Collision with Terrain During Takeoff of Parachute Jump Flight Beech King Air 65-A90, N256TA Mokuleia, Hawaii June 21, 2019

Accident Report

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Aircraft Accident Report

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National
Transportation
Safety Board

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Abstract: This report discusses the June 21, 2019, accident involving a Beech King Air 65-A90 airplane, N256TA, that impacted terrain after takeoff from Dillingham Airfield, Mokuleia, Hawaii. The airplane was operated by Oahu Parachute Center LLC under the provisions of Title 14 *Code of Federal Regulations* (*CFR*) Part 91 on a local parachute jump (skydiving) flight. The pilot and 10 passengers were fatally injured. Safety issues identified in this report address the need for an appropriate regulatory framework for parachute jump operations, including standards for initial and recurrent training and maintenance and management policies and procedures; the need for increased Federal Aviation Administration (FAA) oversight of parachute jump operations; and the need for safety management systems for parachute jump operators. These safety issues are also discussed in the National Transportation Safety Board's (NTSB) aviation investigation report, titled *Enhance Safety of Revenue Passenger-Carrying Operations Conducted Under Title 14 Code of Federal Regulations Part 91*, addressing broader systemic safety issues associated with revenue passenger-carrying operations currently conducted under Part 91 (NTSB/AAR-21/03). The Mokuleia accident investigation also identified safety issues concerning the pilot's aeronautical experience and training that were addressed by three recommendations to the FAA contained in a report titled *Provide Inspectors with Automatic Notification of Flight Instructors with Substandard Student Pass Rates* (NTSB/ASR-20/06). Both reports can be accessed from the Aviation Accident Reports page of the NTSB's website.

Contents

Figures

Tables

Abbreviations

A&P	airframe and powerplant
AC	advisory circular
AD	airworthiness directive
agl	above ground level
AOA	angle of attack
ATC	air traffic control
CFR	*Code of Federal Regulations*
CG	center of gravity
FAA	Federal Aviation Administration
FAR	*Federal Aviation Regulations*
FSDO	flight standards district office
HDH	Dillingham Airfield
msl	mean sea level
NTSB	National Transportation Safety Board
OPC	Oahu Parachute Center
PIC	pilot-in-command
PTRS	Program Tracking and Reporting Subsystem
THC	delta-9-tetrahydrocannabinal (marijuana)
USPA	United States Parachute Association

1. Factual Information

1.1 History of Flight

On June 21, 2019, about 1822 Hawaii-Aleutian standard time, a Beech King Air 65-A90 airplane, N256TA, impacted terrain after takeoff from Dillingham Airfield (HDH), Mokuleia, Hawaii.[1] The pilot and 10 passengers were fatally injured, and the airplane was destroyed. The airplane was owned by N80896 LLC and was operated by Oahu Parachute Center (OPC) LLC under the provisions of Title 14 *Code of Federal Regulations* (*CFR*) Part 91 as a local parachute jump (skydiving) flight.[2] Visual meteorological conditions prevailed at the time of the accident.[3]

OPC had scheduled five parachute jump flights on the day of the accident and referred to the third through fifth flights of the day as "sunset" flights because they occurred during the late afternoon and early evening. The accident occurred during the fourth flight. The accident pilot was the pilot-in-command (PIC) for each of the OPC flights that departed on the day of the accident.

The pilot and 8 of the 10 passengers initially boarded the airplane. These eight passengers comprised three OPC tandem parachute instructors, three passenger parachutists, and two OPC parachutists performing camera operator functions.[4] The pilot began to taxi the airplane from OPC's location on the airport. According to a witness (an OPC tandem instructor who was not aboard the accident flight), the two other passengers—solo parachutists who had been on the previous skydiving flight and were late additions to the accident flight—"ran out to the airplane and were loaded up at the last minute."

The pilot taxied the airplane to runway 8 about 1820, and the airplane departed about 1822. According to multiple witnesses, after the airplane lifted off, it banked to the left, rolled inverted, and descended to the ground. One witness stated that, before impact, the airplane appeared to be intact and that there were no unusual noises or smoke coming from the airplane. A security camera video showed that the airplane was inverted in a 45° nose-down attitude at the time of impact. The airplane impacted a grass and dirt area about 630 ft northeast of the departure end of the runway, and a postcrash fire ensued.

The airplane was not equipped, and was not required to be equipped, with a cockpit voice recorder or a flight data recorder. The accident flight was not detected by radar at the Federal

[1] All times in this report are Hawaii-Aleutian standard time.

[2] OPC was required to comply with the provisions of 14 *CFR* Part 105, Parachute Operations. According to section 105.3, "parachute operation" is defined as "the performance of all activity for the purpose of, or in support of, a parachute jump." Section 105.3 defines "parachute jump" as "a parachute operation that involves the descent of one or more persons to the surface from an aircraft in flight when an aircraft is used or intended to be used during all or part of that descent."

[3] For more information, see the factual information and analysis sections of this report. Additional information can be found in the public docket for this National Transportation Safety Board accident investigation (case number WPR19MA177) by accessing the Investigation Dockets link at the NTSB website.

[4] According to 14 *CFR* 105.3, a passenger parachutist is "a person who boards an aircraft, acting as other than the parachutist in command of a tandem parachute operation, with the intent of exiting the aircraft while in-flight using the forward harness of a dual harness tandem parachute system to descend to the surface."

Aviation Administration's (FAA) Hawaii Control Facility, which was the air traffic control (ATC) facility with jurisdiction of the airspace over HDH. The FAA found no audio communications between the accident airplane and ATC on the day of the accident.

1.1.1 Flight Before the Accident Flight

According to a postaccident interview, a total of 13 occupants—the pilot, 10 solo parachutists, 1 passenger parachutist, and 1 tandem instructor—were aboard the airplane on the flight immediately before the accident flight.[5] Three experienced parachutists who were on that flight were interviewed by, or provided written accounts to, the National Transportation Safety Board (NTSB) about the flight.[6] One of the parachutists stated that, during that flight, the airplane entered a steep left bank after takeoff that flattened out before the airplane entered another steep left bank. Another parachutist stated that the airplane's left bank occurred at a lower altitude than he expected. This parachutist also stated that the airplane's left turn after takeoff was "more aggressive" than what he considered to be normal and that the pilot had briefly relaxed the turn during climbout but then resumed the more aggressive turn. The other parachutist stated that the pilot "banked [the airplane] a little hard on a high rate turn at a seemingly low altitude." This parachutist characterized the takeoff as "a little spicy for [his] liking."[7] (Other reports of the pilot's takeoff technique are discussed in section 1.2.3.)

The three parachutists all stated that the parachuting group had received a drop zone briefing from OPC staff before boarding the airplane.[8] Two of the parachutists stated that the briefing was thorough and that it discussed, among other things, the main and alternate landing areas and airplane loading procedures. These parachutists also stated that the group members were advised to keep their seat belts fastened until 1,500 ft above ground level (agl).[9] One of these parachutists also stated that, even though some members of the group had previous parachute jump experience, they were asked to listen to the briefing.

None of the parachutists mentioned a briefing from the pilot after they boarded the airplane.[10] One parachutist stated that the pilot checked that the airplane occupants were wearing their seat belts and that the door was closed. (The airplane was equipped with a transparent roll-up

[5] As previously stated, the accident pilot was the pilot of this flight (the third OPC flight and first sunset flight of the day).

[6] One of the parachutists stated that he was part of a group of nine skydivers aboard the flight and that he was making his first parachute jump with OPC as the operator of the flight. Another parachutist stated that most members of the group had not previously made parachute jumps at HDH.

[7] A less-experienced parachutist who was also on the flight immediately before the accident flight recalled other parachutists stating that the pilot had made "a low aggressive turn" during departure.

[8] Title 14 *CFR* 105.3 defines a "drop zone" as "any pre-determined area upon which parachutists or objects land after making an intentional parachute jump or drop."

[9] According to former company pilots, OPC tandem instructors were responsible for briefing the passengers about the use of their seat belts, including that they should remain fastened until the airplane reached an altitude of 1,500 ft agl. At that altitude, the passengers could unbuckle their seat belts, and those passengers who were not solo jumpers would then be connected to a tandem instructor.

[10] One of the parachutists indicated that such a briefing would have been "uncommon" because the parachutists' helmets would have made it difficult to hear the pilot. Former OPC pilots stated that they typically did not conduct a passenger briefing.

door in the aft cabin.) Another parachutist stated that all of the airplane occupants kept their seat belts fastened until the airplane reached 1,500 ft agl and then removed them.

1.2 Personnel Information

The pilot, age 42, held a commercial pilot certificate issued on December 13, 2017, with airplane single- and multiengine land and instrument airplane ratings. (The FAA does not have a specific rating, specific training, or a specific evaluation for pilots of commercial parachute jump flights.) His second-class FAA medical certificate was issued on November 1, 2018, with no limitations. The pilot reported, on his most recent medical certificate application, that he had accumulated 750 flight hours, 232 hours of which occurred during the previous 6 months.

According to company records, the pilot began flying for OPC on March 9, 2019, and he reported (on an insurance form dated March 8, 2019) that he had 872 hours of total flight experience, with 771 hours as PIC and 101 hours as second-in-command. His flight experience included 1.7 hours as PIC in turboprop single-engine airplanes, 396 hours as PIC in multiengine piston airplanes, and 27 hours in multiengine turbine airplanes.

The pilot's last recorded logbook entry, on March 21, 2019, indicated that he had 897.7 hours of total flight experience, including 83.5 hours in turbine airplanes. Company records showed that, between that date and June 21, 2019 (the date of the accident), the pilot flew the airplane on 82 work days and that he averaged 2.3 hours of flight during each of those days. Thus, the pilot's total flight experience at the time of the accident would have been about 1,086 hours, including about 985 hours of PIC time, of which about 214 hours were as PIC in the accident airplane. He would have flown about 496, 179, and 60 hours in the previous 12 months, 90 days, and 30 days, respectively.

According to the résumé that the pilot provided to OPC, from March 2018 to February 2019, the pilot was employed by JAV Imagery in St. George, Utah, for which he conducted Part 91 aerial observation flights in a Piper Aztec PA23-250T. The pilot's résumé also indicated that, from April 2017 to March 2018, he was employed as a first officer by Riter Aviation in Torrance, California, which conducted Part 91 flight operations in a Beech King Air C90GTi.[11] According to his brother, the pilot had also performed aerial observation flights for Eagle View Aerial in California.

The pilot's roommate stated that the pilot did not drink, smoke, or use drugs and that he did not have any financial difficulties. She stated that the pilot always went to sleep between 2100 and 2130, typically awoke at 0700, and went to work about 0730.

[11] The pilot referenced the Beech King Air C90GTx in his résumé, which is the marketing term that the manufacturer used for a winglet-equipped C90GTi-series airplane.

Each of the tandem instructors held a valid FAA third-class medical certificate at the time of the accident, as required by the United States Parachute Association (USPA) for a tandem instructor rating.[12]

1.2.1 Notices of Disapproval

The pilot took three practical examinations and was disapproved for each on his first attempt.[13] On July 9, 2017, the pilot was disapproved for his private pilot certificate with an airplane single-engine land rating. The areas requiring reexamination were takeoffs, landings, and go-arounds. The pilot received his certificate after a retest on July 22, 2017.

On October 26, 2017, the pilot was disapproved for his private pilot instrument airplane rating. The area requiring reexamination was instrument approach procedures. The pilot received his rating after a retest on November 13, 2017.

On December 2, 2017, the pilot was disapproved for his commercial pilot certificate with an airplane multiengine land rating. The areas requiring reexamination were takeoffs, landings, go-arounds, performance and ground reference maneuvers, and multiengine operations. The pilot received his certificate after a retest on December 13, 2017.

1.2.2 Training

The accident pilot's logbook and company records showed that he received training on the accident airplane from another OPC pilot on March 9 and 10, 2019. According to the documents, on March 9, the pilot logged two parachute flights with a total flight time of 1.6 hours and three touch-and-go takeoffs and landings; on March 10, the pilot logged four parachute flights with a total flight time of 2.4 hours.[14]

During a postaccident interview, the OPC pilot who provided the training stated that he had the accident pilot sit in the copilot seat for one or two parachute flights and then had him move to the pilot's seat to conduct the other parachute flights. (The airplane was not equipped with a copilot control yoke.) The OPC pilot also stated that the accident pilot had "gotten a good feel" for the company airplane and had "good stick" skills. The OPC pilot further stated that the accident pilot received training regarding the minimum control speed with the critical engine inoperative and performed takeoff exercises and steep turns. In addition, the OPC pilot stated that he and the accident pilot discussed airspeeds and NTSB accident reports and watched videos from the King Air Academy.[15]

[12] The USPA is a voluntary organization located in Fredericksburg, Virginia, that supports and promotes safe skydiving operations. For more information about the organization, including the requirement for tandem instructors to maintain a third-class medical certificate, see the USPA's website at https://uspa.org (accessed January 25, 2021).

[13] According to the FAA, in 2017, about 76% of student pilots (or pilots receiving instruction if they possessed a private pilot certificate) passed their certificate or rating practical examination on the first attempt.

[14] The company records did not include the three touch-and-go takeoffs and landings on March 9.

[15] According to its website, the King Air Academy provides initial and recurrent training on Beech King Air airplanes, including educational videos on the academy's YouTube channel (accessed January 25, 2021).

The pilot received initial flight instruction at Riter Aviation. The pilot's flight instructor was also the owner of the company. The pilot's flight logs showed that, during April and May 2017, he logged 4.6 hours in a single-engine Piper PA-28 airplane before he began logging flight time in a twin-engine King Air C90GTi airplane.[16] According to FAA records, the King Air C90GTi airplane (N715GC) was owned at that time by a finance corporation in Yucaipa, California; Riter Aviation operated the airplane under Part 91 for a fruit company in Los Angeles, California, that had subcontracted its pilot services to the aviation company. The Riter Aviation owner was the PIC for these flights.

The pilot's flight logs showed that, between May 2 and July 11, 2017, he logged 43 hours of flight time in the King Air C90GTi airplane as a student pilot; table 1 shows these 43 hours. Of the 43 hours, 27.8 hours were logged while receiving dual instruction under 14 *CFR* 61.129, which addressed the operating experience required for a commercial pilot certificate.[17] The remaining 15.2 hours were logged as "first officer training" on May 25, June 22, and July 11, 2017.[18] All but one of the logbook entries were signed off by the accident pilot's flight instructor; the entry for May 2, 2017, had no instructor signoff.

Table 1. Accident pilot's King Air flight instruction while a student pilot.

