Aviation Investigation Final Report

Location:	Kalaupapa, Hawaii	**Accident Number:**	WPR14FA068
Date & Time:	December 11, 2013, 15:22 Local	**Registration:**	N687MA
Aircraft:	Cessna 208B	**Aircraft Damage:**	Destroyed
Defining Event:	Loss of engine power (total)	**Injuries:**	1 Fatal, 3 Serious, 5 Minor
Flight Conducted Under:	Part 135: Air taxi & commuter - Scheduled		

Analysis

The airline transport pilot was conducting an air taxi commuter flight between two Hawaiian islands with eight passengers on board. Several passengers stated that the pilot did not provide a safety briefing before the flight. One passenger stated that the pilot asked how many of the passengers had flown over that morning and then said, "you know the procedures." The pilot reported that, shortly after takeoff and passing through about 500 ft over the water, he heard a loud "bang," followed by a total loss of engine power. The pilot attempted to return to the airport; however, he realized that the airplane would not be able to reach land, and he subsequently ditched the airplane in the ocean. All of the passengers and the pilot exited the airplane uneventfully. One passenger swam to shore, and rescue personnel recovered the pilot and the other seven passengers from the water about 80 minutes after the ditching. However, one of these passengers died before the rescue personnel arrived.

Postaccident examination of the recovered engine revealed that multiple compressor turbine (CT) blades were fractured and exhibited thermal damage. In addition, the CT shroud exhibited evidence of high-energy impact marks consistent with the liberation of one or more of the CT blades. The thermal damage to the CT blades likely occurred secondary to the initial blade fractures and resulted from a rapid increase in fuel flow by the engine fuel control in response to the sudden loss of compressor speed due to the blade fractures. The extent of the secondary thermal damage to the CT blades precluded a determination of the cause of the initial fractures.

Review of airframe and engine logbooks revealed that, about 1 1/2 years before the accident, the engine had reached its manufacturer-recommended time between overhaul (TBO) of 3,600 hours; however, the operator obtained a factory-authorized, 200-hour TBO increase. Subsequently, at an engine total time since new of 3,752.3 hours, the engine was placed under the Maintenance on Reliable Engines (MORE) Supplemental Type Certificate (STC) inspection program, which allowed an immediate increase in the manufacturer-recommended TBO from 3,600 to 8,000 hours. The MORE STC inspection program

documents stated that the MORE STC was meant to supplement, not replace, the engine manufacturer's Instructions for Continued Airworthiness and its maintenance program.

Although the MORE STC inspection program required more frequent borescope inspections of the hot section, periodic inspections of the compressor and exhaust duct areas, and periodic power plant adjustment/tests, it did not require a compressor blade metallurgical evaluation of two compressor turbine blades; however, this evaluation was contained in the engine maintenance manual and an engine manufacturer service bulletin (SB). The review of the airframe and engine maintenance logbooks revealed no evidence that a compressor turbine metallurgical evaluation of two blades had been conducted. The operator reported that the combined guidance documentation was confusing, and, as a result, the operator did not think that the compressor turbine blade evaluation was necessary. It is likely that, if the SB had been complied with or specifically required as part of the MORE STC inspection program, possible metal creep or abnormalities in the turbine compressor blades might have been discovered and the accident prevented.

The passenger who died before the first responders arrived was found wearing a partially inflated infant life vest. The autopsy of the passenger did not reveal any significant traumatic injuries, and the autopsy report noted that her cause of death was "acute cardiac arrhythmia due to hyperventilation." Another passenger reported that he also inadvertently used an infant life vest, which he said seemed "small or tight" but "worked fine." If the pilot had provided a safety briefing, as required by Federal Aviation Administration regulations, to the passengers that included the ditching procedures and location and usage of floatation equipment, the passengers might have been able to find and use the correct size floatation device.

Probable Cause and Findings

The National Transportation Safety Board determines the probable cause(s) of this accident to be:

The loss of engine power due to the fracture of multiple blades on the compressor turbine wheel, which resulted in a ditching. The reason for the blade failures could not be determined due to secondary thermal damage to the blades.

