ASSESSMENT OF RESPONSE TO
AVIATION SAFETY RECOMMENDATION A94-17

AMENDMENTS TO DHC-6 AIRCRAFT FLIGHT MANUAL

Background

The occurrence flight was scheduled to proceed from Red Lake to Kenora, and then to Thunder Bay, Ontario. The flight crew arrived at the airport after a seven hour lay-over at Red Lake and prepared for departure. There were no passengers for the leg to Kenora, but there were passengers scheduled to fly out of Kenora to Thunder Bay.

During the taxi to the runway, the pre-take-off checks were completed and the captain conducted the briefing for a standard ten degree flap take-off. He then decided to practice a short take-off and landing (STOL) type take-off. He informed the first officer, and selected the flaps to 30 degrees. The captain lined up on the button of runway 08. The engines were set to take-off power and after approximately 300 feet of ground roll, the aircraft became airborne.

Initially the aircraft climbed, and then it began to descend. The aircraft then climbed again, more steeply than before, and then suddenly descended in a steep nose-down attitude, crashing half-way down the runway. The captain received minor injuries; the first officer was seriously injured. The aircraft sustained substantial damage. The Board determined that inappropriate short take-off and landing (STOL) take-off procedures were applied, which placed the aircraft in a flight regime outside of the aircraft performance envelope for sustained flight. The aircraft stalled at an altitude from which recovery was not possible.

Contributing to the occurrence was the general acceptance of the use of STOL techniques as an approved procedure.

The Board completed its deliberations and released its A92C0048 final report on 08 April 1994 which included Recommendation A94-17.

Board Recommendation A94-17 (08 April 1994)

The Twin Otter aircraft has an international reputation as a STOL aircraft, and it is often employed in operations demanding short field operations. However, to indicate that the maximum performance STOL configuration of the Twin Otter does not meet certification standards, the manufacturer has provided a "NOTE" in the "Normal Operating Procedures" section of the Supplementary Operating Data Manual.

International aircraft publication standards of the General Aviation Manufacturers' Association and the Air Transport Association promote the use of a system of NOTES, CAUTIONS, and WARNINGS in flight manuals. A "NOTE" is meant to expand further on a topic; a

"CAUTION" deals with matters that, if not strictly observed, could result in damage or destruction of equipment; and a "WARNING" directs attention to potentially critical information that, if disregarded, could lead to personal injury or loss of life. Although air crew may not know the exact definitions of NOTES, CAUTIONS, and WARNINGS, they are generally familiar with their relative importance through frequent exposure to them; that is, NOTES receive less attention than CAUTIONS and WARNINGS.

The use of the word "Normal" in the Twin Otter Supplementary Operating Data Manual to describe STOL procedures that do not provide the level of safety required by regulations for Normal Category Operations is misleading. Further, the message contained in the associated NOTE is more in line with what air crew would expect to be labelled as a WARNING.

As evidenced by this occurrence, the limitations of operating the Twin Otter in the maximum performance STOL configuration were not fully recognized by at least one Canadian operator. Consequently, Transport Canada issued a memorandum to its Regional Directors General on "the widespread use of unauthorized STOL procedures" for the DHC-6, alerting TC officials "to the hazards inherent in these procedures." The memorandum indicated "that operators should be made aware that the use of these procedures are not permitted" and "inspectors should ensure that these unapproved STOL operations are not being utilized by operators." Except for the internal Transport Canada memorandum, the Board is not aware of any formal communication or direction being given to Canadian operators regarding "non-approved" STOL procedures for the DHC-6. In March 1994, four randomly chosen DHC-6 operators in different regions across Canada indicated that Transport Canada had not contacted them regarding STOL procedures, and that STOL take-offs were being employed. Furthermore, given that the DHC-6 is widely used throughout the world, there does not appear to have been any related correspondence to international agencies responsible for foreign DHC-6 operators.