Date	Remarks in pilot logbook	Number of hours
May 2, 2017	"Commercial long X-C [cross-country]" and "*FAR* [*Federal Aviation Regulations*] 61.129(b)(4)(i) and (ii)"	7.8
May 11 and 12, 2017	"*FAR* 61.129(b)(1)(3)(iii)"	5.7
May 17 and 18, 2017	"Dual cross-country *FAR* 61.129(b)(4)(ii)"	8.2
May 25, 2017	"Dual cross-country, First Officer Training"	4.5
June 22, 2017	"First Officer Training, Border Crossing"	6.3
June 23, 2017	"61.129(b)(4)(i)" and "Commercial Long X/C"	6.1
July 11, 2017	"First Officer Training X-country"	4.4

Note: Title 14 *CFR* 61.129(b)(4)(i) required, for an airplane multiengine rating, "one cross-country flight of not less than 300 nautical miles total distance with landings at a minimum of three points, one of which is a straight-line distance of at least 250 nautical miles from the original departure point." Title 14 *CFR* 61.129(b)(4)(ii) required, for an airplane multiengine rating, "5 hours in night VFR [visual flight rules] conditions with 10 takeoffs and 10 landings (with each landing involving a flight with a traffic pattern) at an airport with an operating control tower." The logbook entry for May 2, 2017, indicated that eight takeoffs and landings occurred.

In addition to the 43 hours of flight time that the accident pilot logged between May and July 2017, his logbook showed 9.5 hours in the King Air C90GTi airplane between October 9 and

[16] The King Air C90GTi airplane used for the pilot's training was manufactured in 2012 and equipped with two Pratt & Whitney Canada PT6 turbine engines. The airplane had a dual yoke installation, even though there was no regulatory requirement for a second pilot for this airplane model; the minimum flight crew was one pilot.

[17] A typical progression for pilot certificates is student pilot, private/commercial pilot (with a single-engine land rating), and then commercial pilot (with a multiengine land rating).

[18] In response to an NTSB information request about the pilot's training events, on March 2, 2020, the FAA provided a legal opinion that stated, "from a regulatory perspective, the FAA does not have 'first officer training.' Because the term is not used in the FAA's regulations, it is unclear what the [flight instructor] signoff for 'first officer training' means." The FAA also stated that it would need more information to assess whether the training was in compliance with regulations.

November 22, 2017, including 9.1 hours receiving "*FAR* 61.127(b)(2)" instruction.[19] Thus, the pilot had logged a total of 52.5 hours in the King Air C90GTi airplane during initial instruction.

There was no other record of the accident pilot receiving King Air instruction or logging turbine time before his employment with OPC. As a result, the NTSB attempted to interview the Riter Aviation flight instructor to determine the type of training that he provided to the accident pilot as well as the accident pilot's proficiency in the King Air airplane.[20] The NTSB made initial contact with the flight instructor on July 5, 2019, but he did not provide the requested information, and subsequent attempts to make further contact with the flight instructor were unsuccessful.

1.2.3 Pilot Takeoff Technique

Witnesses provided information about the accident pilot's specific takeoff technique. A former OPC pilot, who worked for the company at the same time as the accident pilot, stated that the accident pilot would bank hard and pitch up aggressively during departures as a "thrill ride" for passengers. An OPC tandem instructor, who had flown with the accident pilot four times, stated that, during each of those flights, it felt as if the pilot was pitching and banking the airplane to maneuver it out of the traffic pattern area and that the pitch and bank were thus not "overly aggressive." Another former OPC pilot stated that banking the airplane hard at 100 ft agl was not unusual and was done to make the turn over the beach park (see figure 5 in section 1.5) to avoid the drop zone area, but he thought that the accident pilot "abused the airplane."

A pilot for another parachute operator at HDH, who had observed the accident pilot flying the accident airplane, stated that, when the accident pilot was newly employed by OPC, he flew "normal" takeoffs and landings. This witness added that, during the weeks preceding the accident, the pilot had changed his takeoff technique and appeared to be "showing off." Specifically, according to the witness, the accident pilot would pitch up the airplane and begin banking to the left before reaching the threshold at the departure end of runway 8, clearing nearby trees by about 50 ft. The witness stated that the pilot's use of high pitch and bank looked as if he was "trying to get the most out of the airplane." The witness further stated that, when the accident pilot rotated and banked the airplane simultaneously, the bank angles were greater than 45°.

Last, a witness, who was located at the beach near the departure end of runway 8 about 1830 on the evening before the accident flight, reported that he saw "a very aggressive takeoff of a King Air aircraft, similar to the one that crashed." This witness, who was a major with the Royal Canadian Air Force at the time of the accident, stated that, when the airplane was about 10 ft off the ground, the airplane "pulled up and to the left in one motion," which put the airplane in "an estimated 70 [degree bank angle] or more turn as it climbed out." The witness added that he was

[19] (a) Title 14 *CFR* 61.127 addresses the flight proficiency requirements for a commercial pilot certificate, and paragraph (b)(2) of the regulation requires instruction in 11 specific areas, including performance maneuvers, slow flight and stalls, and emergency operations. (b) Between July 11 and October 9, 2017, the pilot had logged instructional flight time (from the Riter Aviation flight instructor) in the Piper PA-28 (single-engine) and PA-23 (twin-engine) airplanes and cross-country flight time in the PA-28 airplane.

[20] According to FAA records, during the 2-year period ending April 10, 2020, 59% of students that the Riter Aviation flight instructor endorsed passed their certificate or rating practical examination on the first attempt. (The accident pilot's three consecutive first-attempt failures occurred before the 2-year period covered by the FAA records.)

used to seeing aggressive maneuvers because of his military aviation experience, but the maneuver that he witnessed "looked dangerous."

1.3 Airplane Information

1.3.1 General

Beechcraft Aircraft Corporation manufactured the accident airplane with the serial number LJ-256, and the FAA issued a standard airworthiness certificate for the airplane on March 2, 1967.[21] The airplane had been owned by N80896 LLC, Granite Bay, California, since 2011 and was leased to OPC for 2 years starting May 15, 2017.[22] Figure 1 shows the accident airplane at HDH.

Source: Mr. Morgen Jackson

Figure 1. Accident airplane

The airplane had accumulated 15,104 total flight hours and 24,569 total flight cycles as of September 27, 2018, which was the date of the most recent logbook entry that included flight hour and flight cycle data. The airplane was equipped with two Pratt & Whitney Canada PT6A-20 dual-spool turbopropeller engines and two Hartzell HC-B3TN-3B three-bladed, hydraulically actuated, constant-speed propellers.

According to the Beechcraft King Air *A90 Pilot Operating Manual*, trim tabs on the rudder, elevator, and left aileron were adjustable from the center pedestal through closed-circuit cable systems, which drove jackscrew-type actuators.[23] Position indicators for the trim tabs were

[21] The airplane's most recent airworthiness certificate was dated May 3, 2012.

[22] The accident occurred about 5 weeks after the lease ended. The available evidence did not indicate whether the airplane owner had extended the contract with OPC.

[23] Trim systems are critical to the basic control of an airplane and are designed to help minimize a pilot's workload by aerodynamically assisting with the forces required to position the flight control surfaces to which the trim tabs are attached. The trim tab on the left aileron helped adjust the roll control forces of the airplane.

integrated with their respective controls. Each elevator had a trim tab with a travel limit from 10° trailing edge up to 21° trailing edge down. The left aileron trim tab travel limit was 7.5° trailing edge up or down. (The right aileron had an anti-servo tab.) The Beechcraft King Air *Model 65-A90 FAA Flight Manual* stated that the left wing aileron and trim tab needed to be checked before flight.

The airplane was equipped with a stall warning system. According to Textron Aviation (which acquired Beechcraft Aircraft Company in March 2014), the stall warning system consisted of a red stall warning light on the upper left corner of the instrument panel, a circuit breaker on the right subpanel, a transistor mounted behind the instrument panel, and a lift transducer on the leading edge of the left wing.[24] When aerodynamic pressure on the lift transducer vane indicated that a stall was imminent, the transistor actuated so that the stall warning light would illuminate. According to the Beechcraft King Air *A90 Pilot Operating Manual*, with the gear and flaps down, the stall warning would trigger when the airplane's airspeed was 4 to 8 knots above the stall speed. The Beechcraft King Air *Model 65-A90 FAA Flight Manual* indicates that the 1-G (wings-level flight) stall speed is about 67 knots for an airplane weight of about 7,900 pounds with flaps up and power on.[25]

1.3.2 Weight and Balance

The weight and balance for the airplane was last recorded on February 7, 2009. According to the weight and balance record, the airplane was weighed in a skydiving configuration with one pilot seat; the copilot seat had been removed in April 1996 as part of the major alteration to configure the airplane for skydiving operations. The airplane's basic empty weight was 5,130 pounds; this weight was consistent with the related information in the Beechcraft King Air *Model 65-A90 FAA Flight Manual*. At some point after the airplane was last weighed, the copilot seat was reinstalled; the seat could be positioned facing forward or aft.[26] The weight and balance record was not updated to account for the additional 28 pounds of the copilot seat assembly.

The NTSB calculated that the airplane's weight at the time of the accident takeoff was 7,925 pounds. The maximum certificated takeoff weight for the airplane was 9,300 pounds. The Beechcraft King Air *Model 65-A90 FAA Flight Manual* showed that, with the landing gear extended at the calculated takeoff weight, the forward and aft center of gravity (CG) limits were 148.1 and 160.4 inches, respectively.[27] The manual did not indicate a change in the CG limits with landing gear retraction.

[24] The stall warning system installed on the accident airplane did not include a stall warning horn, which was incorporated in later Beech 65-A90 airplane models.

[25] A former OPC pilot stated that company pilots would typically conduct takeoffs with flaps up.

[26] The date of the copilot seat reinstallation did not appear in the maintenance records. In addition, FAA Airworthiness Directive (AD) 97-06-06 required an inspection of the pilot and copilot chair locking pins to ensure full engagement and prevent inadvertent movement. Maintenance records showed that the inspection was last performed for the pilot's seat on February 25, 2010, but there was no record of compliance with the AD for the copilot seat.

[27] The NTSB considered various scenarios in calculating possible CGs for the accident flight; see section 2.2.2 for more information.

According to the OPC owner, company pilots did not calculate a weight and balance for each flight and instead used a generic "formula." A former OPC pilot stated that, for the airplane's weight and balance calculation, company pilots used a "normal" value for fuel and a passenger weight based on 13 passengers (the maximum number of passengers that the airplane accommodated while leased to OPC) with an average weight of 185 or 190 pounds per person.[28] The company then calculated a baseline CG to ensure that the CG did not exceed the forward and aft limits for 13 or fewer passengers.

OPC did not include, in its baseline CG calculation, the weights of tandem parachute systems, tandem harnesses, or single parachute systems. According to the OPC owner, each tandem parachute system weighed about 58 pounds, each tandem harness weighed about 8 pounds, and each single parachute system weighed about 25 pounds. The pilot did not have a parachute.

1.3.3 Previous Accident

On July 23, 2016, the accident airplane was involved in an accident that involved a loss of control while climbing to the jump altitude near Byron Airport, Byron, California.[29] The pilot and the 14 passengers were not injured, and the airplane was substantially damaged. The airplane was operated by Bay Area Skydiving, and the pilot involved in the Mokuleia accident was not the pilot of this flight.

According to the pilot involved in the Byron accident, as the airplane neared the planned jump area and altitude, the airplane's airspeed was a little slow, and the airplane abruptly stalled, rolled to the left, and began to spin. The pilot briefly regained control of the airplane, but the airplane subsequently stalled and entered a second left spin. During the second spin event, all of the passengers jumped successfully from the airplane. The pilot recovered control of the airplane again, but, shortly afterward, the airplane stalled and entered another left spin. The pilot recovered control of the airplane another time and flew back to the airport. The pilot noted that airplane was handling abnormally, but he was able to land without further incident.

The right horizontal stabilizer and elevator separated from the airplane during the recovery sequence and were subsequently found in a field a few miles south of the airport. Magnified optical examination revealed that the fracture surfaces on the right horizontal stabilizer, elevator, and attachment bracket were consistent with overstress separation. The NTSB found that the right horizontal stabilizer and elevator were likely overstressed during the airplane's left spin recovery, which led to their in-flight separation due to G forces and airflow beyond the right horizontal stabilizer's limit. The NTSB determined that the probable cause of the accident was as follows:

> The pilot's failure to maintain an adequate airspeed and his exceedance of the airplane's critical angle of attack, which resulted in an aerodynamic stall and

[28] The Beech 65-A90 had a fuel capacity of 384 gallons. The fueler at HDH stated that the OPC airplane usually departed with less than one-half of the maximum fuel load and that each flight used about 25 gallons of fuel.

[29] For more information about this accident, see case number WPR16LA150 at the NTSB's website.

subsequent spin.[30] Also causal to the accident was the pilot's failure to follow prescribed spin recovery procedures, which resulted in increased airspeed and airflow and the subsequent overstress separation of the right horizontal stabilizer. Contributing to the accident was the pilot's inadequate preflight weight and balance calculations, which resulted in the center of gravity being aft of the limit.

1.3.3.1 Repairs Resulting From the Previous Accident

The airplane's logbook indicated that, by May 18, 2017, repairs had been made to the airplane as a result of the previous accident.[31] After completion of the repairs, a "flight through turbulent air" inspection of the airplane was conducted. This inspection, an unscheduled maintenance task that was part of the manufacturer's inspection program for King Air 90-series airplanes, included internal and external inspections of the wings.

The repairs to the airplane included the replacement of the right horizontal stabilizer with the assembly from a Beech 65-90 airplane (an earlier airplane model with serial number LJ-87) using new hardware.[32] According to the Textron Aviation empennage installation drawing, the right horizontal stabilizer installed on the airplane was not an approved replacement for the one previously installed on the accident airplane (serial number LJ-256), even though the elevator assembly was the same on both airplanes. Further, the manufacturer's illustrated parts catalog showed that the right horizontal stabilizer from airplane LJ-87 was not a suitable replacement for the one that was previously installed on the accident airplane.

Textron Aviation had no record on file requesting or authorizing the installation of the LJ-87 right horizontal stabilizer on the accident airplane. Also, the FAA airworthiness file for the accident airplane, which should contain all records of major alterations and major repairs, contained no records of the repairs performed as a result of the July 2016 accident, including the replacement of the right horizontal stabilizer.[33]

In addition, FAA Airworthiness Directive (AD) 77-22-01 required an inspection of the aft bulkhead and horizontal stabilizer aft spars every 600 hours. This AD was performed as part of the repairs and inspections after the previous accident, but review of the logbook showed that, as of May 18, 2017, compliance with the AD was 712 hours overdue.

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[30] The FAA's *Pilot's Handbook of Aeronautical Knowledge* (FAA-H-8083-25B) defines "critical angle of attack" as "the angle of attack at which a wing stalls regardless of airspeed, flight attitude, or weight" (FAA 2016).

[31] This work was signed off by a mechanic with an Airframe & Powerplant (A&P) certificate and an Inspection Authorization. The mechanic indicated that the airframe had been inspected and "was found to be in an unairworthy condition" because the "right engine and propeller controls [were] binding" and the "left and right engine controls [were] not symmetrical." On June 1, 2017, another A&P mechanic signed off that these issues had been resolved.

[32] This Beech 65-90 airplane, N98B, was manufactured in 1965. As previously stated, the accident airplane was a Beech 65-A90.

[33] According to 14 *CFR* Part 43, appendix B, "each person performing a major repair or major alteration shall—(1) Execute FAA Form 337…(2) Give a signed copy of that form to the aircraft owner; and (3) Forward a copy of that form to the FAA…within 48 hours after the aircraft, airframe, aircraft engine, propeller, or appliance is approved for return to service."

