting in controlled flight into terrain (CFIT) near St. Mary's, Alaska.[62] The pilot and three passengers died, and six passengers received serious injuries; the airplane sustained substantial damage. The NTSB determined that contributing to the accident were the operator's inadequate procedures for operational control and flight release and its inadequate training and oversight of operational control personnel.

The St. Mary's, Alaska, accident occurred 1 week after another accident involving the same operator in which a Beech 1900C, N575X, landed short of the runway in Deadhorse, Alaska, on November 22, 2013.[63] The NTSB again cited as contributing factors the operator's inadequate procedures for operational control and flight release and its inadequate training and oversight of operational control personnel. These are examples of numerous Part 135 accidents and incidents in which the NTSB has determined that inadequate operational safety oversight was a contributing factor. Each of these accidents may have been prevented if an SMS had been in place.

After the October 14, 2004, accident involving Pinnacle Airlines flight 3701, N8396A, in Jefferson City, Missouri, the NTSB issued Safety Recommendation A-07-10, which asked the FAA to require SMS programs for Part 121 operators (NTSB 2007a). This recommendation was classified "Closed—Acceptable Action" after the FAA's final rule requiring SMS programs for Part 121 air carriers was issued on January 8, 2015, and became effective on March 9, 2015. Because the benefits of SMS programs are not limited to Part 121 operators, the NTSB has also advocated for SMS programs for Part 91 business operators and Part 135 HEMS operators.

After the July 10, 2007, crash of a Cessna 310R, N501N, operated by the National Association for Stock Car Auto Racing under Part 91 in Sanford, Florida, the NTSB issued Safety Recommendation A-09-16, which asked the FAA to develop a SAFO encouraging all Part 91

[61] More information about this accident, NTSB case number ERA14FA120, can be found by accessing the Aviation Accident Database at www.ntsb.gov.

[62] More information about this accident, NTSB case number ANC14MA008, can be found by accessing the Aviation Accident Database at www.ntsb.gov.

[63] More information about this accident, NTSB case number ANC14LA007, can be found by accessing the Aviation Accident Database at www.ntsb.gov.

business operators to adopt SMS programs that include sound risk management practices.[64] The FAA addressed this recommendation by issuing Information for Operators message 11010 on April 11, 2011, and, on September 12, 2011, the NTSB classified the recommendation "Closed—Acceptable Action."[65] As the result of an increase in fatal HEMS accidents in 2008, the NTSB issued Safety Recommendation A-09-89, which asked the FAA to require all HEMS operators to implement SMS programs that include sound risk management practices.[66] In a September 24, 2014, response, the FAA stated that its goal was to require SMS for all Part 135 operators but that it did not have the resources to address a rule for SMS for HEMS operators at that time. Therefore, on December 5, 2014, the NTSB classified Safety Recommendation A-09-89 "Closed—Unacceptable Action."

When the FAA issued its final rule in January 2015 requiring SMS programs for 14 *CFR* Part 121 air carriers, the key requirements for an SMS were modularized in newly-created 14 *CFR* Part 5, "Safety Management Systems." In its final rule, the FAA stated that its intent in developing Part 5 was to establish a uniform standard that could be extended to apply to other operating parts, including Part 135 (NARA 2015). However, in the 20 months that have elapsed since Part 5 was established, the FAA still has not issued a notice of proposed rulemaking to address SMS for Part 135 operators.

The safety benefits of SMS programs have been demonstrated by Part 121 carriers and Part 135 HEMS operators who have voluntarily implemented SMS programs (Bergin 2013; Buckner 2013). Because Part 135 operations often involve carrying passengers for hire, the FAA is responsible for ensuring that Part 135 operators have adequate safety protections in place for the flying public. Accidents related to organizational culture are preventable, yet, as can be seen by this accident and the other Part 135 accidents mentioned above (Clay, Alabama; St. Mary's Alaska; and Deadhorse, Alaska), Part 135 accidents tied to operational safety issues are pervasive.

Rulemaking in this area is long overdue, given that fatal Part 135 accidents related to organizational culture continue to occur, that the FAA has created a modular set of requirements to support application of SMS rulemaking beyond Part 121 carriers, and that the FAA has previously stated its intent to expand SMS rulemaking to Part 135 operators. The NTSB concludes that SMS programs can benefit all 14 *CFR* Part 135 operators because they require the operators to incorporate formal system safety methods into their internal oversight programs. Therefore, the NTSB recommends that the FAA require all 14 *CFR* Part 135 operators to establish SMS programs.

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[64] More information about Safety Recommendation A-09-16 can be found by accessing the Safety Recommendations link at www.ntsb.gov.

[65] Information for Operators message 11010 encouraged general aviation (Part 91) operators "to incorporate Safety Management Systems as a standard business practice regardless of type of aircraft operated."

[66] More information about Safety Recommendation A-09-89 can be found by accessing the Safety Recommendations link at www.ntsb.gov.

2.5 Fatigue Evaluation

The NTSB evaluated a number of criteria, including recent sleep, sleep quality, and circadian factors, to determine whether the flight crewmembers were experiencing fatigue at the time of the accident.

2.5.1 Captain's Fatigue Evaluation

There was no evidence of circadian disruption, sleep disorders, or medical conditions for the captain that indicated poor sleep quality. His work schedule for the accident trip and his preceding trip complied with Part 135 rest requirements.

According to PED records, the captain had a sleep opportunity of about 9 hours on the night before the accident. However, during the second, third, and fourth nights before the accident, the captain's sleep opportunities were less than 6 hours 15 min each night. Although no data were available to establish the captain's normal amount of sleep need, if the captain required the amount recommended by the National Sleep Foundation (7 to 9 hours for adults ages 26 to 64), less than 6 hours sleep for 3 consecutive nights would constitute a sleep debt (Hirshkowitz 2015).

PED logs indicate that nap opportunities may have been available to the captain during the day on November 7 and 8 (3 and 2 days before the accident). However, even if these gaps in PED usage were used for naps, research suggests that fragmented sleep (which may be more likely during daytime naps) is less restorative than unfragmented sleep (Stepanski 2002). Further, although research suggests that well placed naps can improve alertness for up to 24 hours, any naps taken by the captain 2 to 3 days before the accident would likely not have affected his alertness on the day of the accident (Dinges et al. 1987). Also, if the captain had accumulated a sleep debt, research indicates that fatigue-related effects can linger after 1 night of near-normal recovery sleep such as that possibly experienced by the captain on the night before the accident (Sallinen et al. 2008; Belenky 2003; Van Dongen et al. 2003). However, because no data were available regarding the captain's normal sleep needs, the existence of a sleep debt at the time of the accident could not be determined.

The captain's behavior during the accident flight could have been consistent with the known effects of fatigue. For example, the captain's decision to allow the first officer to fly the airplane with revenue passengers aboard was contrary to common company practices and could indicate impaired decision-making. Additionally, his continued decisions not to take control of the aircraft from the first officer despite the first officer's failure to maintain proper airspeed and descent rate could indicate the inability to adapt behavior to accommodate new information. Although these actions may have been influenced by fatigue, they can also be attributed to other factors identified in this investigation such as poor CRM and procedural intentional noncompliance.[67] Further, the captain's lack of adherence to the company's SOPs was so pervasive that, even if fatigue were present, it was most likely not the only factor affecting his performance. The NTSB concludes that the captain's degraded performance during the flight was consistent

[67] FAA SAFO 07006 defines procedural intentional noncompliance as the deliberate failure to follow regulations, SOPs, and established company policy.

with the effects of fatigue, but insufficient evidence exists about his normal sleep needs to determine whether he was fatigued at the time of the accident.

2.5.2 First Officer's Fatigue Evaluation

There was no evidence of sleep disorders or medical conditions for the first officer that indicated poor sleep quality in the days before the accident. Although his work schedule for the accident trip complied with Part 135 rest requirements, as discussed in section 2.4.3, the flight logs for the first officer's preceding trips showed an insufficient rest period before an overnight trip on November 7.

According to the flight logs, the first officer did not have an opportunity to rest on the night of November 7, which could have led to fatigue caused by circadian disruption. The first officer's sleep opportunities on the nights of November 8 and 9 were ample and aligned with normal circadian rhythm, as they occurred during local night time; however, no data were available regarding the actual amount of time he spent sleeping within those periods.

It is possible that residual effects of fatigue due to circadian disruption can exist for days following the disruption (Gallo and Eastman 1993). PED usage data showed that during the day on November 8, the first officer had a maximum sleep opportunity of 7 hours 44 min; however, it was not continuous, as it was interrupted at its midpoint by the first officer sending a text message. Thus, the first officer's ability to get restorative sleep during this period would have been affected by both the challenge of obtaining sleep during the day and the interruption that resulted in fragmented sleep. In addition, the captain of the first officer's 2-day trip (on November 6 and 7) stated during sworn testimony that the first officer called him on the evening of November 8 and said that he was feeling fatigued from the overnight trip, which had ended early that day. Considering the circadian disruption due to the overnight trip on November 7, the fragmented rest period during the day on November 8, and the self-report of fatigue on November 8, the first officer was likely experiencing fatigue during the accident flight.

The first officer exhibited some behaviors consistent with fatigue, such as fixation and degradation of visual scan, difficulty reasoning as demonstrated by his confusion over the MDA, and poor performance on flying the aircraft to standards (Caldwell et al. 2004). Although these behaviors are consistent with the effects of fatigue, they are also consistent with the performance deficiencies that the first officer displayed during simulator training at his previous employer. Further, as with the captain, the first officer's behavior can also be attributed to other factors identified in this investigation, such as poor CRM and procedural intentional noncompliance. The NTSB concludes that, as a result of circadian disruption and Execuflight's improper crew scheduling that did not provide the first officer with adequate rest for his preceding trip, the first officer was likely experiencing fatigue; however, the extent to which fatigue contributed to his deficient performance on the accident flight could not be determined.

2.6 Operational Issues

2.6.1 Hawker 700A Nonprecision Approach Procedure

Although landings are authorized at flaps 25°, the normal landing flap configuration on the Hawker 700A is flaps 45°. For precision approaches (such as an ILS approach), Execuflight Hawker 700A procedures call for the pilot to select flaps 45° at glideslope intercept, which typically occurs when the airplane is above 1,000 ft agl, and fly the remainder of the approach at flaps 45° to landing. Precision approaches, therefore, do not require a flap configuration change as the airplane descends on the final segment of the approach. However, for nonprecision approaches (such as the accident approach), Execuflight Hawker 700A pilots are trained to use a step-down technique that does require a flap configuration change during the final segment of the approach. Descent is initiated at the FAF with flaps 25°, and, upon arrival at the MDA, the airplane is leveled off until it reaches the point of "runway assured." The pilot then selects flaps 45° and descends to the runway.

Since many nonprecision approaches, such as the AKR localizer 25 approach, have MDAs about 400 to 500 ft agl, the step-down technique entails a configuration change, accompanied by changes in pitch and power, when the airplane is well below 1,000 ft agl. Selecting flaps 45° in the Hawker 700A causes a nose-down change in pitch attitude and, because of the extra drag, an increase in rate of descent unless power is added. The NTSB notes that the accident pilots did not perform the accident approach as they were trained; rather, they selected flaps 45° before reaching the FAF, which further increased the difficulty of the step-down approach because it required them to maintain level flight with flaps 45° upon reaching the MDA.

Configuration changes below 1,000 ft agl are contrary to the definitions of a stabilized approach provided in AC 120-71A and AC 120-108. One of the criteria listed in AC 120-71A for an approach in IMC to be considered stabilized is that the airplane must be in the proper landing configuration from 1,000 ft height above touchdown to landing in the touchdown zone. AC 120-108 characterizes a stabilized approach as "maintaining a stable approach speed, descent rate, vertical flightpath, and configuration to the landing touchdown point" and states that the airplane should "depart the FAF configured for landing and on the proper approach speed, power setting, and flightpath." When questioned as to what constituted a stable approach, CAE Simuflite Hawker instructors provided varying definitions, some of which conflicted with the criteria listed in AC 120-71A.

The NTSB found that all Hawker 700A pilots receiving instruction at CAE Simuflite, FlightSafety, and SimCom, which are the three largest Part 142 training centers in the United States offering Hawker 700- and 800-series training, are being trained to conduct nonprecision approaches using the same step-down technique that Execuflight's pilots were taught. The NTSB concludes that the nonprecision approach procedure that many Hawker 700- and 800-series pilots are trained on does not meet the stabilized approach criteria published in AC 120-71A. Therefore, the NTSB recommends that the FAA, in conjunction with Textron Aviation and Hawker 700- and 800-series training centers, develop and incorporate into Hawker 700- and 800-series pilot training programs a nonprecision approach procedure that aligns with the stabilized approach criteria outlined in AC 120-71A and eliminates configuration changes at low altitudes.