Since the DHC-6 Twin Otter is marketed as a STOL aircraft, since the information provided by the manufacturer regarding limitations on the "non-approved" procedures for maximum performance STOL take-offs is misleading, and since Transport Canada has advised its Regional Directors General that "the use of these procedures are not permitted," there is room for considerable misunderstanding in the global aviation community regarding the safe operation of this aircraft in the STOL configuration. Therefore, the Board recommends that:

> The Bombardier Corporation amend the Twin Otter (DHC-6) Aircraft Flight Manual (PSM 1-63-1A) and Supplementary Operating Data Manual (PSM 1-63-1) to include appropriate warnings regarding any safety limitations associated with the operation of the aircraft in the "maximum performance" STOL configuration.
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Bombardier's Response to A94-17 (23 June 1994)

On 23 June 1994, in response to Recommendation A94-17, Bombardier Regional Aircraft / de Havilland Inc. stated the following:

> Bombardier Regional Aircraft / de Havilland Inc. disagree with some of the Board's comments and suggestions in the Communiqué and in the final report. Specifically, we

believe that the Aircraft Flight Manual (PSM 1-63-1A) and Supplementary Operating Data Manual (PSM 1-63-1) adequately address the Board's concerns expressed within Safety Action Section 4.2.2 of the report and in the third paragraph on page 3 of the Communiqué.

Properly trained flight crews operating the DHC-6 Twin Otter under Part 4 (MAXIMUM PERFORMANCE STOL TAKE-OFF AND LANDING [LANDPLANE]) of PSM 1-63-1, the Supplementary Operating Data Manual, have adequate information provided to them by the "NOTE" and "CAUTION" on page 4-1-1, Section 1 of the Normal Operating Procedures.

The "NOTE" at the beginning of the "NORMAL OPERATING PROCEDURES" is adequate to apprise flight crew of the uniqueness of the operation. A "WARNING" would become inappropriate after these procedures have been approved by the operators local regulatory authority. The procedures become "NORMAL OPERATING PROCEDURES" following regulatory authority approval.

The "CAUTION" which follows, clearly identifies the requirement for adequate training.

Board Assessment of Responses to A94-17 (17 November 1997)

On 27 October 1994 the Board approved the following assessment of Bombardier's response:

Since the DHC-6 Twin Otter is marketed as a STOL aircraft and that the information provided by the manufacturer regarding limitations on the "non-approved" procedures for maximum performance STOL take-offs is misleading, the Board recommended that: The Bombardier Corporation amend the Twin Otter (DHC-6) Aircraft Flight Manual (PSM 1-63-1A) and Supplementary Operating Data Manual (PSM 1-63-1) to include appropriate warnings regarding any safety limitation associated with the operation of the aircraft in the "maximum performance" STOL configuration (A94-17).

The Bombardier Corporation does not agree with the recommendation and contends that the present format and information in the manual is adequate. Bombardier also feels that changing the "NOTE" that highlights the fact that this manoeuvre did not meet the safety standard required under CAR 3 to a "WARNING" would not be appropriate in countries where regulatory approval has been granted.

Whether or not regulatory approval has been granted, the potentially hazardous situation of maximum performance STOL takeoffs exists. Since the Twin Otter is capable of flying at a speed well below the minimum single engine control airspeed (Vmca), an engine failure immediately following lift-off could result in a loss of control. For pilots not aware of the risks associated with nor properly trained on the STOL procedure, their reaction to an engine failure might not be appropriate. This is the reason that TC is now developing guidelines for STOL operations before approving their use.

Subsequent to Bombardier's initial response to the Recommendation, the staff offered to discuss with Bombardier the potential hazard of STOL operations. Bombardier did not reply to this offer.

> Since DHC 6 pilots may continue to be unaware of the risks associated with STOL operations (where Vto < Vmca), the response by Bombardier Corporation is assessed as **Unsatisfactory**.

Afterward, TSB conducted a number of annual reassessments in which both Bombardier's position and the Board's rating remained unchanged. The last recorded reassessment of responses to Recommendation A94-17 is dated 17 November 1997.