The NTSB attempted to interview the mechanic who oversaw the repairs resulting from the July 2016 accident to learn more about the maintenance that was and was not performed on the accident airplane, but the mechanic had been stationed out of the country and was not reachable for an interview.

1.3.3.2 Airplane Condition After Previous Accident

The NTSB examined photographs from the July 2016 accident investigation as well as photographs and videos of the airplane that were taken before and after that accident (which were provided by the public or were publicly available) to determine the airplane's condition before the June 2019 accident flight.

Photographs taken during the investigation of the July 2016 accident showed wrinkles in the top skin of the left wing immediately outboard of the engine and aft of the forward spar. The wrinkles, shown in figure 2, were consistent with compression buckling. The direction of wing twist indicated by the wrinkles was leading edge up for the wing tip.

Source: Textron Aviation

Figure 2. Wrinkles in the top skin of the left wing after the July 2016 accident

Photographs taken during the 2016 accident investigation further showed that the top of the left wing had a raised ridge aft of the forward spar in the outboard wing skin panel and that the small fairing panel that covered the top rear spar attachment for the left wing had an upward compression buckle. The photographs also showed that the gap between the left propeller spinner and the engine cowl was not uniform around the circumference of the spinner and that the propeller was oriented slightly downward relative to the cowl. (In contrast, the gap between the right propeller spinner and engine cowl was uniform.)

A video of the airplane from 2011 showed the trim tab on the left aileron close to the trailing, or normal, position, but the photographs taken during the 2016 accident investigation showed that the left aileron trim tab was deflected downward.[34] An in-flight photograph from the ferry flight to deliver the airplane from the US mainland to Hawaii in June 2017 also showed the deflection of the left aileron trim tab and wrinkled skin on the left upper wing, as shown in figure 3.[35]

Source: Mr. Adam Townley-Wren

Note: The arrow indicates the aileron trim tab deflection, and the wrinkled skin is shown within the circle.

Figure 3. Photograph showing aileron trim tab deflection and wrinkled skin on the left wing

[34] On February 1, 2021, the accident airplane owner provided the NTSB with a photograph of the airplane that showed the downward deflection of the left aileron trim tab. The owner indicated that the photograph was taken on January 15, 2015.

[35] The NTSB conducted postaccident interviews with the pilot who ferried the airplane to Hawaii as well as the airplane owner. The ferry pilot stated that his preflight checks found that the airplane was airworthy, and he did not recall the airplane needing any abnormal aileron trim during the ferry flight. The airplane owner stated that he was told that the wrinkles on the left wing skin were "typical" for an older airplane, The airplane owner also stated that he had "a high degree of confidence in the structural integrity of the wing" because nondestructive inspection and testing after the accident showed no damage on the left wing spar.

A photograph that was taken during the investigation of the 2016 accident showed that the aileron trim knob was set to the full left-wing-down position during the accident flight. A November 2018 photograph, which was taken about 1.5 years after completion of the repairs resulting from the 2016 accident, also showed the aileron trim knob set to the same position, as shown in figure 4.

Source: Mr. Morgen Jackson

Figure 4. Aileron trim knob in its full left-wing-down position

According to a former OPC pilot who trained multiple other pilots in the accident airplane (including the pilot who provided company training to the accident pilot), the accident airplane would not fly straight and level without full left-wing-down aileron trim. This former OPC pilot stated that the airplane owner was aware of this issue and told him that the condition had something to do with "the left wing being bent."[36]

1.3.4 Maintenance Inspection Program

OPC was responsible for all maintenance and inspections on the accident airplane (while the airplane was leased to the company) in accordance with 14 *CFR* Parts 43 and 91, which addressed maintenance, preventative maintenance, and alterations. (Part 43 also addressed rebuilding). Title 14 *CFR* 91.409(f)(3) required OPC to comply with the aircraft manufacturer's inspection program. The manufacturer's inspection program for King Air 90-series airplanes, as described in chapter 5 of the manufacturer's *Aircraft Maintenance Manual*, was divided into four consecutive 200-hour phase inspections that were required to be completed within 20 hours of the

[36] During a postaccident interview, the airplane owner stated that the airplane required some aileron trim to fly straight and level but that, once the airplane was trimmed, it flew fine.

prescribed time. A complete inspection cycle was 800 hours or 24 months.[37] The manufacturer required that no airplane exceed 12 months without the completion of at least one phase inspection.

The OPC owner stated that a contract mechanic performed maintenance on the accident airplane. The mechanic had an Airframe & Powerplant (A&P) certificate issued on July 27, 2015, and an Inspection Authorization issued on March 27, 2017. FAA records showed that the mechanic had his previous A&P certificate and Inspection Authorization revoked on February 8, 2005, due to the falsification of records for two aircraft. The mechanic's most recent A&P certificate and Inspection Authorization were issued after he underwent a reexamination.[38]

A video of the airplane on the ground about 30 minutes before the accident flight, which was taken by a skydiver who worked at HDH, showed the deflection of the left aileron trim tab. During a postaccident interview, the OPC contract mechanic stated that "when [he] did the rig check and the stop checks on the flight controls and the trim checks, everything worked smoothly" and that "there [were] no trim issues or flight control issues on the aircraft." After this postaccident interview, the NTSB made multiple requests to the mechanic for a follow-up interview to learn more information about the maintenance performed on the airplane while it was leased to OPC, but the mechanic did not respond to the NTSB's requests.

The maintenance records for the accident airplane were not consistent with the applicable federal regulations in the following areas:

- The initial logbook entry for December 8, 2017, indicated that a 100-hour inspection of the airframe had been completed in accordance with 14 *CFR* Part 43 Appendix D.[39] A note stating "Phase 1 [inspection]" was written above the entry, but the phase 1 inspection checklist was not completed.[40]

- The phase 3 inspection that was completed on September 27, 2018, contained flight control system items that were not signed off as completed; some of these items were out of specifications and had no corrective actions noted.[41] Specifically, the elevator cable tension was recorded as 8 pounds, but the nominal range was 27 to 36 pounds; the rudder cable tension was also recorded as 8 pounds, but the nominal range was

[37] The phase 1, 2, 3, and 4 inspections were required every 200, 400, 600, and 800 hours, respectively, and every 800 hours thereafter. The most recent phase 1 through 4 inspections were performed, respectively, on December 8, 2017; April 4, 2018; September 27, 2018; and May 18, 2017.

[38] About 8 months after this accident, another fatal accident occurred at HDH (NTSB case number ANC20FA024). The mechanic had also provided maintenance for that airplane, a Cessna 305. As a result of these accidents, the FAA had initially suspended the mechanic's A&P certificate pending a reexamination but has since revoked the mechanic's certificate permanently.

[39] Guidance on periodic maintenance (such as a 100-hour inspection) was found in FAA Advisory Circular 43.13-1B, which contained "methods, techniques, and practices…for the inspection and repair of nonpressurized areas of civil aircraft, only when there are no manufacturer repair or maintenance instructions" (FAA 1998). (As previously stated, the airplane manufacturer had an inspection program for King Air 90-series airplanes, but the program did not include routine maintenance requirements in between phase inspections.)

[40] The phase 1 inspection focused on the airplane's nose landing gear area, nose gear, pilot's compartment, cabin section, rear fuselage and empennage, wings, main landing gear area, engines, and landing gear retraction followed by an operational inspection and a postinspection.

[41] The phase 3 inspection focused on the same areas as the phase 1 inspection.

75 to 91 pounds; the aileron cable tension was recorded as 52 pounds, but the nominal range was 42 to 48 pounds; and the aileron trim tab cable tension was also recorded as 52 pounds, but the nominal range was 9 to 16 pounds. No record was found for the elevator trim tab cable tension.[42]

- No record documented that the required daily engine compressor washes were performed while the airplane was operating at HDH, which had an ocean (salty) atmosphere that could lead to corrosion.[43] A former OPC pilot stated that the salt spray that accumulated on the airplane was not washed away.[44]

1.3.5 Restraint Information

At the time of the accident, the airplane was equipped with two vinyl-covered longitudinal straddle bench seats mounted to the floor structure about 6 inches from the base of the interior cabin walls, which were curved. The left bench extended from the back of the pilot's seat to the forward edge of the cabin door opening (on the left side of the airplane) and had five belted seating positions. The right bench extended from the copilot's seat to the aft edge of the cabin door opening and had seven belted seating positions.[45] The aft-facing copilot's seat could be used for a passenger. According to the OPC owner, the copilot seat was "always" occupied by a tandem instructor for weight and balance purposes.

Twelve single lift-latch belt buckle harnesses were installed to restrain the passengers seated on the benches.[46] Each seat belt was intended to be looped through the lower leg strap or horizontal back strap of the respective parachute harness. The belts were tethered with floor fittings to seat rails on the outboard sides of the benches. The pilot and copilot seats were each equipped with a lift-latch lap belt; the pilot's seat was also equipped with a four-point harness.

According to the airplane owner, when he flew the airplane, solo parachute jumpers would typically use a single seat belt. The owner also stated that it was "not unusual" for tandem instructors to share a single seat belt with their jumpers.

[42] In addition, the inspection of the fuel probe for leaks at the point of attachment was not signed off as completed.

[43] Chapter 5 of the manufacturer's *Aircraft Maintenance Manual* indicated that engines operated in a salty atmosphere should be washed in accordance with engine maintenance manual procedures. The engine motor compressor wash task (an unscheduled maintenance task) was to be accomplished daily. During a postaccident interview, the owner of the accident airplane stated his belief that the engine compressor washes were being accomplished, but he did not state how frequently they were being performed.

[44] The OPC contract mechanic stated that the accident pilot was performing the engine compressor washes. The mechanic added that the pilot had occasionally relubricated the right engine's bleed valve.

[45] Maintenance records provided contradictory and incomplete accounts of the airplane's seating and seat belt arrangements; as a result, the cabin configuration information was based on witness statements, photographs, and videos.

[46] The airplane owner stated that an additional seat belt had been installed on the copilot left seat rail to accommodate a passenger seated on the floor over the center wing spar. (Title 14 *CFR* 91.107(a)(3)(ii) permits the use of the floor as an aircraft seat as long as the person is aboard for the purpose of participating in sport parachuting.) The OPC owner stated that he was not aware of the installation of this belt and that he would have removed it because he did not want anyone seated on the floor.

According to the OPC owner, all passengers were instructed to wear their own seat belt, and the tandem instructors and their jumpers were expected to wear separate seat belts until they approached an altitude of 1,500 ft agl, at which time each instructor and jumper would unbuckle and attach to each other using a tandem harness. The OPC owner stated that he had heard about instances in which camera operators were unrestrained so that they could move around the cabin to record video footage. The OPC owner further stated that there was a "financial incentive" for camera operators to record good footage during the takeoff and climb to the jump altitude to sell to parachuting customers.[47]

1.4 Meteorological Information

The closest weather reporting station to HDH was at Wheeler Airfield, Wahiawa, Hawaii, which was 14 miles southeast of HDH. The conditions surrounding the time of the accident were as follows:

- At 1756 (26 minutes before the accident), the wind was from 180° at 6 knots, visibility was 10 statute miles, few clouds were at 1,300 ft agl, a broken ceiling was at 6,000 ft agl, the temperature was 75°F and the dew point was 70°F, and the altimeter setting was 29.93 inches of mercury.
- At 1856 (34 minutes after the accident), the wind was from 180° at 4 knots, visibility was 10 statute miles, few clouds were at 5,000 ft agl, a broken ceiling was at 7,000 ft agl, the temperature was 75°F and the dew point was 68°F, and the altimeter setting was 29.94 inches of mercury.

Sunset on the day of the accident in Mokuleia occurred at 1913.

1.5 Airport Information

HDH is located 2 miles west of Mokuleia (which is about 22 miles west-northwest of Honolulu, Hawaii) and has an elevation of 14 ft mean sea level (msl). HDH is a nontowered airport that has a single paved runway surface designated 8/26, which was 9,007 ft long and 75 ft wide. Runway 8 included a 1,993-ft displaced threshold that accommodated sailplane operations, and runway 26 included a 1,995-ft displaced threshold. The displaced threshold markings and runway designators formed a 5,000-ft-long section of runway 8/26 for use by light powered aircraft. The

[47] According to the OPC owner, each camera operator helmet was equipped with two GoPro cameras.

active parachute drop zone was located at the east end of the airport beyond the runway 26 displaced threshold. Figure 5 provides an overview of the airport.

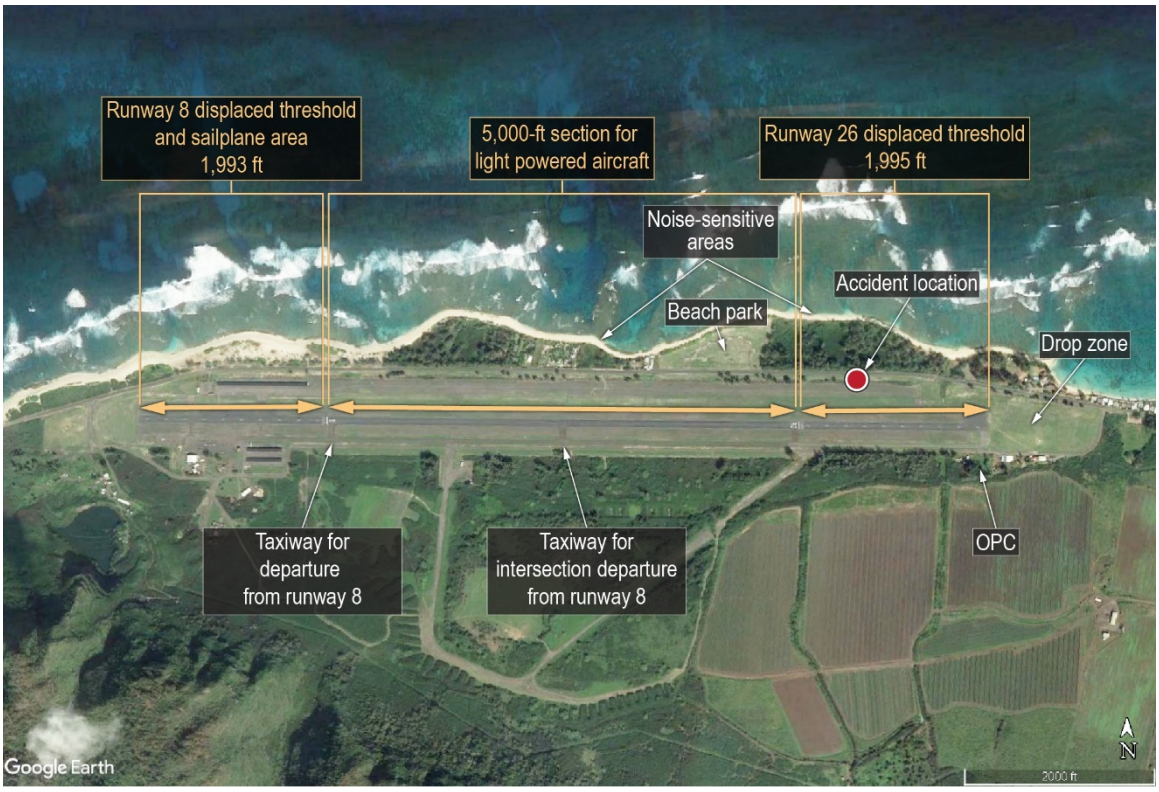


Figure 5. Airport environment

According to the OPC owner and a former OPC pilot, for departures from runway 8, the airplane would turn left at midfield and fly over the adjacent beach park to avoid noise-sensitive areas along the beach and the drop zone at the east end of the airport. The accident airplane owner stated that he had observed takeoffs from runway 8 and did not see any operators (including OPC) perform intersection departures (that is, departures from any runway intersection other than the one at the runway designator). An intersection departure from the 5,000-ft section of runway 8 for light powered aircraft would leave about 2,500 ft of runway remaining. The 1,995-ft length of the runway 26 displaced threshold would also be available for departure.