Further, no definition of "runway assured" was found in the HS 125-700A Flight Manual, Execuflight GOM, Execuflight Training Manual, or Execuflight SOPs, and the Execuflight chief pilot and CAE Simuflite Hawker instructors provided various definitions for the term, ranging from when the runway was in sight to when the wheels touched down on the runway. Some of the definitions provided appeared to conflict with 14 *CFR* 91.175(c)(1), which states, regarding descending below the MDA, that no pilot may operate an airplane below the MDA unless it "is continuously in a position from which a descent to a landing on the intended runway can be made at a normal rate of descent using normal maneuvers, and for operations conducted under part 121 or part 135 unless that descent rate will allow touchdown to occur within the touchdown zone of the runway of intended landing." The NTSB concludes that many Hawker 700- and 800-series pilots are receiving inconsistent training regarding the meaning of "landing assured" that may conflict with the language of 14 *CFR* 91.175(c)(1). Therefore, the NTSB recommends that the FAA, in conjunction with Textron Aviation and Hawker 700- and 800-series training centers, develop and incorporate into Hawker 700- and 800-series pilot training programs a definition of the term "landing assured" that aligns with the language of 14 *CFR* 91.175(c)(1).

2.6.2 Continuous Descent Final Approach Technique

As described in section 1.12.2, CDFA is a specific technique for flying the final approach segment of a nonprecision instrument approach as a continuous descent, without level-off, from a specific altitude near the FAF to a point about 50 ft above the landing runway threshold. AC 120-108 recommends the use of CDFA in lieu of the step-down type of nonprecision approach that Execuflight pilots were trained to conduct, which can lead to unstabilized approaches because of multiple thrust, pitch, and altitude adjustments inside the FAF. As noted in the AC, the CDFA technique requires no specific aircraft equipment other than that specified by the nonprecision approach procedure, and, as noted by the International Civil Aviation Organization (ICAO), it minimizes the risk of unstabilized approaches and CFIT.[68]

The NTSB has long been a proponent of the CDFA technique for nonprecision approaches. After the November 12, 1995, crash involving American Airlines flight 1572, a McDonnell Douglas MD-80, N566AA, which struck trees while on approach to Bradley International Airport, in Windsor Locks, Connecticut, the NTSB issued Safety Recommendations A-96-128 and -132, which asked the FAA to develop, and encourage the use of, CDFAs for all airports served by commercial carriers. After the August 6, 1997, crash involving Korean Airlines flight 801, a Boeing 747-300, HL7468, at Nimitz Hill, Guam, on final approach to A.B. Won Guam International Airport, Agana, Guam, the NTSB issued Safety Recommendations A-00-11 through -14, which asked the FAA to address the equipment and training needed for CDFAs. The FAA

[68] ICAO Doc 8168, vol. I, part I, amendment 3, 1.7.1, states, "Studies have shown that the risk of controlled flight into terrain (CFIT) is high on non-precision approaches. While the procedures themselves are not inherently unsafe, the use of the traditional step down descent technique for flying non-precision approaches is prone to error, and is therefore discouraged. Operators should reduce this risk by emphasizing training and standardization in vertical path control on non-precision approach procedures. Operators typically employ one of three techniques for vertical path control on non-precision approaches. Of these, the continuous descent final approach (CDFA) technique is preferred. Operators should use the CDFA technique whenever possible as it adds to the safety of the approach operation by reducing pilot workload and by lessening the possibility of error in flying the approach."

took actions that satisfied these recommendations, and the NTSB classified them all "Closed—Acceptable Action" or "Closed—Acceptable Alternate Action."[69]

On October 19, 2004, the pilots of Corporate Airlines flight 5966, a British Aerospace Jetstream 32, N875JX, failed to follow established standard procedures during a nonprecision approach at night in IMC, including their descent below the MDA before required visual cues were available, which continued until the airplane struck trees near Kirksville, Missouri. The NTSB concluded that the use of a CDFA technique, with its resultant stabilized, moderate rate-of-descent flightpath and obstacle approach clearance, would have better positioned the accident airplane for a successful approach and landing. The NTSB issued Safety Recommendation A-06-8, which asked the FAA to require all Part 121 and 135 operators to incorporate the constant-angle-of-descent technique into nonprecision approach procedures and to emphasize the preference for that technique where practicable (NTSB 2006a).

On May 21, 2009, the FAA issued SAFO 09011, which recommended that Part 121 and 135 operators always use a constant-angle-of-descent stabilized approach technique when conducting nonprecision approaches. On January 20, 2011, the FAA issued AC 120-108 to promote the CDFA technique. On May 20, 2011, the FAA published a supplemental notice of proposed rulemaking (SNPRM), titled "Qualification, Service, and Use of Crewmembers and Aircraft Dispatchers," which proposed a requirement for Part 121 operators to train and incorporate the CDFA technique into their nonprecision approach procedures (NARA 2011).

On November 14, 2012, the NTSB indicated that it agreed with the FAA that if the final rule contained the proposed language in the SNPRM, it would satisfy Safety Recommendation A-06-08 regarding Part 121 operators and that SAFO 09011 satisfied the recommendation regarding Part 135 operators. Therefore, pending the issuance of a final rule as described in the SNPRM and a review of information confirming that SAFO 09011 has been widely adopted by Part 135 operators, the NTSB classified Safety Recommendation A-06-8 "Open—Acceptable Alternate Response." However, the final rule, which was published on November 12, 2013, did not contain any requirements regarding nonprecision approach techniques (NARA 2013).

On August 14, 2013, UPS flight 1354, an Airbus A300-600, N155UP, crashed short of runway 18 during a nonprecision localizer approach at night in IMC at Birmingham-Shuttlesworth International Airport, Birmingham, Alabama. Although the flight crew set up and briefed a CDFA approach, the flight crew executed a "dive and drive" approach. As a result of the investigation, the NTSB classified Safety Recommendation A-06-8 "Closed—Unacceptable Action/Superseded" and issued Safety Recommendation A-14-76, which asked the FAA to require POIs of Part 121, 135, and 91 subpart K operators to ensure that FAA-approved nonprecision instrument approach landing procedures prohibit "dive and drive" as defined in AC 120-108 (NTSB 2014b).

In a December 24, 2014, response, the FAA stated that although the CDFA technique was the preferred method for accomplishing a nonprecision approach, it "does not concur that operators should be prohibited from performing a dive and drive maneuver. In certain situations, primarily

[69] More information about Safety Recommendations A-96-128 and -132 and A-00-11 through -14 can be found by accessing the Safety Recommendations link at www.ntsb.gov.

dependent on weather conditions and runway alignment in combination with runway visibility, a dive and drive maneuver could benefit an operator." The FAA further stated that "dive and drive is prudent and safe when done correctly and under appropriate circumstances," and that it would take no further action to address Safety Recommendation A-14-76. On February 26, 2015, the NTSB classified Safety Recommendation A-14-76 "Closed—Unacceptable Action."

While the FAA has indicated that it favors the use of CDFA, the technique is only in guidance material (AC 120-108), and operators are not required to incorporate the information into their manuals. In this case, Execuflight training guidance did not specify the use of CDFA on nonprecision approaches, and, although several CAE Simuflite instructors indicated they may teach CDFA as a technique, no formal instruction on using the CDFA technique was provided to Execuflight pilots before the accident. After the accident, Execuflight voluntarily revised its training guidance and, on January 21, 2016, notified the FAA of its intent to require the use of CDFA on all nonprecision approaches conducted in Hawker 700- and 800-series airplanes and include CDFA in its approved training program for these airplanes.

The NTSB continues to believe that all air carriers should use CDFA and that the FAA must do more to ensure that operators incorporate the CDFA technique in their training and manuals and use it whenever possible. Based on the circumstances of this accident and many previous accidents, the NTSB concludes that despite the guidance in AC 120-108, many operators do not train their flight crews how to perform a CDFA and to use a CDFA whenever possible. Therefore, the NTSB recommends that the FAA require 14 *CFR* Part 121, 135, and 91 subpart K operators and 14 *CFR* Part 142 training centers to train flight crews in the performance and use of the CDFA technique as their primary means for conducting nonprecision approaches.

2.6.3 Accuracy of Data Entered into Weight-and-Balance Software

Execuflight pilots primarily computed their airplane's weight and balance by means of the Ultra-Nav software program, which required that an airplane's basic operating weight first be entered as a default weight. Entering the correct basic operating weight was critical since it included the weights of the required crew, their baggage, and other standard items such as meals and potable water. However, according to the Ultra-Nav printouts for the accident airplane, its current basic operating weight of 14,276.92 lbs was not used on the calculations for the accident flight or any of the previous flights during the 2-day trip. Instead, the flight crew used a default of the airplane's basic empty weight of 13,815 lbs. Because this weight did not include the weight of the required crew, their baggage, and other items typically included in the basic operating weight, the use of this weight resulted in an approximate 462-lb underestimate of the airplane's takeoff weight on each flight of the 2-day trip.

It is unclear who at Execuflight incorrectly entered the default basic operating weight into Ultra-Nav, as any crewmember who had access to the system could change the default. Once the erroneous entry was made, the chief pilot and the flight crew missed multiple opportunities to recognize and correct the error. The chief pilot did not recognize the error when the flight crew sent him the Ultra-Nav printout for each leg of the trip, and the flight crew did not recognize that their weight-and-balance calculations were based on an incorrect default entry.

Additionally, weight-and-balance documentation found at the accident site indicated an erroneous basic operating weight for the airplane of 13,976.92 lbs and indicated that the APU had been removed from the airplane. However, the APU had been reinstalled and was present at the accident site. When the maintenance on the APU was completed in February 2015, the documentation showing the 13,976.92-lb basic operating weight should have been replaced with documentation showing the actual basic operating weight of 14,276.92 lbs. The presence of the incorrect document on board the airplane meant that had the flight crew wanted to verify the default basic operating weight entered in the Ultra-Nav program using documentation on board the airplane, they would have done so using incorrect information. The NTSB concludes that Execuflight failed to ensure that correct weight-and-balance information was on board the airplane and entered into the company's weight-and-balance software, which resulted in the flight crew underestimating the airplane's takeoff weight on each flight of the 2-day trip. Although, as previously discussed in section 2.4.3, the incorrect weight-and-balance information did not adversely affect the airplane's performance during the accident flight, the NTSB is concerned that this type of error could have serious ramifications.

Software programs, such as Ultra-Nav, provide a useful tool for pilots to calculate weight-and-balance and performance information before flights. They help in eliminating errors when using charted information, save time, and reduce pilot workload during preflight planning. However, the information generated from these programs is only as good as the information first entered into the programs as defaults, and operators should regularly review their software program data to ensure that it contains the most current and accurate information for weight-and-balance calculations. Therefore, the NTSB recommends that the FAA issue a SAFO describing the circumstances of this accident and reminding operators to ensure that current and accurate information is entered into weight-and-balance software programs used in their operations.

2.7 Federal Aviation Administration Oversight

2.7.1 Oversight of Execuflight's Flight Operations

The POI's primary surveillance of Execuflight operations came from review of Execuflight manuals and the periodic 14 *CFR* 135.299 line checks he would conduct on Execuflight pilots. However, these line checks were not conducted during normal revenue operations, and the line-check flights conducted on Execuflight pilots typically remained local in the Florida area. More significantly, the Execuflight POI stated that he did not conduct en route inspections on Execuflight or any of the other Part 135 operations he oversaw.

FAA Order 8900.1, volume 6, chapter 2, section 9, "Safety Assurance System: Cockpit En Route Inspections," states, in part, the following:

> The primary objective of cockpit en route inspections is for an inspector to observe and evaluate the in-flight operations of a certificate holder within the total operational environment of the air transportation system. En route inspections are one of the Federal Aviation Administration's (FAA) most effective methods of accomplishing its air transportation surveillance objectives and responsibilities.

These inspections provide the FAA with an opportunity to assess elements of the aviation system that are both internal and external to an operator.

