Aviation Investigation Final Report

Location:	Seattle, Washington	**Accident Number:**	WPR16LA127
Date & Time:	June 2, 2016, 02:20 Local	**Registration:**	N301DM
Aircraft:	Piper PA46	**Aircraft Damage:**	Substantial
Defining Event:	Electrical system malf/failure	**Injuries:**	2 None
Flight Conducted Under:	Part 91: General aviation - Personal		

Analysis

The pilot departed in dark night conditions for the cross-country flight. While air traffic control vectored the accident airplane for the instrument approach to the destination airport, both of the airplane's generator circuit breakers popped out, but the pilot did not observe a generator failure light. He subsequently pushed both circuit breakers in and they remained in. Shortly thereafter, when given the final vector to join the localizer, the instrument panel went dark, and all post lights, backlit gauges, and engine instrument gauges went dark and failed. The failure also affected the three green landing gear down-and-locked lights and the landing gear warning horn. According to the pilot, it was too dark to see the position of all the circuit breakers; rather than troubleshooting the problem in the air, he elected to proceed with the instrument approach. The pilot subsequently landed with the landing gear retracted, which resulted in substantial damage to the undercarriage and the left wing.

A postaccident examination revealed that a diode located between the left main electrical bus circuit breaker and the main bus was found to have a separated flag terminal, which caused an open circuit. As a result, it is likely that before the accident, the left tie bus and main bus circuit was not providing a conductive electrical path, which required the right tie bus and main bus circuit to carry the full load. When the right main electrical bus circuit breaker tripped due to an excessive electrical load, the electrical path from the tie bus to the main bus no longer provided power. Subsequent testing of the subject diode revealed that the solder joint had failed in overstress though the diode itself was functional.

The pilot reported that he did not refer to or use the airplane's emergency procedures checklist for a generator failure, which directs the pilot to reduce electrical loads in the event of such a failure. Depending on how much the electrical load was reduced, the pilot may have prevented the right main circuit breaker failure and retained the ability to lower the landing gear. Additionally, the pilot failed to use the emergency landing gear extension procedure. The generator failure emergency procedures checklist contains a CAUTION that states, "Without electrical power, the landing gear must be lowered with the emergency extension procedure. The gear position lights, and the flaps will be inoperative."

Had the pilot used the checklists for a generator failure and, subsequently, for gear extension, this accident would have likely been prevented.

Probable Cause and Findings

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

The pilot's failure to use the emergency procedures checklist for generator failures or for gear extension following a loss of electrical power due to the separated flag terminal of a diode in overstress, which resulted in a gear-up landing.

Findings

Aircraft	DC rectifier-converter - Failure
Personnel issues	Use of checklist - Pilot
Personnel issues	Lack of action - Pilot

Factual Information

History of Flight

Approach-IFR initial approach	Electrical system malf/failure (Defining event)
Landing-flare/touchdown	Landing gear not configured
Landing	Abnormal runway contact

On June 2, 2016, about 0220 Pacific daylight time, a Piper PA 46-350P, N301DM, was substantially damaged when it was involved in an accident during a gear-up landing at Boeing Field/King County International Airport (BFI), Seattle, Washington. The private pilot and passenger were not injured. The airplane was operated as a Title 14 *Code of Federal Regulations (CFR)* Part 91 personal flight.

The cross-country flight, which departed Reno, Nevada, about two and one-half hours prior to the accident, was being conducted in night visual meteorological conditions.

The pilot reported that just before he was given a final vector for the instrument landing system (ILS) 13R approach to BFI, and at an elevation of 2,200 ft mean sea level (msl), he noticed that the two tie buss generator circuit breakers had tripped (popped out) with no noticeable failures. The pilot did not notice a generator annunciator light. He then pushed both circuit breakers in. Shortly thereafter he was given the final vector to join the localizer, when the whole panel went dark – all of the post lights, backlit gauges, and engine instrument gauges failed. The G500, both GNS530's, the 2 Garmin Transponders, the GMX200, the audio panel, and the autopilot were still functional.

