Transportation Safety Board of Canada
Bureau de la sécurité des transports du Canada

AVIATION INVESTIGATION REPORT
A10C0060

FUEL STARVATION AND FORCED LANDING

VENTURE AIR
BEECH 95-55 C-FBJA
PIKWITONEI, MANITOBA, 3 nm E
13 MAY 2010

Canada

Aviation Investigation Report

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Summary

The Venture Air Beech 95-55 (registration C-FBJA, serial number TC-71) departed Thicket Portage for a day visual flight rules flight to Thompson, Manitoba, about 29 nautical miles (nm) north. Shortly after take-off, the pilot used his cell phone to contact the Winnipeg Flight Information Centre. The pilot indicated that the aircraft was experiencing an electrical problem and that the flight would arrive at Thompson in 12 minutes, without radios or transponder. There were no further communications with the aircraft. About 30 minutes after the telephone call was received, a series of emergency signals from a tracking system carried by the pilot were received. A helicopter was dispatched to the location indicated by the tracking system. The aircraft was located about 3 nm east of Pikwitonei, about 25 nm northeast of Thicket Portage and 27 nm southeast of Thompson. The pilot, sole occupant, sustained minor injuries. The aircraft was destroyed on impact with trees and terrain, but the emergency locator transmitter did not activate. There was no post-crash fire. The accident occurred during daylight hours at about 0950 Central Daylight Time.

Ce rapport est également disponible en français.

Other Factual Information

Weather and NOTAMs

The closest weather reporting station to the route flown is Thompson, Manitoba. The Thompson weather at the time of the accident was as follows: wind from 150° true (T) at 3 knots, visibility 15 statute miles (sm), scattered clouds at 10 000 feet above ground level (agl), broken clouds at 13 000 feet agl, broken clouds at 25 000 feet agl, temperature 12°C, dew point 5°C, and altimeter setting 29.89 inches of mercury (in Hg). Similar conditions suitable for visual flight rules (VFR) flight were experienced throughout the flight.

A Notice to Airmen (NOTAM) was effective for Pikwitonei from 0800 to 1700 [1] that required a 10 minute notice by radio or telephone to have maintenance vehicles removed from the runway.

Pilot Qualifications

The pilot held a commercial pilot license (CPL) valid for single and multi-engine land aircraft and had a valid medical certificate. The pilot had obtained a CPL in 2002, but subsequently had been employed in ground positions. Before being employed by Venture Air in 2010, the pilot flew minimally to maintain the CPL. In the 12 months prior to the start of training on the Beech 95-55, the pilot had flown a total of 2.3 hours.

The pilot's training for employment with Venture Air was in accordance with *Canadian Aviation Regulations* (CAR) Standard 723 and a pilot proficiency check (PPC) was completed on the accident aircraft on 13April 2010. While CAR Standard 723 does not require company indoctrination training, the operator provided the pilot with such training, using a computer-assisted learning program. Company records indicated that the pilot met the requirements of CAR 703.88 and CAR 401.05 to be designated as a pilot-in-command and carry passengers.

Following the PPC, the pilot began commercial flights with passengers on 11 May 2010. On 13 May 2010, the day of the accident, the pilot's total flying time was approximately 277 hours, including 45 hours on multi-engine aircraft. This included about 12 hours on type with approximately 5 hours flown in the accident aircraft.

History of the Flight

On the morning of the accident, the pilot was well rested and first flew the aircraft on a return flight from Thompson to South Indian Lake. Prior to this initial flight, fuel levels were checked visually by the pilot and estimated that the auxiliary fuel tanks were just over one-half full and that the main fuel tanks were one-half full. After the morning flight to South Indian Lake, the pilot departed from Thompson with 2 passengers and flew to Thicket Portage. For the return flight to Thompson, the pilot was the only occupant on board. All flights were conducted under visual flight rules (VFR). A map of the local area is provided in Appendix A.

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[1] All times are Central Daylight Time (Coordinated Universal Time minus 5 hours).

At Thicket Portage, both engines were shut down before the passengers deplaned. The engines were then restarted for the return flight to Thompson. As part of the before start checklist, the battery and generator switches were selected on. The engines turned over more slowly than normal during the start. During the before take-off check, the pilot did not set the air-driven directional gyro (DG); its location on the co-pilot's panel made it difficult to reach the heading knob and to see the display. The fuel selectors were left selected to main tanks.