Regarding crewmember observations, the order states that inspectors should observe and evaluate the crew during each phase of flight, including an evaluation of crewmember adherence to approved procedures, proper use of all checklists, and adherence to sterile cockpit procedures. Specifically, regarding the approach phase of flight, the order states that "procedures used during the selected approach (instrument or visual) should be accomplished as outlined in the operator's maneuvers and procedures document" and lists the following 12 specific areas for inspectors to observe and evaluate:

1. Approach checklists
2. Approach briefings, as appropriate
3. Compliance with ATC clearances and instructions
4. Navigational tracking/heading and pitch control
5. Airspeed control, reference speed for final approach (V_{REF})
6. Flap and gear configuration schedule
7. Use of FD [flight director], autopilot, and autothrottles
8. Compliance with approach procedure
9. Sinkrates
10. Stabilized approach in the full landing configuration
11. Flightcrew callouts and coordination
12. Transition to visual segment, if applicable

Significantly, in this accident, the flight crew was deficient in 10 of the 12 areas, and the cumulative results were catastrophic.[70]

2.7.2 Oversight of Execuflight's Pilot Training

The FAA's oversight system did not identify or address the deficiencies in Execuflight's training that were discovered during this investigation. The FAA POI who had oversight responsibilities for Execuflight also oversaw 15 other certificates and characterized his workload as "very busy." He periodically conducted line and ramp checks and would "sample" flight manifest and training records. The POI had oversight responsibilities for Execuflight since

[70] The two areas in which deficiencies were not identified in this accident were "compliance with ATC clearances and instructions" and "use of FD, autopilot, and autothrottles."

May 24, 2004, yet had never been to CAE Simuflite in Dallas to observe Execuflight simulator training. He had also never observed Execuflight in-house training, including the basic indoctrination course and the CRM training. The POI was unaware that an audit of the Hawker 800XP training program for Execuflight pilots, required by Execuflight's operations specifications, was 1 year overdue until the NTSB advised him of the discrepancy.[71]

FAA Order 8900.1, volume 6, chapter 2, section 21, "Safety Assurance System: Training Program Inspections for Parts 121 and 135," provides direction and guidance to be used by POIs for conducting training program inspections. Section 21 states that "the inspector's objective is to ensure that the operator's training program complies with regulatory requirements and instructional methods are effective." It identifies five primary inspection areas to be observed: training curriculums, courseware, instructional delivery methods, testing and checking methods, and specific topics (identified from Program Tracking and Reporting Subsystem archived data or other sources).

The POI used the services of two CAE Simuflite training center evaluators to conduct checkrides on Execuflight pilots; the evaluators would inform the POI of the pass/fail outcomes from each Execuflight pilot checkride. However, monitoring pass/fail statistics does not constitute comprehensive oversight of an operator's training program or ensure that the operator's training program complies with regulatory requirements and that instructional methods are effective, as outlined in FAA Order 8900.1. The POI never observed simulator or in-house training at Execuflight and was not aware of the delinquent status of the operator's own training audit program for one of its fleets. In addition, as previously discussed, maintenance records for the accident airplane contained discrepancies (regarding documenting the removal and replacement of the APU), and the airplane's weight-and-balance records showed an incorrect basic operating weight.[72] Therefore, the NTSB concludes that the FAA failed to provide adequate oversight of Execuflight's pilot training, maintenance, and operations.

2.7.3 En Route Surveillance

En route inspections can enhance the FAA's oversight by providing an opportunity to observe the crew's use of SOPs outside of the training and checking environment.[73] The Execuflight POI relied primarily on line checks to conduct his operational oversight, yet line checks flown locally do not constitute the same evaluation of the operator within the total operational environment of the air transportation system as en route inspections during normal line operations. Although the FAA considers en route inspections one of its most effective assessment tools, the FAA does not require inspectors of Part 135 operators to accomplish this critical surveillance activity.

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[71] The operations specifications required Execuflight to conduct the recurring audits at least once every 24 months and present each audit evaluation to the POI for review and acceptance.

[72] The FAA's principal maintenance inspector assigned to Execuflight was responsible for the oversight of these documents.

[73] Unlike a 14 *CFR* 135.299 line check (which evaluates the pilot on a pass-fail basis, is documented in the pilot's training file, and must be administered by an approved check airman or FAA inspector), an en route inspection is an assessment tool that allows an FAA inspector to observe and assess the operation as a whole.

As a result of the East Coast Jets accident in Owatonna, Minnesota, on July 31, 2008, the NTSB issued Safety Recommendation A-11-30, which asked the FAA to require that Part 135 PIC line checks be conducted independently from other required checks and be conducted on flights that truly represent typical revenue operations (NTSB 2011a). In an August 8, 2013, response, the FAA stated that it had reviewed existing policy and guidance regarding PIC line checks and the implications on inspector workload of the recommended action. The FAA's review revealed that Part 135 flights can be sporadic and often occur long distances from FAA facilities. As a result, the FAA believed that the recommended action would be logistically problematic and would increase FAA workload without a corresponding improvement in safety. The FAA believed that current guidance to POIs on line checks was appropriate and planned no further action. On November 7, 2013, the NTSB classified Safety Recommendation A-11-30 "Closed—Unacceptable Action" because the FAA did not plan to address the safety problem identified in the accident. The NTSB concludes that this accident again shows that FAA guidance for POIs regarding conducting 14 *CFR* Part 135 PIC line checks on flights other than in regular revenue service is not effective in identifying pilots who are not complying with SOPs.

As a result of the October 25, 2002, crash of a Raytheon (Beechcraft) King Air A100 while attempting to land in Eveleth, Minnesota, on December 2, 2003, the NTSB issued Safety Recommendation A-03-51, which asked the FAA to conduct en route inspections and observe ground training, flight training, and proficiency checks at all Part 135 on-demand charter operations (NTSB 2003). In a November 20, 2008, response, the FAA stated that, although en route inspections are one of the most effective methods for surveillance of an operator, arbitrarily assigning a minimum number of en route inspections for all on-demand operations would not increase safety and would not be the best use of its resources. Instead, the FAA believed that it should prioritize surveillance activities of its inspectors by identifying weaknesses or potential safety risks in operator performance and allowing inspectors to apply the appropriate level of surveillance to any particular operator. The FAA developed the Surveillance Priority Index (SPI), a tool that provided a ranked order of assessed safety risks and was to be used as the basis for surveillance activities, identifying the amount of oversight and prioritizing the timing of surveillance required for a particular operator. The FAA proposed use of the SPI as an alternative action to address the recommendation.

On July 31, 2009, the NTSB replied that the plans to develop the SPI and require FAA Part 135 on-demand inspectors to use the SPI to prioritize their oversight activities, including en route surveillance, and to conduct at least one en route inspection annually for each on-demand operator, was an acceptable alternate response. The NTSB also asked that the FAA summarize the specific types of oversight activities conducted on Part 135 on-demand operators in the year before and the one after implementation of the SPI to learn how many en route inspections were conducted and the number of different operators for which at least one en route inspection was conducted. On August 4, 2010, the FAA published a change to Order 8900.1 that required FAA inspectors for Part 135 on-demand operators to use the SPI.

In an August 20, 2015, response, the FAA provided data regarding the number of Part 135 operators for which en route surveillance was conducted during fiscal years 2012, 2013, and 2014, and data regarding the number of collective times these operators were inspected. The FAA stated that it believed it had addressed Safety Recommendation A-03-51 and planned no further action. On November 19, 2015, the NTSB replied that, although the FAA had not supplied data documenting any changes in its oversight program for Part 135 on-demand operators as a result of implementing the SPI, the data it did supply showed that about 5% of all Part 135 operators received en route surveillance annually and that the number was declining each year. Consequently, the NTSB classified Safety Recommendation A-03-51 “Closed—Unacceptable Action.”

The Execuflight POI stated that he did not know what pilots did in normal operations since he only got to see them during their 14 *CFR* 135.299 line checks. Had the POI conducted en route inspections of Execuflight flights, the problems with failure to follow SOPs, CRM, and other required flight deck procedures may have been discovered and corrected before the accident occurred. The NTSB notes that the requirements in FAA Order 8900.1 for the POI to use the SPI existed before this accident occurred, yet the SPI did not identify the widespread noncompliance with SOPs at Execuflight. The NTSB concludes that this accident illustrates that the FAA’s SPI was ineffective in identifying 14 *CFR* Part 135 operators in need of increased surveillance.

In its August 20, 2015, response, the FAA had also indicated that it was implementing a new oversight system for Part 135, called the Safety Assurance System (SAS) and that SAS will replace the SPI. When this accident occurred, SAS had not been fully implemented for Part 135 operators. The NTSB concludes that the implementation of the SAS represents an opportunity to develop and use oversight procedures to identify and correct problems with failures of 14 *CFR* Part 135 operators to use SOPs. Therefore, the NTSB recommends that the FAA review the SAS and develop and implement procedures needed to identify 14 *CFR* Part 135 operators that do not comply with SOPs.

2.8 Cockpit Voice Recorder Maintenance Procedures

The 30-minute tape recovered from the CVR was not damaged or affected by impact forces or postcrash heat exposure; however, the quality of all recorded channels was poor. As a result, the transcript that was developed contained numerous fragmented phrases and passages where conversations were missing or unintelligible. Additionally, the poor quality of the recording precluded a sound spectrum study from extracting definitive engine speeds from recorded background frequencies. The poor quality of the CVR recording was due, in large part, to electrical interference, likely from the aircraft’s alternating current generator. This interference was likely the consequence of particular characteristics of the CVR installation and the age of the airplane. The CVR quality issue may have been detected via functional checks performed with the engines running or by downloading and reviewing CVR content from an actual flight. However, checks of the CVR performed without the engines running would have missed the problematic electrical interference.

The problem with poor quality CVR recordings that were not detected and corrected is not limited to this accident. Including this investigation, at least seven NTSB investigations in the last 10 years have identified problems with CVR quality. In the August 16, 2015, midair collision in San Diego, California, the poor CVR quality was likely due to the improper maintenance of the

CVR.[74] Without proper maintenance, either the erase head did not function as designed or the magnetic tape became overly worn, causing old content not to be erased before new content was recorded. The CVR quality issue may have been detected via more robust functional checks or by downloading and reviewing CVR content from an actual flight. In the other five cases noted in section 1.12.1, the inoperative CVR, inoperative components, or inoperative channels could have been detected with more robust maintenance, functional checks, or by downloading and reviewing CVR content from an actual flight.

The NTSB has previously issued recommendations concerning the need for CVR functional checks. As a result of its longstanding concerns about the availability of CVR information after reportable accidents and incidents, on August 29, 2002, the NTSB issued Safety Recommendation A-02-25, which asked the FAA to require that operators of airplanes equipped with CVRs implement daily CVR test procedures to test the functionality of the CVR system before the first flight of each day, as part of an approved aircraft checklist.[75]

On March 23, 2004, an Era Aviation Sikorsky S-76A++ helicopter, N579EH, crashed into the Gulf of Mexico about 70 nm south-southeast of Scholes International Airport, Galveston, Texas. The captain, copilot, and eight passengers died, and the helicopter was destroyed by impact forces. The investigation revealed that the helicopter's CVR had been improperly installed, and the functional check of the CVR after installation did not detect the faulty installation. As a result, on March 25, 2006, the NTSB classified Safety Recommendation A-02-25 "Closed—Superseded" and issued Safety Recommendation A-06-23, which asked the FAA to do the following:

> Require all operators of aircraft equipped with a cockpit voice recorder (CVR) to (1) test the functionality of the CVR before the first flight of each day as part of an approved aircraft checklist and (2) perform a periodic maintenance check of the CVR as part of an approved maintenance check of the aircraft. The CVR preflight test should be performed according to procedures provided by the CVR manufacturer and should include listening to the recorded signals on each channel to verify that the audio is being recorded properly, is intelligible, and is free from electrical noise or other interference. The periodic maintenance check of the CVR should include an audio test followed by a download and review of each channel of recorded audio. The downloaded recording should be checked for overall audio quality, CVR functionality, and intelligibility. (NTSB 2006b)

In a July 7, 2006, response, the FAA stated that it would issue a SAFO advising operators to test the functionality of the CVR before the first flight of each day, and on November 8, 2006, the FAA issued SAFO 06019. In a November 8, 2014, response, the FAA stated that Order 8900.1 requires all pilots of aircraft equipped with a CVR to test the function of the CVR before the first flight of each day as part of an approved aircraft checklist. The FAA also stated that it had revised

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[74] More information about this accident, NTSB case number WPR15MA243A/B, can be found by accessing the Aviation Accident Database at www.ntsb.gov.

[75] More information about Safety Recommendation A-02-25 can be found by accessing the Safety Recommendations link at www.ntsb.gov.

Order 8900.1, volume 4, chapter 14, section 9, paragraph 4-1553, subparagraph A, to state the following:

> A. Requirements of CVR Maintenance Procedures. The Avionics ASI [aviation safety inspector] is responsible for determining that the maintenance procedures ensure that tests are conducted according to procedures provided by the CVR manufacturer and shall include, at a minimum, listening to the recorded signals on each channel to verify that the audio is being recorded properly, is intelligible, and is free from electrical noise or other interference.

On December 12, 2014, the NTSB classified Safety Recommendation A-06-23 "Closed—Acceptable Action." The NTSB noted two FAA actions as supporting the closure status: (1) the issuance of SAFO 06019 and (2) the revision to Order 8900.1 that assigned the avionics inspector responsibility for ensuring that CVR maintenance procedures included listening to the recorded signals on each channel.

