Aviation Investigation Final Report

Location:	Anchorage, Alaska	**Accident Number:**	ANC18LA005
Date & Time:	October 21, 2017, 05:30 Local	**Registration:**	N363JH
Aircraft:	RAYTHEON AIRCRAFT COMPANY B200	**Aircraft Damage:**	Substantial
Defining Event:	Landing gear not configured	**Injuries:**	4 None
Flight Conducted Under:	Part 135: Air taxi & commuter - Non-scheduled - Air Medical (Medical emergency)		

Analysis

The pilot was conducting an air medical flight during early morning hours in dark night visual meteorological conditions and was flying an instrument approach to the destination airport. A review of air traffic control communications found that during the instrument approach, the pilot gave an incorrect readback twice to the terminal radar approach controller and flew through the approach course. The pilot reported that, before landing, he failed to visually check and confirm indications that the landing gear were down and locked; he also did not respond to warning tones that should have sounded to indicate this condition during the latter stages of the approach. Upon touchdown on the runway with the landing gear not extended, the airplane skidded on the underside of the fuselage and came to rest on the runway.

The airplane sustained substantial damage to the right engine mount. Although the landing gear switch was found in the down position, it could not be determined when it was placed in that position.

Evidence indicates that the accident occurred during the window of circadian low, and the pilot's sleep periods were fragmented in the days before the accident and he did not have a contiguous 8 hours of sleep that was typical of his sleep pattern when not working overnight periods; both of these factors likely contributed to the pilot being fatigued about the time of the accident. The pilot reported that he felt the effects of fatigue, including impaired judgment, as he approached the destination airport. The pilot's readback errors and his failure to extend the landing gear are consistent with performance degradation due to fatigue. The pilot cited being on a long duty period, failing to manage his rest, failing to manage the cockpit, and allowing complacency to set in as factors that affected his performance.

Probable Cause and Findings

The National Transportation Safety Board determines the probable cause(s) of this accident to be:
The pilot's failure to extend the landing gear before landing, which resulted in a gear-up landing. Contributing to the accident was the pilot's fatigue and complacency.

Findings

Personnel issues	Use of equip/system - Pilot
Aircraft	Configuration - Incorrect use/operation
Personnel issues	(general) - Pilot
Personnel issues	Complacency - Pilot

Factual Information

History of Flight

Prior to flight	Miscellaneous/other
Landing	Landing gear not configured (Defining event)

On October 21, 2017, about 0530 Alaska daylight time, a Raytheon Aircraft Company (RAC) B200 airplane, N363JH, sustained substantial damage following an unintentional gear-up landing at the Ted Stevens Anchorage International Airport (ANC), Anchorage, Alaska. The certificated airline transport pilot, two flight medics, and one patient sustained no injuries. The airplane was registered to and was operated by Bering Air, Inc., as a Title 14 *Code of Federal Regulations* Part 135 instrument flight rules air ambulance flight, operating as Medevac 363JH. Dark night, visual meteorological conditions were present at the time of the accident and flight following procedures were used by the operator. The airplane departed from the Nome Airport, Nome (OME), Alaska, about 0320.

The pilot reported that the purpose of the flight was to transport a patient to a medical treatment facility in Anchorage, Alaska. The pilot started his duty day on October 20, at 1830 at the company headquarters at OME. The medical evacuation flight was on a weather hold for several hours and the pilot got permission from the company director of operations (DO) to rest at his home about 5 minutes away. The pilot arrived at his home about 2130 and went to sleep about 2140. At 0113 on October 21, he awoke with a telephone call from the company dispatch center for a medical evacuation flight. The pilot described his sleep during the approximate 3.5-hour nap as good and added that he was "sleeping a real deep sleep." The pilot reported back to the company headquarters, completed his preflight duties, and the airplane departed from OME without incident.