At 0926 the aircraft took off from Runway 29, the landing gear was selected up and climb power was set. Almost immediately, radio communications, the global positioning system (GPS) and transponder were lost. A review of the Thompson recorded radar information indicated that the aircraft's transponder stopped transmitting about 2 minutes after take-off. A right climbing turn was initiated towards the track of 355 degrees for Thompson. A visual assessment of the gear, using a mirror mounted on the engine nacelle, revealed that the landing gear was only partially retracted.

At 0929, the pilot contacted the Winnipeg Flight Information Centre (FIC) by cell phone, and indicated that the flight had departed from Thicket Portage and was currently at 4500 feet above sea level (asl), estimating arrival at Thompson in 12 minutes, and was without radios (NORDO) or transponder. The landing gear problem was not reported during the phone conversation.

After departure, although the electrically-powered horizontal situation indicator (HSI) was not functioning, the pilot used it in an attempt to establish the track to Thompson. While an area map was available in the cockpit, a ground feature was not selected to confirm the departure track and the pilot became disoriented. Since the air-driven DG was not set, the pilot attempted to use the standby magnetic compass. The pilot had difficulty using the standby compass and remained uncertain of the aircraft's position. When an electrical odour accompanied by smoke in the cockpit was noted, all electrical switches were selected off.

When the railroad tracks running from Thicket Portage to Pikwitonei were identified, the pilot elected to follow the rail line northeastward to Pikwitonei before proceeding to Thompson. Concerned by the smoke and the possibility of a fire, the pilot considered this to be a safer route in case of a forced landing. Fuel was considered to be ample for the new routing. The battery master was turned on, and with the generators off, the landing gear was selected down. The gear went down, but the pilot did not notice a green gear-down light and the landing gear remained the pilot's greatest concern. The gear was left down for the remainder of the flight.

Just prior to reaching Pikwitonei, the generators were selected on. A high indication on the left ammeter and a lower indication on the right ammeter were observed. The avionics master was selected on. A review of the Thompson recorded radar information indicated that the aircraft transponder activated at 0942, about 5 miles west of Pikwitonei and about 15 minutes after the emergency began. The last item on the electrical smoke or fire checklist is to "Land at the nearest suitable airport".

In the vicinity of Pikwitonei, the pilot made a decision to land because of concern with the smoke, but without the knowledge that the runway might be blocked as per the issued NOTAM. A 6-mile downwind was intentionally flown in order to set up for a long straight-in approach. The wings were rocked in an attempt to lock the landing gear and then a base turn was initiated. During the turn, the right engine lost power. After the right engine power loss was confirmed, the right auxiliary fuel tank was selected. During the troubleshooting of the right engine, the left engine lost power. Neither engine was feathered in the hope that the windmilling engines would restart. The radar display indicated that the aircraft entered a right turn and then disappeared from the radar at 0946 about 3 to 4 miles east of Pikwitonei, some 20 minutes after take-off.

The aircraft crashed on a north-westerly heading in a wooded area about 3 nm east of Pikwitonei. The force of the impact was severe and the pilot lost consciousness briefly, but sustained only minor injuries. When the pilot regained consciousness fuel was observed leaking from the fractured right wing. Since there was a possibility of fire, the pilot exited the aircraft taking the fire extinguisher and retreating to a safe distance. A short time later, the pilot returned to the wreckage; turned on the aircraft's emergency locator transmitter (ELT) through the remote switch mounted on the aircraft's instrument panel and retrieved the handheld SPOT ™ satellite personal tracking device from the cabin. [2] At 1012, the pilot pushed the 911 button on the SPOT unit which alerted the company (through the SPOT emergency response center) of the accident. At 1057 the Department of National Defence, Joint Rescue Coordination Center (JRCC) in Trenton, Ontario, picked up the ELT signal and initiated a search. A Search and Rescue aircraft was operating in the area at the time of the crash and located the site with the aid of the ELT signal and the SPOT 911 coordinates. A local civilian helicopter was contracted to take rescuers to the site. The pilot was picked up at 1135 and transported to the hospital in Thompson for medical treatment.

