Transportation Safety Board of Canada

Bureau de la sécurité des transports du Canada

AVIATION INVESTIGATION REPORT
A08O0333

RUNWAY OVERRUN

JAZZ AIR LP (AIR CANADA JAZZ)
DE HAVILLAND DHC-8-100 C-GTBP
NORTH BAY JACK GARLAND AIRPORT, ONTARIO
14 DECEMBER 2008

Canada

Aviation Investigation Report

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Summary

The Air Canada Jazz DHC-8-100 (registration C-GTBP, serial number 066) operating as flight JZA7779 departed Toronto/Lester B. Pearson International Airport, Ontario, under instrument flight rules for a regularly scheduled flight to North Bay, Ontario. The flight crew planned a stabilized constant descent angle non-precision approach to Runway 08 at the North Bay Jack Garland Airport. The aircraft touched down approximately 8900 feet past the threshold of Runway 08, which is 10 000 feet in length, and overran the end at 2348 Eastern Standard Time. The aircraft came to rest approximately 260 feet past the end of the runway in two to three feet of snow. There were no injuries and the aircraft sustained minor damage.

Ce rapport est également disponible en français.

Other Factual Information

History of the Flight

Before departure, the flight crew checked the weather and notices to airmen (NOTAM). [1] A NOTAM indicated that the glideslope associated with the instrument landing system (ILS) for Runway 08 was unserviceable, and would remain so at arrival in North Bay. The latest weather report indicated reduced visibility because of light drizzle and mist, and that a low ceiling was present (see Appendix A). The runway visual range (RVR), taken from the NAV CANADA website, indicated 6000 feet. The weather forecast indicated improving visibility and ceiling at the planned time of arrival.

During the pre-flight briefing, the flight crew discussed performing a stabilized constant descent angle (SCDA) vertical speed (VS) non-precision approach (NPA) because this type of approach had a lower approach ban for Air Canada Jazz than a standard non–precision approach.

The runway surface condition (RSC) report for Runway 08/26 indicated that the centre 120 feet of the runway was 60 per cent bare and wet, 40 per cent compact snow, the remainder was 100 per cent compact snow, and the Canadian Runway Friction Index (CRFI), which represents braking coefficients of friction, was 0.33.

The flight departed Toronto/Lester B. Pearson International Airport at 2306. [2] The first officer (FO) was seated in the right seat and was the pilot flying (PF); the captain was seated in the left seat and was the pilot not flying (PNF).

Before descent, the flight crew briefed for an SCDA localizer (LOC) approach for Runway 08 (see Appendix B). The briefing was to use pilot monitored approach (PMA) procedures, operate the aircraft at 120 knots indicated airspeed (KIAS), cross the final approach fix (FAF) at 2500 feet above sea level (asl), [3] and then descend at 700 feet per minute (fpm) to the minimum descent altitude (MDA) of 1480 feet. The touchdown zone elevation is 1170 feet.

The autopilot was on during the approach. The captain had the left horizontal situation indicator (HSI) selected to VOR/LOC [4] with distance measuring equipment (DME). The flight management system (FMS) was selected to the Terrain Avoidance Warning System screen but was not being used for navigation purposes. The FO also had the right HSI selected to VOR/LOC, while the FMS was displaying approach information. It could not be determined if the FO's HSI was selected to display the DME information. Neither flight crew member was cognizant of the distance to the runway during the final descent to the FAF.

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1 See Appendix I – Glossary for a list of abbreviations and acronyms used in this report.

2 All times are Eastern Standard Time (Coordinated Universal Time minus five hours).

3 All altitudes are in feet above sea level (asl) unless otherwise noted.

4 Very high frequency omnidirectional range/localizer

The aircraft turned onto the final approach track in descent, levelling at 2500 feet 0.2 nautical miles (nm) before the FAF. It crossed the FAF at approximately 170 KIAS; the ground speed was 200 knots. At the FAF, the aircraft began to decelerate. It could not be determined whether the crew began timing the final approach over the FAF or not. The aircraft slowed to the flap and landing gear extension speeds and began its descent 1 nm past the FAF at a descent rate of approximately 700 fpm, displaced above the desired flight path. At 3.3 nm past the FAF, the aircraft reached its target airspeed of 120 KIAS (140 knots ground speed) configured for landing. The aircraft crossed the missed approach point (MAP) at an approximate altitude of 1700 feet, 220 feet above the MDA (see Appendix C). The flight crew members were not aware that they were above the desired flight path.

The aircraft continued its descent, and at or near the MDA, a limited number of runway edge lights came into view. Using PMA procedures, the captain became the PF, disconnected the autopilot, and began the landing sequence.

The flight crew was using a Vref [5] of 104 KIAS, and touched down with an airspeed of 109 KIAS (Vref + 5 KIAS), with 1200 to 1050 feet remaining on Runway 08. The runway end lights were not sighted but, shortly after touchdown, the approach lights for Runway 26 came into view.