The pilot stated that this failure also affected the 3 green landing gear down and locked lights, and the landing gear warning horn. The pilot stated that he looked for the cause, but in the darkness, it was difficult to see the position of the circuit breakers. He then proceeded with the approach in order to get the airplane on the ground as soon as possible. "I elected to 'fly the plane' rather than flying around and getting distracted trying to trouble shoot the problem, possibly putting us at more risk." The pilot added that he didn't know what other systems may have been affected that could possibly affect the safety of flight. He also mentioned that when the autopilot joined the localizer and glideslope, he lowered the flaps and extended the [landing] gear sequentially. He opined that at this time he felt the gear [extend], but without the 3 green gear down and locked lights, and without the gear warning horn, he was unable to determine if the gear was down and locked. He subsequently made a gear-up landing on runway 13R at BFI, slid down the runway, and came to a stop upright, after which he shut down the engine.

The pilot reported that later that morning after the accident, he observed that the landing gear was extended by gravity free-fall. He also noticed that one of the two tie buss main circuit breakers on the right side of the [circuit breaker] panel, an 80-amp circuit breaker, was popped out, the one he had been unable to see before in the darkness of night. The pilot reported that when he reset the breaker, the panel lights came back up, the gear warning horn came on, the landing gear cycled normally, and the 3 green landing gear lights illuminated. Subsequently, an airframe and powerplant mechanic discovered that the second 80-amp main breaker on the left side of the [circuit breaker] panel was inoperative, to which the

pilot commented, "The [air]plane was functioning on only one half of its electrical system, which likely caused the depletion of the batteries, and caused the remaining main breaker to pop. If the other main breaker had been functional, I would not have experienced the electrical failure, the gear would have deployed normally, and the 3 green gear locked lights would have illuminated, and the landing would have been uneventful."

During a postaccident examination it was revealed that the right main electrical bus circuit breaker on the tie bus circuit breaker panel was open. When it was reset the main electrical bus functions returned. Further troubleshooting found that the left main electrical bus circuit breaker on the tie bus circuit breaker panel remained closed, but there was no conductivity from the circuit breaker to the main bus. A diode between the left main electrical bus circuit breaker and the main bus was found to have a separated flag terminal, which caused an open circuit. As a result, during the accident sequence the left tie bus/main bus circuit was not providing a conductive electrical path, which required the right tie bus/main bus circuit to carry the full load. When the right main electrical bus circuit breaker tripped there was no longer an electrical path providing power from the tie bus to the main bus. With power lost to the main bus, the landing gear would not deploy, the landing gear warning lights would not illuminate, and the landing gear unsafe warning horn would be inoperative.

The pilot mentioned during the postaccident interview that having encountered icing conditions while en route, he activated all of the airplane's deicing equipment shortly after he departed Reno; the equipment remained on throughout the entirety of the flight, including the gear-up landing. The pilot also mentioned that he did not shed any electrical loads as required by the emergency procedures checklist for an electrical failure, nor did he refer to or use the emergency procedures checklist for the emergency landing gear extension procedure. The emergency procedures checklist for both generator and alternator failure contains a CAUTION that states, "Without electrical power, the landing gear must be lowered with the emergency extension procedure. The gear position lights, and the flaps will be inoperative." The pilot opined that his primary concern at the time was to get the airplane on the ground.

On June 22, 2016, JetPROP LLC, the company that performed the generator circuit breaker upgrade installation, released Service Information Letter (SIL) 16-560-01 for aircraft converted prior to 2008 to replace the two 80-amp generator circuit breakers on the tie bus circuit breaker panel with 90-amp circuit breakers. JetPROP LLC added Rev D to drawing 560.12.053 "Starter Generator Schematic" in April of 2008 to upgrade these circuit breakers "to increase the available current from 160 to 180 amps". When asked what notices JetPROP gave to the fleet regarding this change, JetPROP replied that the only submission was the SIL from 2016.

The rectifier diode was examined at NTSB Headquarters by an NTSB Materials Engineer. Subsequently, a Systems Specialist report was generated relative to the separation of a terminal lead from the diode. The report revealed that a solder joint between the diode and the flag terminal failed in a tension/overstress condition along the bottom edge of the diode. When the diode was functionally tested it was found to be operational.