ATC Requirements

Postaccident interviews indicated that a typical OPC flight involved a 15-minute climb to an altitude of 14,000 ft (and a total flight time of about 30 minutes).[48] According to 14 *CFR* 105.13, Radio Equipment and Use Requirements, OPC pilots were required to notify ATC 5 minutes before the parachutists were to exit the airplane so that facility personnel could clear (or advise about) potential conflicts in the airspace.

[48] According to 14 *CFR* 91.211, supplemental oxygen was not required for the pilot because the airplane spent less than 30 minutes at cabin pressure altitudes above 12,500 ft msl up to 14,000 ft msl.

The three OPC flights before the accident flight could not be positively identified using radar data because the accident airplane did not have a discrete transponder code. The radar data available for flights from HDH on the day of the accident identified three flights that departed about 0820, 0930, and 1725. The other two parachute jump operators at HDH reported that none of their airplanes flew on the day of the accident. Thus, the available radar data could have been associated with the three OPC flights before the accident flight.

A review of ATC audio from 1700 to 1900 on the day of the accident found no contact from the accident airplane to advise of a parachute jump. The audio included the time during which the third OPC flight of the day was most likely operating.

Title 14 *CFR* 105.25, Parachute Operations in Designated Airspace, addresses operations in class G airspace (which covered HDH) and requires that PICs notify ATC about parachute operations between 1 and 24 hours before such operations begin. The regulation also states that ATC could accept written notification from the parachute operator regarding the scheduled parachute operations to be conducted during a specific period not exceeding 1 year. According to the FAA, the accident pilot did not notify ATC of the commercial parachute jump operations on the day of the accident, and OPC did not notify ATC of any commercial parachute jump operations that would be occurring during the year preceding the accident.

1.6 Wreckage and Impact Information

The airplane struck the ground inverted and nose down on a magnetic heading of 011°. The airplane's left wing impacted the ground first, and ground scars and airframe damage indicated that the airplane rotated around the left-wing tip during the impact sequence. The debris path continued for about 40 ft to the airport perimeter fence, and almost all of the debris was located near the fence and the impact point.

Most of the airframe, including almost all of the fuselage, was consumed by a postcrash fire. The left outboard wing, which contained the stall warning system lift transducer, was damaged by impact forces and postcrash fire, and the stall warning light was not located within the wreckage.

Portions of both horizontal stabilizers, including their elevators, were found within the wreckage, and the left horizontal stabilizer was more extensively consumed by fire than the right horizontal stabilizer. Fragments from the left forward, left aft, and right forward horizontal stabilizer spar stubs remained bolted to fragments from their respective fuselage bulkheads. The right aft horizontal stabilizer spar stub broke at the fuselage skin, and the inboard portion remained bolted to the bulkhead.

The left and right main landing gear housing cylinders were found in the retracted position, and there were no ground scars or other damage that would have been consistent with landing gear extension. The nose landing gear assembly was also found in the retracted position.

The attitude indicator on the cockpit instrumentation panel showed that the airplane's pitch was 45° nose down and that the airplane's roll was 142° to the left.

Except for most of the left elevator and its trim tab, fragments of the flight control surfaces and their associated trim tabs were identified in the wreckage; the missing areas of each had been consumed by the postcrash fire. Control continuity could not be established due to postcrash fire damage, kinks in the flight control cables that were consistent with impact damage, and cuts made in the flight control cables during recovery efforts.

The right elevator outboard of the trim tab was found intact. The extension from the right pitch trim actuator face to the center of the rod bolt was 1.06 inches. According to Textron Aviation, this actuator extension was consistent with a pitch trim tab position of 5° trailing edge down, which was close to the takeoff position.

The aileron control stops in the left wing were found intact and unbent. The aft stop was found adjusted so that the bolt was almost fully seated. The bolt for the forward stop was fully extended and would have been contacted when the left aileron was moving in the trailing-edge-up direction. The aileron trim knob on the cockpit control pedestal was found in the full left-wing-down position.

The left-wing aileron trim actuator extension from the face of the actuator to the center of the actuator rod bolt was 0.65 inch. According to Textron Aviation, this actuator rod extension was consistent with a trim tab position of 7.5° trailing edge down, which was the trim tab down travel limit. The aileron trim tab position corresponded with the aileron trim knob position in the cockpit. (Full deflection of the aileron trim tab downward would cause the left aileron to move upward and the right aileron to move downward, resulting in a left roll tendency.)

The rudder trim control knob on the cockpit control pedestal was found in the near center position. The rudder trim actuator extension from the face of the actuator to the center of the actuator rod bolt was 8.65 inches. According to Textron Aviation, this actuator rod extension was consistent with a trim tab position of 5° trailing edge right.

The remnants of the flap handle showed that the handle was in the up position. The position of both left flap actuators was consistent with the flaps in the up position. The outboard right flap actuator was found oriented toward the flaps-up position.

The left engine was located on the right side of the debris field in an upright position. The propeller hub separated from the engine at the propeller shaft adjacent to the flange, and the hub was found mostly embedded in the ground. All of the propeller blades remained attached to the hub, and one of the blades was fractured midspan.

The right engine was located on the left side of the debris field in an upright position. The propeller hub remained attached to the engine, and two of the propeller blades had fractures at the blade tips and were separated from the hub at the retaining clamps, which were also fractured.

Neither engine showed any indications of preimpact damage, such as an uncontainment, a case rupture, or an in-flight fire. Examination of both engines found that they were rotating at a high speed at the time of impact, and damage to both propeller pistons indicated that they were at blade angles consistent with the engines producing high power. The damage to the blades on both

propellers and the damage to the retaining clamps on the right propeller were consistent with both propellers producing near-rated power at the time of impact.

Most of the pilot seat, copilot seat, and passenger benches were consumed by fire. The lap belt portion of the pilot seat's four-point harness was found in the latched position. The two shoulder harness end fittings were found unsecured.[49] The copilot seat's lap belt buckle was not located in the wreckage.

Twelve lift-latch belt buckle assemblies for the passengers were located. Four of the buckle assemblies were latched, and the other eight assemblies were unlatched. One latched buckle assembly was wrapped around the lower parachute harness of a solo jumper, and the 11 remaining buckle assemblies were found distributed throughout the wreckage.

Five electronic devices were recovered within the wreckage: three digital cameras, one personal electronic device, and one device that could not be identified. All five devices sustained varying degrees of thermal and structural damage. No data were recovered from any of these devices.

1.7 Medical and Pathological Information

According to the autopsy of the pilot performed by the Department of the Medical Examiner, City and County of Honolulu, Hawaii, the pilot's cause of death was multiple blunt force injuries. Toxicology testing performed at the FAA Forensic Sciences Laboratory was negative for all tested-for drugs. The testing identified ethanol in the pilot's kidney specimens but not his muscle specimens. Ethanol is commonly found in beer, wine, and liquor but can also be produced in postmortem tissues.

At the request of the medical examiner, toxicology testing was performed by NMS Labs on the other airplane occupants. The toxicology testing of a camera operator's femoral blood specimens detected 32 ng/ml of Delta-9-tetrahydrocannabinal (THC), which is the main psychoactive compound in marijuana; 64 ng/ml of Delta-9-carboxy-THC (an inactive metabolite); and 7.7 ng/ml of 11-hydroxy-delta-9-THC (an active metabolite). The toxicology testing of a tandem instructor's liver specimens detected 22 ng/gm of THC, 850 ng/gm of Delta-9-carboxy-THC, and 11 ng/gm of 11-hydroxy-delta-9-THC.[50]

THC has mood-altering effects, including euphoria and relaxation, and causes alterations in motor behavior, perception, cognition, memory, learning, endocrine function, food intake, and regulation of body temperature. Specific performance effects include a decreased ability to concentrate and maintain attention. Impairment in retention time and tracking, subjective sleepiness, distortion of time and distance, vigilance, and loss of coordination in divided attention tasks have been reported. Significant performance impairments are usually observed for at least 1 to 2 hours after marijuana use, and residual effects can occur for up to 24 hours after use. THC blood concentrations typically peak while smoking marijuana, and peak concentrations of the THC

[49] A review of multiple videos showing the accident pilot found that he did not routinely wear his shoulder harness while operating the airplane.

[50] Blood specimens from this tandem instructor were not available for testing due to the severity of his injuries.

active metabolite occur about 9 to 23 minutes after smoking started. Blood concentrations of THC and its active metabolite decline rapidly and are often less than 5 ng/ml at 3 hours after use (NHTSA 2014).

According to the OPC owner, both the camera operator and tandem instructor had safety responsibilities for the accident flight. The OPC owner stated that the camera operators coordinated the parachute jump by informing the pilot when the drop zone was approaching (so that the pilot could properly configure the airplane) and advising the parachutists when it was time to exit the airplane. The tandem instructor was responsible for the successful outcome of the planned jump with one of the parachutists. Also, as previously stated, OPC tandem instructors were responsible for briefing the passengers about the use of their seat belts.

1.8 Tests and Research

1.8.1 Video Study

The NTSB received a video from a personal electronic device that was recorded by a passenger on the flight preceding the accident flight. The passenger video showed mostly the interior of the airplane; ground references—the ocean and two trees—were visible through a window for 3.5 seconds. The trees were visible for 2.1 seconds; during that timeframe, the airplane appeared to be in a nose-up attitude (having already departed from runway 8) and was transitioning to a left turn toward the ocean. Figure 6 is a still image from the video in which the two trees can be seen through one of the airplane windows; the location of the accident site is also noted.

The passenger video also recorded sound. The spectrum analysis of the sound signal indicated that both of the airplane's engines were operating at the same constant speed during the previous flight.

Source: Mr. Matt Jaskol

Figure 6. Video image from the flight preceding the accident flight showing the two trees in relation to the accident location

1.8.2 Airplane Performance Study

As part of the NTSB's performance study for this accident, Textron Aviation provided data indicating that the Beech 65-A90's average airplane acceleration during takeoff was 5 knots per second; this acceleration was based on flight tests with both engines operating. Also, this

acceleration represented a takeoff from a complete stop to a climb altitude of about 80 ft agl, resulting in a distance of about 2,052 ft during a 45-second time frame.[51]

The NTSB is not aware of any video or witness report indicating the airplane's location on runway 8 for the beginning of the accident takeoff roll. If the takeoff roll had been initiated with 4,500 ft of runway available (from the runway 8 intersecting taxiway), the performance data indicated that the airplane would have climbed to about 100 ft agl when it was over the displaced threshold for runway 26 and near the trees along the runway.[52]

According to the Beech 65-A90 takeoff performance information, the accident flight likely lasted for about 1 minute. The airplane wreckage was located about 3,030 ft beyond the intersecting taxiway and 460 ft to the left of the runway centerline. Thus, the impact location was consistent with the takeoff distance calculations for an intersection departure.

The left aileron trim tab was found in the wreckage in the full left-wing-down position; this position compensated for the aerodynamic effects resulting from damage likely sustained during the July 2016 accident that was not subsequently repaired.[53] The possible effects of this left wing anomaly included a reduction in the aileron deflection that would be available for maneuvering, higher drag, and/or higher stall speeds for that wing.

The use of full left-wing-down aileron trim would have relieved the pilot from having to maintain a control wheel force for wings-level flight. The aileron trim knob in the cockpit was found in the full left-wing-down position, but the performance study was not able to determine, with the available information for this investigation, the extent that the trim tab position relieved the control wheel pressure forces for the pilot during the accident flight.

In addition, the performance study considered whether an accelerated stall could have occurred.[54] As previously stated, the Beech 65-A90 1-G stall speed for the accident conditions (7,900 pounds, flaps up, and power on) is about 67 knots. Calculations showed that, during the left turn from the 50-ft obstacle point (1,750 ft from the runway intersection) to the accident site, a bank angle of about 20° would have been required to reach the accident site, but the 50-ft obstacle point location might not have been where the turn during the accident flight was initiated (given the turn location during the previous flight). If the left turn had been initiated at the runway 26 designator (near the two trees shown in figure 6), which was consistent with the turn location during the previous flight, a tighter turn would have been necessary. Additional calculations showed that a bank angle of about 60° would have been required, which would have placed the

[51] The normal takeoff distance chart in the Beechcraft King Air *Model 65-A90 FAA Flight Manual* indicated that, with conditions similar to the accident flight (a light wind, sea-level airport altitude, and gross takeoff weight of about 7,900 pounds), about 1,750 ft would be needed to clear a 50-ft obstacle. The distance chart data and the flight test data that Textron Aviation provided showed similar takeoff results.

[52] The 4,500-ft length comprised about one-half of the 5,000-ft portion of runway 8 for light powered aircraft as well as the 1,995-ft displaced threshold for runway 26.

[53] As previously stated, the photograph from the 2017 ferry flight and a video of the airplane taken just before the 2019 accident flight also showed the deflection of the left aileron trim tab.

[54] An accelerated stall has load factors above 1 G and speeds greater than the airplane's 1-G stall speed.

airplane in a flight regime conducive to an accelerated stall.[55] The airplane's trajectory at impact was approximately perpendicular to the runway.

1.9 Organizational and Management Information

1.9.1 Oahu Parachute Center

OPC began operations in June 2017. The OPC owner essentially ran the company by himself and had no previous experience running a parachute operation, but he stated that he had performed "over 18,000 tandem jumps" as a tandem instructor. At the time of the accident, OPC employed five tandem instructors, two camera operators, one video editor, one parachute packer, one scheduler, and the accident pilot, all of whom were contractors.[56] OPC operated one airplane (the accident airplane) and, according to the OPC owner, was closed on Tuesdays for airplane maintenance.

According to former company pilots, OPC did not have any written procedures or manuals about the company's parachute jump operations. One former company pilot stated that he "never signed any paperwork" while with the company.

OPC did not have a training curriculum or company training manuals for OPC pilots. A former OPC pilot, who was not a flight instructor but provided training to multiple OPC pilots (not including the accident pilot), stated that the company did not provide him with direction for training except to teach new pilots to start the engines, taxi, take off, fly the jump run, and land the airplane, after which the pilots would be "good to go." The former pilot also stated that "there was no money to take the airplane off the line" for training and that training consisted of "a couple of jump runs." The former pilot further stated that most of the company's training involved viewing King Air Academy videos on YouTube instead of hands-on training.