SAFO 06019 may have helped identify the accident airplane's CVR problem; however, Execuflight's POI indicated he was not familiar with the SAFO and that it was only a recommended action. Although the FAA indicated in SAFO 06019 that the POI is responsible for checking that approved aircraft checklists include a requirement for all pilots of aircraft equipped with a CVR to test the function of the CVR before the first flight of each day, Execuflight's POI appears to have been unaware of this requirement, and Order 8900.1 does not provide guidance similar to the SAFO for the POI.

Although Order 8900.1 states that the avionics inspector (in this case, the PAI) is responsible for determining that an operator's maintenance procedures ensure that tests are conducted according to procedures provided by the CVR manufacturer, Execuflight's PAI indicated that most CVR functional checks actually performed do not conform to the CVR manufacturer's procedures. In addition, although Order 8900.1 explicitly states that the functional check should ensure that the recorded signal "is free from electrical noise or other interference," Execuflight's PAI was unable to adequately perform this check and did not find the problem identified in this investigation: the loud tone of about 400 Hz and associated harmonics. The NTSB concludes that, had an adequate functional test of the CVR installed on the accident airplane been performed with the engines running or by downloading and reviewing CVR content from an actual flight, the poor quality of the CVR recording may have been detected and corrected.

On July 21, 2016, the FAA issued AC 20-186, "Airworthiness Operational Approval of Cockpit Voice Recorder Systems," which provides guidance for compliance with FAA regulations related to required CVR systems. The AC canceled AC 25.1457-1A, "Cockpit Voice Recorder Installations," dated November 3, 1969, which was in effect at the time of the accident. In its December 8, 2015, comments on the FAA's draft AC 20-186, the NTSB stated that despite the FAA's amendments to Order 8900.1 and its issuance of SAFO 06019, "the NTSB continues to receive CVRs that have supposedly passed operational tests using comprehensive self-test and automatic fault reporting but still have unusable audio content. The NTSB also continues to receive unusable audio content from CVRs that have passed maintenance functional tests; however, such tests did not include a download that would have confirmed proper operation." The NTSB also indicated that the new AC provided an opportunity to strengthen the guidance (1) for flight crews about performing robust operational tests by listening to recorded audio using existing CVR design features and (2) for operators about performing a robust functional test that specifically includes CVR download and review.

Had AC 20-186 been in effect before this accident, the quality problems with this CVR, may have been identified. Therefore, the NTSB recommends that the FAA review the problems with the quality of the CVR data in this accident to (1) determine why the problems were not detected and corrected before the accident, despite the requirements in FAA Order 8900.1 and the guidance in SAFO 06019, and (2) determine if the procedures in AC 20-186 would have ensured that the CVR problems were identified and corrected before the accident, and if not, revise AC 20-186 to ensure that such problems will be identified and corrected.

3. Conclusions

3.1 Findings

1. The flight crew was properly certificated and qualified in accordance with federal regulations and company requirements. No evidence was found indicating that the flight crew's performance was affected by toxins, alcohol or other drugs, or medical conditions.

2. Postaccident examination of the airplane found no evidence of any preimpact structural, engine, or system failures.

3. The air traffic controller's handling of the flight was not a factor in this accident.

4. As a result of the flight crew's failure to complete the approach briefing and the Approach checklist as per standard operating procedures, the captain and first officer did not have a shared understanding of how the approach was to be conducted.

5. Before the airplane reached the final approach fix, when the first officer reduced airspeed and placed the airplane in danger of encountering a stall, the captain should have taken control of the airplane or called for a missed approach, but he did not do so.

6. When the airplane reached the minimum descent altitude, the approach was not stabilized, and the captain should have called for a missed approach according to standard operating procedures, but he did not do so.

7. When attempting to arrest the airplane's descent, the first officer did not appropriately manage pitch and thrust control inputs to counter the increased drag from the 45° flap setting, which resulted in an aerodynamic stall.

8. The captain's failure to enforce adherence to standard operating procedures and his mismanagement of the approach placed the airplane in an unsafe situation that ultimately resulted in the loss of control.

9. The impact forces of the accident were survivable for some occupants, but the immediate and rapidly spreading postcrash fire likely precluded the possibility of escape.

10. Operational flight data monitoring programs could provide 14 *Code of Federal Regulations* Part 135 operators with objective information regarding the manner in which their pilots conduct flights, and a periodic review of such information could assist operators in detecting and correcting unsafe deviations from company standard operating procedures.

11. Because Execuflight did not fully evaluate the information it had concerning the first officer's significant training difficulties at his previous employer, the company missed an opportunity to determine if the first officer was fully capable of operating its airplanes safely.

12. The flight crew did not demonstrate effective crew resource management during the accident flight.

13. Deficiencies in Execuflight's crew resource management (CRM) training program, including the cursory review of CRM topics, the lack of appropriate evaluation of CRM examinations, and the lack of continual reinforcement of CRM principles, resulted in the flight crew receiving inadequate CRM training.

14. Although the flight crew's multiple deviations from standard operating procedures (SOPs) concerning weight and balance on each flight of the 2-day trip likely did not directly contribute to the accident, these deviations represent a pattern of routine disregard for SOPs.

15. Execuflight's management had multiple opportunities to identify and correct the flight crew's routine disregard for standard operating procedures regarding preflight planning but failed to do so.

16. Execuflight's casual attitude towards compliance with standards illustrates a disregard for operational safety, an attitude that likely led its pilots to believe that strict adherence to standard operating procedures was not required.

17. Safety management system programs can benefit all 14 *Code of Federal Regulations* Part 135 operators because they require the operators to incorporate formal system safety methods into their internal oversight programs.

18. The captain's degraded performance during the flight was consistent with the effects of fatigue, but insufficient evidence exists about his normal sleep needs to determine whether he was fatigued at the time of the accident.

19. As a result of circadian disruption and Execuflight's improper crew scheduling that did not provide the first officer with adequate rest for his preceding trip, the first officer was likely experiencing fatigue; however, the extent to which fatigue contributed to his deficient performance on the accident flight could not be determined.

20. The nonprecision approach procedure that many Hawker 700- and 800-series pilots are trained on does not meet the stabilized approach criteria published in Advisory Circular 120-71A.

21. Many Hawker 700- and 800-series pilots are receiving inconsistent training regarding the meaning of "landing assured" that may conflict with the language of 14 *Code of Federal Regulations* 91.175(c)(1).

22. Despite the guidance in Advisory Circular 120-108, many operators do not train their flight crews how to perform a continuous descent final approach (CDFA) and to use a CDFA whenever possible.

23. Execuflight failed to ensure that correct weight-and-balance information was on board the airplane and entered into the company's weight-and-balance software, which resulted in

the flight crew underestimating the airplane's takeoff weight on each flight of the 2-day trip.

24. The Federal Aviation Administration failed to provide adequate oversight of Execuflight's pilot training, maintenance, and operations.

25. This accident again shows that Federal Aviation Administration guidance for principal operations inspectors regarding conducting 14 *Code of Federal Regulations* Part 135 pilot-in-command line checks on flights other than in regular revenue service is not effective in identifying pilots who are not complying with standard operating procedures.

26. This accident illustrates that the Federal Aviation Administration's Surveillance Priority Index was ineffective in identifying 14 *Code of Federal Regulations* Part 135 operators in need of increased surveillance.

27. The implementation of the Safety Assurance System represents an opportunity to develop and use oversight procedures to identify and correct problems with failures of 14 *Code of Federal Regulations* Part 135 operators to use standard operating procedures.

28. Had an adequate functional test of the cockpit voice recorder (CVR) installed on the accident airplane been performed with the engines running or by downloading and reviewing CVR content from an actual flight, the poor quality of the CVR recording may have been detected and corrected.

3.2 Probable Cause

The National Transportation Safety Board determines that the probable cause of this accident was the flight crew's mismanagement of the approach and multiple deviations from company standard operating procedures, which placed the airplane in an unsafe situation and led to an unstabilized approach, a descent below minimum descent altitude without visual contact with the runway environment, and an aerodynamic stall. Contributing to the accident were Execuflight's casual attitude toward compliance with standards; its inadequate hiring, training, and operational oversight of the flight crew; the company's lack of a formal safety program; and the Federal Aviation Administration's insufficient oversight of the company's training program and flight operations.

4. Recommendations

To the Federal Aviation Administration:

Require all 14 *Code of Federal Regulations* Part 135 operators to install flight data recording devices capable of supporting a flight data monitoring program. (A-16-34)

After the action in Safety Recommendation A-16-34 is completed, require all 14 *Code of Federal Regulations* Part 135 operators to establish a structured flight data monitoring program that reviews all available data sources to identify deviations from established norms and procedures and other potential safety issues. (A-16-35)

Require all 14 *Code of Federal Regulations* Part 135 operators to establish safety management system programs. (A-16-36)

In conjunction with Textron Aviation and Hawker 700- and 800-series training centers, develop and incorporate into Hawker 700- and 800-series pilot training programs a nonprecision approach procedure that aligns with the stabilized approach criteria outlined in Advisory Circular 120-71A and eliminates configuration changes at low altitudes. (A-16-37)

In conjunction with Textron Aviation and Hawker 700- and 800-series training centers, develop and incorporate into Hawker 700- and 800-series pilot training programs a definition of the term "landing assured" that aligns with the language of 14 *Code of Federal Regulations* 91.175(c)(1). (A-16-38)

Require 14 *Code of Federal Regulations* (*CFR*) Part 121, 135, and 91 subpart K operators and 14 *CFR* Part 142 training centers to train flight crews in the performance and use of the continuous descent final approach technique as their primary means for conducting nonprecision approaches. (A-16-39)

Issue a safety alert for operators describing the circumstances of this accident and reminding operators to ensure that current and accurate information is entered into weight-and-balance software programs used in their operations. (A-16-40)

Review the Safety Assurance System and develop and implement procedures needed to identify 14 *Code of Federal Regulations* Part 135 operators that do not comply with standard operating procedures. (A-16-41)

Review the problems with the quality of the cockpit voice recorder (CVR) data in this accident to (1) determine why the problems were not detected and corrected before the accident, despite the requirements in Federal Aviation Administration Order 8900.1 and the guidance in Safety Alert for Operators 06019, and (2) determine if the procedures in Advisory Circular (AC) 20-186 would have ensured that the CVR problems were identified and corrected before the accident, and if not, revise AC 20-186 to ensure that such problems will be identified and corrected. (A-16-42)

To Textron Aviation:

Work with the Federal Aviation Administration and Hawker 700- and 800-series training centers to develop and incorporate into Hawker 700- and 800-series pilot training programs a nonprecision approach procedure that aligns with the stabilized approach criteria outlined in Advisory Circular 120-71A and eliminates configuration changes at low altitudes. (A-16-43)

Work with the Federal Aviation Administration and Hawker 700- and 800-series training centers to develop and incorporate into Hawker 700- and 800-series pilot training programs a definition of the term "landing assured" that aligns with the language of 14 *Code of Federal Regulations* 91.175(c)(1). (A-16-44)

To Hawker 700- and 800-series training centers:

Work with the Federal Aviation Administration and Textron Aviation to develop and incorporate into Hawker 700- and 800-series pilot training programs a nonprecision approach procedure that aligns with the stabilized approach criteria outlined in Advisory Circular 120-71A and eliminates configuration changes at low altitudes. (A-16-45)

Work with the Federal Aviation Administration and Textron Aviation to develop and incorporate into Hawker 700- and 800-series pilot training programs a definition of the term "landing assured" that aligns with the language of 14 *Code of Federal Regulations* 91.175(c)(1). (A-16-46)

BY THE NATIONAL TRANSPORTATION SAFETY BOARD

CHRISTOPHER A. HART
Chairman

ROBERT L. SUMWALT
Member

BELLA DINH-ZARR
Vice Chairman

EARL F. WEENER
Member

Adopted: October 18, 2016

Board Member Statement

Member Robert L. Sumwalt filed the following concurring statement on October 25, 2016.

I believe the organization that chartered this aircraft expected to get a professionally managed aircraft. I suspect they expected to get a professionally flown aircraft. And, I further believe they expected that when the regulator, the Federal Aviation Administration, issued an Air Carrier Certificate to Execuflight, they expected the FAA to provide adequate surveillance of Execuflight. Tragically, as this investigation found, those charter customers did not get what they expected or deserved in any of these respects. Their expectations were based on a house of cards that created an illusion of safety

The facts of this investigation revealed a litany of failures – both in the organization and in the cockpit.