The flight from OME to the ANC Class C airspace was without incident. The pilot reported that after being handed off from the Anchorage Air Route Traffic Control Center to the Anchorage Approach Control, he received clearance to descend to 6,000 ft mean sea level (msl) followed with a vector heading and a descent clearance to 2,000 ft msl. As he was descending through about 4,000 feet msl, he visually confirmed the airport and requested a visual approach. He reported the air traffic controller didn't respond to his request, and he requested a visual approach again.

The controller responded back with a vector for the instrument landing system (ILS) runway 7 right approach. The pilot reported his groundspeed was about 210 kts indicated airspeed, he joined the final approach course, and was cleared to land. He reported he believes he was given a vector heading that was too close to the final approach fix and the airplane went through the final approach fix. The pilot then received another heading and he re-established himself on the final approach course. The radar flight track data is shown below in figure 1.

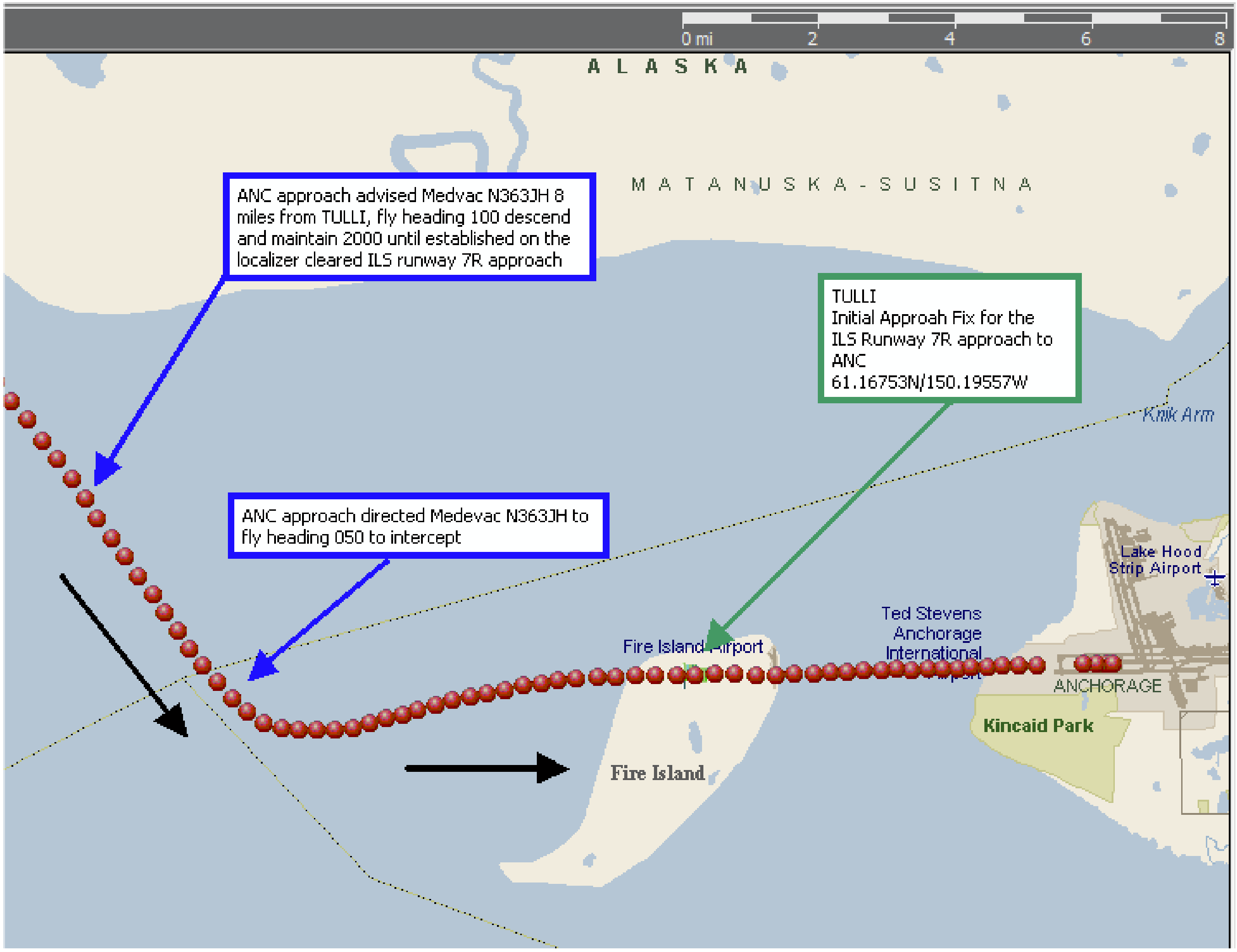

Figure 1 – Radar flight track data of the airplane, showing the initial approach fix and the destination airport.

For the landing, the pilot selected the approach flaps setting. He reported he failed to visually check and confirm for the three-landing gear down and locked indication lights in the cockpit. Upon touchdown on the runway with the landing gear not extended, the airplane skid on the pod installed on the underside of the fuselage along with the two engine nacelle assemblies on each wing. During the landing sequence, the metal 4-blade Hartzell HC-E4N-3G propellers for each engine separated about midspan due to runway impact damage as shown below in figure 2. The right side forward fuselage sustained minor damage from various separated propeller blade debris impacts. The airplane came to rest on the runway, and the occupants egressed without further incident.

Figure 2 – View of the right side of the airplane on the runway.

A National Transportation Safety Board (NTSB) air safety investigator responded to the accident site, arriving about 1 hour after the accident. During a post-accident on scene inspection of the accident airplane, the landing gear selector was found in the down position.

During a post-accident interview, the pilot stated that he, "… felt real good flying the airplane from Nome to Anchorage. Just the fatigue started to set in when I was coming in the outer ring of the Class C airspace into Anchorage." He added, "I feel like my judgment was impaired at the end of the flight."