The aircraft departed the end of the runway at an airspeed of approximately 58 KIAS and came to rest in two to three feet of snow, approximately 260 feet past the threshold of Runway 26. There was no apparent damage to the aircraft; therefore, the flight crew elected to keep the engines running to supply heat and electrical power to the aircraft.

Stabilized Constant Descent Angle Non-Precision Approach

On 08 September 2006, Transport Canada (TC) issued Commercial and Business Aviation Advisory Circular (CBAAC) 0238 regarding SCDA approaches. Excerpts are cited below:

> The aim of an SCDA NPA procedure is to minimize the vertical manoeuvring required while flying most NPAs from the final approach segment through to touch down. The goal is to achieve a final approach vertical path that approximates that of a normal glide path....
>
> Using the SCDA NPA procedure, the aircraft is **not** flown at minimum altitudes for extended periods of time…. No later than crossing the FAF, the aircraft descends stabilized on the planned constant descent angle configured for landing, with stable airspeed, power setting, and attitude. The aircraft is descended towards MDA until the runway environment is sighted and the descent continued to landing, or until it reaches MDA, ... where a missed approach is commenced….

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[5] Landing reference speed or threshold crossing speed

> When flown correctly, the position where a missed approach is commenced following an SCDA NPA to MDA will occur before the published MAP…. Therefore, the missed approach climb will normally occur some distance before reaching the published MAP....
>
> The SCDA NPA procedure reduces pilot workload by reducing the number of positions required to commence a descent from, and when to level off at the published minimum IFR altitudes. The SCDA NPA technique's vertical flight path increases the aircraft's altitude above terrain and obstacles for most of the approach, and reduces the period of time the aircraft is flown at minimum altitudes.

The safety benefits derived from a stabilized final approach during an NPA have been recognized by most organizations including the International Civil Aviation Organization (ICAO), the United States Federal Aviation Administration, and TC Civil Aviation.

Starting 16 July 2011, the European Union will mandate all European operators to fly NPAs using the continuous descent final approach (CDFA) technique, equivalent to an SCDA approach, unless otherwise approved by the authority for a particular approach to a particular runway. [6]

Instrument Approach Design Criteria and Depiction

According to ICAO Annex 4, detailed criteria for the establishment of instrument approach procedures and the resolutions of associated altitudes/heights are contained in the *Procedures for Air Navigation Services — Aircraft Operations* (PANS-OPS, document 8168).

Annex 4 (Aeronautical Charts) to the Convention on International Civil Aviation states that, when DME is required for use in the final approach segment, a table showing altitudes/heights for each 2 km or 1 nm, as appropriate, shall be shown. Annex 4 also recommends that, for the profile view of the instrument approach charts, a rate of descent table should be shown, and a final approach descent gradient with descent angle to the nearest one tenth of a degree shall be shown for NPA with a FAF. [7]

PANS-OPS state that, where distance information is available, to facilitate a CDFA, descent profile advisory information for the final approach should be provided to assist the pilot in maintaining the calculated descent gradient. This information should consist of a table showing altitudes/heights through which the aircraft should be passing at each 2 km or 1 nm as

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6 *Official Journal of the European Union*, Subpart E, All Weather Operations, Aerodrome operating minima – General, Appendix 1 (New) to OPS 1.430 (d) 2, 20 September 2008.

7 International Civil Aviation Organization, Annex 4 to the Convention on International Civil Aviation, Aeronautical Charts, Chapter 11, sections 11.10.8.2, 11.10.8.4, and 11.10.8.5, 25 November 2004.

appropriate. [8] Countries that have adopted PANS-OPS do include distance/altitude checkpoints, and Jeppesen charts of instrument approach procedures from those countries depict the distance/altitude table as promulgated by the Aeronautical Authority.

Jeppesen plans to support the European changes in its current publications. For CDFA profiles, Jeppesen will show DME versus altitude bands, distance versus altitude bands or timing versus altitude tables. If not provided by the State, those altitudes will be calculated by Jeppesen. [9]

In accordance with the *Civil Air Navigation Services Commercialization Act*, NAV CANADA is responsible for the provision of aeronautical information services (AIS) in Canada for the purposes of ICAO Annex 4, which includes approach charts.

Instrument approach procedures in Canada are designed according to the criteria published in TC's publication *Standard Criteria for the Development of Instrument Procedures* (TP 308). NAV CANADA is responsible for publication of the approach plates. TP 308 states that, where ICAO annexes 4 and 15 refer to the above-mentioned PANS-OPS document 8168, reference shall be made to TP 308. However, TP 308 does not have a specification to create DME/altitude checkpoints for NPA procedures and NAV CANADA does not publish them in the *Canada Air Pilot* (CAP). Consequently, the Jeppesen instrument procedures plates for Canada do not publish altitude/distance checkpoints in their profile view. Jeppesen's Canadian plates include a descent table and a final approach descent profile; the CAP does not.