Execuflight. The investigation found that Execuflight had a "casual attitude towards standards" and compliance. Further, the report noted, "The repeated deviations from sound operational practices identified in this investigation indicated a culture of complacency and disregard for rules…"

During a post-accident interview, Execuflight's sales agent, a 4 ½ -year employee of Execuflight, told investigators: "I think we're very safe. Our maintenance is great." (see *Interview Summaries*,[1] page 389). In spite of his belief, the investigation found otherwise. For example, the aircraft's weight and balance documents showed the APU was removed from the aircraft in December 2014. However, contrary to the requirements of FAA regulations, investigators found no notation in the aircraft maintenance records to denote removal of the APU. Maintenance records from February 2015 indicated the APU was removed and replaced on February 9, but the company then failed to amend the aircraft's weight and balance documents to reflect the added weight from the reinstallation. Although not causal to the accident, I believe this poor attention to detail regarding maintenance records is reflective of how Execuflight operated.

The company had no formalized method for employees to report safety concerns. When asked if pilots had the authority to refuse a flight, the CEO insisted they could, yet there were no written policies or guidelines to support this. Written policies, procedures, and guidelines are only useful if they are followed, and the investigation of this tragedy found Execuflight wasn't an organization that rigorously followed such rules. A few days prior to the accident, for example, Execuflight scheduled the first officer without the legally required rest period. The company did not follow their procedures for grading the accident pilots' CRM tests. And, despite each of the accident pilots being terminated from their previous employers, Execuflight did not do due diligence to determine the specifics of why they were terminated.

[1] Operational Factors Group Chairman's Report, Attachment 2 – FXE Interview Transcripts.

The illusion of safety continued. Execuflight's sales agent told investigators, "I would say, yes, we're are [*sic*] very top notch. ARGUS Gold, Wyvern Registered, very safe." His reference to ARGUS and Wyvern was that they had standing with two industry auditing organizations (see *Interview Summaries*, p. 389)

The pilots. There were multiple aspects of the accident flight that were substandard, and several of these were causal to the accident. The probable cause cited "the flight crew's mismanagement of the approach and multiple deviations from company standard operating procedures." Despite the entire approach being flown significantly below V_{ref} speed, the crew did not correct this critically urgent situation. That failure ultimately led to the crash when they allowed the aircraft to stall.

But being slow on final approach was not the only aspect of the crew's mismanagement of the flight. While descending below 10,000 feet, the crew failed to reduce speed to 250 knots, as required by regulations. They displayed a lax attitude toward conducting the approach briefing and checklists. Required callouts were not made, the approach was flown at the improper configuration, and the crew failed to discontinue an unstabilized approach. And, although not directly a factor in this accident, the investigation found the captain had a history of failing to designate an alternate airport when weather conditions required one. When viewed collectively, these performance failures painted a picture of a crew destined not for Akron, but for tragedy.

The NTSB and industry sources have found that failure to comply with procedures has been a factor in the vast majority of crashes over the past several decades. For example, a 1994 NTSB safety study of 37 crew-involved air carrier accidents found that procedural errors, such as not making required callouts or failing to use appropriate checklists, were found in 29 of the 37 reviewed accidents.[2] A Flight Safety Foundation study found that intentional crew non-compliance was a factor in 39.5% of the worldwide accidents they reviewed.[3]

Analysis of Line Operations Safety Audit (LOSA) data from over 16,000 line flights revealed that flight crewmembers who intentionally deviated from SOPs made, on average, three times more errors, mismanaged more errors, and found themselves in more undesired aircraft situations, compared with those flight crewmembers that did not intentionally deviate from procedures.

Conversely, following procedures has a positive effect on safety. A Boeing study analyzed 138 airline accidents that claimed 5,686 lives over a ten-year period. The study analyzed factors that could have prevented each accident. The most highly ranked accident

[2] NTSB. (1994). *Safety study: A review of flightcrew-involved, major accidents of U.S. air carriers, 1978 through 1990.* (NTSB Report No. NTSB/SS/94-01). Washington, DC: Author.

[3] Khatwa, R. & Helmreich, R. (1999). Killers in aviation: FSF task force presents facts about approach-and-landing and controlled-flight-into-terrain accidents. *Flight Safety Digest*. November 1998 – February, 1999. 17(11-12). pp. 1-77. Retrieved from http://flightsafety.org/fsd/fsd_nov-feb99.pdf

prevention strategy was following procedures, which could have prevented 48 percent of the accidents.[4]

Regulatory oversight. The Board found that contributing to the accident was "the Federal Aviation Administration's insufficient oversight of [Execuflight's] training program and flight operations." Due to funding limitations, the FAA's principal operations inspector (POI) assigned to Execuflight never visited Execuflight's training at Simuflite, and he was not aware that an internal Execuflight audit was one year overdue. Despite the deficiencies identified in this investigation, the POI told NTSB that Execuflight was a "very good operator." Once again, there was an illusion of safety.

Industry audits. Finally, I'm concerned that an organization that had so many safety-related issues could have an ARGUS Gold rating and be Wyvern Registered. Discriminating customers look to, and trust, such "seals of approval" when selecting their air travel provider. This is not the first time the NTSB has seen an organization pass an industry audit, only to find after an accident that there was an illusion of safety. In June 2007, a chartered Cessna 550 operated by Marlin Air crashed into Lake Michigan, claiming the lives of all six onboard. NTSB found egregious safety violations and deficiencies, including falsified training records, along with serious financial issues with Marlin Air. NTSB also found FAA failed to detect these training irregularities. Marlin Air possessed an ARGUS Gold rating.[5]

In another case, NTSB investigated a crash involving East Coast Jets at Owatonna, MN.[6] Issues similar to the Akron crash were found in that crash. The NTSB found that the captain of that flight "did not comply with well-designed procedures intended to minimize operational errors, including sterile cockpit adherence, and this atmosphere permitted inadequate briefing of the approach and monitoring of the current weather conditions, including the wind information on the cockpit instruments; inappropriate conversation; nonstandard terminology; and a lack of checklist discipline throughout the descent and approach phases of the flight." And similarly, NTSB determined that the FAA POI assigned to East Coast Jets was not sufficiently aware of East Coast Jets' training. At the time of the accident, East Costs Jets held an ARGUS platinum rating, the highest safety rating awarded to operators that successfully pass an ARGUS on-site safety audit.

Although not involving ARGUS, another case involved a Gulfstream G4 crash at Bedford, MA.[7] The investigation found the crew habitually failed to comply with preflight checks, having not performed a complete flight control check in 98 percent of the past 175

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[4] Weener, E. (1993, November). *Accident prevention strategies*. Paper presented at 46th Flight Safety Foundation / International Federation of Airworthiness International Air Safety Seminar, International Air Safety Seminar. Kuala Lampur, Malaysia.

5 Marlin Air Inc. Operational factors/human performance 14 - interview summaries, page 3. Retrieved from http://dms.ntsb.gov/pubdms/search/document.cfm?docID=304500&docketID=44492&mkey=65921

[6] NTSB. (2011). *Aircraft accident report: Crash during attempted go-around after landing, East Coast Jets Flight 81, Hawker Beechcraft Corporation 125-800A, N818MV, Owatonna, Minnesota, July 31, 2008.* (NTSB Report No. NTSB/AAR/11-01). Washington, DC: Author.

[7] NTSB. (2015). *Aircraft accident report: Runway Overrun During Rejected Takeoff, Gulfstream Aerospace Corporation G-IV, N121JM, Bedford, Massachusetts, May 31, 2014.* (NTSB Report No. NTSB/AAR/15-01). Washington, DC: Author.

flights. However, the organization had successfully undergone two IS-BAO audits and received glowing comments from the auditor about the quality of the organization.

I am very concerned these industry audits did not detect serious safety deficiencies. Customers rely on them to make their travel choices, and when audits fail to detect the very things they are designed to catch, it further bolsters an illusion of safety.

5. Appendixes

Appendix A: Investigation

The National Transportation Safety Board (NTSB) was initially notified of this accident on November 10, 2015. An investigator-in-charge from the Central Regional Office and investigators from NTSB headquarters in Washington, DC, traveled to the accident scene. The team was accompanied by Vice Chairman Bella Dinh-Zarr.

Investigators or investigative groups from the following disciplines participated: Operations, Human Performance, Aircraft Performance, Medical, Aircraft Systems, Aircraft Structures, Aircraft Powerplants, Maintenance Records, Air Traffic Control, Meteorology, and Cockpit Voice Recorder.

Parties to the investigation were the Federal Aviation Administration, Execuflight, Textron Aviation, Honeywell International, and the National Air Traffic Controllers Association.

Appendix B: Cockpit Voice Recorder Transcript

The following is a transcript of a Fairchild GA-100 tape cockpit voice recorder, serial number 00044, installed on an Execuflight British Aerospace HS 125-700A (N237WR), which crashed during approach at Akron Fulton International Airport (AKR) in Akron, Ohio.

LEGEND	
CAM	Cockpit area microphone voice or sound source
HOT	Flight crew audio panel voice or sound source
RDO	Radio transmissions from N237WR
AC-91S	Radio transmissions from aircraft registration ending in 91S
CTR-A	Radio transmission from an undetermined center controller
CTR-CLE	Radio transmission from the Cleveland center controller
CTR-INDY	Radio transmission from the Indianapolis center controller
APR-AKR	Radio transmission from the Akron approach controller
Wx-LHQ	Automated Weather Broadcast from Fairfield County Airport, Lancaster Ohio
Wx-AKR	Automated Weather Broadcast from Akron Fulton International Airport
EGPWS	Enhanced Ground Proximity Warning System
-1	Voice identified as the pilot
-2	Voice identified as the co-pilot
-3	Voice identified as a passenger
-?	Voice unidentified
*****	Unintelligible word
#	Expletive
@	Non-pertinent word
( )	Questionable insertion
[ ]	Editorial insertion

Note 1: Times are expressed in eastern standard time (EST).
Note 2: Generally, only radio transmissions to and from the accident aircraft were transcribed.
Note 3: Words shown with excess vowels, letters, or drawn out syllables are a phonetic representation of the words as spoken.
Note 4: A non-pertinent word, where noted, refers to a word not directly related to the operation, control or condition of the aircraft.

CVR Quality Rating Scale

The levels of recording quality are characterized by the following traits of the cockpit voice recorder information:

Excellent Quality Virtually all of the crew conversations could be accurately and easily understood. The transcript that was developed may indicate only one or two words that were not intelligible. Any loss in the transcript is usually attributed to simultaneous cockpit/radio transmissions that obscure each other.

Good Quality Most of the crew conversations could be accurately and easily understood. The transcript that was developed may indicate several words or phrases that were not intelligible. Any loss in the transcript can be attributed to minor technical deficiencies or momentary dropouts in the recording system or to a large number of simultaneous cockpit/radio transmissions that obscure each other.

Fair Quality The majority of the crew conversations were intelligible. The transcript that was developed may indicate passages where conversations were unintelligible or fragmented. This type of recording is usually caused by cockpit noise that obscures portions of the voice signals or by a minor electrical or mechanical failure of the CVR system that distorts or obscures the audio information.

Poor Quality Extraordinary means had to be used to make some of the crew conversations intelligible. The transcript that was developed may indicate fragmented phrases and conversations and may indicate extensive passages where conversations were missing or unintelligible. This type of recording is usually caused by a combination of a high cockpit noise level with a low voice signal (poor signal-to-noise ratio) or by a mechanical or electrical failure of the CVR system that severely distorts or obscures the audio information.

Unusable Crew conversations may be discerned, but neither ordinary nor extraordinary means made it possible to develop a meaningful transcript of the conversations. This type of recording is usually caused by an almost total mechanical or electrical failure of the CVR system.

TIME and SOURCE	INTRA-AIRCRAFT CONTENT	TIME and SOURCE	AIR-GROUND COMMUNICATION CONTENT
14:20:52 EST **START OF RECORDING** **START OF TRANSCRIPT**			
14:20:54.5 **HOT-?**	***.		
14:21:01.0 **HOT-?**	***.		
14:21:07.6 **HOT-1**	***.		
14:21:09.4 **HOT-2**	***.		
14:21:14.7 **HOT-2**	I-I (was) sayin' this it is going to be direct HUUVR and then direct destination. right?		
14:21:19.2 **HOT-1**	he doesn't want us to do the rest of the-ehh ***.		
14:21:25.2 **HOT-2**	one (nine) thousand. ***.		
14:21:34.7 **HOT-?**	***.		
14:21:51.9 **HOT-1**	well (so you're) climbing with V-S?		
14:21:55.0 **HOT-(2)**	I don't know. I was asking.		