Another former OPC pilot stated that the company's King Air training "was a joke." This former pilot also stated that his training on the airplane was "minimal" and that his instructor advised, at the completion of training, "not to get uncoordinated."

1.9.2 Federal Aviation Administration Oversight

Title 14 *CFR* 105.9, Inspections, stated that the FAA can inspect any parachute jump operation (including inspections at the site where the parachute jump operation is being conducted) to determine compliance with Part 105 regulations. The FAA Flight Standards District Office (FSDO) located at Daniel K. Inouye International Airport, Honolulu, Hawaii, provided oversight of parachute jump operations at HDH. At the time of the accident, three parachute jump operators (including OPC) were located at HDH.

[55] The bank angle calculations are estimates given that the airplane would have been climbing at the time.

[56] During a postaccident interview, a former OPC pilot stated that the company "had difficulty keeping commercial multiengine-rated pilots" but did not explain why this situation was occurring.

Guidance for inspections of parachute jump operations was provided in FAA Order 8900.1, Flight Standards Information Management System, volume 6, chapter 11, section 5, "Surveillance of Sport Parachute Activities."[57] According to FAA Order 1800.56S, National Flight Standards Work Program Guidelines, the inspection guidance applied to Part 91 parachute jump operations conducted in accordance with Part 105.[58] Inspectors were to perform annual inspections for each parachute jump operation within a FSDO's jurisdiction, including a parachute jump inspection and ramp inspections. The FSDO operations inspector who conducted these inspections at OPC stated that the surveillance activities that the FAA required for parachute jump operations were not extensive and that the FAA had limited oversight of those operations.

FAA Orders 8300.10 and 8700.1, Joint Flight Standards Information Bulletin for Airworthiness (FSAW 93-09) and General Aviation (FSGA 93-02), Parachutists Regulatory Status, dated January 25, 1993, stated the following:

> Federal Aviation Regulations dealing with sport parachute operations were promulgated primarily to ensure protection of other users of the National Airspace System and the general public from sport parachuting activities. It has been determined that parachute jumping is a sport activity and, as such, should be subject to the FARs only to the extent necessary to protect others…. Aviation safety inspectors…having surveillance responsibilities of sport parachute activities should be aware that it is the FAA position that parachutists should not be considered passengers when evaluating the regulatory compliance status of such operations.[59]

Inspections at Oahu Parachute Center

The FSDO operations inspector conducted a parachute jump inspection and a ramp inspection at OPC on March 7, 2018.[60] The inspector stated that he observed parachute jumps and checked for cloud clearance requirements to ensure that no one had jumped through the clouds.[61] Once the jumpers were safely on the ground, the inspector checked two tandem parachute systems to ensure that the reserve parachute packing dates were current. The inspector recalled observing the airplane's takeoffs and landings and reviewing the flight manuals, which appeared to be current

[57] Additional guidance in the order was contained in volume 6, chapter 1, section 3, "Inspect Part 91 Maintenance Records," and section 4, "Conduct a Part 91 Ramp Inspection," which defined a ramp inspection as "surveillance of an airman, operator, air agency, or aircraft…sufficient to show compliance with [federal regulations] during actual operations at an airport or heliport."

[58] Version S of FAA Order 1800.56 was in effect at the time of the accident. Version S was canceled on October 1, 2019, when version T became effective. The order stated that inspector comments "should cover, as applicable, pilot certification and medical certificate, aircraft maintenance/inspection, aircraft fueling procedures, and aircraft configuration for sport skydiving operations." The order also stated that inspectors needed to verify "harness and reserve parachute marking compliance." Version U of the order became effective on June 20, 2020.

[59] This FAA position did not eliminate the requirements of 14 *CFR* 91.107 regarding passengers' use of safety belts.

[60] This inspection occurred during the fiscal year 2018 cycle (October 1, 2017, to September 30, 2018). The fiscal year 2019 inspection had not occurred before the date of the accident (June 21, 2019) but was not required to be completed until September 30, 2019.

[61] The parachute jump inspection and ramp inspection did not include verification of the ATC notifications required by Part 105 (see section 1.5), and the operations inspector stated that he did not verify this information during his inspection of OPC.

at the time, but did not recall if he reviewed the airplane logbook. The inspector stated that he did not review the flight logbook for the pilot at that time or talk with the OPC owner.

The FSDO operations inspector further stated that the ramp inspection included a check of the pilot's flight and medical certificates and a check of the airplane, including a walk-around to determine whether the airplane was properly configured with seat belts. The inspector stated that OPC had met the requirements of the inspection, and no issues were noted in the FAA inspection records. The inspector added that he was not aware that the airplane had been involved in a previous accident and that he had not met the OPC accident pilot.

FAA records also showed that, on December 7, 2017, a FSDO airworthiness inspector conducted a ramp inspection and an aircraft records inspection at OPC for the accident airplane. The records indicated that the inspections were "satisfactory"; no further comments were provided. The former OPC pilot who was involved with this ramp inspection stated that it was more of a "paperwork inspection" than a "physical inspection."

According to FAA Order 8900.1, a purpose of this ramp inspection was to review the general airworthiness of an airplane by examining it for items that could affect safety of flight, such as cracks, damage, and loose or missing fasteners. The order also stated that a purpose of this aircraft records inspection was to ensure that records showing major repairs were being retained for 1 year after the work was performed and that records showing major alterations were being retained with the aircraft indefinitely. The NTSB wanted to interview the airworthiness inspector to determine whether he conducted the inspections at OPC according to FAA guidance and whether he noted the numerous airframe anomalies on the accident airplane, but the airworthiness inspector was no longer employed by the FAA at the time of the accident and was not available to be interviewed.

1.10 Additional Information

1.10.1 Previous Report on Parachute Jump Operations

In September 2008, the NTSB issued a special investigation report about the safety of parachute jump operations, which detailed the results of the NTSB's review of 32 accidents between 1980 and 2008 involving these operations (NTSB 2008). The NTSB identified recurring safety issues, including the inadequate maintenance and inspection of aircraft used in these operations. As a result, the NTSB recommended that the FAA "require parachute jump operators to develop and implement Federal Aviation Administration-approved aircraft maintenance and inspection programs" (A-08-63). The NTSB classified this recommendation "Closed—Unacceptable Action" on December 12, 2014.[62]

[62] On October 28, 2013, the FAA stated that "we cannot legally require an owner/operator to adopt manufacturers' recommended maintenance instructions" but that it encouraged operators to voluntarily review and incorporate those instructions. The FAA also stated that the requirements of existing regulations satisfied the intent of this recommendation. On December 12, 2014, the NTSB stated that it remained concerned that operators of aircraft used in parachute jump operations were not required to develop and implement FAA-approved aircraft maintenance and inspection programs.

The NTSB also identified, as a recurring safety issue, pilot performance deficiencies in basic airmanship tasks and recommended that the FAA take the following actions:

> Require parachute jump operators to develop initial and recurrent pilot training programs that address, at a minimum, operation- and aircraft-specific weight and balance calculations, preflight inspections, emergency and recovery procedures, and parachutist egress procedures for each type of aircraft flown. (A-08-65)
>
> Require initial and recurrent pilot testing programs for parachute jump operations pilots that address, at a minimum, operation- and aircraft-specific weight and balance calculations, preflight inspections, emergency and recovery procedures, and parachutist egress procedures for each type of aircraft flown, as well as competency flight checks to determine pilot competence in practical skills and techniques in each type of aircraft. (A-08-66)

Both safety recommendations were classified "Closed—Unacceptable Action" on June 16, 2011.[63]

For more information about these safety recommendations and their classifications, see the Case Analysis and Reporting Online database at the NTSB's website.

1.10.2 Advisory Circular 105-2E

FAA Advisory Circular (AC) 105-2E, Sport Parachuting, was issued on December 4, 2013, to improve sport parachuting safety and provide information to all parties associated with sport parachuting operations.[64] The AC provided information for parachutists, parachute riggers, and pilots who transport parachutists to ensure that sport parachute operations are conducted in accordance with Part 105 requirements.

The AC stated that the PIC was solely responsible for the operational requirements of Parts 91 and 105, including compliance with the special operating limitations and placards required for flight with the door open or removed. The PIC was also responsible for ensuring that

[63] On March 8, 2011, the FAA stated that its current regulations and planned revisions to Advisory Circular 105-2 met the intent of these safety recommendations. The FAA also stated, "we decline to require specialized training and testing for pilots of aircraft conducting parachuting operations." On June 16, 2011, the NTSB restated its concern that requirements for pilots of parachute jump operations were not consistent with those for pilots of other revenue-based operations, such as Part 135 on-demand operations.

[64] Safety Recommendation A-08-67 asked the FAA to "revise the guidance materials contained in Advisory Circular 105-2C, 'Sport Parachute Jumping,' to include guidance for parachute jump operators in implementing effective initial and recurrent pilot training and examination programs that address, at a minimum, operation- and aircraft-specific weight and balance calculations, preflight inspections, emergency procedures, and parachutist egress procedures." On May 18, 2011, the FAA issued AC 105-2D, Sport Parachuting, but the NTSB considered the FAA's actions regarding this recommendation to be incomplete because the AC did not contain initial and recurrent training and examination programs, as requested. On July 23, 2015, the NTSB stated that the revisions to AC 105-2E (issued December 4, 2013) satisfied the intent of Safety Recommendation A-08-67 and classified the recommendation "Closed—Acceptable Action."

all occupants had been briefed on the operation of their restraint system and that the airplane's weight and balance stayed within limits.[65]

In the AC, the FAA recommended that pilots flying aircraft for the purpose of sport parachuting receive appropriate initial and recurrent training. According to the AC, the training program should include "testing to ensure a high level of competence in the jump aircraft being flown." The recommended training in the AC included subjects that are unique to parachute jump operations, such as opening and closing the jump door, configuration for jump runs and jumper exits, weight shift in-flight procedures for exiting jumpers, drop zone surface and airspace familiarization, and emergencies caused by jump activities.

[65] As previously stated, OPC delegated the passenger seat belt briefing to tandem instructors. Title 14 *CFR* 91.107 required pilots to ensure that passengers were briefed on the use of their seat belts; the regulation did not state that pilots had to conduct this briefing themselves. No evidence indicated whether the accident pilot ensured that the passengers on the accident flight were briefed about the use of their seat belt or the method that he might have used to accomplish the requirement.

2. Analysis

2.1 Introduction

This accident occurred during takeoff after the airplane banked to the left and rolled inverted at a low altitude and then descended to the ground. Security camera video showed the airplane's high-energy impact with the ground and an ensuing postcrash fire, which consumed almost all of the fuselage. The accident was not survivable. Postaccident examination showed that the landing gear, flaps, and elevator trim positions appeared to be appropriately configured for the initial climb phase of takeoff. Sections 2.2.1 through 2.2.3 describe the accident sequence.

As a result of this accident investigation, the NTSB identified safety issues associated with (1) the FAA's system for tracking flight instructors' student pass rates, which are a measure of the instructors' ability to successfully train students, and (2) the FAA's guidance for providing surveillance of those instructors with substandard pass rates. In response, the NTSB issued a safety recommendation report titled *Provide Inspectors with Automatic Notification of Flight Instructors with Substandard Student Pass Rates* (NTSB/ASR-20/06), which contained three recommendations to the FAA. Those three recommendations are discussed in section 2.3 of this report.

In addition, the NTSB identified the following safety issues during this accident investigation:

- the need for an appropriate regulatory framework for parachute jump operations, including standards for initial and recurrent training and maintenance and management policies and procedures;
- the need for increased FAA oversight of parachute jump operations; and
- the need for safety management systems (SMS) for parachute jump operators.

These safety issues are discussed in the NTSB's aviation investigation report addressing broader systemic safety issues associated with revenue passenger-carrying operations currently conducted under Part 91. That aviation investigation report, titled *Enhance Safety of Revenue Passenger-Carrying Operations Conducted Under Title 14 Code of Federal Regulations Part 91* (NTSB/AAR-21/03), can be accessed from the Aviation Accident Reports page of the NTSB's website. Sections 2.4 through 2.6 of this report include references to safety recommendations from the Part 91 aviation investigation report.

2.2 Accident Summary

2.2.1 Takeoff and Initiation of Left Turn

The accident flight was one of five flights that OPC had scheduled for the day of the accident, the last three of which OPC considered to be "sunset" flights. The available evidence

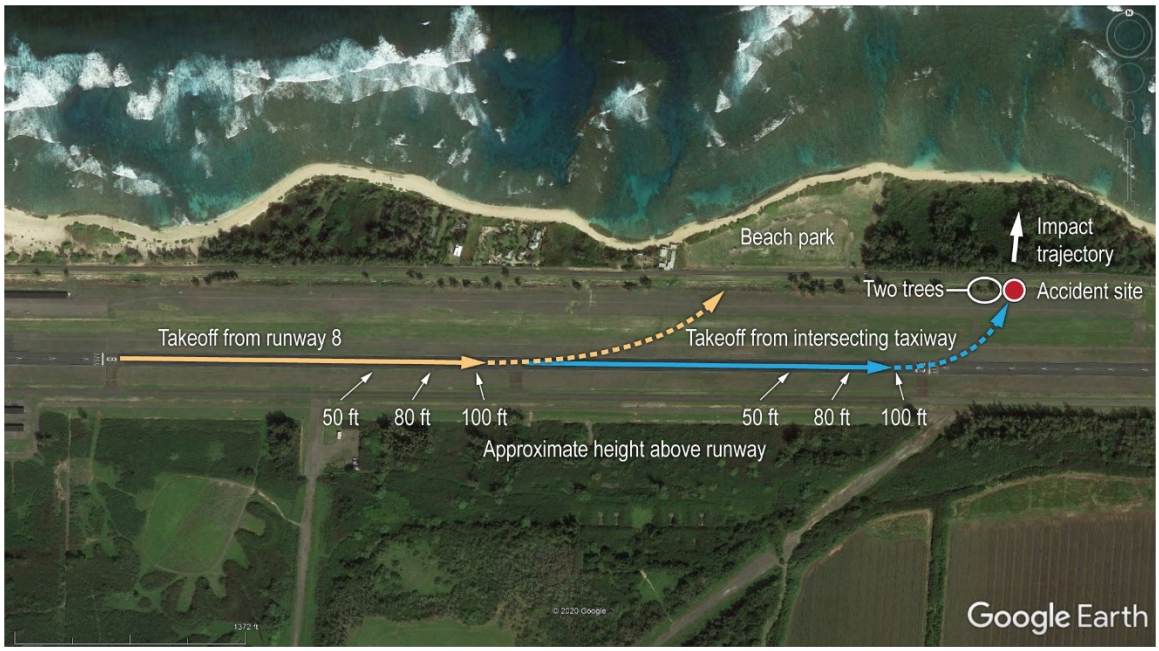
indicated that the first of the three sunset flights departed from runway 8 about 1725. The accident flight immediately followed the first sunset flight.