Air Canada Jazz Procedures

The Air Canada Jazz aircraft operating manual (AOM) outlines SCDA approaches and provides the limitations and guidance on how to perform them. According to Air Canada Jazz operating procedures, for any NPA, the aircraft is to be configured for landing with the landing gear down, flap set at 15°, airspeed 120 KIAS, and landing check completed one to two miles before the FAF. The aircraft must be level crossing the FAF for an SCDA approach.

Beyond the FAF, the aircraft is descended at a rate that is determined from the profile view of the Jeppesen approach plate (see Appendix B) for the ground speed to be flown. A ground speed of 120 knots corresponds to 646 fpm, which is rounded up to 700 fpm. The glideslope intercepts the FAF at an altitude of 2440 feet, which is rounded up to 2500 feet.

Examples of SCDA flight path angle (FPA) calculations are provided in the AOM, including a chart to calculate vertical speed from the desired ground speed and FPA. However, an example for the chart uses KIAS, not ground speed, to obtain the fpm value.

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[8] International Civil Aviation Organization, document 8168, *Procedures for Air Navigation Services - Aircraft Operations*, Volume II, Construction of Visual and Instrument Flight Procedures, Part I, Section 4, Chapter 9, Page I-4-9-2, Subsection 9.4.3.5.

[9] Jeppesen Briefing Bulletin (JEP 08-D), *Aerodrome Operating Minimums According to EU-OPS 1*, 26 September 2008.

The aircraft was equipped with a Universal Avionics System Corporation (UASC) FMS, which has a vertical navigation (VNAV) feature that can be coupled to the flight guidance control panel for lateral and vertical navigation during most global navigation satellite system (GNSS) NPAs.

The FMS presents a vertical flight path on the HSI in a similar manner as an ILS glideslope; however, it is an FMS–calculated glideslope (pseudo glideslope). The VNAV feature can also be used to conduct an SCDA approach; however, the localizer approach for Runway 08 is not a stand-alone GNSS. Also, restrictions published in the AOM and aircraft flight manual (AFM) prohibit the use of FMS navigation for localizer-based approaches. As a result, the FMS vertical guidance (pseudo glideslope) was not available to the crew. Both the flight crew members routinely flew ILS and VNAV style approaches and were accustomed to approaches with vertical guidance.

The AOM states that PMA procedures are to be used for ILS approaches only. For other types of approaches, including SCDA approaches, the flight crew members are to use non–PMA procedures. The standard operating procedures (SOPs) for an SCDA approach differ from that of a PMA approach. While some of the items are similar, there are different call-outs to make between crew members at different pre-determined intervals and locations during an approach. The SCDA VS and PMA SOPs and their associated calls are in Appendix D.

Following several low-visibility accidents that occurred in the late 1990s, the TSB issued Recommendation A02-01 to the Department of Transport to expedite the approach ban regulations prohibiting pilots from conducting approaches in visibility conditions that are not adequate. In 2006, TC introduced new regulations for low-weather instrument approaches.

The Air Canada Jazz company operations manual (COM) states that RVR, when available and reported, governs instrument approaches. Where no RVR is reported for the intended approach, the reported visibility is governing. With certain exceptions, pilots of aircraft are prohibited from completing an instrument approach past the outer marker or FAF to a runway if either the reported visibility or RVR values measured for the runway of intended approach are less than the minima in the approach ban tables.

There are two tables in the COM that flight crew members use to determine the applicable approach ban minima (see Figure 1 and Figure 2). The tables list advisory visibilities with corresponding approach ban visibility. The approach ban for table 1 equates to about 75 per cent of the advisory visibility, while table 2 equates to 50 per cent of the advisory visibility. For an NPA, when not using an SCDA or approach with vertical guidance (APV), table 1 must be used; when using SCDA or APV, table 2 must be used.

Approach Ban			
Canada Air Pilot Advisory Visibility (JEPP)		Approach Ban Visibility (RVR)	
½ sm	(2600 ft RVR)	3/8 sm	(1600 ft RVR)
¾ sm	(4000 ft RVR)	5/8 sm	(3000 ft RVR)
1 sm	(5000 ft RVR)	¾ sm	(4000 ft RVR)
1 ¼ sm		1 sm	(5000 ft RVR)
1 ½ sm		1 ¼ sm	(6000 ft RVR)
1 ¾ sm		1 ½ sm	(RVR > 6000 ft)
2 sm		1 ½ sm	(RVR > 6000 ft)
2 ¼ sm		1 ¾ sm	(RVR > 6000 ft)
2 ½ sm		2 sm	(RVR > 6000 ft)
2 ¾ sm		2 ¼ sm	(RVR > 6000 ft)
3 sm		2 ¼ sm	(RVR > 6000 ft)