In his written statement, the pilot stated he was responsible for the accident. He listed what he believed were the mitigating factors for his performance in writing (in part):

1. Long duty period (13 hours). I felt clear and alert at the beginning of the flight, however my alertness began to diminish at the beginning of the arrival phase of the flight.

2. I failed to manage my rest accordingly.

3. I failed to manage the cockpit accordingly. Had I selected flaps beyond approach flaps I would have received a gear handle light and a warning horn.

4.I failed to check for the 3 gear down and locked lights.

5. I am feeling very comfortable in the BE20; however, I allowed for complacency to set in.

The operator reported that there were no preimpact mechanical failures or malfunctions with the airframe or engine that would have precluded normal operation.

Pilot Information

Certificate:	Airline transport	**Age:**	57,Male
Airplane Rating(s):	Single-engine land; Multi-engine land	**Seat Occupied:**	Left
Other Aircraft Rating(s):	None	**Restraint Used:**	4-point
Instrument Rating(s):	Airplane	**Second Pilot Present:**	No
Instructor Rating(s):	None	**Toxicology Performed:**	No
Medical Certification:	Class 1 With waivers/limitations	**Last FAA Medical Exam:**	September 30, 2017
Occupational Pilot:	Yes	**Last Flight Review or Equivalent:**	April 21, 2017
Flight Time:	23121 hours (Total, all aircraft), 662 hours (Total, this make and model), 14746 hours (Pilot In Command, all aircraft), 208 hours (Last 90 days, all aircraft), 58 hours (Last 30 days, all aircraft), 2 hours (Last 24 hours, all aircraft)		

On October 19, the pilot reported he went to sleep at 1000 and woke up about 1400. He took a nap from 1700 to 1800. He went on duty at 1935 and was off duty at 0925 on October 20. On October 20, the pilot reported he went to sleep at 1000, but did not recall when he awoke. He reported sleeping again from about 2140 on October 20, to 0113 on October 21.

A review of the company's flight and duty records revealed the pilot worked the two days prior to the accident, but not did perform flight duties. The preceding three and four days prior to the accident, the pilot flew a total of 8.1 hours. The preceding fifth and sixth days prior to the accident, the pilot worked but did not perform flight duties. The remaining preceding days in the month of October 2017, the pilot was on vacation.

