AVIATION OCCURRENCE REPORT

IN-FLIGHT ENGINE FIRE AND SEPARATION

AIR NORTH
DOUGLAS DC-4(C54A-DC) C-FGNI
BRONSON CREEK, BRITISH COLUMBIA
14 AUGUST 1996

REPORT NUMBER A96P0175

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Summary

The DC-4 aircraft (serial number 10389) was on a visual flight rules flight from Bronson Creek, British Columbia, to Wrangell, Alaska, with a crew of three and about 16,600 pounds of cargo on board. The departure from the remote mining strip was uneventful until the aircraft approached 1,500 feet above sea level, when the crew heard a whining noise in their headsets. Believing that the whining was caused by an inverter problem, they switched inverters, but the problem persisted. Electrical instrument indications in the cockpit then became erratic, and the number 2 engine, on the left wing, began to misfire; its fire warning light in the cockpit illuminated briefly, but without the accompanying bell. The captain confirmed visually that the number 2 engine was on fire and the crew carried out the engine fire drill; however, the fire did not extinguish. The captain commenced a right-hand turn to return to the Bronson Creek airstrip, and announced to the crew that the number 2 engine had separated from the wing. The captain applied maximum power to the three remaining engines; however, the aircraft began to lose altitude. Both pilots held the rudder and aileron controls at full right deflection in an attempt to prevent the aircraft from yawing or rolling to the left. The aircraft was shaking violently at that time, and the crew members were unable to read any of the engine or flight instruments. At about 50 feet above ground level, just short of the Iskut River, the pilots closed the

throttles. The aircraft descended rapidly, and the burning left wing struck a tree just as the fuselage contacted the surface of the river. The three occupants escaped the burning aircraft, and the first officer and load master swam to safety. The captain is missing and is presumed to have drowned. The aircraft was destroyed.

Ce rapport est également disponible en français.

Other Factual Information

The accident site is located in the Iskut River, at 56º41.57 North and 131º06.22 West, 1.2 nautical miles (nm) from the Bronson Creek airstrip. The crew escaped the partially submerged cockpit by jumping into the river out the right-hand side, the captain and first officer through the cockpit window, and the load master through the crew door.

Helicopters from Bronson Creek were at the site in less than 10 minutes, and rescuers located the first officer and load master on the south shore of the river. They began to search for the captain almost immediately; three helicopters and three vessels were involved. The RCMP and search and rescue personnel continued to search the river downstream of the accident for two additional days, but did not find the captain.

The number 2 engine and propeller were found about 2.3 nm from the crash site. The engine was recovered and transported to the TSB Regional wreckage examination facility. Sections of the fire wall and the engine mounts were subsequently sent to the TSB Engineering Branch for further examination.

Portions of the burned-out left wing and the number 1 engine have since been recovered by salvage crews; however, the strong river current and fluctuating water levels have prevented further recovery of the aircraft wreckage or engines. Therefore, the technical content of this report concentrates on the available airframe and engine records, and the physical examination of the recovered number 2 engine.

The flight crew was licensed and qualified in accordance with existing regulations, and both pilots had successfully completed their recurrent training on the DC-4 aircraft in September 1995. The captain had accumulated a total of about 12,500 hours of flying time, including 1,500 hours on type, while the first officer had accumulated a total of about 2,900 hours of flying time, including 420 hours on type. The crew had been on duty for about five hours, and this was their third flight of the day.

The aircraft operation at Bronson Creek involved flying ore concentrate from the mine to nearby Wrangell, where it was taken by surface transportation to a smelter. The flights were normally of short duration, usually conducted at near-maximum gross weight for the aircraft, and were flown in mountainous terrain. Flight operations were demanding for both pilots and aircraft because they involved repetitive, short, and arduous flights. As a result, the ageing DC-4 aircraft required, and received, intense maintenance attention.

Available aircraft records indicate that the 51-year-old airplane was maintained in accordance with existing regulations. It had accumulated 50,754.8 hours total airframe time, and the last 50-hour inspection had been completed on 05 August 1996. Four days before the accident, the carburettor and the fuel pump were changed on the number 2 engine.

At the time of take-off, both the aircraft weight of about 61,900 pounds and the centre of gravity were within the prescribed limits. A DC-4 performance graph (circa 1946) for one engine inoperative indicates that the aircraft should have been able to maintain a rate-of-climb of 550 feet per minute. This performance prediction was based on a new airframe and specification engines. No graph is available for the situation

where an engine falls off the aircraft, thereby inducing unpredictable factors such as increased airframe drag, sudden weight and balance changes, and profoundly detrimental aerodynamic effects. As well, the theoretical performance figures do not account for the effect of airframe ageing and a service life of more than 50 years and 50,000 flight hours.

The natural tendency of an aircraft, under conditions of asymmetric thrust, is to roll and yaw towards the engine that is not producing thrust. Control inputs are required to offset this tendency, but if the airspeed of the aircraft falls below the speed for minimum control in the air (VMCA), flight control inputs alone will not be sufficient to prevent the yawing moment, and control of the aircraft will probably be lost if the pilot does not reduce asymmetric thrust. VMCA for this aircraft with an engine physically separated from the aircraft is unknown.