According to a former OPC pilot, the standard departure from runway 8 necessitated a turn to the left at midfield to fly over the adjacent beach park to avoid the noise-sensitive areas along the beach and the drop zone at the east end of the runway (see figure 5). Airplane performance data were consistent with the former OPC pilot's statement and showed that, for a runway 8 departure using the 7,000 ft of runway available, the airplane had ample distance to rotate, climb, and turn toward the beach park (the established turning point) to avoid the noise-sensitive areas and the drop zone.[66] However, a departure from runway 8 using the intersecting taxiway at midfield would leave 4,500 ft of available runway for takeoff, resulting in rotation farther down the runway (adjacent to the beach park) and a turn soon thereafter to avoid the noise-sensitive areas and the drop zone.

The NTSB analyzed a video that was recorded by a passenger during the first sunset flight (the flight before the accident flight). The video showed that, shortly after takeoff, the pilot flew the airplane beyond the beach park and initiated a left turn at a relatively low altitude, directly over the area that would become the accident site, and toward the noise-sensitive areas. A comparison of takeoff performance data with the airplane's approximate position shown in the video revealed that the pilot likely initiated the takeoff roll from the runway 8 intersection.

For the accident flight, there was no video or witness report indicating the airplane's location on the runway at the beginning of the takeoff roll. Because the accident location was directly under the flightpath (specifically, the location of the turn) of the previous flight, the NTSB determined that, for the accident flight, the pilot most likely followed a similar flight trajectory and performed a takeoff from the runway 8 intersection rather than the standard departure location, as shown in figure 7.

[66] Although runway 8/26 was 9,007 ft long, the pilot would not have used the runway 8 1,993-ft displaced threshold for takeoff because that area was for sailplane use. Thus, about 7,000 ft of runway would have been available for a departure from runway 8.



Note: The standard takeoff flight trajectory is shown in yellow, and the accident takeoff flight trajectory is shown in blue. The dotted blue line shows the calculated turn radius and not necessarily the accident flight's ground track. The location of the two trees, which were visible in the passenger video discussed in section 1.8.1, and the location of the accident site were used to determine the airplane's likely flight trajectory.

Figure 7. Comparison of the standard and accident takeoff flight trajectories

The NTSB considered reasons why the pilot might have conducted an intersection takeoff with 4,500 ft of available runway remaining instead of using the full 7,000 ft that was available on runway 8. One possibility is that the pilot's normal practice was to conduct an intersection takeoff and that he was willing to accept the higher level of risk associated with an intersection takeoff (that is, less runway would be available if an aborted takeoff was necessary).[67] However, the accident airplane owner stated that, when he observed OPC departures from runway 8, he did not see any intersection takeoffs. (The accident airplane owner did not indicate whether the departures that he observed involved the accident pilot.)

Another possibility is that the pilot might have perceived pressure to take off quickly so that he could return to the airport in time for the last scheduled flight (and the third sunset flight) of the day. For the second sunset flight (the accident flight), the pilot began to taxi the airplane about 1820, and the airplane departed about 1822. The duration of an OPC parachute jump flight was about 30 minutes, so the accident flight (if it had been flown successfully) would have returned to the airport about 1852. Sunset in Mokuleia on the day of the accident was at 1913, at which time the airport would be closed to civil aircraft. Thus, although the last sunset flight could have departed shortly after the airplane returned to the airport, there would not have been enough time

[67] In September 2017, the NTSB issued Safety Alert No. 071, titled "Do Your Takeoff Homework; Runway Length Matters," to highlight the potential hazards associated with intersection takeoffs, including reduced options if a problem occurred during departure.

for that flight to be completed by 1913.[68] No evidence indicated whether the pilot was aware of the time of sunset on the day of the accident.

Because there was no video or witness report of the accident takeoff, the NTSB considered reports about the takeoff technique that the pilot had previously used to determine the events that likely occurred after takeoff. On the evening before the accident flight, a witness with military pilot experience saw "a very aggressive takeoff of a King Air aircraft, similar to the one that crashed." The witness stated that, when the airplane was about 10 ft off the ground, the airplane "pulled up and to the left in one motion," which put the airplane in "an estimated 70 [degree bank angle] or more turn as it climbed out." The witness also stated that the maneuver "looked dangerous."

The takeoff that this witness observed was most likely performed by the accident pilot (given that he was OPC's only pilot and the similarities between the observed airplane and accident airplane) and was likely representative of the takeoff technique that he routinely used (based on reports of other takeoffs that he performed). Specifically, a former OPC pilot stated that the accident pilot would bank hard and pitch up aggressively during departures as a "thrill ride" for passengers. Also, a pilot at another parachute jump operator at HDH stated that the accident pilot's takeoffs had become more aggressive, with pitch and bank occurring simultaneously and bank angles exceeding 45°, and that he appeared to be "showing off."[69] In addition, experienced parachutists who were aboard the flight before the accident flight stated that the airplane had entered a low-altitude steep left bank after takeoff and that the takeoff was more aggressive than what they considered to be normal.

The airplane's trajectory at impact was approximately perpendicular to the runway, indicating that the pilot made a quick aggressive left turn toward the beach during the accident flight. No parachutists were landing in the drop zone at the east end of the airport at the time of the accident takeoff, and the other two parachute jump operators at HDH had no operations on the day of the accident, so the pilot would not have had to make the aggressive turn to avoid the drop zone. (Airport procedures encouraged pilots to avoid flying over the drop zone regardless of whether parachutists were landing.) Thus, given the available evidence for this investigation, the pilot's aggressive turn was most likely the result of his takeoff technique. The NTSB concludes that, after making an intersection takeoff, the pilot conducted an intentional aggressive takeoff maneuver involving a low-altitude high-bank turn and simultaneous pitch-up maneuver.

[68] The available evidence for this accident did not include the manifest for the last sunset flight; thus, the NTSB could not determine whether paying passengers were waiting for that flight. The OPC owner stated that company pilots were paid by passenger load.

[69] The Beech King Air 65-A90 was certified as a normal category airplane, and aerobatic maneuvers were not approved for the airplane. However, according to 14 *CFR* 91.303, the maneuvers that the pilot conducted constituted aerobatic flight.

2.2.2 Airplane Performance

Security camera video indicated that the airplane was inverted in a 45° nose-down attitude during the final moments of the accident flight. Examination of the accident site showed that the airplane's left wing impacted the ground first.

The FAA's *Airplane Flying Handbook* (FAA-H-8083-3B) states that an airplane, at the same gross weight, airplane configuration, CG location, power setting, and environmental conditions, will consistently stall at the same indicated airspeed if no acceleration is involved.[70] The handbook also states that an airplane will stall at a higher indicated airspeed when the airplane is subject to excessive maneuvering loads, including steep turns, pull-up maneuvers, or other abrupt changes to the airplane's flightpath. This type of stall is referred to as an "accelerated maneuver stall."

An accelerated stall can be encountered when a pilot increases the airplane's angle of attack (AOA) rapidly. Accelerated stalls that result from abrupt maneuvers, such as the pilot's aggressive pitch and bank during takeoff, tend to be more rapid or severe than unaccelerated (1-G) stalls and can occur at lower-than-anticipated pitch attitudes. A pilot's failure to immediately address an accelerated stall can result in a loss of control.

The NTSB used the available evidence from this investigation to calculate CG scenarios for the accident flight.[71] With one passenger seated in the aft-facing copilot seat and all other passengers seated in the cabin on the two bench seats (discussed in section 1.3.5), the CG at takeoff, for an airplane weight of 7,925 pounds, would have been about 156.7 inches, which was within the airplane's CG limits and was the forwardmost CG that could have existed during the accident flight.[72] However, it is possible that the two parachutists who boarded the airplane late (just before departure) were not secured and that one or both camera operators, who had a financial incentive to record video footage during the flight, were unsecured and moving around the cabin. Under these conditions, the CG would have been farther aft.

The NTSB located in the wreckage the 12 lift-latch buckle assemblies for the bench seats, 8 of which were unlatched. Thus, between three and five passengers were likely unsecured at the time of impact.[73] If these unsecured passengers slid toward the back of the airplane during the pilot's aggressive pitch-up maneuver, a weight shift beyond the aft CG limit could have occurred, but the available evidence was insufficient to determine whether a weight shift occurred during the accident flight. However, given the multiple unbuckled passengers, the last-minute boarding

[70] The term "acceleration," as used in this context, does not denote an increase in airspeed; instead, the term denotes an acceleration in the vertical axis, that is, an increase in G loading.

[71] This evidence included the medical examiner's chart depicting passenger locations at the accident site, which was the basis for assumed passenger locations in the cabin at takeoff. The chart indicated that a solo parachutist and a camera operator were found in the debris field near the aft cabin.

[72] The NTSB made this calculation using the basic operating weight of the airplane, estimated fuel on board, pilot and passenger weights, and parachute gear weights. OPC did not provide documentation of the company's weight and balance calculation for the accident flight. OPC's standard calculation method, which did not include the parachute gear weights (tandem parachute systems, tandem harnesses, and single parachute systems), is discussed in section 2.5.1.

of two passengers in the aft cabin, the possibility that the camera operators were positioned in the aft cabin during takeoff (because of their roles in capturing video of the passengers and coordinating the parachute jump), and the potential for a weight shift during the aggressive pitch-up maneuver, the NTSB concludes that the airplane was likely operated near or possibly beyond the aft CG limit during the accident takeoff.

The accident airplane would have been controllable with a CG near the aft limit and was operated that way during previous flights. However, an aft CG reduces an airplane's static longitudinal stability, which is a measure of the airplane's tendency to return to equilibrium about its pitch axis. An aft CG also results in lighter control column forces that could cause a pilot to overcontrol an airplane. Flight test data from Textron Aviation showed that the Beech 65-A90 airplane had acceptable control column forces for conditions similar to those involving the accident flight (CG near the aft limit, flaps and gear up, and maximum continuous power).[74] Nevertheless, during the accident flight, the lighter control column forces (due to the airplane's operation near the aft CG limit) could have resulted in an increased airplane pitch response and a subsequently higher AOA when the pilot moved the control column aft during the takeoff. Because the pilot performed the accident takeoff aggressively, the resulting AOA likely exceeded the stall AOA quickly and with little warning.[75]

Although the pilot's previous takeoffs occurred without incident, the pilot likely overcontrolled the airplane during the accident flight while performing the aggressive takeoff maneuver, which caused the airplane to enter an accelerated stall at an altitude between about 100 and 200 ft. The airplane's orientation and trajectory at the time of impact were consistent with a sharp turn and loss of control. Thus, the NTSB concludes that the pilot's aggressive takeoff maneuver caused an accelerated stall and a subsequent loss of control at an altitude from which recovery was not possible.

2.2.3 Left Wing Anomaly

Examination of the airplane after the July 2016 accident showed that the left wing was twisted, as indicated by the wrinkles in the top skin of the wing (immediately outboard of the engine and aft of the forward spar). The wing twist likely occurred during the July 2016 accident given the high airframe stresses that the airplane sustained.[76] The direction of wing twist indicated by the wrinkles was leading edge up for the wing tip. Because the left wing was twisted in the leading-edge-up direction, it had a higher angle of incidence than the right wing and thus a higher AOA during level flight.[77] This higher angle of incidence could result in a tendency for the left

[74] These flight test data were considered acceptable compared with the requirements of *Civil Aviation Regulations* Part 3, the certification basis for the airplane. The Part 3 regulation was established in 1956.

[75] The FAA's *Airplane Flying Handbook* stated that accelerated stalls could "surprise an inexperienced pilot."

[76] On February 1, 2021, the NTSB received a photograph of the accident airplane from the airplane owner; the photograph was reportedly taken in January 2015. Although the photograph showed the left aileron trim tab downward deflection, the orientation of the airplane in the photograph did not allow the NTSB to assess the condition of the top skin in the left wing.

[77] According to an FAA glossary, an aircraft's angle of incidence is "the acute angle formed between the chord line of an airfoil and the longitudinal axis of the aircraft on which it is mounted."

wing to stall first and the airplane to roll to the left during high AOA conditions. Multiple witnesses indicated that, after the accident airplane lifted off, it rolled left wing down.

The left wing was not repaired after the July 2016 accident, and the airplane required full left-wing-down aileron trim to fly straight and level, as shown in multiple photographs taken between the completion of the accident repairs and the June 2019 accident.[78] The left aileron trim tab was found at its trailing-edge-down travel limit, which was consistent with the full left-wing-down trim position. The requirement for left aileron trim indicated that the twisted left wing was producing more lift in flight than the right wing, creating a rolling moment that could have been due to the left wing's higher angle of incidence.[79] The higher AOA of the left wing would have resulted in that wing stalling first. Thus, the stall margin for the left wing would have been reduced.[80] The NTSB concludes that the twisted left wing that resulted from the airplane's previous accident reduced the airplane's stall margin, which likely caused the left wing to stall before the right wing and precipitated the airplane's roll to the left.

The full left-wing-down position of the aileron trim tab (set using the aileron trim knob in the cockpit) was one indication of the left wing anomaly. The Beechcraft *Model 65-A90 FAA Flight Manual* stated that the left aileron and trim tab needed to be checked before flight, but there was no evidence indicating that the pilot questioned the abnormal position of the trim tab during preflight checks of the airplane.[81] The aileron trim knob was found in the wreckage in the full left-wing-down trim position. Thus, the pilot had likely accepted the practice of having the aileron trim knob in its full left-wing-down position to compensate for the right roll resulting from the twisted left wing. However, this positioning of the aileron trim knob so that the airplane could fly wings level meant that the pilot had no further left-wing-down trim authority (precluding his ability to reduce control wheel forces) and limited left-wing-down aileron authority, which decreased the airplane's margin of safety.

Another indication of the left wing anomaly was the position of the left aileron forward and aft control surface stops, which were found adjusted unevenly; the forward stop was fully extended, and the aft stop was almost fully retracted. The NTSB could not determine the reason for this control surface stop arrangement, but it is likely that maintenance personnel made control rigging adjustments to counter the effects of the damage that resulted from the July 2016 accident. The control surface stop arrangement would have affected the maximum rolling moment for the airplane in each direction but was likely not a factor in this accident.

[78] As previously stated, a still image from a video taken just before the accident flight showed the deflection of the trim tab on the left aileron.

[79] The application of left aileron and left aileron trim was needed to balance the rolling moment and reduce the pilot's control wheel force, respectively.

[80] According to the FAA's *Pilot's Handbook of Aeronautical Knowledge*, a stall margin "exists between the current AOA that the airfoil is operating at, and the AOA at which the airfoil will stall" (FAA 2016).

[81] There was also no evidence indicating that any former OPC pilot, during preflight checks of the accident airplane, questioned the abnormal position of the aileron trim tab.

2.3 Pilot's Aeronautical Experience and Training

2.3.1 Initial Training

The accident pilot logged his first airplane flight on April 22, 2017, and received his private pilot and commercial pilot certificates 3 and 8 months later, respectively. However, he failed the initial checkrides for both certificates and for his instrument rating. Although the accident pilot passed each checkride on a second attempt, his three consecutive first-attempt failures indicated that he was poorly trained and poorly prepared for the responsibilities associated with each certificate.[82]

The accident pilot received his flight instruction from Riter Aviation. His flight instructor was the company owner, who also operated a Beech King Air C90GTi airplane as the PIC for a fruit company that had subcontracted its pilot services to Riter Aviation. During his initial flight training, the accident pilot logged about 53 hours in the King Air C90GTi airplane. However, this flight time was primarily logged as dual instruction while he was still a student pilot. The flights were operated for the fruit company and included extended cross-country commercial Part 91 operations conducted with passengers in the cabin. Thus, it is unlikely that the accident pilot received any meaningful training during these flights and that the flights were most likely conducted by the flight instructor with the accident pilot sitting in the copilot seat.