A review of the company's pilot training records revealed the pilot received basic indoctrination training on November 11, 2014, with the latest recurrent basic indoctrination training being received on December 22, 2016. The pilot received initial RAC B200 ground curriculum training on March 13, 2016. The pilot received the latest recurrent RAC B200 ground curriculum training on December 29, 2016. The pilot did not recall whether he had received any training on fatigue management, circadian rhythms, or sleep disorders since he has been employed at Bering Air.

A Federal Aviation Administration (FAA) review of the pilot's FAA medical records found no reported or diagnosed issues with fatigue or sleeping.

The pilot reported he had no difficulties falling asleep, but he might "occasional get an interruption". He would take naps while on duty while waiting for a flight to be assigned. He further reported he has never "nodded off" or fallen asleep in the airplane while performing the duties as a pilot.

Aircraft and Owner/Operator Information

Aircraft Make:	RAYTHEON AIRCRAFT COMPANY	**Registration:**	N363JH
Model/Series:	B200	**Aircraft Category:**	Airplane
Year of Manufacture:	2002	**Amateur Built:**	
Airworthiness Certificate:	Normal	**Serial Number:**	BB-1799
Landing Gear Type:	Retractable - Tricycle	**Seats:**	4
Date/Type of Last Inspection:	October 4, 2017 Continuous airworthiness	**Certified Max Gross Wt.:**	12500 lbs
Time Since Last Inspection:		**Engines:**	2 Turbo prop
Airframe Total Time:	3182 Hrs at time of accident	**Engine Manufacturer:**	Pratt & Whitney Canada
ELT:	C126 installed, not activated	**Engine Model/Series:**	PT6A-41
Registered Owner:	Bering Air, Inc.	**Rated Power:**	800 Horsepower
Operator:	Bering Air, Inc.	**Operating Certificate(s) Held:**	Rotorcraft external load (133), Commuter air carrier (135), On-demand air taxi (135)

The airplane was equipped with a Garmin G1000 all-glass avionics suite.

The RAC B200 (also called a "King Air) Pilot's Operating Handbook (POH) describes the landing gear system and states in part:

The retractable tricycle landing gear is electronically controlled and hydraulically activated.

In flight, as the landing gear moves to the full down position, the down lock switches are actuated and interrupt current to the pump motor. When the red gear in-transit light in the LDG GEAR CONTROL extinguishes and the three green GEAR DOWN indicators illuminate, the landing gear is in the fully extended position.

The POH also describes the landing gear warning system and states in part:

The landing gear warning system is provided to warn the pilot that the landing gear is not down during specific flight regimes. Various warning modes result, depending upon the position of the flaps.

With the FLAPS in the UP or APPROACH position and either or both power levers retarded below approximately 80% N1, the warning horn will sound intermittently and the LDG GEAR CONTROL lights will illuminate. The horn can be silenced by pressing the GEAR HORN SILENCE button located on the left power lever. The lights in the LDG GEAR CONTROL cannot be cancelled. The landing gear warning system will be rearmed if the power levers are advanced sufficiently.

With the FLAPS beyond APPROACH position, the warning horn and LDG GEAR CONTROL lights will be activated regardless of the power settings, and neither can be cancelled.

The Bering Air King Air G1000 Normal Procedures checklist discusses the before landing procedures and states:

Gear – Down

Lights – On

Ice Vanes – Extended

Yaw Damp – Off

Flaps – Set & Ind

Meteorological Information and Flight Plan

Conditions at Accident Site:	Visual (VMC)	**Condition of Light:**	Night/dark
Observation Facility, Elevation:	PANC,132 ft msl	**Distance from Accident Site:**	1 Nautical Miles
Observation Time:	13:53 Local	**Direction from Accident Site:**	276°
Lowest Cloud Condition:	Few / 5500 ft AGL	**Visibility**	10 miles
Lowest Ceiling:	Broken / 7500 ft AGL	**Visibility (RVR):**	
Wind Speed/Gusts:	7 knots /	**Turbulence Type Forecast/Actual:**	None / None
Wind Direction:	360°	**Turbulence Severity Forecast/Actual:**	N/A / N/A
Altimeter Setting:	29.28 inches Hg	**Temperature/Dew Point:**	-5°C / -12°C
Precipitation and Obscuration:	No Obscuration; No Precipitation		
Departure Point:	NOME, AK (OME)	**Type of Flight Plan Filed:**	IFR
Destination:	Anchorage, AK (ANC)	**Type of Clearance:**	IFR
Departure Time:		**Type of Airspace:**	Class D

Airport Information

Airport:	TED STEVENS ANCHORAGE INTL ANC	**Runway Surface Type:**	Asphalt;Concrete
Airport Elevation:	151 ft msl	**Runway Surface Condition:**	Dry
Runway Used:	07R	**IFR Approach:**	ILS;Visual
Runway Length/Width:	12400 ft / 200 ft	**VFR Approach/Landing:**	None

Wreckage and Impact Information

Crew Injuries:	3 None	**Aircraft Damage:**	Substantial
Passenger Injuries:	1 None	**Aircraft Fire:**	None
Ground Injuries:	N/A	**Aircraft Explosion:**	None
Total Injuries:	4 None	**Latitude, Longitude:**	61.167778,-150.001937(est)

The airplane was recovered and transported to secure location for a comprehensive damage assessment. The airplane sustained substantial damage to the right engine mount as shown below in figure 3.