The number 2 engine was a Pratt & Whitney R2000-7M2 (serial number P-108882) reciprocating radial engine, and had a Hamilton Standard 23E50-473 propeller (serial number FC-3492). The engine had accumulated 1,241 hours since its last overhaul, and 19.8 hours since its last inspection; the propeller had accumulated 2,314.6 hours since its last overhaul, and 19.8 hours since last inspection. The propeller, which had separated from the engine, was examined at the site, and no evidence of pre-existing failure or malfunction was found.

Control cables for both left-wing engines were routed down the left wing, and the cables for the number 1 engine passed behind the number 2 engine. These two engines shared common cable pulley brackets in the vicinity of the number 2 engine; the physical separation of the number 2 engine from the wing, therefore, would have affected the number 1 engine controls since the pulley brackets would have been disrupted.

The examination revealed that the number 2 engine and firewall had separated from the wing when the aluminum support channels failed. These channels, located aft of the firewall, held the steel fittings that attached to the engine mounts, and these steel fittings were still attached to the detached engine. The two inboard aluminum channels exhibited “broom-strawing” patterns, melting, and other damage consistent with exposure to high heat, while the outboard channels showed evidence of mechanical stress.

Examination of all available engine and nacelle components revealed that the fire was in the engine compartment, between the firewall and the accessory section of the engine. The components that were located on the inboard, upper side of the accessory section evidenced the greatest heat concentration; this area is adjacent to the engine mounting structure which had melted in several minutes. There were no signs of intense heat in the lower outboard area of the firewall, indicating that the fire was localized. Potential fuel sources were identified in the upper, inboard area of the firewall, and included several pressurized fuel lines which carried fuel for engine priming and for cockpit indications, and a hydraulic line carrying pressurized hydraulic fluid from the pump to airframe hydraulic systems. Potential sources of ignition for the fire include electrical solenoids, the starter motor, the generator, and exhaust components. However, the actual ignition source could not be identified.

The engine fire extinguishing system is mechanically controlled by the pilots, and consists of selector valves, discharge handles, and four 15-pound carbon dioxide bottles which can be discharged in pairs. There are 17

fire-detecting thermocouples on each engine, as well as 6 thermocouples for the inboard nacelle, and a distribution ring through which the carbon dioxide is delivered to the separate engine sections.

Analysis

Because further recovery of the aircraft wreckage was not possible, this analysis concentrates on the technical aspects of all available airframe and engine records, and the examination of the number 2 engine.

The flight crew were required to deal with multiple emergencies in a short period of time. The flight control difficulties experienced by the pilots are consistent with a significant loss of engine power on the left wing. The physical separation of the number 2 engine from the aircraft likely affected the power output from the number 1 engine, because the departing engine probably interfered with the controls for that engine. The sudden loss of power, and the combination of the significant aircraft weight and balance changes, the impaired aircraft handling characteristics, and the deteriorating in-flight performance would have raised the VMCA to a value above that which the aircraft was able to maintain. Under these circumstances, the crew was forced to reduce power on the engines to maintain control of the aircraft, and had no alternative but to force-land the aircraft.

The sequence of events that led to the accident began with the engine fire, and the electrical malfunctions were the result of wiring burned by the fire. The intense fire damage to the engine and firewall obliterated any evidence which could identify the cause or the source of the fire. The source of a rapid and destructive fire involving the firewall and engine accessories is usually fed by fuel or hydraulic fluid. It is probable that a hydraulic or fuel line became loose or broke and sprayed fuel or hydraulic fluid under system pressure into an area, and that the fluid was ignited by one of the several sources of ignition in that area.

The following Engineering Branch report was completed:

LP 137/96 - Electrical Fire Analysis.

Findings

1. The crew was certified and qualified for the flight in accordance with existing regulations.

2. Aircraft records indicate that the aircraft was maintained in accordance with existing regulations.

3. The aircraft weight and centre of gravity at take-off were within prescribed limits.

4. An intense, localized fire behind the number 2 engine caused the engine to separate from the aircraft.
5. The physical separation of the number 2 engine probably interfered with the controls to the number 1 engine.

6. With maximum power applied to the remaining engines, the pilots could not maintain altitude or directional control because the aircraft speed was below VMCA for that configuration.

7. The captain was missing following the crash landing and is presumed drowned.

Causes and Contributing Factors

The number 2 engine separated from the aircraft as a result of an intense fire in the wing. The loss of the engine rendered the aircraft uncontrollable, and the pilots were forced to land in the river.

This report concludes the Transportation Safety Board's investigation into this occurrence. Consequently, the Board, consisting of Chairperson Benoît Bouchard, and members Maurice Harquail, Charles Simpson and W.A. Tadros, authorized the release of this report on 9 September 1997.