Transportation Safety Board of Canada

Bureau de la sécurité des transports du Canada

AVIATION INVESTIGATION REPORT
A03P0268

COLLISION WITH DOCK

WEST COAST AIRLINES LTD.
DE HAVILAND DHC-6 100 (TWIN OTTER) C-FGQH
VANCOUVER HARBOUR, BRITISH COLUMBIA
03 SEPTEMBER 2003

Canada

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Summary

The de Havilland DHC-6 (Twin Otter) float plane, (C-FGQH, serial number 106), with 2 pilots and 11 passengers on board, was at the dock preparing for a charter flight from Vancouver Harbour, British Columbia to Victoria. The number 2 (right-hand) engine was started normally and the pilot-in-command (PIC) signalled to the dockhand to untie the aircraft. The dockhand responded by disconnecting the auxiliary power unit, confirming the untie signal, and untying both mooring lines from the dock.

The PIC then initiated the start of the number 1 (left-hand) engine. During start, the unsecured aircraft drifted free and swung right to a position approximately perpendicular to the dock. As the number 1 engine spooled up, and with reverse selected on the number 2 engine, the aircraft began to accelerate forward and veer in a left-hand arcing turn toward an adjacent dock. The PIC attempted to stop the forward motion of the aircraft by applying full reverse with both engines. Unknown to the PIC, a mechanical fault did not allow the propellers to go into reverse, and the increase in power accelerated the aircraft toward the dock; the PIC shut the engines down using the fuel control levers. The aircraft struck the dock and the left float was ripped from its mounts, allowing the aircraft to tip to the left as the float sank. The 13 people aboard the aircraft escaped onto a maintenance float; there were no injuries. The accident occurred at 1020 Pacific daylight time.

Ce rapport est également disponible en français.

Other Factual Information

Company's Normal Start Procedure

When operating from the company's Vancouver Harbour base, trained dockhands are available to aid in the arrival and departure activities. Under those conditions the company has adopted procedures that require the aircrew to shut down the engines with the propellers selected to FEATHER rather than secured on the LATCHES (zero thrust position).

A normal start with the propellers in FEATHER requires that the aircraft be securely tied to the dock to restrict movement during the start sequence. This is necessary because, during start, as the propeller blades move from the feathered position into the operating range, a momentary surge of forward thrust will occur. Before signalling the release of the mooring lines, the pilots must ensure that both engines have been started and are functioning properly, and both propellers are functional in forward and reverse thrust ranges. When the untie signal is given to the dockhand, the normal response is for the dockhand to release all mooring lines to allow the aircraft to depart from the dock.

Two days prior to this occurrence a company pilot, on a charter mission to a remote site, had been struck by a spinning propeller while securing the aircraft to a mooring line. Consequently, company personnel had become particularly sensitive to the dangers of working in the vicinity of the propellers.

Non-Standard Procedure

On the day of the Vancouver Harbour accident, the PIC of the aircraft decided to alter the normal departure procedure and to use a procedure that is published in the company's standard operating procedures (SOP) for use when operating at remote sites. That alternate procedure is designed to ensure the safety of untrained personnel on a departure float by preventing them from having to work around a spinning propeller. The sequence for the alternate start requires the aircrew to do the following:

- Start the right engine;
- Untie the mid bollard of the float;
- Pivot the aircraft right so that the left propeller is no longer hanging over the dock;
- Start the left engine; and
- Once both engines and propellers are functioning, untie the heel of the float.

The planned use of this alternate start and departure procedure was not fully briefed to either the first officer or the involved dockhand.

Propeller Control

The aircraft is equipped with reversible-pitch, fully-feathering, constant-speed propellers, along with associated protection systems to guard against a loss of propeller control. A beta backup system provides a means of preventing the propeller blades from being driven into an unacceptable low pitch or reverse position if a mechanical failure of the propeller control system occurs.

Beta backup protection can be overridden by the pilot for those operations where the pilot requires reverse thrust. Specifically, when the pilot twists the grip of the power levers before moving the levers into the reverse thrust range, the twisting action activates a microswitch that overrides the beta backup system and allows the propellers to move into reverse. This power-lever microswitch is installed beneath the left power-lever gate and protrudes into a panel-covered compartment immediately left of the power-lever quadrant. The mechanical components of the microswitch are exposed within the panelled compartment.

The accident aircraft had been in service for about two weeks following a major refit. During the refit and overhaul process, the ignition system for the engines had been modified to change from an older glow plug ignition to a newer spark ignition. The modification had been accomplished in accordance with DHC-6 Service Bulletin No. 6/527 entitled "Installation of Spark Ignition". As part of that modification, a number of wires associated with the older system had been isolated, tie wrapped, and stowed in the vicinity of the exposed power-lever microswitch. Instructions contained within SB 6/527 do not provide any specific clearance requirements between the wire bundle and the affected micro-switch, do not require removal of the unused wires (thus allowing an increase to the wire bundle size), and do not highlight any special care that should be taken in the vicinity of the micro-switch.

Mechanical Malfunction

An inspection of the aircraft following the accident revealed that the wrapped wire bundle associated with the modified ignition system had come into contact with the exposed mechanical components of the power-lever microswitch. This contact impeded the normal operation of the microswitch. During the two-week period of operation following the refit, no flight or maintenance personnel reported any problem related to activating reverse thrust.

Analysis

The PIC used a non-standard start and departure procedure in an attempt to reduce the dockhand's exposure to the aircraft propeller system. The motivation for this plan was a heightened awareness of risk because of a recent accident involving a crew member being struck by a propeller during a mooring operation at a remote site.