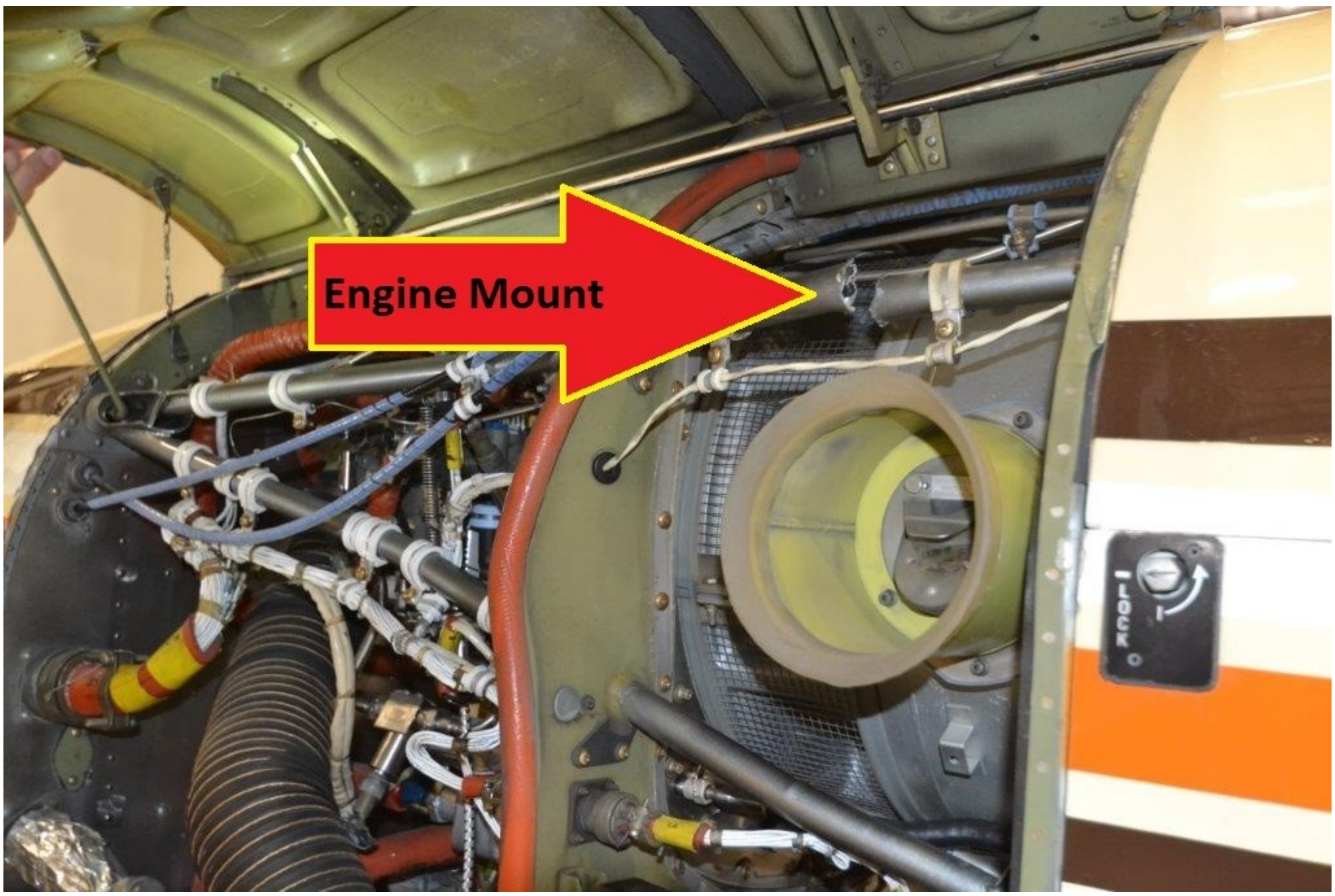

Figure 3 – View of the fractured right engine mount (courtesy of Bering Air).

The Bering Air director of maintenance reported that after an internal inspection of both Pratt & Whitney Canada PT6A-61 turbo prop engines, it was determined that it was not economically feasible to repair both engines as two new engines were purchased instead.

Communications

The pilot checked in with the Anchorage terminal radar approach control (A11) controller at 05:19 at 10,300 ft msl descending to 10,000 ft msl. The A11 controller advised that the automatic terminal information service information Sierra was current and asked the pilot which runway he was requesting. The pilot advised that he would like to land on runway 7 right for the south airpark for Ross Aviation. In response, the controller instructed the pilot to fly heading 120 [degrees] and to descend and maintain 6,000 ft msl for a radar vector to runway 7 right. The pilot responded with 12,000 and 6,000. The controller did not correct the incorrect readback.

Two minutes later, the controller instructed the pilot to descend at pilot discretion and maintain 2,000 ft msl. The pilot acknowledged the pilot discretion descent to 2,000 ft msl.

At 05:24, the controller requested the pilot to say flight conditions. The pilot did not respond. At 05:25 the controller advised the pilot that he was 8 miles from the TULLI (the initial approach fix), then fly heading 100 [degrees], maintain 2,000 ft msl until established on the localizer, and cleared the pilot for the ILS runway 7 right approach. The pilot acknowledged the assigned heading of 100 and that he was cleared for the ILS runway 25 approach and then corrected himself and acknowledged he was cleared for the runway 7 right ILS approach. At 05:26 the controller instructed the pilot to fly heading 050 [degrees] to intercept the final approach course for the ILS runway 7 right approach. The pilot acknowledged the 050 [degree] heading.

One minute later, the A11 controller called the Anchorage air traffic control tower (ATCT) controller and asked about the visibility on the final approach course to runway 7. The ATCT controller advised that he could see the airplane. The A11 controller advised the ATCT controller to watch out for the airplane because the pilot was not taking everything down and sounded like he was a little busy in the cockpit. The ATCT controller acknowledged.

At 05:27 the A11 controller asked the pilot if he was established on final and after a positive response from the pilot, instructed the pilot to contact the ATCT controller.