Site Examination

The aircraft was examined on-site by TSB investigators. The aircraft struck the ground in a steep left-wing-low, shallow descent angle. After ground contact, the aircraft continued to roll left to the inverted position as it entered trees. Both wings were broken outboard of the engine nacelle, the tail was broken off forward of the vertical stabilizer, the left engine was torn free of the aircraft and the right engine was broken free of its mounts. The propellers were in fine pitch and did not exhibit signs of rotation beyond wind-milling speed. The engine magneto switches were tested and despite the dislocation of the engines, the wiring remained intact and was found to function normally. All 3 landing gear were extended, but due to the damage it could not be determined if the gear was in a locked position. The flaps were retracted. All visible electrical wiring and components in the cockpit and nose baggage compartment were checked for signs of overheating and electrical burning odors; none were detected and all circuit breakers were in. The generator drive belts were intact and tensioned correctly. The cabin area remained intact forward of the rear cabin bulkhead with minimal vertical compression. The left hand over-wing exit was open. The ELT remained attached to its bracket and wiring harness inside the aft fuselage area. Both batteries were removed from the wreckage and examined. There was no characteristic smell of battery overheating.

All 4 fuel caps were present and secure with no sign of fuel staining or leakage. No fuel odor was detected around the wreckage. Both wings were fractured in the area of the auxiliary fuel tank filler caps. Both auxiliary tank fuel bladders were torn open and a small quantity of fuel was observed in the folds of the right auxiliary fuel bladder. The main fuel cell caps were opened with the wings in the post impact inverted position. No fuel came out of either main tank cap area, but the integrity of the main fuel cells could not be determined. Both main engine fuel filters were examined and the screens were clean with no evidence of contamination. The

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2 SPOT Inc© is a GPS transmitter system that transmits the device's position, usually once every 10 minutes.

fuel lines in both engine compartments were intact with no signs of leakage. The fuel lines between the main metering unit and manifold valve were opened and only a small residual quantity of fuel was recovered. The engines were in a position such that any fuel in the lines would have been trapped.

The aircraft was recovered from the site and taken to the operator's base for further examination after a delay of several weeks caused by conditions at the site and wreckage transport issues. Ground electrical power was applied to the aircraft and the aircraft's electrical system powered up normally with no sign of electrical burning or smell. The landing gear motor was removed and disassembled for examination. The motor had a strong electrical burning smell and the armature had visible signs of overheating. The motor was re-assembled and found to function normally. Both aircraft generators, voltage regulators, generator paralleling relay, avionics and battery master relay, ELT and the aircraft radio package were removed for further testing and evaluation.

Aircraft Electrical System

The aircraft's electrical components were powered by a 28 volt (V) direct current (DC) [3] electrical bus that received its power from 3 separate electrical power sources, two 12V, 25 amp (A) lead acid batteries connected in series, and the left and right engine-driven 40A generators. Each of the 3 electrical power sources was capable of independently powering the electrical bus within the constraints of the electrical load applied. The batteries were connected to the electrical bus through a master switch and battery relay. The generators were connected to the electrical bus through individual toggle switches and voltage regulators, adjusted to 28.25 ±.25V. A reverse current relay within the voltage regulator connected and disconnected the generator from the electrical bus depending on internal settings. If the generator voltage was lower than the bus voltage, the generator was disconnected. A system paralleling relay was used to balance the electrical load between the 2 generators. The paralleling unit decreased the voltage output of the high regulator and increased the voltage output of the low regulator.