Findings

Aircraft	Turbine section - Failure
Aircraft	Scheduled maint checks - Not inspected
Aircraft	Life jacket - Incorrect use/operation
Personnel issues	Lack of communication - Pilot

Factual Information

History of Flight

Enroute-climb to cruise	Loss of engine power (total) (Defining event)
Emergency descent	Ditching

HISTORY OF FLIGHT

On December 11, 2013, about 1522 Hawaiian standard time, a Cessna 208B, N687MA, was destroyed following a loss of engine power and ditching into the Pacific Ocean near Kalaupapa, Hawaii. One passenger was fatally injured, the airline transport pilot and two passengers were seriously injured, and five passengers received minor injuries. The airplane was registered to Leis Air LLC, and operated by Makani Kai Air under the provisions of 14 Code of Federal Regulations (CFR) Part 135. Visual meteorological conditions prevailed for the cross-country flight, and a company flight plan had been filed. The flight departed from the Kalaupapa Airport on the island of Molokai, about 2 minutes prior to the accident, with an intended destination of the Honolulu International Airport on the island of Oahu.

In a written statement, the pilot reported that shortly after takeoff from runway 05, at an altitude of about 400 feet above ground level (agl), he began a left turn for a downwind departure. Shortly after passing 500 feet agl, the pilot motioned toward the power lever to reduce power for the climb when he heard a loud "bang" followed by an immediate loss of engine power. The pilot continued the turn toward land, verified the fuel valves were on, and observed all engine gauges displaying "zero." The pilot realized the airplane was not going to make it to land, and rolled the wings level while broadcasting a mayday distress call. Shortly after, the airplane landed within open ocean water in a flat or slightly nose up attitude.

All the passengers and the pilot exited the airplane through the rear right door, and the airplane remained on the water surface for approximately 25 minutes before it sank. One passenger swam to shore, and United States Coast Guard and Maui Fire and Rescue helicopters recovered the pilot and 7 passengers from the water about 80 minutes after the ditching.

Review of video taken by one of the passengers (which started with the airplane descending toward the water, showed the impact, and continued for about 15 minutes) indicated that the airplane impacted the water in a wings level, slightly nose-high attitude. The video showed that the airplane remained intact after contacting the water, and remained afloat throughout the video.

PERSONNEL INFORMATION

The pilot, age 60, held an airline transport pilot certificate with a multiengine land rating and type ratings in the Boeing 737 and 777. He had commercial privileges in single-engine land airplanes and gliders, and he held a flight instructor certificate with multiengine airplane, single-engine airplane, and glider ratings. His most recent first class medical certificate was issued on December 9, 2013, with the limitation "must wear corrective lenses."

According to the operator, the pilot satisfactorily completed his most recent Part 135 proficiency/competency check on May 9, 2013. The pilot reported that he had accumulated a total flight time of about 16,000 hours of which 250 hours were in Cessna 208Bs. In the past 90 days, 30 days, and 24 hours, the pilot had flown 150, 50, and 10 hours, respectively, all in Cessna 208Bs.

AIRCRAFT INFORMATION

The airplane, a Cessna 208B, was manufactured in 2002 and equipped with a Pratt and Whitney Canada PT6A-114A 675-horsepower turbo-prop engine, serial number PCE-PC1021, which had accumulated 4,899.6 hours and 9,303 cycles since new at the time of the accident.

Review of the engine and airframe logbooks revealed that in July 2012 the engine had reached Pratt & Whitney Canada's (P&WC) recommended time between overhaul (TBO) of 3,600 hours, however, the operator obtained a factory authorized 200-hour TBO extension, which was subsequently approved by the FAA.

On July 23, 2012, at a total time since new of 3,752.3 hours total time, the engine was placed onto the Maintenance on Reliable Engines (MORE) STC, which extended the TBO from 3,600 hours to 8,000 hours, which was subsequently approved by the FAA. The MORE STC literature states that the MORE Instructions for Continued Airworthiness (ICA) is not a stand-alone document but is only a supplement to the PW&C engine maintenance program requiring that all the inspection and maintenance specified in the PW&C manual must be performed in addition to inspections and maintenance specified by the MORE program, such as a more frequent borescope inspection of the hot section, periodic inspection of the compressor and exhaust duct areas, and periodic Power Plant Adjustment/Tests.

In conflict with the P&WC guidance, which requires engine condition trend monitoring (ECTM), a method of continuously monitoring engine health, the MORE STC does not recommend ECTM. The operator elected to follow the MORE program guidance and did not conduct ECTM.