The pilot checked in with the ATCT controller, was issued the wind condition, and was cleared to land on runway 7 right. The ATCT controller advised the pilot that he could expect a right turn on taxiway Foxtrot from runway 7 right to the south airpark. At 05:30, after several attempts to raise the pilot on the frequency by the ATCT controller and the A11 controller, the pilot advised that the airplane was off runway and needed a tow.

A review of ATC services provided by A11 and Anchorage ATCT to the pilot indicated no deficiencies with established air traffic control (ATC) procedures as defined in FAA Order 7110.65, *Air Traffic Control*. The pilot's statement that he requested a visual approach to runway 7 right on two occasions was not supported by the recorded ATC transmissions between the pilot and the ATCT controller.

Flight recorders

The airplane was not equipped with a crashworthy cockpit voice recorder system or a flight data recorder system, nor were either required to be for 14 *CFR* Part 135 air ambulance operations.

Organizational and Management Information

Federal Aviation Administration

Bering Air did not use, nor was required to use a pre-flight risk analysis as a fixed wing air ambulance operator. 14 *CFR* 135.617 lists out requirements for a formal pre-flight risk analysis to be conducted by rotary wing air ambulance operators. Required topics in the pre-flight risk analysis include areas such as flight considerations, human factors, weather, etc.

The NTSB investigator-in-charge (IIC) asked the FAA if a similar requirement is in place for 14 *CFR* Part 135 fixed wing air medical operators to conduct a formal pre-flight risk analysis (looking at areas such as flight considerations, human factors, weather, etc.). The FAA stated:

Helicopter air ambulance (HAA) aircraft routinely operate in to and out of off-airport landing sites as authorized in Operations Specification A021. HAA flights are also often conducted under VFR in remote areas. Given this consideration, many factors including flight considerations, human factors, weather, etc. are required by §135.617 to be considered by the pilot in command in a preflight risk analysis prior to the first leg of each HAA operation.

Fixed-wing air ambulance operations, on the other hand, are generally conducted at the same airports other non-air ambulance (air carrier and general aviation) aircraft normally operate to or from. Since the risk for fixed-wing air ambulance operations is generally no greater than other non-air ambulance operations conducted under part 135, a requirement for a formal risk analysis program is not presently required by regulation.

14 *CFR* Part 135.330 Crew Resource Management (CRM) Training states "each certificate holder must have an approved crew resource management training program that includes initial and recurrent training." This regulation also states the training program must include at least the following CRM areas:

1. Authority of the pilot in command;

2. Communication processes, decisions, and coordination, to include communication with Air Traffic Control, personnel performing flight locating and other operational functions, and passengers;

3. Building and maintenance of a flight team;

4. Workload and time management;

5. Situational awareness;

6. Effects of fatigue on performance, avoidance strategies and countermeasures;

7. Effects of stress and stress reduction strategies; and

8. Aeronautical decision-making and judgment training tailored to the operator's flight operations and aviation environment.

Bering Air

The Bering Air Company Operations Manual, which is accepted by the FAA, discusses medical evacuation flights and states in part:

Bering Air is equipped and prepared to provide medical evacuation flights, hereafter referred to as medevac, on an on-demand basis. In conducting these flights Bering Air is limited to providing transportation services for medical personnel and patients.

Normal operational control will be exercised for medevac flights that occur during daytime business hours. Operational control during initiation of a medevac after hours will be exercised by the President, Director of Operations, Chief Pilot, Station Manager, or their designate only.

The PIC will continue to have the final authority as to the safe conduct of a medevac flight. Patient condition may affect how expeditiously a flight is conducted but should not affect safe operating procedures. Pilots should keep communication open with the medical personnel on board as much as possible; however, pilots should isolate themselves from medical personnel during take-off and landing and any other phase of flight which presents an increase in workload on the pilot.

The term "Medevac" will be utilized only for that portion of the flight requiring expeditious handling.