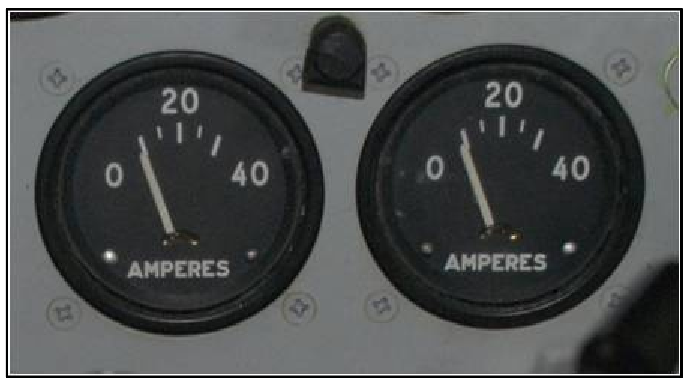

Photo 1. C-FBJA ammeter reading with Generators OFF

The generator output was indicated by 2 direct reading ammeters (as opposed to the charge-discharge type ammeter) mounted on the instrument panel behind the throttle quadrant (see Photo 1). The ammeter readings increase or decrease in direct proportion to the electrical load applied. While the scale starts at 0A and goes to 40A, the positioning of the 0 and the 40 do not align with the markings of the scale. This arrangement is such that a reading of zero could be misinterpreted as 10A.

3 All voltages are expressed in DC.

Aircraft Maintenance History

The occurrence aircraft was manufactured in 1961 and had undergone numerous modifications. A Garmin navigation/communication system was installed comprising a GNS-530A main display and control unit and GTX-330 Transponder. Information from the GPS memory was downloaded and the last known position contained in the unit was at the threshold of Runway 29 at Thicket Portage.

The one-piece instrument panel was a post-production modification that incorporated a segmented annunciator panel located below the glare shield, directly in front of the pilot. Two segments of the panel were used to illuminate, in amber, the words "Left Generator" and "Right Generator" to indicate a generator failure. The generator failure lights were controlled through a set of relays connected to the generator paralleling unit. Generator armature voltage present at either terminal of the paralleling unit energized the respective relay and turned the light off. This occurred independent of the voltage regulator reverse current relay operation. Extinguishing of the generator light did not necessarily indicate that the generator was connected to the electrical bus. The absence of the light indicated only that the generator was providing voltage to the paralleling unit. Confirmation that the reverse current relay in the voltage regulator had connected the generator output to the bus bar was provided by ammeter indication. Testing of the generator lights found that when illuminated, the lights were not conspicuous. When voltage was reduced, the lights dimmed significantly.

The aircraft underwent a 100-hour inspection on 30 March 2010, approximately 7 flight hours prior to the occurrence. One of the aircraft's main batteries was replaced. The second battery was considered in marginal condition, but serviceable for use. When batteries are connected in series, a marginal battery can substantially lower the combined battery output voltage, as the marginal battery tends to act as a resistor and the good battery attempts to charge the lower one. [4] The aircraft had experienced an overvoltage situation in 2007, approximately 300 flight hours prior. The right voltage regulator was replaced and both regulators were balanced. Other than a generator drive belt replacement in 2008 there were no reports of charging system problems since 2007.

Component Testing and Examination

The aircraft's generators, voltage regulators and paralleling unit were bench-tested for operation. The paralleling unit functioned normally. The generators were operated with a test voltage regulator and the left generator was found to operate normally. The right generator output was low, producing 22V to 24V. The right generator's armature was examined and showed signs of arcing and abnormal wear. The armature damage may have been associated with the overvoltage situation that occurred 300 flight hours prior. The generators were then tested with their respective voltage regulator. The left voltage regulator reverse current relay pull-in and drop-out voltages [5] were found to be set to 28.8V and 25.8V respectively. The left voltage regulator was found to be adjusted to 24.9V, well below the 28.25 ±.25V normally

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4 The aircraft wreckage was left in situ until it could be recovered several weeks later. When the wreckage was recovered the batteries had been taken from the site by persons unknown. Consequently, the batteries were unavailable for further examination or testing.

5 The voltage at which the generator is connected and disconnected to the electrical bus.

required and below the drop-out voltage of the left generator reverse current relay. The right voltage regulator failed to operate due to an open shunt coil winding and could not be tested.

The avionics and battery master relays were tested and found to operate normally. The relays opened around 3V to 4V and closed around 11V. The radio and navigation units were tested and operated normally down to about 8V, where they dropped offline.

Emergency Locator Transmitter

The ELT did not activate during the crash and the unit was sent to the TSB Laboratory for examination and testing. The ELT was identified as model ME406, part number 453-6603, manufactured by Artex Aircraft Supplies Inc. and approved for use in the accident aircraft. The ELT had been recertified on 10 February 2010 and a label indicated a battery replacement date of March 2015. The ELT unit-mounted switch was turned to the ON position and a strong signal was heard on both frequencies. A frequency check was carried out and both the 121.5 MHz and 406 MHz frequencies met specifications.