According to the airframe and engine records, when the engine was placed onto the MORE STC, an engine hot section inspection (HSI) was performed. Guidance for managing and performing an HSI is contained in the P&WC applicable engine maintenance manual and service bulletin (SB), No. 1703 titled "Operating Time Between Overhauls and Hot Section Inspection Frequency Recommendations". Revision 6 of the P&WC SB 1703 was applicable at the time. The maintenance manual and SB required a compressor turbine (CT) blade metallurgical evaluation, which consisted of selecting two random pre-SB1669 CT blades, sectioning them and evaluating the samples in a materials laboratory. The tests destroy the two samples. No documentation was located to show that this inspection was complied with.

According to the operator, the combined guidance documentation between the MORE literature, P&WC Maintenance Manual and the P&WC SB was confusing. They further stated that they interpreted the P&WC guidance recommending the destructive blade testing if a TBO extension was being requested from P&WC, however, since the TBO extension was granted via the MORE STC, which did not contain blade sectioning instructions, they deemed that this task was not necessary because they believed the increased inspection intervals required in MORE STC guidance, would effectively manage the CT blades.

Two other HSI tasks, a combustion liner cooling ring gap check and a trim thermocouple verification, which are recommended by the P&WC maintenance manual, but not required under the MORE STC,

were not accomplished. The MORE STC documentation also does not reference the P&WC publication service information letter (SIL) PT6A-116R3 "Borescope Inspection in Conjunction with Fuel Nozzle Check" which better illustrates the borescope examination of the trailing edges of the CT blades.

At the time of the accident, the engine had been operating under the MORE STC for about 1,137.3 hours. The most recent inspection performed on the engine prior to the accident was conducted 3.9 hours prior, and consisted of the MORE STC 100, 200, and 400-hour inspections. The MORE STC program 400-hour inspection included a hot-section inspection, which only required inspection of the compressor blades via a borescope.

METEOROLOGICAL INFORMATION

At 1454, the reported weather conditions at the Molokai Airport, Kaunakakai, Hawaii, located about 8 nautical miles southwest of the accident site, were wind from 040 degrees at 15 knots gusting to 26 knots, visibility 10 miles, sky clear, temperature 27 degrees C, dew point 19 degrees C, and altimeter setting 29.95 inches of mercury.

WRECKAGE AND IMPACT INFORMATION

The airplane was recovered from the ocean on December 18, 2013, 7 days after the accident, and transported to Honolulu, Hawaii, on a barge. It was examined under the supervision of the NTSB investigator-in-charge in Honolulu on December 19, 2013. The airframe was fragmented into numerous pieces, which were crushed and battered in a manner consistent with being repeatedly rolled over on a hard, uneven surface by wave action. The engine had separated from the airframe, and the propeller remained attached to the engine. The three propeller blades remained intact, were bent, and appeared to be in the feather position. The engine was subsequently shipped to P&WC for further examination.

SURVIVAL FACTORS

The airplane was configured with two flight crew seats and nine passenger seats. The pilot occupied the left flight crew seat, and the right flight crew seat was not occupied. There were four passenger seats on the left side of the airplane, which were numbered from front to back as seats 1, 3, 5, and 7, and five passenger seats on the right side of the airplane, which were numbered from front to back as seats 2, 4, 6, 8, and 9. All the passenger seats except seat 9, which was located aft of the passenger door at the rear of the cabin, were occupied. For purposes of this report, the passengers will be identified by their seat numbers; for example, passenger 1 was the person seated in seat 1 during the accident flight.

The pilot reported that he hit his head on the instrument panel during the water impact, and was "bleeding badly" as a result. He unstrapped his harness, yelled at the passengers to get out, and started to grab seat cushions to use as floatation devices. He looked for life vests, saw one, and gave it to a passenger who said his wife did not have one. He did not take time to look for his own life vest as the airplane was filling with water. After checking to see that the cabin was empty, he exited through the door at the rear of the cabin. He told the passengers to swim away from the airplane because he was concerned that it would sink rapidly and drag them down. The current and waves, which he estimated to be 6 to 8 feet high, gradually separated the group. The pilot's reported weight was 240 pounds.