Figure 1. COM Table 1

Approach Ban			
Canada Air Pilot Advisory Visibility (JEPP)		Approach Ban Visibility (RVR)	
½ sm	(2600 ft RVR)	¼ sm	(RVR 1200 ft)
¾ sm	(4000 ft RVR)	3/8 sm	(RVR 2000 ft)
1 sm	(5000 ft RVR)	½ sm	(RVR 2600 ft)
1 ¼ sm		5/8 sm	(RVR 3400 ft)
1 ½ sm		¾ sm	(RVR 4000 ft)
1 ¾ sm		1 sm	(RVR 5000 ft)
2 sm		1 sm	(RVR 5000 ft)
2 ¼ sm		1 ¼ sm	(RVR 6000 ft)
2 ½ sm		1 ¼ sm	(RVR > 6000 ft)
2 ¾ sm		1 ½ sm	(RVR > 6000 ft)
3 sm		1 ½ sm	(RVR > 6000 ft)

Figure 2. COM Table 2

The published advisory visibility for the localizer Runway 08 is one statute mile (sm) or an RVR of 5000 feet. Using a standard step-down NPA approach, the approach ban would be ¾ sm or RVR of 4000 feet; however, using an SCDA approach, the flight crew would use table 2 with an approach ban of ½ sm or RVR of 2600 feet. On the night of the occurrence, the flight crew members were conducting an SCDA approach and, therefore, used table 2.

The airspeed indicators were equipped with bugs [10] that enable the flight crew to set the Vref and approach speed. During an approach, the flight crew will normally maintain 120 KIAS to 500 feet then gradually reduce to the bugged approach speed to achieve Vref at touchdown.

After the occurrence, during the cockpit examination, the captain's white bug was found set at zero; the orange bug was set at 98 KIAS. The FO's airspeed indicator was equipped with two white bugs, which were also set at or near zero, while the orange bug was set at about 110 KIAS. According to company procedures, the white bug should have been set for a Vref of 104 KIAS and the orange bug at 113 KIAS (Vref + 5knots + 4 knots for ½ the gust factor), for both airspeed indicators.

Air Canada Jazz Training Program

According to TC's CBAAC 0238, and subsection 725.124(54) of the *Commercial Air Service Standards* (CASS), the operator shall ensure that flight crews receive ground and simulator or flight training that addresses SCDA NPA procedure proficiency within its initial and recurrent training programs.

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10 See Appendix E for airspeed bug setting procedures.

SCDA approaches are in the Air Canada Jazz *Training Program Manual* (TPM) as an initial training item. Initial SCDA training is conducted in Session 1 of simulator training. Session 1 is about two hours in length and covers many manoeuvres. The briefing for Session 1 reviews SCDA procedures, and the simulator script for Session 1 calls for an SCDA NPA.The TPM is not specific in regards to SCDA approaches; it does not mention the items required by CASS subsection 725.124(54), including the importance of the MAP in relation to the MDA. Furthermore, SCDA approaches are not mentioned in any other part of the TPM, including recurrent training or ground school.

In accordance with subsection 725.124(54) of the CASS, training for SCDA approaches must be included in an operator's recurrent training syllabus. However, the Air Canada Jazz TPM does not specifically state when SCDA recurrent training will be conducted. The TPM states that all items in the initial syllabus must be covered in a four-year cycle. The *Canadian Aviation Regulations* (CARs) do not state the frequency of recurrent training for SCDA approaches, and subparagraph 725.124(8A)(c)(i) of the CASS states that all items for the initial training syllabus must be covered over a definite period of time (through a cycle). Subsection S745.124(8) of TC's guidance material states that the recurrent training program must cover all of the training program every two or three years as applicable.

The flight crew members had received the company's SCDA training as part of their initial training; however, they had not received any recurrent training regarding SCDA approaches either in the simulator or ground school. The FO had not performed a SCDA VS approach while flying the line during employment with Air Canada Jazz or with previous employers. The captain had performed SCDA VS approaches as a FO on another aircraft type with Air Canada Jazz.

The Air Canada Jazz TPM lists emergency procedures training as required by CASS subsection 725.124(14); however, procedures for disabling the flight data recorder/cockpit voice recorder (FDR/CVR) following an accident or incident are not mentioned in the TPM.

Regulations

TC issued Operations Specification (Ops Spec) 503 to Air Canada Jazz that authorized the use of lower approach ban minima. The Ops Spec was valid if the air operator complied with the requirements of section 705.48 of the CARs and section 725.48 of the CASS. In addition, to conduct an SCDA approach, Air Canada Jazz must comply with subsection 705.48(3) of the CARs, and section 725.48 and subsection 725.124(54) of the CASS (see Appendix F).

Notwithstanding TC approval, the Air Canada Jazz SCDA training did not comply with the requirements of paragraph 705.124 (1)(a) of the CARs, paragraph 725.48(a) and subsection 725.124(54) of the CASS: the flight crew members had not received initial SCDA training that would satisfy the regulations and standards, nor did they receive any recurrent training.

According to subsections 705.48(2) and (3) of the CARs, both SCDA and step-down NPA approaches are eligible for the reduced approach ban values authorized under Ops Spec 503. There are certain requirements in the CARs to meet, which are similar for both types of approaches and can be found in Appendix F.

TC issued CBAAC 0246 in September 2005, which was superseded by TC Advisory Circular (AC) 700-013 [11] on 01 January 2010. The CBAAC requested air operators to review their training programs to ensure that all flight crew members and ground personnel receive adequate training with regard to the proper procedures to safeguard on-board recorded data following an occurrence.