The ELT is equipped with a single-axis G-switch which is activated when the unit senses an acceleration force along its longitudinal axis greater than 4.5 feet per second (2.3 G’s). The G-switch is mounted at one end of an internal tube. A ball mounted inside the tube travels to the end of the tube by acceleration forces and then reverses direction or rebounds back along the tube when the acceleration stops, until it contacts the G-switch.

Functional testing of the ELT’s crash-sensing circuitry was carried out. A solid state accelerometer was mounted on the case of the ELT. The ELT was held by hand and jolted forward along the longitudinal axis of the ELT body (in the direction of the arrow) to simulate a sudden stoppage. The output of the accelerometer and the voltage across the G- switch were captured by an oscilloscope. The test was repeated several times and the G-switch operated within the specified range. Several tests were conducted where G-loads of varying force and varying angles away from the longitudinal axis of the tube were introduced. In some cases the G-switch activated and in some cases it did not. It was noted that as the angle of force moved away from the longitudinal axis of the tube, the ball could be heard to hit the end of the tube, but not rebound back against the G-switch. In those cases the ELT did not activate. The manufacturer offers a multi-axis momentary G-switch ELT, designed to operate at all impact angles. The installation of multi-axis ELTs in fixed wing aircraft is not required by regulation.

Aircraft Fuel System

The fuel system consisted of 4 non-interconnected fuel cells of a total fuel capacity of 136 US gallons of useable fuel. Each wing held a 37 usable US gallon main cell and a 31 usable US gallon auxiliary cell. The fuel gauges were of the ratiometer type designed to minimize errors caused by fluctuations in the electrical system voltage.

AD 72-11-02 required fuel quantity indicator markings in the form of a yellow band from empty to the 1/4 marking. The Pilot Operating Handbook (POH), Section II, 2-8 also references these markings and indicates that take-offs should not be made in this range. These range markings were not present on the accident aircraft fuel gauges although records indicate that AD 72-11-02 was accomplished. The fuel quantity indicators did not carry the Beechcraft logo.

The POH and checklist specify that take-off and landing must be on the main fuel tanks with not less than 13 gallons in each main tank. Turning type takeoffs or takeoffs immediately following fast taxi turns are prohibited because of the possibility of fuel inlet porting. The fuel from the auxiliary fuel tank is preferably consumed in cruise, thus ensuring that sufficient fuel is present in the main tanks to comply with the 13 gallon take-off and landing restriction.

The aircraft was last refuelled on 13 April 2010 resulting in a full fuel load of 136 US gallons (816 pounds). Seven journey log entries were made following the refuelling for a total flight time of 3.6 hours. The last entry was made on 12 May 2010 indicating a departure fuel of 350 pounds. There were no entries made for the morning flight completed on the day of the accident. TSB results of fuel calculations for the 7 flights corresponded closely to the 7 journey log entries and indicated that the total fuel on board for the first departure on 13 May 2010 was about 290 pounds. However, for the same flight, after visually determining the fuel in the tanks, the pilot reported a fuel load of 480 pounds to the company which was noted on the company's flight tracking form. TSB calculations indicated that the total fuel on board on departure from Thicket Portage was sufficient for the flight and a 30 minute reserve. TSB also calculated the quantity of fuel remaining in the main tanks for each flight. The calculations indicated that the main tanks, as used by the pilot, would have been exhausted at approximately the time the engines stopped in the vicinity of Pikwitonei.

Aircraft Seat Belts

The pilot's seat was equipped with a restraint system which consisted of a lap belt and a double-ended shoulder strap threaded through a loop from an overhead inertia reel. The pilot used both the lap belt and the shoulder straps.

Company Flight Following

The SPOT satellite device was used by the company for flight following and tracking purposes. The company's policy was to have the pilot activate the SPOT Check-In mode prior to takeoff to indicate that the flight is underway. The pilot would then activate the Track Progress mode which would allow tracking of the flight, in 10 minute intervals, on a web page accessible to the operator. At 0713 the pilot activated the Check-In mode prior to takeoff on the first flight of the day from Thompson to South Indian Lake, however the pilot did not activate the Track Progress mode and the flight's progress could not be tracked.