Passengers 1 and 2, a married couple, both sustained serious injuries. Their daughter reported that her father (passenger 1) sustained broken ribs and a gash on his head, and her mother (passenger 2)

sustained broken ribs and a broken sternum. She further reported that her father said they received a passenger briefing for the morning flight from Honolulu to Kalaupapa, however, did not receive a briefing for the accident flight. Passenger 1's reported weight was 200 pounds and passenger 2's reported weight was 175 pounds.

Review of the video, recorded by passenger 8, indicated that the fatally injured passenger, passenger 3, exited the airplane under her own power while wearing an inflated life vest. Passenger 3's life vest was examined, and determined to be an infant life vest. One of the two CO2 cartridges installed in the vest was punctured and empty, and the other cartridge was full, consistent with a partially inflated life vest. Passenger 3's reported weight was 220 pounds.

Passenger 4, who was traveling with passenger 3, reported that the pilot did not give a safety briefing before takeoff. He said that after the airplane impacted the water, he saw other passengers with life vests, and asked where they were located. Someone told him they were in the seat pockets, and he found one, put it on, and went to the back of the airplane. Passenger 4 further stated that he was at the rear door passing seat cushions out to passengers who were already in the water when passenger 3 came to the door; she was wearing a life vest, and she inflated the vest. They got into the water, and he inflated his life vest. Passenger 4 stayed with passenger 3 as they drifted away from the airplane. He noted that passenger 3 was "not really saying anything but was breathing very hard and fast." Later, he noticed that passenger 3's eyes were closed, and she was no longer breathing hard.

Passenger 4 added that the pouch that the life vest was stored in was difficult to open and that the vest was "very tight" on his neck and difficult to remove when he got on shore. He said that "even with the life vest on I was surprised [at] how much effort was needed to keep my head above the waves and to avoid swallowing water." He did not use the life vest's waist strap. Passenger 4's life vest was examined, and determined to be an adult life vest. Passenger 4's reported weight was 175 pounds.

Passengers 5 and 6, a married couple, reported that the pilot assigned them seats, but did not provide a safety briefing prior to the flight. The pilot asked them how many of them had flown over that morning, and then said, "you know the procedures." After the water impact, passenger 6 opened the door at the rear of the cabin, and immediately jumped into the water without a life vest. Passenger 5 jumped out behind him, and she also did not have a life vest. Someone was throwing life vests out of the airplane, and passenger 6 grabbed two of them. He inflated a life vest without putting it on, and held onto it. He assisted his wife (passenger 5) in putting on and inflating a life vest; she did not use the life vest's waist strap. She reported that the life vest "pushed up around her head and was choking her." The life vests worn by passengers 5 and 6 were examined, and determined to be adult life vests. Passenger 5's reported weight was 210 pounds and passenger 6's reported weight was 200 pounds.

Passenger 7 reported that everyone exited the airplane without difficulty. He recalled helping an older couple put on their life vests before they exited the airplane. He said that they were having difficulty opening the pouches that the vests were stored in so he opened the pouches for them, helped them put the vests on, and inflated one CO2 cartridge on each vest. After exiting the airplane, he swam to shore. He later found that he had inadvertently put on an infant life vest, which he said seemed "small or tight" although it "worked fine." Passenger 7's reported weight was 160 pounds.

Passenger 8 reported that it took a few minutes for everyone to exit the airplane and that he did not notice anyone having a problem. His video showed that he obtained a life vest from the seat pocket in front of his seat. Passenger 8's reported weight was 160 pounds.

An autopsy of the fatally injured passenger was conducted by Pan Pacific Pathologists, LLC, of Wailuku, Hawaii, under the authority of the Maui Police Department. The findings listed in the autopsy report included "acute cardiac arrhythmia" and "no significant traumatic injuries." The report noted that she was observed by another passenger "to be fearful and hyperventilating shortly before losing consciousness." According to the autopsy report, her cause of death was "acute cardiac arrhythmia due to hyperventilation."

Review of 14 CFR 135.117, briefing of passengers before flight, revealed that section A states in part "…Before each takeoff each pilot in command of an aircraft carrying passengers shall ensure that all passengers have been orally briefed on…Location and means for opening the passenger entry door and emergency exits…Location of survival equipment…If the flight involves extended overwater operation, ditching procedures and the use of required flotation equipment."