According to the Advisory Circular, paragraph 725.135(i) of the CASS requires the inclusion of FDR and CVR procedures in the COM. It is expected that the appropriate steps for disabling of a FDR and/or CVR following an accident or incident will be included in these procedures.

In addition, clause 705.124(2)(a)(iv)(C) of the CARs requires that an air operator's training program include initial and annual training on emergency procedures. This training should include procedures for disabling the FDR/CVR following an accident or incident, and must be provided to flight crew members and ground personnel.

Current requirements as set out in section 3.4.3 of the *Aeronautical Information Manual* (AIM) state in part: "Where a reportable incident occurs, the pilot-in-command, operator, owner and any crew member of the aircraft involved shall, as far as possible, preserve and protect the flight data recorders and the information recorded thereon."

Required Visual Reference

Section 101.01 of the CARs, section GEN 5.1 of the AIM, and the CAP general pages define required visual reference as follows:

> In respect of an aircraft on an approach to a runway, means that portion of the approach area of the runway or those visual aids that, when viewed by the pilot of the aircraft, enable the pilot to make an assessment of the aircraft position and rate of change of position, in order to continue the approach and complete a landing.

The Air Canada Jazz COM, section 9.19.3 of the AIM, and the CAP general pages list 10 items, of which pilots should see at least one of the items to continue the approach to a safe landing and meet the requirements for required visual reference. One of these items is the parallel runway edge lights, another is the runway centreline lights. For a full listing, see Appendix G.

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[11] TC Advisory Circular 700-013, *Procedures and Training for the Preservation of Aircraft Recorded Data*.

North Bay Airport

The flight service station (FSS) at North Bay operates between 0630 and 2230; outside those hours, the mandatory frequency (MF) is not staffed by FSS personnel and the automatic terminal information service (ATIS) does not broadcast. Therefore, pilots must get the RSC from NOTAMs, company reports, or through other air traffic services (ATS) units such as the area control centre.

The airport was following Priority 1A from its Winter Operations Plan (see Appendix H) and snow removal operations were being conducted on Runway 08/26; this included clearing all lights and signage. There were windrows, approximately three feet in height, on the edges of the cleared portion and at the end of Runway 08. The windrow at the end of the runway most likely obstructed the view of the runway end lights.

The 2200 aircraft movement surface condition report (AMSCR) for Runway 08/26 reported the above-mentioned windrow on either side of the cleared portion, and that clearing was in progress. Another AMSCR at 0105 on 15 December 2008 (approximately one hour after the occurrence) also reported the windrow on either side of the cleared portion, and that clearing was in progress.

A NOTAM J [12] is a special series NOTAM notifying of the presence of hazardous conditions due to contaminants on runways. It shall be disseminated if certain criteria are met, including information related to the runway not being cleared to the full width. The NOTAM J shall then include a description of the contaminated portion of the runway such as depth of snow, windrows, snow banks, etc.

The NOTAM J from North Bay at 2200, on the night of the occurrence, indicated the RSC conditions; however, it did not mention the three-foot windrows reported on the AMSCR, nor that snow removal was taking place.

According to the NAV CANADA Canadian NOTAM Procedures Manual, the aerodrome authority is responsible for provision of runway surface conditions and braking action information to the flight information centre (FIC) or FSS. According to the North Bay Winter Operations Plan, the airport and NAV CANADA have agreed to the following local procedure [13]:

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12 NAV CANADA, Canadian NOTAM Procedures Manual, Version 6, 25 October 2007, Chapter 7.

13 North Bay Jack Garland Airport, Winter Operations Plan 2008/2009.

> Upon completion of a field inspection, the operator will verbally provide the NAV CANADA Air Traffic Services (ATS) Unit with the new RSC/CRFI information, who will then forward such up-to-date information to pilots both firsthand and via the ATIS broadcast. As soon as possible when time permits, the operator will fax the RSC form to the NAV CANADA Flight Information Centre (FIC) for official NOTAM distribution.

According to local procedures, the AMSCR report is also faxed to Air Canada Jazz dispatch. However, this information was not included in the aircraft communications addressing and reporting system (ACARS) RSC reports during the flight. Because the FSS was closed, the information was not included in the ATIS but was disseminated using the NOTAM procedures.

Flight Crew

The flight crew members were certified and qualified for the flight in accordance with existing regulations.

The crew's flight and duty times were in accordance with existing regulations. The captain was free from duty for the two-week period before the occurrence. The FO's last day free of duty was the day before the occurrence; before that, he had five days of non-flying duties. The flight crew's work/rest schedules were not considered contributory to the occurrence.

The captain joined Air Canada Jazz in January 2000, transitioned to the DHC-8 in November 2007 and was subsequently appointed captain. The captain had approximately 9500 hours' total time including 4000 hours on the DHC-8, 500 hours as pilot-in-command.