Task Saturation

Pilots can be subjected to task saturation when the workload becomes high, and there are multiple tasks to perform and limited time. Inexperienced pilots are particularly susceptible in high workload situations. A basic defence which is taught to pilots is the mantra: "aviate, navigate then communicate". This mantra reinforces the need for a pilot to fly the aircraft first and that maintaining control of the aircraft is primary. Once the pilot has the aircraft and its systems under control, focus can be placed on navigation, and then communication. Task saturation can lead to poor prioritization of tasks and focusing on one task to the exclusion of others. Pilots can combat task saturation by using checklists effectively and by developing good crosschecking skills. Management can ensure that appropriate checklists and procedures are available and that pilots are trained and knowledgeable in their use.

The following TSB Laboratory report was completed:

LP 073/2010 NVM Recovery, ELT, Lamps

This report is available from the Transportation Safety Board of Canada upon request.

Analysis

The first indication of a loss of electrical power occurred immediately after take-off, when the electrically-operated landing gear did not fully retract and all avionics power was lost. The transponder also stopped transmitting and the aircraft was no longer being tracked by radar.

The simultaneous occurrence of these electrical malfunctions indicates that they are likely related to low electrical bus voltage caused by a loss of both generators, combined with low battery voltage. The left generator's voltage regulator had been adjusted too low for the left generator to power the electrical bus by itself. The right generator's voltage regulator had an open shunt coil winding which rendered it unserviceable. Prior to the electrical failure it is likely that the right voltage regulator had been functioning and was increasing the voltage of the left generator through the paralleling unit to bring the left generator on line. Therefore, both generators were relying on the serviceability of the right voltage regulator in order to feed the electrical bus. It could not be determined when the right voltage regulator failed; however, when it failed, it would have caused the voltage of the left generator regulator to drop back to its initial setting of 24.9V. The reverse current relay in the left regulator was set at 25.8 volts and would have disconnected the left generator from the electrical bus.

On engine start in Thicket Portage, the engines turned over more slowly than normal. This may be an indication that the right voltage regulator had failed previously and that the batteries were beginning to discharge. With low battery voltage, the right generator failure light would dim significantly and would not be conspicuous. The left generator would still provide voltage at the paralleling unit and the left generator failure light would extinguish; however, neither generator would be connected to the electrical bus and consequently, the ammeters would read zero. The ammeter scale can be misleading in that, with no power applied, the gauge could be interpreted as reading 10A. A low battery condition may also have pre-existed because 1 of the batteries was considered marginal although serviceable on the 100-hour inspection. The mismatch of the batteries would have reduced their combined efficiency since they were connected in series.

The retraction of the landing gear after take-off would have placed a high electrical strain on the already depleted battery state, and caused the landing gear motor to stall as the voltage dropped. Electrical current passing through the stationary landing gear motor would have continued to drain the batteries and caused the overheating in the armature, which would have caused the smoke and odour that were observed. As the battery voltage fell below 8V, the radio, transponder and navigation equipment would have dropped offline and the aircraft would have disappeared from the radar.

When the pilot turned the master switch off, the smoke and odour disappeared as electrical power to the landing gear motor was removed. When the pilot turned the master switch back on and selected the landing gear down, the landing gear extended due to the lower extension loading on the landing gear. Attempts by the pilot to restore generator function may have brought the left generator online briefly, although with its output of 24.9 volts it is unlikely to have remained connected to the electrical bus for any length of time. Since the aircraft’s transponder was observed on radar in the vicinity of Pikwitonei, it is likely that the residual battery power was sufficient to close the avionic and battery master relays and power the transponder.

The pilot’s response to the electrical malfunction after take-off was to communicate rather than aviate first and assess the malfunction and then navigate. The cell phone call to the FIC distracted the pilot from assessing the extent of the electrical problem and taking corrective action in a systematic way. Because the DG had not been set and a ground feature had not been selected prior to take-off to confirm the departure track, the pilot’s VFR navigation technique relied solely on the heading reference provided by the HSI. The HSI malfunction due to the electrical problem was not immediately recognized and consequently, the pilot became lost. When smoke or fumes were detected in the cockpit the pilot had lost situational awareness. This loss of situational awareness eliminated the pilot’s best option, which was an immediate return to Thicket Portage, while completing the aircraft checklist for electrical smoke or fire.