According to the FAA, 14 *CFR* Part 61 regulations allow a student pilot to log flight training and aeronautical experience toward a commercial pilot certificate; however, the pilot must be trained and evaluated at the commercial pilot level. The accident pilot had accumulated only 4.6 hours as a student pilot when he began logging (and the instructor began endorsing) commercial pilot training and experience. A pilot with that amount of flight time could not be expected to consistently perform at the commercial pilot level. Thus, it is likely that the instructor endorsed the pilot's logbook for dual commercial flight instruction that the pilot did not receive. The NTSB concludes that the pilot's initial training did not provide him with adequate experience and proficiency for Beech King Air operations.

According to the FAA's *Aviation Instructor's Handbook* (FAA-H-8083-9B, dated 2020), a flight instructor's job "is to 'mold' the learner pilot into a safe pilot who takes a professional approach to flying."[83] The handbook also stated that a flight instructor "is responsible for training an applicant to established standards in all subject matter areas, procedures, and maneuvers" for the desired certificate. However, some of the pilot's flight time that the flight instructor endorsed was logged as "first officer training," which, according to the FAA, was not a term used in regulations addressing training requirements. Because it was unclear what "first officer training" comprised, the FAA could not determine whether this training complied with regulations. The NTSB concludes that, by indicating that the accident pilot completed dual commercial flight instruction that he likely did not receive and by not providing initial training according to

[82] These checkrides were the only ones that the pilot attempted and subsequently passed.

[83] FAA-H-8083-9A, dated 2008, was in effect at the time that the flight instructor provided training to the accident pilot.

established standards, the pilot's flight instructor showed a lack of professionalism and a disregard for aviation safety.

According to FAA records, for the 2-year period ending April 10, 2020, only 59% of students that the Riter Aviation flight instructor endorsed passed their certificate or rating practical examination on the first attempt. (The accident pilot's three consecutive first-attempt failures occurred before the 2-year period covered by the FAA records.) As indicated in 14 *CFR* 61.197, one method for renewal of a flight instructor certificate for a 2-year period is for the applicant to provide a record showing that at least 80% of five or more students passed a practical test for a certificate or rating on the first attempt during the preceding 2 years. The FAA was not aware of the Riter Aviation flight instructor's substandard student pass rate because there was no mechanism to provide such notification automatically to FAA inspectors who oversee flight instructors. On January 7, 2021, the NTSB issued three recommendations to the FAA addressing this matter.[84]

2.3.2 Oahu Parachute Center Pilot Training

When the pilot began his employment with OPC, he had accumulated about 872 hours of total flight experience. However, as previously stated, the pilot had only logged about 53 hours in a Beech King Air airplane, which is a high-performance, twin turbine-powered airplane that is significantly more complex than the Piper Aztec PA23-250T twin piston-powered airplane that the pilot had flown for his previous employer. Also, because the pilot logged the King Air time as dual instruction while still a student pilot, he likely did not fully comprehend much of the instruction at that time. Thus, the pilot might have been overconfident in his abilities to safely operate the King Air airplane in commercial parachute jump operations. In addition, OPC most likely did not verify the King Air experience noted in the pilot's logbook given the company's need for a commercial multiengine-rated pilot.

OPC had no structured pilot training program to ensure that company pilots, including the accident pilot, were proficient in the Beech King Air airplane and commercial parachute jump operations before conducting flights. A former OPC pilot, who provided King Air 65-A90 training to multiple other OPC pilots (but did not train the accident pilot), stated that the company did not provide him with any direction for training except to teach new pilots how to start the engines, taxi the airplane, take off, fly the jump run, and land the airplane, after which the new pilots would be "good to go." The former company pilot also stated that "there was no money to take the airplane off the line" just for training and that training consisted of "a couple of jump runs." In addition,

[84] Safety Recommendation A-20-40 asked the FAA to "develop a system to automatically notify your inspectors of those flight instructors (within each inspector's geographic area of responsibility) whose student pass rate in the Program Tracking and Reporting Subsystem has become substandard so that the inspectors can perform additional surveillance according to the guidance in Order 8900.1, Flight Standards Information Management System, volume 6, chapter 1, section 5, 'Surveillance of a Certificated Flight Instructor'." Safety Recommendation A-20-41 asked the FAA, until the system proposed in Safety Recommendation A-20-40 is implemented, to direct its inspectors "to (1) review the Program Tracking and Reporting Subsystem on an ongoing basis to identify those flight instructors (within each inspector's geographic area of responsibility) with a substandard student pass rate and (2) provide additional surveillance of those instructors according to the guidance in Order 8900.1, Flight Standards Information Management System, volume 6, chapter 1, section 5, 'Surveillance of a Certificated Flight Instructor'." Safety Recommendation A-20-42 asked the FAA to "revise Order 8900.1, Flight Standards Information Management System, volume 6, chapter 1, section 5, 'Surveillance of a Certificated Flight Instructor,' to include flight instructors with a substandard student pass rate as one of the criteria necessitating additional surveillance of a flight instructor.

the former company pilot stated that most of OPC's training involved viewing King Air Academy videos on YouTube instead of hands-on training. Another former OPC pilot stated that the company provided "minimal" training on how to fly the King Air 65-A90 airplane.

No pilot training requirements were included in 14 *CFR* Part 105, but, in AC 105-2E, the FAA recommended that pilots of sport parachuting operations receive appropriate initial and recurrent training that includes testing to ensure a high level of competency in the airplanes being flown. The AC, which was not mandatory, recommended numerous training subjects, some of which apply specifically to parachute jump operations.

The pilot's logbook and company records showed that the pilot's training occurred during two commercial parachute jump flights on March 9, 2019 (the pilot's first day working for OPC), with a total flight time of 1.6 hours, and four parachute jump flights on March 10, 2019, with a total flight time of 2.4 hours. Because a typical parachute jump flight was about 30 minutes (0.5 hour), the pilot would have had 0.6 hour available for Beech King Air 65-A90 flight instruction on March 9 and 0.4 hour available on March 10, for a total of 1 hour of company flight instruction. This amount of time was insufficient for providing flight instruction to a new company pilot and for checking his competency as a pilot.

The OPC pilot who provided the training stated that he had the accident pilot watch him perform one or two of the parachute jump flights from the right seat and that the accident pilot then operated the other parachute jump flights.[85] However, the accident airplane did not have a right-side control yoke, so the accident pilot's training did not include any manipulation of the flight controls before he began operating parachute jump flights. In addition, the pilot's minimal training did not provide him with the necessary experience to fully understand the altered handling qualities of the airplane with a CG that was near the aft limit. Thus, the NTSB concludes that the Beech King Air 65-A90 flight training that OPC provided to new company pilots was insufficient and did not ensure that the accident pilot, who lacked training and experience in the airplane make and model, was prepared for the company's parachute jump operations, which included the operation of the airplane near its aft CG limit. The next section presents a recommendation that the NTSB issued as part of its Part 91 aviation investigation report to address the lack of a training requirement for commercial parachute jump flight operations.

2.4 Airplane Condition and Maintenance Records

Repairs to the airplane were made after the July 2016 accident, but airframe anomalies still existed at the time of the June 2019 accident. In addition to the twisted left wing (discussed in section 2.2.3), these anomalies included left-wing skin panels and fairing panels that did not align properly and a non-uniform gap between the left propeller spinner and the engine cowl, all of which are signs of structural deformation.

The airplane was to be maintained in accordance with the requirements of 14 *CFR* Parts 43 and 91. However, the airplane maintenance records contained several discrepancies that occurred while the airplane was leased to OPC. For example, the OPC contract mechanic signed off the

[85] As stated previously, the OPC pilot who trained the accident pilot stated that the accident pilot also received training on the minimum control speed with the critical engine inoperative, takeoffs, and steep turns.

phase 3 inspection as completed on September 27, 2018, but some tasks related to the airplane's flight control system were not signed off as completed, including adjusting cable tensions into their normal ranges. Although out-of-specification cable tensions would likely not have contributed to this accident, the low elevator and rudder cable tensions could have led to decreased motion or deflection, and the high aileron and aileron trim cable tensions could have led to premature wear on the cable parts.[86] No record was found for the elevator trim tab cable tension.

In addition, no logbook entries were found to document the daily engine compressor wash that was required to prevent corrosion when the airplane was operated in a salty atmosphere. The OPC contract mechanic stated that the accident pilot had been performing the engine compressor washes and maintenance on an engine bleed valve, which would have been inappropriate given that the pilot did not hold an A&P certificate. Also, the mechanic should have been performing those tasks according to engine maintenance manual procedures.

The maintenance records also showed discrepancies before the airplane's lease with OPC began. For example, the repairs that resulted from the July 2016 accident included the replacement of the right horizontal stabilizer (which had departed the airplane during flight) with a horizontal stabilizer assembly from a Beech 65-90.[87] According to Textron Aviation documents, the Beech 65-90 horizontal stabilizer assembly was not an acceptable replacement for the horizontal stabilizer on the accident airplane, a Beech 65-A90. Also, a major repair record was required to be filed with the FAA for the repairs associated with the airplane's right horizontal stabilizer, but this record was not filed. In addition, the twisted left wing was not repaired.

The maintenance records noted that, as part of the repairs that were done as a result of the July 2016 accident, a mechanic performed a "flight through turbulent air" inspection of the airplane. This mechanic should have been aware at that time of the left wing anomaly (given the wrinkles in the top skin of the left wing) and taken action in response. However, the mechanic took no action, and the airplane continued to fly with the twisted left wing, including during the subsequent ferry flight from the US mainland to Hawaii. The pilot who ferried the airplane to Hawaii stated, during a postaccident interview, that he did not recall the airplane needing any abnormal aileron trim, but a photograph taken by the pilot during the ferry flight showed the deflection of the left aileron trim tab.

Once the airplane was in Hawaii and was operated by OPC, company pilots should have informed the OPC owner about the need for full left-wing-down aileron trim during flight, but no evidence indicated that any company pilot brought this matter to the OPC owner's attention. In addition, the OPC contract mechanic should have noted the wing anomalies during phase inspections and initiated corrective action. However, the OPC contract mechanic stated that

[86] The NTSB was unable to determine, with the evidence available during this accident investigation, whether the paperwork was not completed or the cable tensions were not adjusted. If the latter, the airplane would have been flown for some time with cable tensions out of their normal ranges.

[87] Although AD 77-22-01, which required an inspection of the aft bulkhead and horizontal stabilizer aft spars, was 712 hours overdue at the time of the July 2016 accident, no evidence suggested that noncompliance with the AD was a factor in that accident. However, the overdue AD was an example of inadequate maintenance while the airplane was being used for parachute jump operations. The AD was subsequently performed as part of the repairs to the accident airplane.

"everything worked smoothly" when he checked the flight controls and trim systems during inspections and that there were "no trim issues or flight control issues on the aircraft."

The airplane owner stated, during a postaccident interview, that the airplane required some aileron trim to fly straight and level but that, once the airplane was trimmed, it flew fine. The airplane owner also stated that he was told that the wrinkles in the left wing skin (which indicated the wing twist) were "typical" for an older airplane. The airplane owner further stated that he had "a high degree of confidence in the structural integrity of the wing" because nondestructive inspection and testing results showed no damage on the left wing spar.[88]

In addition, postaccident interviews found that OPC pilots were aware of the full left-wing-down position of the left aileron trim tab, but no effort was made to address this anomaly. The available evidence did not indicate whether the OPC owner, who was not a pilot, was aware of the condition of the airplane's left wing. However, the OPC owner was ultimately responsible for the safety of company operations; thus, he should have been concerned about the condition of the airplane and ensured that any safety issues were properly resolved, but that did not occur.

The NTSB concludes that the accident airplane was not airworthy because (1) it had not been properly repaired after the previous accident and (2) OPC and its contract mechanic did not maintain the airplane in an airworthy condition.[89] The NTSB also concludes that the airplane's maintenance records were not kept in a manner that was consistent with the requirements of pertinent federal regulations. To address the aircraft maintenance and pilot training deficiencies found in this and other accident investigations discussed in the Part 91 aviation investigation report, the NTSB issued Safety Recommendation A-21-9 in, which asked the FAA to do the following:

> Develop national safety standards, or equivalent regulations, for revenue passenger-carrying operations that are currently conducted under Title 14 *Code of Federal Regulations* Part 91, including, but not limited to, sightseeing flights conducted in a hot air balloon, intentional parachute jump flights, and living history flight experience and other vintage aircraft flights. These standards, or equivalent regulations, should include, at a minimum for each operation type, requirements for initial and recurrent training and maintenance and management policies and procedures.

[88] The airplane's maintenance records did not provide information about this nondestructive inspection and testing.

[89] As previously stated, another fatal accident occurred at HDH about 8 months after the accident (NTSB case number ANC20FA024). The mechanic had also provided maintenance for that airplane, a Cessna 305. Although the FAA had initially suspended the mechanic's A&P certificate pending a reexamination after these accidents, the FAA has since revoked the mechanic's certificate permanently.

2.5 Oahu Parachute Center Issues

2.5.1 Safety of the Parachute Jump Operation

As stated previously, OPC allowed passengers to be transported in an airplane with a twisted left wing, which is a known serious flight control issue. Also, OPC had not implemented standardized procedures or written guidance for the company's parachute jump operations and, as discussed in section 2.3.2, provided no structured initial or recurrent training for company pilots. Further, as shown in table 2, OPC failed to ensure that the company's operations and the accident pilot's actions were consistent with applicable Part 91 and 105 regulations.

Table 2. OPC's inconsistencies with applicable Part 91 and 105 regulations.

Regulation	Requirement	Relation to accident circumstances
14 *CFR* 91.9(a) and 91.103(b)(2)	"No person may operate a civil aircraft without complying with the operating limitations specified in the approved Airplane or Rotorcraft Flight Manual." "Each pilot in command shall, before beginning a flight, become familiar with all available information concerning that flight. This information must include…aircraft gross weight."	OPC used flawed assumptions in its calculation of the airplane's weight and balance. (See the discussion in this section.)
14 *CFR* 91.13(a) and 105.5	"No person may operate an aircraft in a careless or reckless manner so as to endanger the life or property of another." "No person may conduct a parachute operation, and no pilot in command of an aircraft may allow a parachute operation to be conducted from an aircraft, if that operation creates a hazard to air traffic or to persons or property on the surface."	The pilot's aggressive takeoff manuevers posed significant safety hazards to people and property and were inappropriate for a commercial pilot transporting passengers for a parachute jump operation. (See section 2.2.1.)
14 *CFR* 91.105(b)	"Each required flight crewmember of a U.S.-registered civil aircraft shall, during takeoff and landing, keep his or her shoulder harness fastened while at his or her assigned duty station."	The pilot seat's shoulder harness end fittings were found unsecured, indicating that the pilot did not wear his shoulder harness during the accident flight. Multiple videos showed that the pilot did not routinely wear his shoulder harness while operating the airplane. (See section 1.6.)
14 *CFR* 91.303(a), (b), (d), and (e)	"No person may operate an aircraft in aerobatic flight…Over any congested area of a city, town, or settlement…Over an open air assembly of persons…within 4 nautical miles of the center line of any Federal airway…Below an altitude of 1,500 feet above the surface."	The pilot's aggressive takeoff maneuver constituted aerobatic flight, which was defined by the regulation as "an intentional maneuver involving an abrupt change in an aircraft's attitude, an abnormal attitude, or abnormal acceleration, not necessary for normal flight." The Beech *Model 65-A90 FAA Flight Manual* also prohibited aerobatic maneuvers. (See section 2.2.1.)