Item 9 states that "before each takeoff the pilot in command shall ensure that each person who may need the assistance of another person to move expeditiously to an exit if an emergency occurs and that person's attendant, if any, has received a briefing as to the procedures to be followed if an evacuation occurs. This paragraph does not apply to a person who has been given a briefing before a previous leg of a flight in the same aircraft."

TESTS AND RESEARCH

Further examination of the engine was conducted under the supervision of the NTSB Powerplants Group Chairman at the facilities of Pratt and Whitney Canada, St. Hubert, Quebec, Canada, on January 21-23, 2014. Externally the engine appeared intact; however, all the external surfaces exhibited damage consistent with ocean current activity rolling the engine on the ocean floor. There was corrosion on all metal engine components consistent with immersion in salt water. The power turbine blades were all present, but fractured, with 1/3rd to 4/5ths of their spans remaining. Signatures consistent with overload separation were observed on all the power turbine blade fracture surfaces.

The compressor turbine vane ring was intact, and the leading edges were undamaged; however, the trailing edges of all the vanes were fractured due to impact with associated material loss and subsequent thermal distress. The compressor turbine shroud segments were intact, and coated with a metal spray deposit consistent with melted material from the compressor turbine blades. There were two impact marks in the shape of a turbine blade chord on two shroud segments. The compressor turbine blades were all present, but fractured, leaving between 1/3rd and 2/3rds of each blade span remaining. All of the surfaces of the blades and the disk were coated with a fine white deposit, which made observation of the fracture surfaces difficult.

The compressor turbine wheel was sent to the Pratt and Whitney Canada materials laboratory for blade removal, cleaning, sectioning, and analysis. Metallographic examination of the four shortest blades and eight other randomly selected blades was performed. No evidence of fatigue cracking was observed. Evidence of melting at the tip of the blades was present; however, due to the extent of this thermal damage, no evidence of creep could be observed. An inclusion was noted in one of the examined blades;

it was located away from the main fracture surface with no adjacent cracks. No other examined blades exhibited inclusions.

Approximately 50 percent of the reduction gear box (RGB) housing was corroded to the point of being dissolved. The corrosion was consistent with long-term immersion of magnesium material in a salt water environment. Internal components such as the propeller shaft, bearings, and gears remained intact. The aft RGB housing was almost completely dissolved, leaving a white powder residue. Removal of this residue exposed the 1st stage sungear, carrier, and planet gears, which exhibited no evidence of pre-impact damage. The 2nd stage sungear, planet gears, and carrier appeared intact and the investigation team elected not to further disassemble the RGB. The propeller governor and the overspeed governor were present; however they were coated with a moist watery deposit.

The internal gears of the accessory gear box (AGB) were coated with a white powdery deposit, consistent with magnesium oxide, however they were all intact and the AGB was not further disassembled.

The fuel heater, fuel pump, fuel control unit (FCU), flow divider valve (FDV), and fuel nozzles were sent to the P&WC accessories laboratory for detailed examination. The fuel heater was dented and scratched at many locations, and the fuel outlet fitting was fractured. Testing of the thermal element revealed that it was nonfunctional, which would result in fuel being heated at all times. The fuel pump was externally undamaged, however the input drive spline could not be turned. There was no evidence of cavitation on the gears, gear pockets, or bearings. The bearing seal surfaces, gear sides, and gear-shaft journals had a polished appearance. There were no leak paths observed on the carbon-seal surfaces.

There was metallic, consistent with magnesium oxide, residue and environmental debris attached to the exterior of the propeller governor (CSU), in the driveshaft cavity and in the gasket strainer. The driveshaft could not be turned by hand. Movement of the rest arm, speed control lever, and beta-valve clevis were restricted. Surface corrosion was observed on the external steel fittings. The speed control lever linkage bolt was bent. The ball-head flyweights showed surface corrosion, but fell freely and evenly. There was organic debris in the ball-head cavity and in the gear-pockets. It was not possible to remove the drive gear. The drive-gear and pilot valve required force to remove them, and surface corrosion was present on the pilot-valve. The reset-post was difficult to remove. There was no debris visible in the air bleed orifice.

For further details of the engine examination, see the Powerplants Group Chairman's Report in the public docket for this investigation.