The pilot was uncertain of his exact position, was dealing with an electrical power failure and a landing gear malfunction as well as the possibility of a fire. The pilot actions indicate that task saturation had occurred. With the exception of using the standby magnetic compass to confirm the orientation of the railroad tracks, the pilot did not prioritize the critical actions required. Fuel management was not addressed and the auxiliary tanks were not selected in cruise. The pilot’s attention became focused on the landing gear malfunction which was dealt with prior to completing the items listed in the electrical fire or smoke emergency checklist. These items were not completed for some 15 minutes as indicated by the appearance of the aircraft’s transponder target on radar in the vicinity of Pikwitonei. The landing gear remained a priority and the pilot extended the approach path and rocked the aircraft to ensure the gear was locked down. The pilot concentrated on this activity and did not address the fuel state of the aircraft.

The engines stopped shortly after the aircraft was rocked to lock the landing gear. The loss of fuel supply and the stoppage of the right engine were likely due to fuel exhaustion as the fuel in the right main tank became depleted. The left engine stopped almost immediately after the right engine had stopped. The stoppage of the left engine may also have resulted from fuel exhaustion if the engines had burned an equal amount of fuel since the aircraft had last been fueled. It is more likely, however, that the engine stopped as a result of fuel starvation as the low level of fuel in the tank allowed the port to become uncovered when the aircraft experienced yaw from asymmetric thrust. The decision not to feather the propeller on the right engine would have resulted in increased drag and greater yaw forces, causing the fuel to move away from the fuel port at the inboard edge of the left tank. With the gear already down, the pilot’s decision not to feather either propeller increased the rate of descent and reduced the pilot’s ability to control the forced landing.

The training the pilot received from the company enabled him to obtain a PPC, and additional company indoctrination training was given using a computer-assisted learning program. However, the recent experience level of the pilot was low. In the 12 months prior to the accident, the pilot had flown a total of approximately 14 hours including the company's training. Consequently, the pilot was susceptible to task saturation. Because the training focused on obtaining a PPC on the Beech 95-55 and completing the company computer-assisted learning program, there was little opportunity for the pilot to refresh the skills and techniques taught during private and commercial pilot training. As a consequence, when faced with a critical and unusual emergency shortly after take-off from Thicket Portage, the pilot's actions rapidly led to task saturation and the inability to handle the emergency effectively.

It is likely that the G-switch orientation was not aligned with the impact force experienced during the crash sequence. As a result, the ELT did not activate during the impact. Since the pilot had not activated the SPOT Track Progress mode, the location and rescue of the pilot would have been delayed had the pilot not been able to activate the ELT and the SPOT 911 button. The use of the lap belt and shoulder harness prevented any serious injuries that could have resulted from the severity of the crash.

Findings as to Causes and Contributing Factors

1. The electrical system likely failed due to low electrical bus voltage caused by the failure of the right voltage regulator and low voltage output of the left regulator.

2. The pilot became distracted while communicating with the FIC by cell phone and did not prioritize the handling of the electrical failure and navigation. Consequently, the pilot became lost.

3. Task saturation, due to the pilot's low experience and currency level, limited the pilot's ability to respond effectively to the multi-faceted emergency. Consequently, the fuel situation was not addressed and the engines stopped because of fuel starvation and fuel porting.

Findings as to Risk

1. The pilot did not activate the SPOT Track Progress mode and the ELT did not activate during the crash despite the severity of the impact with the terrain. As a result, the pilot's rescue could have been delayed.

2. The fuel quantity indicator gauges were not marked with a yellow band as required by regulation. The absence of the yellow band increased the risk of take-off in this prohibited range by removing a visual warning of low fuel condition.

3. The aircraft's single-axis G-switch ELT, though approved and serviceable, did not activate during the crash despite the severity of the impact with the terrain. As a result, the pilot's rescue could have been delayed.

Other Finding

1. Serious injuries were prevented by the use of a lap belt with shoulder harness.

This report concludes the Transportation Safety Board's investigation into this occurrence. Consequently, the Board authorized the release of this report on February 16 2011.

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Appendix A - Area Map