The FO had been employed with Air Canada Jazz since September 2006 and had approximately 4500 hours' total time of which 1300 hours were second in command on the DHC-8.

Aircraft

Records indicate that the aircraft was manufactured in 1987 and was certified, equipped, and maintained in accordance with existing regulations and approved procedures. The weight and centre of gravity were within the prescribed limits.

Flight Recorders

The FDR was a solid-state L3 Communications model FA2100; the occurrence flight was the last recorded flight, numerous previous flights were also recorded.

The CVR was a solid-state L3 Communications model FA2100; it was an older generation unit, using a tape cartridge that records on a continuous loop with a recording capacity of approximately 30 minutes.

After the runway overrun, the flight crew did not disable the CVR by pulling the appropriate circuit breakers. The 31-minute recording retained by the CVR started approximately 11 ½ minutes after the aircraft stopped. Therefore, the CVR remained powered for an additional 42 ½ minutes after the overrun, and only captured audio on the ground following the incident. The entire approach and landing portion of the occurrence flight was overwritten.

The Air Canada Jazz COM requires that the CVR circuit breaker be pulled only after gate arrival on any flight leg during which an incident/accident has occurred. Section 8.2.12 of the COM states the following:

> Deliberate de-activation of operable voice and data recorders (CVR & FDR) is not permitted while in operation. Should an incident or occurrence take place more than 30 minutes prior to gate arrival, the CVR must be allowed to run continuously notwithstanding that the CVR record of such incident will be over-recorded. This is under the direction of Transport Canada who requires that the recorder may only be de-activated as soon as possible following gate arrival. Therefore, on any flight leg during which an incident/accident has occurred, pull the appropriate circuit breaker only after gate arrival.

TSB Aviation Safety Recommendation A99-02

On 02 September 1998, Swissair Flight 111, a McDonnell Douglas MD-11 aircraft, departed John F. Kennedy Airport in New York, New York, en route to Geneva, Switzerland. Approximately one hour after take-off, the crew diverted the flight to Halifax, Nova Scotia, because of smoke in the cockpit. While the aircraft was manoeuvring in preparation for landing in Halifax, it struck the water near Peggy's Cove, Nova Scotia, fatally injuring all 229 occupants on board.

One of the shortcomings identified during the investigation was the limited recording capacity of the aircraft's CVR. The CVR was able to record only 30 minutes, and therefore did not capture the timeframe when the fire started.

On 09 March 1999, the Board released interim safety recommendations as part of its investigation.

The Board recommended to both TC and the European Joint Aviation Authorities that:

> All aircraft that require both an FDR and a CVR be required to be fitted with a CVR having a recording capacity of at least two hours. (A99-02, issued March 1999)

In TC's initial response received by the TSB on 07 June 1999, TC indicated support for this recommendation with the provision that the United States Federal Aviation Administration (FAA) and Canadian requirements remain harmonized. TC's stated intention was to introduce an appropriate Notice of Proposed Amendment into its Canadian Aviation Regulation Advisory Council (CARAC) process.

On 07 March 2008, the FAA issued its Final Rule entitled *Revisions to Cockpit Voice Recorder and Digital Flight Data Recorder Regulations* stating that, by 07 April 2012, CVRs on all turbine engine-powered airplanes have a two-hour recording capacity.

On 15 February 2010, TC indicated that notices of proposed amendment were currently being developed. The TSB is anticipating that any proposed regulatory change would include a retrofit requirement for aeroplanes already in service. TC has previously (06 March 2008) stated that it intended to harmonize with the FAA's Final Rule. At no time has TC provided the TSB with sufficient details about the content of its developing notices of proposed amendment to allow the TSB to accurately assess whether or not the Notice of Proposed Amendment contains a retrofit component.

Given the protracted process required to prepare a Notice of Proposed Amendment, receive CARAC approval, and implement regulatory change, it would appear unlikely that TC can promulgate an amendment to the CARs that would match the FAA's implementation date of 07 April 2012.

The Board is concerned that, notwithstanding TC assurances that it intends to harmonize its rulemaking efforts with those of the FAA, TC's proposed rulemaking will fail to match the FAA's in both scope and schedule.

Despite the above, because TC's proposed regulatory change, if fully implemented, will substantially reduce or eliminate the safety deficiency described in Recommendation A99-02, the Board has assessed TC's response as "Satisfactory Intent."

Analysis

During the approach, the aircraft was flown at a higher airspeed than is referenced in the AOM, and there was a significant tailwind. At the FAF, the airspeed was well above the configuration speeds for the flap and landing gear extension, which delayed the commencement of descent. When the final descent was initiated, about 1 nm after the FAF, the actual FPA was approximately 3° and the aircraft was flying parallel but above the desired vertical profile. Due to the late descent, the aircraft was already past the MAP when it arrived at the MDA. However, the crew did not initiate a missed approach and continued with the landing.