Regulation	Requirement	Relation to accident circumstances
14 *CFR* 91.409(f)(3)	"The registered owner or operator…must select, identify in the aircraft maintenance records, and use…a current inspection program recommended by the manufacturer."	OPC did not comply with the airplane manufacturer's inspection program. (See section 2.4.)
14 *CFR* 105.7	"No person may conduct a parachute operation, and no pilot in command of an aircraft may allow a person to conduct a parachute operation from that aircraft, if that person is or appears to be under the influence of…Any drug that affects that person's faculties in any way contrary to safety."	Toxicology testing showed that one of the tandem instructors and one of the camera operators used marijuana before the accident flight, and both had safety responsibilities for the flight. (See section 2.5.2.)
14 *CFR* 105.13 (a)(1)(ii)	"No person may conduct a parachute operation, and no pilot in command of an aircraft may allow a parachute operation to be conducted from that aircraft, in or into controlled airspace unless, during that flight...radio communications have been established between the aircraft and the air traffic control facility having jurisdiction over the affected airspace of the first intended exit altitude at least 5 minutes before the parachute operation begins. The pilot in command must establish radio communications to receive information regarding air traffic activity in the vicinity of the parachute operation."	The accident pilot did not establish radio communications from the airplane with the Hawaii Control Facility (the ATC facility with jurisdiction of the class G airspace over HDH) before parachutists on the flight before the accident flight exited the airplane at the jump altitude. (See section 2.6.)
14 *CFR* 105.25 (a)(3) and (c).	"No person may conduct a parachute operation, and no pilot in command of an aircraft may allow a parachute operation to be conducted from that aircraft…unless the air traffic control facility having jurisdiction over the airspace at the first intended exit altitude is notified of the parachute operation no earlier than 24 hours before or no later than 1 hour before the parachute operation begins." "For the purposes of paragraph (a)(3) of this section, air traffic control facilities may accept a written notification from an organization that conducts parachute operations and lists the scheduled series of parachute operations to be conducted over a stated period of time not longer than 12 calendar months. The notification must…be submitted at least 15 days, but not more than 30 days, before the parachute operation begins."	The accident pilot did not provide ATC with notification of the commercial parachute jump operations on the day of the accident, and OPC did not provide ATC with notification of the commercial parachute jump operations that would be occurring during the 1 year preceding the accident. (See section 2.6.)

In addition, according to the OPC owner, instead of calculating a weight and balance for each flight, company pilots used a generic "formula." A former OPC pilot stated that the company used a "normal" value for fuel (possibly representing 160 gallons, the airplane's estimated fuel load at the beginning of the day of the accident) and an average weight of about 190 pounds per person for 13 passengers (the maximum number of passengers that the airplane accommodated while leased to OPC). The company then used that information to calculate a baseline CG to ensure that the CG would not exceed the forward and aft limits for any flight with 13 or fewer passengers

aboard. However, the method that OPC used to calculate the airplane's CG for each parachute jump flight, including the accident flight, was flawed because it did not include the weights of tandem parachute systems, tandem harnesses, and single parachute systems. As a result, the accident airplane was continuously flown at weights that were higher than the pilot likely anticipated and with a CG that was near or possibly beyond the aft limit.

The NTSB concludes that OPC's failure to address a safety hazard involving the airplane used for the company's parachute jump operations, inconsistencies with applicable federal regulations, lack of standard operating procedures and structured pilot training, and flawed method for calculating the airplane's CG demonstrated the company's inadequate safety management. In April 2021 the NTSB issued Safety Recommendation A-21-13, which asked the FAA to require SMS for the revenue passenger-carrying operations discussed in the Part 91 aviation investigation report; these operations included intentional parachute jump flights.

2.5.2 Contract Employee Autopsy and Toxicology Results

The results of the pilot's autopsy indicated that he likely did not experience an incapacitating medical event, and his toxicology results showed no evidence of substance use. Ethanol was found in the pilot's kidney specimens but not his muscle specimens. The absence of ethanol in one sample indicated that the identified ethanol was from postmortem production and not ingestion.

Toxicology testing detected THC, the main psychoactive compound in marijuana, in the specimens of one of the tandem instructors and one of the camera operators. Although concentrations of THC typically peak during the act of smoking and concentrations of its active metabolite peak shortly after the start of smoking, concentrations of both THC and its active metabolite decline rapidly and are often less than 5 ng/ml at 3 hours.

The camera operator's femoral blood showed a THC level of 32 ng/ml and a THC active metabolite level of 7.7 ng/ml, indicating that the camera operator had likely used marijuana about 1 to 2 hours before the accident. During that time, significant performance impairments usually occur. Thus, the camera operator was likely impaired to some degree by the effects of his marijuana use.

The tandem instructor's liver tissue tested positive for THC and its active and inactive metabolites, indicating that he used marijuana at some point before the accident flight. However, no blood specimens from the tandem instructor were available for toxicology testing. As a result, the NTSB could not determine whether the tandem instructor was impaired by the effects of marijuana during the accident flight.

Neither the tandem instructor nor the camera operator was subject to FAA oversight or was required to undergo any pre-employment or random drug testing. However, the tandem instructor's and the camera operator's roles were important to the safety of the flight. Tandem instructors briefed passengers about the use of their seat belts, and camera operators coordinated the parachute jump by informing the pilot when the drop zone was approaching and advising the parachutists when they should exit the airplane. Also, the tandem instructor was responsible for the successful and safe outcome of the planned jump with one of the parachutists. Thus, the NTSB concludes that

the tandem instructor's and the camera operator's use of marijuana before the accident flight demonstrated their lack of judgment and professionalism given their safety responsibilities for the accident flight.

In March 2018, the USPA published an article about marijuana use that was written by the organization's director of safety and training. The article stated that, as states legalize marijuana for medical and recreational purposes, "the skydiving community needs to be aware that it may lead to some issues with students, licensed jumpers and instructional rating holders."[90] The article cited the requirements of 14 *CFR* 105.7 (see table 2) and indicated that it was illegal to skydive while under the influence of marijuana. In addition, the article stated that tandem instructors were required to hold an FAA third-class medical certificate and that a requirement of the certificate was for the holder to report "any drug use—legal or illegal—since the last renewal."[91] The article advised that it would be "wise for every [instructional] rating holder to hold themselves to a higher standard to help maintain the highest level of safety, better protect the drop zone legally and avoid any potential problems while dealing with skydiving students."[92]

2.6 Federal Aviation Administration Oversight

FAA Order 8900.1, Flight Standards Information Management System, stated that annual inspections of each parachute operation within a FSDO's jurisdiction should be conducted, including ramp inspections and parachute jump inspections. However, during a postaccident interview, a former operations inspector at the Honolulu FSDO stated that the surveillance activities that the FAA required for parachute jump operations were not extensive.

On March 7, 2018, the FSDO operations inspector conducted a parachute jump inspection and a ramp inspection at OPC. According to FAA records, the parachute jump inspection included an observation of parachute jumps for cloud clearance requirements and a spot check of two tandem parachute systems to ensure that the reserve parachute packing dates were current. The ramp inspection included a check of the airplane, including a walk-around to ensure that the airplane was properly configured with seat belts, and a check of the pilot and medical certificates of the company pilot at the time. The operations inspector stated that he examined the flight manuals, which appeared to be current, but did not review the pilot's flight logbook or speak with the OPC owner, and the inspector could not recall if he saw the airplane logbook. The operations inspector also stated that OPC had met the requirements of the inspections.

On December 7, 2017, a FSDO airworthiness inspector conducted a ramp inspection at OPC, one purpose of which was to review the general airworthiness of the airplane and examine it for any damage that could affect safety of flight.[93] The airworthiness inspector also conducted

[90] As of the date of this report, the use of marijuana (a Schedule I drug) was illegal under federal law.

[91] Department of Transportation and FAA regulations do not require drug testing for third-class medical certificate holders.

[92] For more information, see https://uspa.org/USPAinAction/marijuana-use (accessed March 26, 2021).

[93] This ramp inspection had a different Program Tracking and Reporting Subsystem (PTRS) code than the code for the ramp inspection conducted in March 2018. According to the FAA, PTRS "is a comprehensive information management and analysis system…that provides the means for the collection, storage, retrieval, and analysis of data

an aircraft records inspection, one purpose of which was to ensure that records showing major repairs and major alterations were being retained.

FAA records indicated that the results of the December 2017 inspections were "satisfactory." The records did not note the significant problems with the airplane's left wing, but the general airworthiness ramp inspection, which was usually conducted as a walk-around check, typically identified obvious issues only, such as missing placards and fluid leaks. The NTSB wanted to interview the airworthiness inspector to determine whether he conducted the inspections at OPC according to FAA guidance and whether he noted any of the numerous airframe anomalies on the accident airplane, but the airworthiness inspector was not available to be interviewed.

The FAA's ramp inspections of OPC provided essentially the same level of surveillance as that for any Part 91 general aviation operation, even though OPC was a Part 91 commercial operation. In addition, OPC (and other parachute jump operators) did not receive the same level of FAA oversight and surveillance as other passenger-carrying operations, such as those conducted under Parts 121 and 135.

FAA Orders 8300.10 and 8700.1, Joint Flight Standards Information Bulletin for Airworthiness (FSAW 93-09) and General Aviation (FSGA 93-02), Parachutists Regulatory Status, dated January 25, 1993, stated that "parachute jumping is a sport activity and, as such, should be subject to the FARs only to the extent necessary to protect others." Title 14 *CFR* 105.13 seeks "to protect others" by requiring that pilots notify ATC when parachutists were 5 minutes from exiting the airplane so that facility personnel could clear (or advise about) potential conflicts in the airspace. Also, 14 *CFR* 105.25 requires pilots of commercial parachute jump operations to provide ATC with advance notice of such operations (or a parachute jump operator to provide ATC with notice of scheduled operations that would be occurring up to 1 year ahead of time). However, the parachute jump inspection and operations ramp inspection did not include verification of the ATC notifications required by Part 105 (which the accident pilot did not provide for the first sunset flight on the day of the accident and OPC did not provide for its operations).

The orders further stated that the FAA's position was that "parachutists should not be considered passengers when evaluating the regulatory compliance status of such operations." Even though parachutists assume a level of risk while participating in parachute jump activities, parachutists are airplane passengers during the taxi, takeoff, and climb phases of flight and should thus be assured of a reasonable level of safety, including adequate FAA surveillance of parachute jump operations.[94] However, the NTSB concludes that, even though FAA inspectors accomplished the inspections of OPC that the agency required, those inspections were insufficient for ensuring the safety of this commercial passenger-carrying operation. As part of the Part 91 aviation investigation report, the NTSB reiterated Safety Recommendation A-19-30, which asked the FAA to revise Order 8900.1 to include guidance for inspectors who oversee certain Part 91 revenue

resulting from the many different job functions performed by Aviation Safety Inspectors…in the field, the regions, and headquarters."

[94] Tandem jumpers often have no previous parachute jump experience and might thus not fully understand the level of risk associated with parachute jump operations.

passenger-carrying operations, including parachute jump flight operations, to identify potential hazards and ensure that operators are appropriately managing the associated risks.

3. Conclusions

3.1 Findings

1. After making an intersection takeoff, the pilot conducted an intentional aggressive takeoff maneuver involving a low-altitude high-bank turn and simultaneous pitch-up maneuver.

2. The airplane was likely operated near or possibly beyond the aft center of gravity limit during the accident takeoff.

3. The pilot's aggressive takeoff maneuver caused an accelerated stall and a subsequent loss of control at an altitude from which recovery was not possible.

4. The twisted left wing that resulted from the airplane's previous accident reduced the airplane's stall margin, which likely caused the left wing to stall before the right wing and precipitated the airplane's roll to the left.

5. The pilot's initial training did not provide him with adequate experience and proficiency for Beech King Air operations.

6. By indicating that the accident pilot completed dual commercial flight instruction that he likely did not receive and by not providing initial training according to established standards, the pilot's flight instructor showed a lack of professionalism and a disregard for aviation safety.

7. The Beech King Air 65-A90 flight training that Oahu Parachute Center provided to new company pilots was insufficient and did not ensure that the accident pilot, who lacked training and experience in the airplane make and model, was prepared for the company's parachute jump operations, which included the operation of the airplane near its aft center of gravity limit.

8. The accident airplane was not airworthy because (1) it had not been properly repaired after the previous accident and (2) Oahu Parachute Center and its contract mechanic did not maintain the airplane in an airworthy condition.

9. The airplane's maintenance records were not kept in a manner that was consistent with the requirements of pertinent federal regulations.

10. Oahu Parachute Center's failure to address a safety hazard involving the airplane used for the company's parachute jump operations, inconsistencies with applicable federal regulations, lack of standard operating procedures and structured pilot training, and flawed method for calculating the airplane's center of gravity demonstrated the company's inadequate safety management.

11. The tandem instructor's and the camera operator's use of marijuana before the accident flight demonstrated their lack of judgment and professionalism given their safety responsibilities for the accident flight.

12. Even though Federal Aviation Administration inspectors accomplished the inspections of Oahu Parachute Center that the agency required, those inspections were insufficient for ensuring the safety of this commercial passenger-carrying operation.

3.2 Probable Cause

The National Transportation Safety Board determines that the probable cause of this accident was the pilot's aggressive takeoff maneuver, which resulted in an accelerated stall and subsequent loss of control at an altitude that was too low for recovery. Contributing to the accident were (1) the operation of the airplane near its aft center of gravity limit and the pilot's lack of training and experience with the handling qualities of the airplane in this flight regime; (2) the failure of Oahu Parachute Center and its contract mechanic to maintain the airplane in an airworthy condition and to detect and repair the airplane's twisted left wing, which reduced the airplane's stall margin; and (3) the Federal Aviation Administration's (FAA) insufficient regulatory framework for overseeing parachute jump operations. Contributing to the pilot's training deficiencies was the FAA's lack of awareness that the pilot's flight instructor was providing substandard training.

BY THE NATIONAL TRANSPORTATION SAFETY BOARD

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JENNIFER HOMENDY
Member

BRUCE LANDSBERG
Vice Chairman

THOMAS CHAPMAN
Member

Member MICHAEL GRAHAM did not participate.

Report Date: March 16, 2021

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