TIME and SOURCE	INTRA-AIRCRAFT CONTENT	TIME and SOURCE	AIR-GROUND COMMUNICATION CONTENT
14:21:56.0 **HOT-1**	you have no **.		
14:21:57.6 **HOT-2**	right now I. I (fix) it.		
14:21:58.6 **HOT-1**	***.		
14:22:00.6 **HOT-2**	which one?		
14:22:01.7 **HOT-1**	whatever make you feel good. I mean you want to keep climbing with fifteen hundred feet per minute or two hundred and fifty knots.		
14:22:04.6 **HOT-2**	**.		
		14:22:07.1 **CTR-A**	Zipline fifteen twenty six contact Indy center one two four point four five. goodday.
		14:22:12.7 **RDO-1**	twenty four (forty) five Zipline fifteen twenty six.
14:22:44.7 **HOT-2**	we're gonna lev-- (yeah) we're gonna level off now so I'm not worried about that.		
14:22:49.4 **HOT-(2)**	you're going to do. capture.		

TIME and SOURCE	INTRA-AIRCRAFT CONTENT	TIME and SOURCE	AIR-GROUND COMMUNICATION CONTENT
14:22:53.3 **HOT-1**	***.		
14:22:55.9 **HOT-?**	***.		
14:22:58.5 **HOT-2**	unless you follow it all the time.		
14:23:00.8 **HOT-1**	** I understand what you're saying but I don't want to (ah) follow it.		
14:23:03.4 **HOT-1**	looks like its going to do it whatever it wants to do.		
14:23:06.4 **HOT-?**	***.		
		14:23:09.6 **RDO-1**	Center good morning Zipline fifteen twenty six with you out of sixteen thousand three hundred ah for one (seven) thousand.
		14:23:16.0 **CTR-INDY**	Zipline fifteen twenty six Indy Center. Columbus altimeter three zero zero three.
		14:23:21.3 **RDO-1**	three zero zero three. ***.
14:23:27.0 **HOT-1**	yeah * must. ***. you know. **. like.		

TIME and SOURCE	INTRA-AIRCRAFT CONTENT	TIME and SOURCE	AIR-GROUND COMMUNICATION CONTENT
14:23:32.1 **HOT-?**	I know. ** too.		
14:24:24.3 **HOT-1**	you can speed it up. a little bit.		
14:24:27.5 **HOT-?**	***.		
14:24:35.1 **HOT-?**	***.		
		14:24:37.4 **CTR-INDY**	** my frequency one two four point four five.
14:24:38.0 **HOT-?**	***.		
		14:24:44.7 **RDO-1**	one two four forty five Zipline fifteen twenty six.
		14:24:48.1 **CTR-INDY**	Zipline fifteen twenty six say again.
		14:24:51.5 **RDO-1**	and ah I thought you were talking to me. *. I'll-I'll stay with you one ***.
		14:24:55.3 **CTR-INDY**	Zipline fifteen twenty six (thank you).
14:25:01.5 **HOT-?**	***.		

TIME and SOURCE	INTRA-AIRCRAFT CONTENT	TIME and SOURCE	AIR-GROUND COMMUNICATION CONTENT
14:25:14.4 **HOT-2**	that's another thing I don't under-- I don't understand. we have all these fuel flow indications. but we don't have like a either a fuel pressure or something. * extra (assurances) fuel is actually going **.		
14:25:32.8 **HOT-1**	**.		
14:25:34.2 **HOT-2**	** fuel pressure. will be. will be. *.		
14:25:41.2 **HOT-1**	yeah. *		
14:25:43.8 **HOT-2**	yeah. *.		
14:25:54.1 **HOT-1**	* eight hundred. (just) a fuel pressure.		
14:25:55.5 **HOT-2**	eight hundred probably. but here you-you know.		
14:25:59.5 **HOT-2**	the only thing that you know that the engine is running. so you know that you are good. (otherwise).		
14:26:01.4 **HOT-1**	[chuckle] right.		
14:26:06.0 **HOT-1**	(here) you have radio number one.		

TIME and SOURCE	INTRA-AIRCRAFT CONTENT	TIME and SOURCE	AIR-GROUND COMMUNICATION CONTENT
14:26:08.5 **HOT-2**	number one is mine.		
		14:26:09.0 **Wx-LHQ**	visibility one zero. sky condition overcast one thousand one hundred. temperature zero niner Celsius. dewpoint zero seven Celsius. altimeter three zero zero four. remarks. density altitude three hundred. Fairfield County airport Lancaster Ohio. automated weather observation one niner two six zulu. wind two niner zero at zero seven. visibility one zero. sky condition broken one thousand one hundred. overcast one thousand eight hundred. temperature zero niner Celsius. dewpoint zero--.
14:26:56.1 **HOT-1**	we got ah....we got ah. broken one thousand one hundred. overcast one thousand eight hundred. visibility more than ten miles. (kilometers) I'm sorry.		
14:27:11.7 **HOT-?**	so we got go out **.		
14:27:14.1 **HOT-2**	** do me a favor. put (on) the flight plan the point from the localizer.		
14:27:19.0 **HOT-2**	so we're going to fly it ah eventually hopefully (navigation).		
14:27:27.8 **HOT-2**	** two thousand six hundred. ***. I'll let you brief it to me. **.		
14:27:56.0 **HOT-?**	***.		

TIME and SOURCE	INTRA-AIRCRAFT CONTENT	TIME and SOURCE	AIR-GROUND COMMUNICATION CONTENT
14:28:11.8 **HOT-1**	okay. we got the weather. overcast so we (gonna be) runway twenty--		
14:28:17.2 **HOT-2**	(breaking out).		
		14:28:19.2 **Wx-LHQ**	--information one niner two seven zulu. wind two niner zero at seven. visibility one zero. sky cond--
14:28:23.6 **HOT-?**	**.		
14:28:27.9 **HOT-(1)**	localizer runway two **.		
14:28:32.3 **HOT-1**	(that's what the) briefing (is).		
14:28:37.7 **HOT-1**	twenty six eighty two.		
14:28:43.1 **HOT-?**	***.		
14:28:46.5 **HOT-2**	so we were listening at ah--		
14:28:48.5 **HOT-1**	we were listening ***.		
14:28:53.3 **HOT-1**	(there) is only one runway we (should) use.		

TIME and SOURCE	INTRA-AIRCRAFT CONTENT	TIME and SOURCE	AIR-GROUND COMMUNICATION CONTENT
14:28:55.0 **HOT-2**	yeah.		
14:28:55.5 **HOT-2**	I would say localizer by the winds that they have on the forecast it would be runway two. the localizer.		
14:29:03.4 **HOT-1**	why what's the localizer. one one ten?		
14:29:09.1 **HOT-2**	one one zero decimal niner.		
14:29:12.7 **HOT-1**	final course? final course?		
14:29:18.7 **HOT-1**	(is a).		
14:29:19.4 **HOT-2**	***.		
14:29:20.9 **HOT-1**	two...forty...nine.		
		14:29:30.2 **CTR-INDY**	Zipline fifteen twenty six cross HUUVR niner thousand. Columbus altimeter three zero zero six.
		14:29:36.0 **RDO-1**	HUUVR at niner thousand Zipline fifteen twenty six.
14:29:39.1 **HOT-1**	HUUVR at (nine thousand) * we are fifty miles out.		

TIME and SOURCE	INTRA-AIRCRAFT CONTENT	TIME and SOURCE	AIR-GROUND COMMUNICATION CONTENT
14:29:44.9 **HOT-2**	fifty miles to HUUVR and we are doing ah three hundred. ah five miles per minute.		
14:29:51.3 **HOT-1**	if it--		
14:29:51.5 **HOT-2**	four minutes we should lose how much?		
14:29:55.3 **HOT-1**	** at this point. we wanted to cross at (nine) thousand.		
14:29:58.8 **HOT-2**	(nine) thousand feet.		
14:30:00.1 **HOT-1**	yeah.		
14:30:00.5 **HOT-1**	you know what we can (start shallow).		
14:30:03.0 **HOT-2**	yeah. (we'll) start shallow. and put it on the (right). *.		
14:30:10.2 **HOT-1**	then remember. you're not going anywhere.		
14:30:14.7 **HOT-?**	(nine) thousand. right?		
14:30:18.5 **HOT-1**	now ** whatever he wants to do **.		

TIME and SOURCE	INTRA-AIRCRAFT CONTENT	TIME and SOURCE	AIR-GROUND COMMUNICATION CONTENT
14:30:24.3 **HOT-?**	** press ** look ***.		
14:30:32.9 **HOT-?**	***.		
14:30:46.8 **HOT-?**	*.		
14:30:50.0 **HOT-?**	*** gotta be.		
14:30:55.5 **HOT-?**	***.		
14:31:03.3 **HOT-?**	twenty miles. HUUVR twenty miles. ***.		
14:31:13.1 **HOT-?**	***.		
14:31:17.0 **HOT-1**	oh yeah. we're ***.		
14:31:25.5 **HOT-?**	** you're right ***.		
14:31:41.9 **HOT-1**	so we're going to have a layover here for like three hours *.		
		14:32:17.6 **CTR-INDY**	Zipline fifteen twenty six contact Cleveland Center one three four point niner.

TIME and SOURCE	INTRA-AIRCRAFT CONTENT	TIME and SOURCE	AIR-GROUND COMMUNICATION CONTENT
		14:32:22.5 **RDO-1**	three four point nine Zipline fifteen twenty six. bye-bye.
		14:32:31.0 **RDO-1**	Cleveland Center good morning. Zipline fifteen twenty six with you one four thousand down to nine thousand.
		14:32:36.7 **CTR-CLE**	Zipline fifteen twenty six. Cleveland Center. Akron-Canton altimeter two niner niner five.
		14:32:42.1 **RDO-1**	niner niner five. **.
14:32:44.6 **HOT-1**	(one) (nine) ***.		
14:32:54.0 **HOT-2**	okay so we have the localizer two in there (right?).		
14:32:57.3 **HOT-2**	I mean ah localizer two five. alright.		
14:33:00.8 **HOT-2**	*** we got the inbound. (how's it gonna be). three thousand...		
14:33:07.4 **HOT-1**	(three thousand).		
14:33:08.3 **HOT-2**	...then can go to twenty three.		
14:33:09.1 **HOT-2**	now we got to change the places. * because ** direct **.		

TIME and SOURCE	INTRA-AIRCRAFT CONTENT	TIME and SOURCE	AIR-GROUND COMMUNICATION CONTENT
14:33:16.5 **CAM-3**	you guys know where you're goin'? you know where you're goin'?		
14:33:20.5 **HOT-1**	[laughter]		
14:33:21.5 **HOT-2**	actually. (I'll let) you be here for a couple of minutes. then you gotta go. because there gonna be weather. we cannot be distracted.		
14:33:24.9 **CAM-3**	okay.(you guys). I'm just joking. we're going into Akron-Fulton right?		
14:33:31.8 **HOT-(1or2)**	yep.		
14:33:32.9 **CAM-3**	**.		
14:33:38.8 **HOT-2**	okay. so we go down twenty three. then down to (what's the minimums?).		
14:33:44.8 **HOT-1**	four seventy three.		
14:33:46.7 **HOT-2**	four seventy three.		
14:33:48.3 **HOT-1**	(let's) do four eighty.		

TIME and SOURCE	INTRA-AIRCRAFT CONTENT	TIME and SOURCE	AIR-GROUND COMMUNICATION CONTENT
14:33:52.7 **HOT-2**	then we're gonna put the missed approach.		
14:33:55.1 **HOT-1**	what's the missed approach?		
14:34:02.0 **HOT-?**	three thousand.		
14:34:03.7 **HOT-?**	okay what we do.		
14:34:05.4 **HOT-1**	climb to three thousand. via two forty three ** outbound ***.		
14:34:22.8 **HOT-2**	alright. so we gotta. we're gonna have to. ***. all we have to do is a go to the eh the missed approach. okay so we go three thousand runway heading *** the radial. ***.		
14:34:38.3 **HOT-1**	*** (RITZS) intersection. ***		
14:34:41.5 **HOT-?**	roger.		
14:34:46.4 **HOT-2**	we gotta get that radial. to go to ***--		
14:34:48.5 **HOT-1**	I'll do that.		
14:34:49.3 **HOT-1**	* that's good. that's good.		

TIME and SOURCE	INTRA-AIRCRAFT CONTENT	TIME and SOURCE	AIR-GROUND COMMUNICATION CONTENT
14:34:51.8 **HOT-(1)**	that's exactly what we want to do.		
14:34:54.2 **HOT-2**	so two forty nine. three thousand feet. good. then you. then we put the-the eh V-O-R.		
14:35:07.2 **HOT-1**	**.		
14:35:09.8 **HOT-2**	**.		
14:35:12.0 **HOT-1**	**.		
14:35:14.5 **HOT-2**	**.		
14:35:15.9 **HOT-(1)**	* radial there*.		
14:35:17.0 **HOT-2**	go inbound on the-on the three twenty two. which is ah ***.		
14:35:28.3 **HOT-2**	okay?		
14:35:29.8 **HOT-?**	okay I think. **.		
14:35:31.0 **HOT-?**	**.		