When he signalled the dockhand to untie the aircraft, the pilot expected that just the mid-bollard line would be released, as called for in the alternate start procedure. The change in the start and departure procedure was not fully briefed by the PIC and, as a result, the dockhand responded by releasing all the lines.

As the PIC started to rotate the nose of the aircraft away from the dock, he realized that all the lines had been released, and that the aircraft was adrift. He responded by attempting to hold the aircraft's floats against the dock by using slight reverse on the right-hand engine, while carrying out the start of the left engine. During the left engine start, the aircraft pivoted clockwise to a position about perpendicular with the departure dock (See Appendix A). This rotation was caused by the movement of the left propeller from FEATHER to its operating range.

At some point in this sequence, the normal operation of the power-lever microswitch was impeded by the adjacent wrapped wire bundle. The result was that, even though the PIC was commanding reverse thrust by twisting the power-lever grips and moving the levers into the reverse thrust range, the beta backup system remained engaged, restricting the propellers from moving into reverse pitch. As the engine power increased, with the propellers in forward pitch, the aircraft moved in a forward rather than reverse direction. The PIC's attempt to retard the forward movement by applying increased reverse power had the opposite effect, and accelerated the aircraft forward until it struck the adjacent dock. There was insufficient time for the PIC to respond to this abnormal control situation.

Under normal start conditions, that is, with the aircraft securely tied to the dock, the fault associated with the power-lever microswitch may have been discovered during the post-start checks, which are normally accomplished before the mooring lines are released.

Findings as to Causes and Contributing Factors

1. The PIC deviated from the normal start and untie procedure used at the company's home base and the PIC did not fully brief either the first officer or the involved dockhand on the departure procedure. As a result, the aircraft was not securely tied to the dock during the left engine start.

2. An isolated wire bundle from an unused glow plug ignition system blocked the operation of the power-lever microswitch and restricted the propellers from moving into reverse pitch range.

3. The PIC's attempt to retard the forward movement of the aircraft by applying increased reverse power had the opposite effect and accelerated the aircraft forward until it struck the adjacent dock.

Findings as to Risk

1. Moving parts of the power-lever-controlled microswitch are exposed in an area where adjacent wires may impede normal operation of the microswitch.

Other Findings

1. The PIC had insufficient time to respond to the abnormal control situation.

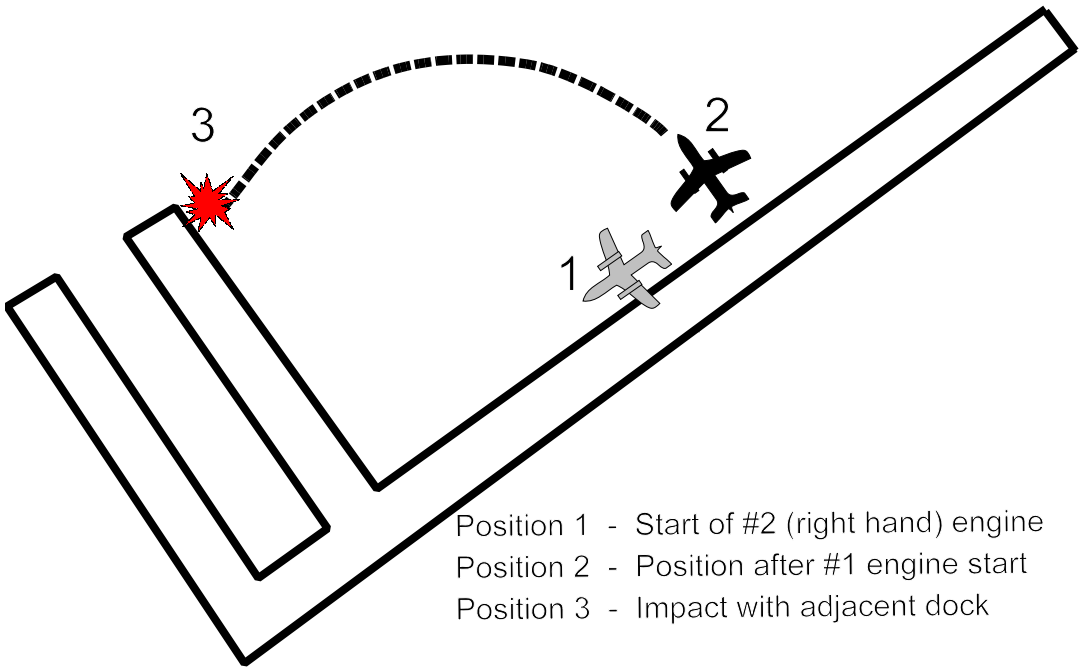
Safety Action Taken

Following this occurrence, the involved company inspected all of the aircraft in its fleet to ensure there were no similar risks to the operation of the microswitch; none was found.

Transport Canada reviewed Bombardier Service Bulletin 6/527 with Bombardier Aerospace and is currently working with the company to incorporate additional instructions with regard to isolating and stowing unused wires in the vicinity of the power-lever micro-switch. Transport Canada is of the opinion that these additional instructions will help reduce the likelihood of interference.

This report concludes the Transportation Safety Board's investigation into this occurrence. Consequently, the Board authorized the release of this report on 17 November 2004.

Appendix A - Dock Layout



Position 1 - Start of #2 (right hand) engine
Position 2 - Position after #1 engine start
Position 3 - Impact with adjacent dock