Both pilots had been required to demonstrate their proficiency in conducting NPAs during recurrent pilot proficiency checks. However, they were accustomed to performing approaches with vertical guidance and their attention was focused on the rate of descent and the MDA. They were not aware that the aircraft was well above the desired flight path or mindful of the timing inbound from the FAF to the MAP. Also, they were not monitoring the distance or DME information and were not cognizant of the distance from the aircraft to the MAP during the approach, most likely because they were accustomed to approaches with vertical guidance. Therefore, they were not aware that the aircraft passed the MAP before reaching the MDA and, when the runway lights came into view, they continued the approach and began the landing sequence.

During the approach, the flight crew members were using PMA procedures, which entails different call-outs at different intervals than SCDA NPA procedures. This is contrary to company SOPs, which state that PMA procedures are to be used for ILS approaches only. Non-compliance with SOPs may result in deviations from safe practices.

The 2200 AMSCR reported the presence of a windrow on either side of the cleared portion of the runway, but this was not reported in the NOTAM J as required by the Canadian NOTAM Procedures Manual, nor was it reported through the ACARS. The windrow at the end of the runway was not reported on the AMSCR and therefore was also not mentioned in the NOTAM or ACARS. The flight crew members were aware of the RSC and CRFI but not aware of the presence of the windrows; therefore, they did not have all the available information to make an assessment of the runway conditions before landing.

The AIM, CAP and Air Canada Jazz COM list numerous items that should be used to establish the required visual reference, and that at least one of these items should be visible to descend below the MDA or decision height. In this case, the flight crew members saw the runway edge lights, but did not see the approach lights, runway end lights, or other indications by which they could ascertain their distance down the runway. Therefore, they could not make an accurate assessment of the aircraft position and rate of change of position. The runway end lights would have allowed the crew members to determine where they were in relation to the runway end and decide whether to perform a missed approach.

Priority 1A of the North Bay Winter Operations Plan includes clearing all lights and signage for Runway 08/26. In this case, however, the runway end lights were blocked from view by a windrow, though clearing was still taking place.

Civil aviation authorities worldwide have recognized that the SCDA-style of approach is safer than the traditional step-down style. However, the Jeppesen approach plates for Canada and the NAV CANADA CAP approach plates do not have detailed profile descent information, including distance and altitude cross checks, even though there is a requirement by the ICAO to have a table showing altitudes/heights for each 1 nm when using DME. Having detailed profile descent information would enable flight crews to quickly reference and cross check their vertical position during an approach.

Furthermore, the CAP approach plates do not show a rate of descent table or a final approach descent gradient as recommended by the ICAO. Therefore, flight crews in Canada may not have all the tools available to safely conduct a SCDA-style approach.

Since Canada does not follow the requirements and recommendations mentioned in ICAO Annex 4, and the guidelines in PANS-OPS, Jeppesen does not depict distance/altitude cross checks on its Canadian approach plates.

Air Canada Jazz is approved by TC to conduct SCDA approaches and was issued Ops Spec 503 for lower approach ban minima. There were no data found, however, to show that the company training program met all the requirements of section 725.48 and subsection 725.124(54) of the CASS, including covering all the training program within a two- to three-year period. Also, the emergency procedures training did not meet the requirements of clause 705.124(2)(a)(iv)(C) of the CARs, yet its training program received TC approval.

The occurrence flight crew had not received adequate initial or any recurrent SCDA training. At the time of the occurrence, Air Canada Jazz did not conduct annual recurrent training for SCDA approaches, nor was it required to, as it was on a TC–approved four-year recurrent training matrix. Therefore, individual pilots may only receive recurrent training on SCDA approaches at four-year intervals. Also, the TPM is not specific and does not mention all the items required by subsection 725.124(54) of the CASS; therefore, there is a risk that other flight crews may not have received adequate initial SCDA training.

Furthermore, although the CARs do not state the frequency or interval of recurrent training for SCDA approaches, they do state that recurrent training be accomplished within a definite period of time and the guidance material states that the recurrent training must cover all the training program every two or three years.

The Air Canada Jazz approach ban minima are reduced if an SCDA approach is performed. As such, some flight crews may elect to choose an SCDA approach instead of a step-down NPA because of the reduced approach ban. However, lack of training and infrequent use of these types of approaches can lead pilots into performing an approach with which they are not familiar during times of poor or deteriorating weather.

For SCDA VS approaches, the ground speed of the aircraft is used to obtain the proper rate of descent for a given FPA. The AOM does not emphasize the importance of using ground speed for an SCDA VS calculation, nor does the TPM, and there is conflicting information pertaining to SCDA VS approaches and the use of airspeed or ground speed. This, combined with inadequate training and infrequent use of SCDA approaches, increases the chance that flight crew members may not be fully cognizant of the effects of ground speed during an SCDA approach, and therefore they may unintentionally deviate from the desired approach profile.

The airspeed bugs were not set at the appropriate approach or Vref speed according to aircraft weight, icing conditions, and wind gust factor. Although this is not in accordance with SOPs, it had a negligible effect on the incident. There is no requirement to bug the target SCDA speed; the aircraft touched down at a speed of 109 KIAS, which is Vref +5 KIAS.