TIME and SOURCE	INTRA-AIRCRAFT CONTENT	TIME and SOURCE	AIR-GROUND COMMUNICATION CONTENT
14:35:32.7 **HOT-1**	(ATIS is)?		
14:35:34.2 **HOT-2**	I gotta. I gotta get **.		
14:35:36.1 **HOT**	[unintelligible discussion between 1 and 2]		
14:35:59.6 **HOT-2**	the overcast is ah is ah ground. from the ground the overcast. right? so.		
14:36:06.2 **HOT-2**	** from the overcast ah the (minima) is four seventy five. so we should come out at eight hundred. and we should have four hundred feet to go to it.		
14:36:17.0 **HOT-?**	(the overcast is ground).		
14:36:19.0 **HOT-?**	(from the ground).		
14:36:19.7 **HOT-?**	**.		
14:36:20.3 **HOT-?**	yeah.		
14:36:21.6 **HOT-1**	no **. the report.		

TIME and SOURCE	INTRA-AIRCRAFT CONTENT	TIME and SOURCE	AIR-GROUND COMMUNICATION CONTENT
14:36:24.1 **HOT-2**	no no no.		
14:36:26.9 **HOT-2**	*** the minima for this approach fifteen twenty.		
14:36:33.3 **HOT-2**	(unless. unless you're high. fifteen sixty).		
14:36:36.2 **HOT-2**	which is ground. where is the ground. five oh one right? *.		
14:36:42.8 **HOT-2**	now. if the overcast is eight hundred. *.		
14:36:43.9 **HOT-1**	(one thousand to the level).		
14:36:45.9 **HOT-2**	if we had *** overcast. ***. then we have three hundred feet to minimums.		
14:36:51.9 **HOT-?**	**.		
14:37:02.6 **HOT-?**	** you know what I'm sayin'.		
14:37:04.9 **HOT-?**	yeah. *. *. *.		
14:37:06.7 **HOT-1**	the report is. is. ***.		

TIME and SOURCE	INTRA-AIRCRAFT CONTENT	TIME and SOURCE	AIR-GROUND COMMUNICATION CONTENT
14:37:09.7 **HOT-2**	yeah I understand. but we can shoot it. we can shoot because the overcast * reporting * eight hundred. ***.		
14:37:19.2 **HOT**	[unintelligible dialogue between the pilots]		
14:37:32.7 **HOT-2**	the cloud base is from the ground. from the ground do we get minimums for us.		
14:37:37.1 **HOT-1**	still. we get ***.		
14:37:38.2 **HOT-2**	**.		
		14:37:39.2 **Wx-AKR**	--three seven zulu. wind two four zero at zero eight. visibility one and one (half). sky condition overcast-- [interrupted by pilot 2 responding to radio call] -- Celsius. dewpoint zero niner Celsius altimeter two niner niner-- [interrupted by pilot 2 responding to radio call] -- density altitude niner hundred. Akron Fulton International Airport automated weather observation-- [interrupted by pilot 2 responding to radio call]-- two four zero at zero eight. visibility one and one half mist. sky condition -- [interrupted by pilot 2 responding to radio call]-- altimeter two niner niner five. remarks-- [interrupted by pilot 2 responding to radio call]-- density altitude niner hundred. Akron Fulton International Airport automated weather observation one niner three eight zulu. wind two four zero at zero eight. visibility one and one half mist. sky condition overcast six hundred broken. temperature one one Celsius. dewpoint zero niner Celsius. altimeter two niner niner five. remar--

TIME and SOURCE	INTRA-AIRCRAFT CONTENT	TIME and SOURCE	AIR-GROUND COMMUNICATION CONTENT
		14:37:44.6 **CTR-CLE**	Zipline fifteen twenty six contact Akron-Canton approach one one eight point six.
		14:37:49.1 **RDO-2**	one one eight point six ahhh Zipline fifteen twenty six.
		14:37:59.2 **RDO-2**	and Akron Approach ah good afternoon. Zipline fifteen twenty one. we are ah (ten) thousand over HUUVR.
		14:38:08.9 **APR-AKR**	sorry. I was (on the landline). * that Zipline fifteen twenty six calling?
		14:38:12.9 **RDO-2**	** over HUUVR nine thousand feet. we are inbound at this time.
		14:38:17.4 **APR-AKR**	Zipline fifteen twenty six fly heading zero six five vector localizer two five final approach course (vector). advise (when you have) weather.
		14:38:24.9 **RDO-2**	* heading zero six five for now. we are in the process of copying the weather. ah maintaining nine thousand. Zipline one five two six.
		14:38:32.6 **APR-AKR**	Zipline one five two six descend at pilot's discretion. maintain fife thousand.
		14:38:37.3 **RDO-2**	P-D five thousand. ah fifteen twenty six. roger.

TIME and SOURCE	INTRA-AIRCRAFT CONTENT	TIME and SOURCE	AIR-GROUND COMMUNICATION CONTENT
		14:38:41.6 **Wx-AKR**	--density altitude niner hundred. Akron Fulton International Airport automated weather observation one niner three eight zulu. wind two four zero at zero eight. visibility one and one (half) mist. sky condition overcast six hundred *. temperature one one Celsius. dewpoint zero niner Celsius. altimeter two niner niner five.
14:38:44.6 **CAM**	[sound of decreased background noise, similar to power reduction]		
14:38:48.8 **HOT-?**	***.		
14:39:17.0 **HOT-1**	we got. two four zero at eight.		
14:39:20.5 **HOT-2**	(that's what I got).		
14:39:22.4 **HOT-1**	one and half mile visibility. overcast at six hundred.		
14:39:26.9 **HOT-2**	and ah what visibility does this approach want?		
14:39:31.8 **HOT-1**	one and three quarter. ah. (us). one and half.		
14:39:35.9 **HOT-2**	* one and. one mile.		

TIME and SOURCE	INTRA-AIRCRAFT CONTENT	TIME and SOURCE	AIR-GROUND COMMUNICATION CONTENT
14:39:38.8 **HOT-1**	okay. one and.		
14:39:39.8 **HOT-2**	one and a half.		
14:39:40.7 **HOT-1**	alright we are visibility we got it.		
14:39:42.7 **HOT-2**	and.		
14:39:44.4 **HOT-1**	yeah but overcast six hundred.		
14:39:46.6 **HOT-2**	like I say *** from the ground. and the and the minima is five hundred ground.		
14:39:52.6 **HOT-1**	okay. listen. focus. ** we are going down to five thousand right.		
14:39:57.2 **HOT-2**	yeah.		
14:40:01.5 **HOT-2**	no. let it-let it go.		
14:40:03.6 **HOT-1**	it will be doing whatever they want to do. to support speed or.		

TIME and SOURCE	INTRA-AIRCRAFT CONTENT	TIME and SOURCE	AIR-GROUND COMMUNICATION CONTENT
14:40:08.0 **HOT-2**	yah. yah. I'm going I'm gonna drive it with the. let me show you now. *.		
14:40:13.6 **HOT-1**	I know what you mean. and now you were doing it to ***. we discussed everything ***.		
14:40:25.0 **HOT-1**	did you do my approach (brief). *** (we gotta go somewhere else right). ***.		
14:40:34.2 **HOT-1**	* if you say that. I might be wrong. I'm not sure.		
14:40:37.9 **HOT-2**	***.		
14:40:39.9 **HOT-1**	I might be wrong. but.		
14:40:41.1 **HOT-2**	(** shoot it).		
14:40:44.8 **HOT-2**	(okay). we're almost there.		
14:40:49.2 **HOT-1**	***.		
14:40:51.9 **HOT-2**	***.		

TIME and SOURCE	INTRA-AIRCRAFT CONTENT	TIME and SOURCE	AIR-GROUND COMMUNICATION CONTENT
14:41:00.1 **HOT-1**	**. R-NAV or.		
		14:41:03.0 **APR-AKR**	* nine one (sierra charlie) ** two two zero. intercept the localizer.
14:41:03.7 **HOT-2**	localizer. he said we going to do a get. expect the localizer.		
14:41:08.8 **HOT-2**	***. the minima is five hundred and ten. *** minima.		
14:41:14.8 **HOT-1**	localizer?		
14:41:15.7 **HOT-2**	yeah.		
14:41:16.0 **HOT-1**	(good).		
14:41:19.4 **HOT-1**	four eighty. four eighty.		
14:41:21.6 **HOT-?**	* four eighty. four eighty.		
14:41:24.9 **HOT-2**	four seventy three.		
14:41:26.5 **HOT-2**	sure?		

TIME and SOURCE	INTRA-AIRCRAFT CONTENT	TIME and SOURCE	AIR-GROUND COMMUNICATION CONTENT
14:41:28.4 **HOT-2**	** four eighty.		
14:41:30.4 **HOT-?**	[grunt].		
14:41:32.0 **HOT-1**	Akron.		
14:41:35.7 **HOT-1**	Akron.		
14:41:36.8 **HOT-2**	yeah. after Akron.		
14:41:38.6 **HOT-1**	fifteen hundred.		
14:41:41.1 **HOT-2**	before Akron we can do maximum twenty three. right? before Akron.		
14:41:44.9 **HOT-?**	**.		
14:41:45.1 **HOT-1**	ten miles before. (should) * go down to...		
14:41:48.6 **HOT-1**	...(we) go down to two thousand three hundred.		
14:41:53.2 **HOT-2**	**. we got. we got. ah direct to (here). **. so. he's gonna vector us. you want to put on the eh the final course.		

TIME and SOURCE	INTRA-AIRCRAFT CONTENT	TIME and SOURCE	AIR-GROUND COMMUNICATION CONTENT
14:41:58.2 **HOT-1**	**.		
14:42:04.3 **HOT-2**	(three) (six) (two).		
14:42:05.6 **HOT-1**	three six two.		
14:42:07.0 **HOT-2**	what is the name of the (Akron)?		
14:42:09.2 **HOT-1**	* Akron.		
14:42:12.8 **HOT-?**	(uhk) [may be saying AKRON NDB identifier, AK]		
14:42:13.8 **HOT-1**	put in on ** top **.		
		14:42:21.1 **APR-AKR**	* niner one sierra. four miles from the outer marker. maintain (two) thousand till established on the localizer. cleared for the localizer two five approach into Akron Fulton.
		14:42:27.7 **AC-91S**	(maintain three thousand till established localizer. ** approach.)
14:42:37.6 **HOT-1**	put it on. **.		

TIME and SOURCE	INTRA-AIRCRAFT CONTENT	TIME and SOURCE	AIR-GROUND COMMUNICATION CONTENT
14:42:48.4 **HOT-1**	put (nine) miles.		
14:42:51.6 **HOT-?**	**. yeah this one.		
14:42:56.2 **HOT-1**	*. (ack) [emphasized] (lohm) [emphasized]. ** Akron N-D-B.		
14:43:04.8 **HOT-1**	which is this.		
14:43:07.1 **HOT-1**	and then the airport which is kilo ***.		
14:43:18.7 **HOT-2**	we could have put in the box Akron itself.		
14:43:26.7 **HOT-?**	yeah. *.		
14:43:31.5 **HOT-1**	he's gonna take us around?		
14:43:32.9 **HOT-2**	yeah. obviously. yeah.		
14:43:38.6 **HOT-2**	I see what you did. you put the N-D-B instead * of putting * name * itself.		
14:43:44.5 **HOT-1**	oh I got'chya.		

TIME and SOURCE	INTRA-AIRCRAFT CONTENT	TIME and SOURCE	AIR-GROUND COMMUNICATION CONTENT
		14:43:44.6 **APR-AKR**	* niner one sierra changed to advisory frequency approved ***.
14:43:46.7 **HOT-2**	see what I'm saying.		
14:43:48.1 **HOT-2**	the same point though?		
14:43:49.2 **HOT-1**	uh. (yeah). that's right.		
14:43:50.2 **HOT-2**	the same point. right. yeah.		
		14:43:52.1 **AC-91S**	** change to advisory. ** (we'll cancel as soon as we can).
14:43:52.2 **HOT-1**	the same one.		
		14:43:59.8 **APR-AKR**	(Zipline) * fifteen twenty six reduce speed to two zero zero. descend and maintain four thousand.
14:43:59.8 **HOT-1**	N-D-B.		
14:44:01.0 **HOT-2**	no. you're gonna need to go to yes. (right there).		
14:44:02.9 **HOT-2**	direct-a to.		