Board Review of A94-17 Deficiency File Status (01 October 2011)

A recent review of all TSB recommendations [1] disclosed that Recommendation A94-17's deficiency file status remained A**ctive** and that a reassessment of its residual risk was required.

Viking Air Limited's Response to A94-17 (17 January 2012)

On 22 February 2006 Viking Air Limited (Viking) acquired the DHC-6 Twin Otter Type Certificate from Bombardier Incorporated and thus became responsible for the product support. In its capacity as type certificate holder, Viking was approached to provide an update with respect to the deficiency identified in Recommendation A94-17.

Viking provided the following response:

> Viking PSM 1-63-1A and PSM 1-63-1 has been replaced by the 1-63-POH and amended to include warnings regarding the use of the Maximum Performance STOL supplement, please refer to the attached. The supplement has been removed from the POH and is obtained via direct request from Viking only. Upon such a request, Viking issues a statement to the operator (in addition to that contained in the POH) regarding the use of the supplement and that it must be approved by the local authority.

Board Reassessment of the Responses to A94-17 (07 March 2012)

The deficiency identified in Recommendation A94-17 was based on the conclusion that the manufacturer's information regarding limitations on the "non-approved" procedures for maximum performance STOL take-offs was misleading and that there existed a potential for misunderstanding in the global aviation community regarding the safe operation of the DHC-6 aircraft. In its initial assessment of Bombardier's response TSB pointed out that, whether or not regulatory authority has been granted, the potentially hazardous situation of maximum performance STOL take-offs remained.

On 28 September 1994, TC published its Air Carrier Advisory Circular (ACAC) No. 0071 entitled *Notice to Operators of De Havilland DHC-6 Twin Otter Aircraft Maximum Performance STOL Takeoff*. This ACAC was developed to set out conditions for those DHC-6 operators requesting the use, in commercial operation, of DHC-6 maximum performance STOL (MPS) take-off supplementary operating data as detailed in the Aircraft Flight Manual. It also stated

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[1] TSB recommendations are those released since TSB was created by an Act of Parliament (the *Canadian Transportation Accident Investigation and Safety Board Act*,) that came into force on 29 March 1990.

that operations employing the MPS take-off procedure would require specific authorization in the form of an Operations Specification.

Subsequently, on 11 August 1998, TC published Operations Specification No. 098 which granted the authority and conditions for the types of MPS take-off operations referred to in Supplementary Operating Data to the DHC-6 Aircraft Flight Manual. The conditions contained in this Operations Specification included requirements for: both Chief and line pilot training, Operations Manual - MPS procedures, and the necessity for certain serviceable equipment (e.g. autofeather system) prior to attempting an MPS departure.

Furthermore, Viking's update states that DHC-6 Aircraft Flight Manual (PSM 1-63-1A) and Supplementary Operating Data Manual (PSM 1-63-1) have been replaced by the DHC-6 Operating Data / Flight Manual (PSM 1-63-POH). Additionally, the POH has been amended to remove the MPS take-off information previously included as part of PSM 1-63-1 and to add warnings regarding the use of such data. Currently, when such information is requested by a DHC-6 operator, Viking policy is to issue a statement to the operator regarding the use of the MPS take-off information and emphasizing that its use must be approved by an appropriate authority.

TSB's Aviation Safety Information System database reveals that subsequent to the release of Recommendation A94-17 there have been 237 occurrences involving DHC-6 aircraft. Given the low incidence of DHC-6 occurrences involving the improper use of MPS take-off procedures, it would appear that the actions taken by both TC and Viking Air Limited have mitigated the risks associated with the deficiency identified in Recommendation A94-17. Consequently, the Board is satisfied that the deficiency identified in Recommendation A94-17 has been substantially reduced.

The response is considered **Fully Satisfactory**.

Next TSB Action (07 March 2012)

The deficiency file is assigned an **Inactive** status.