Pilot Information

Certificate:	Airline transport; Flight instructor	**Age:**	60
Airplane Rating(s):	Single-engine land; Multi-engine land	**Seat Occupied:**	Left
Other Aircraft Rating(s):	Glider	**Restraint Used:**	3-point
Instrument Rating(s):	Airplane	**Second Pilot Present:**	No
Instructor Rating(s):	Airplane multi-engine; Airplane single-engine; Glider	**Toxicology Performed:**	No
Medical Certification:	Class 1 With waivers/limitations	**Last FAA Medical Exam:**	December 9, 2013
Occupational Pilot:	Yes	**Last Flight Review or Equivalent:**	May 9, 2013
Flight Time:	16000 hours (Total, all aircraft), 250 hours (Total, this make and model), 150 hours (Last 90 days, all aircraft), 50 hours (Last 30 days, all aircraft), 10 hours (Last 24 hours, all aircraft)		

Aircraft and Owner/Operator Information

Aircraft Make:	Cessna	**Registration:**	N687MA
Model/Series:	208B	**Aircraft Category:**	Airplane
Year of Manufacture:	2002	**Amateur Built:**	
Airworthiness Certificate:	Normal	**Serial Number:**	208B1002
Landing Gear Type:	Tricycle	**Seats:**	11
Date/Type of Last Inspection:	October 2, 2013 AAIP	**Certified Max Gross Wt.:**	8750 lbs
Time Since Last Inspection:	19 Hrs	**Engines:**	1 Turbo prop
Airframe Total Time:	4881 Hrs as of last inspection	**Engine Manufacturer:**	P&W
ELT:	Installed, activated, aided in locating accident	**Engine Model/Series:**	PT6A SER
Registered Owner:	LEIS AIR LLC	**Rated Power:**	675 Horsepower
Operator:	Makani Kai Air	**Operating Certificate(s) Held:**	Commuter air carrier (135), On-demand air taxi (135)
Operator Does Business As:		**Operator Designator Code:**	MKHA

Meteorological Information and Flight Plan

Conditions at Accident Site:	Visual (VMC)	**Condition of Light:**	Day
Observation Facility, Elevation:	HMK,437 ft msl	**Distance from Accident Site:**	8 Nautical Miles
Observation Time:	14:54 Local	**Direction from Accident Site:**	230°
Lowest Cloud Condition:	Clear	**Visibility**	10 miles
Lowest Ceiling:	None	**Visibility (RVR):**	
Wind Speed/Gusts:	15 knots / 26 knots	**Turbulence Type Forecast/Actual:**	/ None
Wind Direction:	40°	**Turbulence Severity Forecast/Actual:**	/ N/A
Altimeter Setting:	29.95 inches Hg	**Temperature/Dew Point:**	27°C / 19°C
Precipitation and Obscuration:	No Obscuration; No Precipitation		
Departure Point:	Kalaupapa, HI (LUP)	**Type of Flight Plan Filed:**	Company VFR
Destination:	Honolulu, HI (HNL)	**Type of Clearance:**	None
Departure Time:	15:20 Local	**Type of Airspace:**	Class G

Airport Information

Airport:	Kalaupapa LUP	**Runway Surface Type:**	Water
Airport Elevation:	24 ft msl	**Runway Surface Condition:**	Water-choppy
Runway Used:		**IFR Approach:**	None
Runway Length/Width:		**VFR Approach/Landing:**	Forced landing

Wreckage and Impact Information

Crew Injuries:	1 Serious	**Aircraft Damage:**	Destroyed
Passenger Injuries:	1 Fatal, 2 Serious, 5 Minor	**Aircraft Fire:**	None
Ground Injuries:	N/A	**Aircraft Explosion:**	None
Total Injuries:	1 Fatal, 3 Serious, 5 Minor	**Latitude, Longitude:**	21.216667,-156.983337(est)

Administrative Information

Investigator In Charge (IIC):	Struhsaker, James
Additional Participating Persons:	Herman L Rios; FAA; Honolulu, HI Henry Soderlund; Cessna Aircraft Company; Wichita, KS Travis Shilling; Makani Kai Helicopters; Honolulu, HI Marc Gratton; Pratt & Whitney Canada; Longueuil
Original Publish Date:	May 23, 2016
Last Revision Date:	
Investigation Class:	Class
Note:	The NTSB traveled to the scene of this accident.
Investigation Docket:	https://data.ntsb.gov/Docket?ProjectID=88543