Pilot Information

Certificate:	Private	**Age:**	64,Male
Airplane Rating(s):	Single-engine land	**Seat Occupied:**	Left
Other Aircraft Rating(s):	None	**Restraint Used:**	3-point
Instrument Rating(s):	Airplane	**Second Pilot Present:**	No
Instructor Rating(s):	None	**Toxicology Performed:**	No
Medical Certification:	Class 3 With waivers/limitations	**Last FAA Medical Exam:**	January 19, 2016
Occupational Pilot:	No	**Last Flight Review or Equivalent:**	March 6, 2016
Flight Time:	2080 hours (Total, all aircraft), 57 hours (Total, this make and model), 1905 hours (Pilot In Command, all aircraft), 57 hours (Last 90 days, all aircraft), 21 hours (Last 30 days, all aircraft), 5 hours (Last 24 hours, all aircraft)		

Aircraft and Owner/Operator Information

Aircraft Make:	Piper	**Registration:**	N301DM
Model/Series:	PA46 350P	**Aircraft Category:**	Airplane
Year of Manufacture:	1999	**Amateur Built:**	
Airworthiness Certificate:	Normal	**Serial Number:**	4636231
Landing Gear Type:	Retractable - Tricycle	**Seats:**	6
Date/Type of Last Inspection:	December 18, 2015 Annual	**Certified Max Gross Wt.:**	4358 lbs
Time Since Last Inspection:	86 Hrs	**Engines:**	1 Turbo prop
Airframe Total Time:	3582 Hrs as of last inspection	**Engine Manufacturer:**	Pratt & Whitney
ELT:	Installed, not activated	**Engine Model/Series:**	PT6-35
Registered Owner:	On file	**Rated Power:**	750 Horsepower
Operator:	On file	**Operating Certificate(s) Held:**	None

Meteorological Information and Flight Plan

Conditions at Accident Site:	Visual (VMC)	**Condition of Light:**	Night/dark
Observation Facility, Elevation:	BFI,21 ft msl	**Distance from Accident Site:**	
Observation Time:	01:53 Local	**Direction from Accident Site:**	
Lowest Cloud Condition:	Scattered / 2500 ft AGL	**Visibility**	10 miles
Lowest Ceiling:	Broken / 3100 ft AGL	**Visibility (RVR):**	
Wind Speed/Gusts:	10 knots / 18 knots	**Turbulence Type Forecast/Actual:**	None / None
Wind Direction:	170°	**Turbulence Severity Forecast/Actual:**	N/A / N/A
Altimeter Setting:	29.92 inches Hg	**Temperature/Dew Point:**	16°C / 14°C
Precipitation and Obscuration:	No Obscuration; No Precipitation		
Departure Point:	Reno, NV (RNO)	**Type of Flight Plan Filed:**	IFR
Destination:	Seattle, WA (BFI)	**Type of Clearance:**	IFR
Departure Time:	11:57 Local	**Type of Airspace:**	Class D

Airport Information

Airport:	Boeing Field/King County Intl BFI	**Runway Surface Type:**	Asphalt
Airport Elevation:	21 ft msl	**Runway Surface Condition:**	Dry
Runway Used:	13R	**IFR Approach:**	ILS
Runway Length/Width:	10000 ft / 200 ft	**VFR Approach/Landing:**	None

Wreckage and Impact Information

Crew Injuries:	1 None	**Aircraft Damage:**	Substantial
Passenger Injuries:	1 None	**Aircraft Fire:**	None
Ground Injuries:	N/A	**Aircraft Explosion:**	None
Total Injuries:	2 None	**Latitude, Longitude:**	47.529998,-122.30194(est)

Administrative Information

Investigator In Charge (IIC):	Little, Thomas
Additional Participating Persons:	Donald Bacon; Federal Aviation Administration; Renton, WA
Original Publish Date:	November 19, 2020
Last Revision Date:	
Investigation Class:	Class 3
Note:	The NTSB did not travel to the scene of this accident.
Investigation Docket:	https://data.ntsb.gov/Docket?ProjectID=93419