TIME and SOURCE	INTRA-AIRCRAFT CONTENT	TIME and SOURCE	AIR-GROUND COMMUNICATION CONTENT
		14:44:09.6 **APR-AKR**	Zipline fifteen twenty six reduce speed to two zero zero. descend (now) and maintain four thousand.
14:44:15.5 **CAM**	[sound of decreased background sound, similar to power reduction]		
		14:44:15.6 **RDO-1**	two zero zero the speed. and four thousand. Zipline fifteen twenty six.
14:44:19.8 **HOT-1**	we're two zero zero.		
14:44:21.4 **HOT-2**	and then we go down to.		
14:44:22.2 **HOT-1**	doing whatever you want to do.		
14:44:23.5 **HOT-2**	I touch.		
14:44:24.1 **HOT-1**	right now. the ***. we have no **.		
14:44:51.1 **CAM**-?	select the altitude.		
14:44:55.0 **CAM**	[sound of two thumps]		

TIME and SOURCE	INTRA-AIRCRAFT CONTENT	TIME and SOURCE	AIR-GROUND COMMUNICATION CONTENT
14:45:05.5 **CAM**	[splice in CVR tape]		
14:45:16.3 **CAM**	[sound of ratcheting, similar to rotary dial]		
		14:45:24.2 **APR-AKR**	Zipline fifteen twenty six turn left ah heading three five zero.
		14:45:28.2 **RDO-1**	left heading three five zero Zipline fifteen twenty six **.
14:45:31.7 **HOT-2**	three five zero (and) **.		
14:45:37.0 **CAM**	[cough]		
14:45:38.5 **HOT-2**	now he's gonna bring (us) (abeam). the localizer.		
14:45:45.8 **HOT-?**	**.		
14:45:47.0 **HOT-1**	[throat clearing]		
14:45:55.3 **HOT-2**	*** M-S-L.		
14:46:04.8 **HOT-1**	okay.		

TIME and SOURCE	INTRA-AIRCRAFT CONTENT	TIME and SOURCE	AIR-GROUND COMMUNICATION CONTENT
		14:46:05.5 **APR-AKR**	** Zipline fifteen twenty six we do have another aircraft that's inbound to the airport (that) is slower than you. fly heading of three six zero and reduce speed one seven zero. ** descend and maintain three thousand.
14:46:16.9 **CAM**	[sound of decreased noise, similar to power reduction]		
		14:46:18.5 **RDO-1**	down to three thousand. one seven zero on the speed and three five zero Zipline fifteen twenty six.
14:46:25.5 **HOT-1**	three six zero on the speed. one seven zero--		
14:46:28.7 **HOT-2**	three six zero on the speed [spoken loudly].		
14:46:30.3 **HOT-1**	ah. * three [chuckle] six. three six zero on the heading. one seven zero on the speed.		
14:46:34.4 **HOT-2**	three six zero confirmed down to three thousand.		
14:46:36.7 **HOT-1**	down to three thousand. he wants one seven zero knots.		
		14:47:09.1 **APR-AKR**	Zipline fifteen twenty six turn left heading two eight zero. intercept the localizer to Akron Fulton.

TIME and SOURCE	INTRA-AIRCRAFT CONTENT	TIME and SOURCE	AIR-GROUND COMMUNICATION CONTENT
		14:47:15.5 **RDO-1**	two seven ze-- eh two eight zero. intercept the localizer. Zipline fifteen twenty six.
14:47:22.4 **HOT-1**	alright.		
14:47:23.9 **HOT-2**	where are we.		
14:47:25.5 **HOT-1**	***.		
14:47:26.9 **HOT-2**	this is the distance from Akron?		
14:47:30.0 **HOT-1**	***.		
14:47:31.6 **HOT-2**	***.		
14:47:38.7 **HOT-1**	you got your localizer?		
14:47:39.6 **HOT-2**	two eight zero (heading).		
14:47:40.6 **HOT-1**	(go) two eight zero.		
14:47:41.5 **HOT-1**	but you're never gonna capture.		

TIME and SOURCE	INTRA-AIRCRAFT CONTENT	TIME and SOURCE	AIR-GROUND COMMUNICATION CONTENT
14:47:43.0 **HOT-?**	you know.		
14:47:47.4 **HOT-2**	let's see if she's gonna do it though. I will. I till try to. drag every (thing).		
14:47:53.9 **HOT-2**	let's see what she does. okay. just keep me updated on the distance.		
14:48:01.6 **HOT-2**	***.		
14:48:08.0 **HOT-1**	radar altimeter alive.		
14:48:10.4 **HOT-1**	we are like seven miles from Akron ap--		
14:48:14.1 **CAM-?**	[raspy, female voice, unintelligible in background.]		
14:48:14.3 **CAM-1**	oh we got. we got. we got nine degrees pitch up. *. [said with emphasis]		
		14:48:17.4 **APR-AKR**	Zipline fifteen twenty six * on the approach ***. expect no delay.
14:48:21.6 **CAM**	[sound of increased noise, similar to power increase]		

TIME and SOURCE	INTRA-AIRCRAFT CONTENT	TIME and SOURCE	AIR-GROUND COMMUNICATION CONTENT
14:48:25.7 **CAM**	[sound of thump]		
14:48:27.0 **CAM**	[sound of increased noise, similar to landing gear extension]		
14:48:27.2 **CAM**	[after this point until the end of the recording, the increased noise from the gear obscures portions of the recording; most notably, ATC communications.]		
		14:48:28.2 **RDO-1**	okay we'll continue the approach. ah. ***. Zipline fifteen twenty six.
14:48:33.9 **HOT-1**	did you hear what he say? there is an airplane on the approach. (he is) slower than us. he hasn't cancelled. we don't know if he's on the ground. [said with emphasis]		
14:48:34.2 **CAM**	[sound of click]		
14:48:37.7 **HOT-2**	**.		
14:48:41.1 **HOT-2**	***.		
14:48:42.9 **HOT-1**	you can't. [emphasized]		
14:48:44.1 **HOT-2**	why. [loud]		

TIME and SOURCE	INTRA-AIRCRAFT CONTENT	TIME and SOURCE	AIR-GROUND COMMUNICATION CONTENT
14:48:44.6 **HOT-1**	you need to (look). you need to. I mean we were-we were flying like (one thirty nine). nine degrees pitch up.		
14:48:50.1 **HOT-2**	yeah.		
14:48:51.6 **HOT-2**	** speed is one seventy **.		
14:48:55.7 **HOT-1**	** (flaps) ** I know but **.		
14:49:09.0 **HOT-2**	we should (uh)--		
14:49:13.6 **CAM**	[sound of decreased background noise, similar to decrease in airspeed]		
14:49:17.7 **HOT-?**	***.		
14:49:20.4 **HOT-1**	*** you're going one forty ***--.		
		14:49:22.9 **APR-AKR**	Zipline fifteen twenty six I got the cancellation here. and you're ah four miles from the outer compass locator. maintain three thousand until established on the localizer *. cleared localizer two five approach *.

TIME and SOURCE	INTRA-AIRCRAFT CONTENT	TIME and SOURCE	AIR-GROUND COMMUNICATION CONTENT
		14:49:33.3 **RDO-1**	(cleared to) localizer two five. (maintain **). Zipline one five two six. **.
		14:49:40.4 **APR-AKR**	roger.
14:49:41.3 **HOT-1**	look you're going one twenty. you can't keep decreasing your speed **--		
		14:49:42.7 **APR-AKR**	[unintelligible]
14:49:45.3 **HOT-2**	no. one tw--. how do you get one twenty? [said with emphasis]		
14:49:47.1 **HOT-2**	** one twenty five **.		
14:49:48.9 **HOT-1**	v-ref plus (fifteen).		
14:49:50.9 **HOT-2**	(which) is the approach speed.		
14:49:53.0 **HOT-1**	you've (still) got. flaps to go. *		
14:49:54.9 **HOT-2**	and when you put them--		

TIME and SOURCE	INTRA-AIRCRAFT CONTENT	TIME and SOURCE	AIR-GROUND COMMUNICATION CONTENT
14:49:56.1 **HOT-1**	that's what I'm saying. if you keep decreasing your speed--.		
14:50:00.3 **HOT-2**	but why?		
14:50:02.1 **HOT-1**	* because we gonna stall. I don't want to sta--		
14:50:03.9 **HOT-2**	how do you--		
14:50:05.1 **HOT-1**	(but in) I-M-C.		
14:50:12.5 **HOT-1**	alright. after Akron. we are down to.		
14:50:16.2 **HOT-2**	minimums.		
14:50:17.0 **HOT-1**	fifteen hundred.		
14:50:21.0 **HOT-?**	***--.		
		14:50:21.6 **APR-AKR**	Zipline fifteen twenty six change to advisory frequency approved. report cancelling I-F-R in the air on this frequency. or on the ground via remote.
		14:50:29.7 **RDO-1**	(we'll change on to the advisory frequency) ***.

TIME and SOURCE	INTRA-AIRCRAFT CONTENT	TIME and SOURCE	AIR-GROUND COMMUNICATION CONTENT
14:50:35.8 **HOT-?**	***.		
		14:50:39.8 **RDO-1**	Akron. Akron traffic. ah Zipline fifteen twenty (six) is a Hawker jet. on the localizer two five we are (Akron position). **.
14:50:50.8 **HOT-?**	(one) mile.		
		14:50:53.9 **AC-91S**	hey guys. ah we just landed on the loc. and uh broke out right at minimums (right at a) mile.
		14:50:58.9 **RDO-1**	appreciate it.
14:51:00.9 **HOT-2**	(four) miles. full flaps.		
14:51:06.7 **HOT-1**	gear down. before landing. three lights. one. and.		
14:51:13.6 **CAM**	[sound of decreased background sound, similar to power reduction]		
14:51:14.4 **HOT-1**	(are) we going down to.		
14:51:15.7 **HOT-2**	(to).		

TIME and SOURCE	INTRA-AIRCRAFT CONTENT	TIME and SOURCE	AIR-GROUND COMMUNICATION CONTENT
14:51:17.1 **HOT-1**	*.		
14:51:17.4 **CAM**	[sound of thunk]		
14:51:18.2 **HOT-2**	**.		
14:51:25.4 **HOT-1**	*** speed ***.		
14:51:31.3 **HOT-2**	alright we go to minimums (@).		
14:51:32.9 **HOT-1**	alright.		
14:51:36.3 **HOT-2**	can you check. can you check (if I got) (everything). (ignition).		
14:51:39.6 **HOT-1**	everything is (all set).		
14:51:41.2 **HOT-1**	standby. yaw damper. autopilot. (eh).		
14:51:43.9 **HOT-1**	main air valves.		
14:51:44.7 **HOT-2**	*.		

TIME and SOURCE	INTRA-AIRCRAFT CONTENT	TIME and SOURCE	AIR-GROUND COMMUNICATION CONTENT
14:51:45.2 **HOT-1**	I'll take care of them.		
14:51:46.7 **HOT-2**	(alright).		
14:51:49.4 **HOT-1**	v-ref. (localizer).		
14:51:56.6 **HOT-1**	on localizer. you're diving. you're diving. don't dive. two thousand feet per minute buddy... [said with emphasis]		
14:52:01.8 **HOT-2**	yeah.		
14:52:02.5 **HOT-1**	...two thousand feet per minu-- don't go two thousand feet per minute. [said with emphasis]		
14:52:05.1 **HOT-1**	you're ** (me there).		
14:52:06.4 **HOT-1**	oh don't.		
14:52:07.1 **HOT-2**	yeah.		
14:52:07.3 **HOT-1**	don't go two thousand feet per minute.		

TIME and SOURCE	INTRA-AIRCRAFT CONTENT	TIME and SOURCE	AIR-GROUND COMMUNICATION CONTENT
14:52:10.2 **HOT-1**	when you are fifteen hundred feet above the ground. or minimums.		
14:52:15.2 **CAM**	[sound of cyclical sound, similar to windshield wipers; continues until end of recording]		
14:52:17.0 **HOT-1**	ground.		
14:52:20.5 **HOT-1**	keep going.		
14:52:22.1 **HOT-1**	one point one is for the missed approach.		
14:52:27.3 **HOT-1**	okay level off guy. [spoken rapidly]		
14:52:27.4 **CAM**	[sound of rattle, similar to stick shaker]		
14:52:28.3 **HOT-2**	got it.		
14:52:30.1 **CAM**	[sound of rattle, similar to stick shaker]		
14:52:31.3 **HOT-1**	oh #. (focus). [spoken loudly, rapidly]		
14:52:32.8 **GPWS**	pull up.		

TIME and SOURCE	INTRA-AIRCRAFT CONTENT	TIME and SOURCE	AIR-GROUND COMMUNICATION CONTENT
14:52:33.6 **HOT-1andor2**	oh oh oh oh. [said with emphasis]		
14:52:34.7 **HOT**	[sound of thunk, similar to impact]		
14:52:35.0 **HOT**	[sound of squeal, similar to tape recording electronic artifact]		

END OF TRANSCRIPT
END OF RECORDING
14:52:35.4 EST

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