A review of the Bering Air Company Operations Manual found no mention of a fatigue management policy, nor was there required to be one. The Bering Air Company Operations Manual discusses the topic, fit to fly, and states:

It is each pilot's responsibility to ensure he/she is prepared for flight duty. This is important in all operations, and especially on single-pilot, passenger-carrying flights. Do not come to work if you are not fit to fly. The "IM SAFE" checklist provides guidelines to follow:

I Illness

M Medication

S Stress

A Alcohol

F Fatigue

E Eating/Emotion

A review of the Bering Air Training Manual, which is approved by the FAA, lists the required training areas for basic indoctrination. The required training areas for CRM found in the Bering Air Training Manual were:

1. Situational awareness and the error chain

2. Communications

3. Workload assessment and time management

4. Reliance on automation

5. Stress

A review of the Bering Air Training Manual listed the required training areas for the ground curriculum for the RAC B200. The required trainings areas for CRM found in the Bering Air Training Manual were:

1. Situational awareness and the error chain

2. Stress

3. Communications

4. Synergy and crew concept

5. Workload management

6. Decision making

7. Advanced/automated cockpit

The NTSB IIC followed up with the Bering Air DO and asked if he could provide electronic copies to the NTSB of the separate documents (such as presentations, handouts, etc.) that are used to train about the effects of fatigue on performance, fatigue avoidance strategies, and fatigue countermeasures for their pilots. The DO responded that, "we have no other training programs than what is in the training manual."

Additional Information

Fatigue

The FAA has published Advisory Circular (AC) 120-100 Basics of Aviation Fatigue. This document discusses the fundamental concepts of human cognitive fatigue and how it relates to the safe performance of duties by employees in the aviation industry. This document defines fatigue and cognitive performance and states:

Fatigue refers to a physiological state in which there is a decreased capacity to perform cognitive tasks and an increased variability in performance as a function of time on task. Fatigue is also associated with tiredness, weakness, lack of energy, lethargy, depression, lack of motivation, and sleepiness.

Cognitive performance refers to the ability to process thought and engage in conscious intellectual activity, e.g., reaction times, problem solving, vigilant attention, memory, cognitive throughput. Various studies have demonstrated the negative effects of sleep loss on cognitive performance.

This document also defines what a Fatigue Risk Management System (FRMS) is and states:

FRMS is a scientifically based, data-driven process and systematic method used to continuously monitor and manage fatigue risks associated with fatigue-related error. FRMS can be, but is not necessarily required, a fundamental part of an organization's Safety Management System (SMS).

A FRMS along with an SMS are not required for 14 *CFR* Part 135 air medical operators.

This document states the risk factors associated with fatigue and states:

Fatigue associated with aviation operations is a risk factor for occupational safety, performance effectiveness, and personal wellbeing. The multiple flight legs, long duty hours, limited time off, early report times, less-than-optimal sleeping conditions, rotating and non-standard work shifts, and jet lag pose significant challenges for the basic biological capabilities of pilots, crewmembers and shift workers. Humans simply are not designed to operate effectively under the pressured 24/7 schedules that often define aviation operations, whether the operations are short-haul commercial flights, long-range transoceanic operations, or around-the-clock and shift work operations.

FAA AC 117-2 Fatigue Education and Awareness Training Program present guidelines for developing and implementing a fatigue education and awareness training program. This document, while addressed to 14 *CFR* Part 121 certificate holders, discusses the importance of fatigue training and states in part:

Fatigue training requirements are critical to mitigating the risk of fatigue by ensuring that both flight crew members and certificate holders understand the effects of fatigue on the safety of flight.

Administrative Information

Investigator In Charge (IIC):	Hodges, Michael
Additional Participating Persons:	Hugh Youngers; FAA Polaris Certificate Management Office; Anchorage, AK Marc Hamilton; Transportation Safety Board of Canada; Gatineau Marc Gratton ; Pratt & Whitney Canada (Technical Advisor); Saint-Hubert
Original Publish Date:	June 29, 2020
Last Revision Date:	
Investigation Class:	Class
Note:	The NTSB did not travel to the scene of this accident.
Investigation Docket:	https://data.ntsb.gov/Docket?ProjectID=96246