Air Canada Jazz COM includes procedures for the FDR/CVR following an accident or incident, as per AC 700-013. However, the procedures include not disabling the CVR/FDR until gate arrival, which in some circumstances may increase the risk that the CVR be overwritten. According to Air Canada Jazz, this is as per direction from TC; however, this direction could not be produced to the TSB. In this occurrence, and in accordance with Air Canada Jazz SOPs, the flight crew members did not attempt to disable the CVR until they reached the gate and all information regarding the incident was overwritten.

Although the TPM describes the training for emergency procedures, it does not include procedures for disabling the FDR/CVR following an accident or incident as outlined in AC 700-013, which increases the chance of omitting these procedures during training. The lack of information from the 30-minute CVR regarding the approach and overrun event hampered investigators' ability to obtain a timely and complete understanding of the event and hindered the investigation. A two-hour CVR would have captured the event and likely provided important safety information.

The following report was produced by the TSB Laboratory:

LP 166/2008 – DFDR/CVR Analysis

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

Findings as to Causes and Contributing Factors

1. The approach speed of the aircraft was higher than outlined in the Air Canada Jazz standard operating procedures (SOPs). Because the aircraft could not be configured for landing until it slowed to the appropriate speed, commencement of the final descent to the minimum descent altitude (MDA) was delayed.

2. The final descent to the MDA was not initiated at the final approach fix (FAF). Therefore, even though the flight path angle (FPA) of the aircraft was about 3° and the rate of descent was constant, the aircraft was well above the desired vertical profile, resulting in the aircraft reaching the MDA well beyond the missed approach point (MAP).

3. The flight crew was not cognizant of the distance or time to the MAP during the approach. Therefore, the aircraft crossed the MAP before arriving at the MDA, but a missed approach was not conducted.

4. When the runway edge lights came into view, the flight crew continued the approach and began the landing sequence without being able to accurately assess the aircraft position and rate of change of position. This assessment may also have been hindered by a windrow obscuring the runway end lights.

5. Air Canada Jazz had not provided the flight crew members with adequate initial stabilized constant descent angle (SCDA) training, or any recurrent SCDA training and they were therefore unfamiliar with many aspects of SCDA approaches.

6. Transport Canada approved the Air Canada Jazz training program without data to indicate that the SCDA training met the requirements of the *Canadian Aviation Regulations* (CARs) and the *Commercial Air Service Standards* (CASS). This resulted in flight crews not receiving all the required training to safely conduct this type of approach.

Findings as to Risk

1. The Air Canada Jazz policy of a reduced approach ban for SCDA approaches, combined with inadequate training and infrequent use of an SCDA approach, presents the risk that flight crews may conduct an approach with which they are neither familiar, nor properly trained for, during times of poor weather or deteriorating visibility.

2. Transport Canada publication TP 308 does not have a specification to create distance measuring equipment/altitude tables for non-precision approach procedures; therefore, the Jeppesen approach plates for Canada and the NAV CANADA *Canada Air Pilot* (CAP) approach plates do not have detailed profile descent information including a table showing altitudes/heights for each 1 nm when using distance measuring equipment, as required by International Civil Aviation Organization (ICAO) Annex 4. Without this information, there is a risk that flight crews may not be able to quickly reference and cross check their vertical position during the approach.

3. The profile view of the CAP approach plate does not show a rate of descent table or a final approach descent gradient as recommended by ICAO Annex 4. Without this information, there is a risk that situational awareness may decrease.

4. Contrary to company SOPs, the flight crew used pilot monitored approach procedures for an SCDA approach, which could induce errors or miscommunication between crew members during a critical phase of flight.

5. The airspeed bugs were not set at the appropriate approach or Vref speeds, contrary to company procedures. Improper bug setting procedures can result in the aircraft being flown at inappropriate speeds.

6. The aircraft operating manual does not emphasize the importance of using ground speed for an SCDA vertical speed (VS) calculation and there is conflicting information pertaining to SCDA VS approaches and the use of airspeed or ground speed. In addition, because of the deficiencies with SCDA training, there is a risk that flight crews may inadvertently deviate from the intended approach profile.

7. The windrow on the edge of the runway was not reported on the notices to airmen (NOTAM) J or by Air Canada Jazz aircraft communications addressing and reporting system (ACARS), and the windrow at the end of the runway was not reported on the aircraft movement surface condition report (AMSCR). Therefore, the flight crew was not aware of the presence of the windrows and did not have all the available information to make an assessment of the runway conditions before landing.

8. The cockpit voice recorder (CVR) was not disabled following the occurrence and the data were overwritten. Consequently, CVR information relevant to the occurrence was not available to TSB investigators.

9. The Air Canada Jazz *Training Program Manual* (TPM) does not mention procedures for disabling a flight data recorder/cockpit voice recorder following an accident or incident in the emergency procedures training section as described in Transport Canada's Advisory Circular 700-013, which increases the risk that flight crews may not be aware of the proper disabling procedures.

Safety Action Taken

Air Canada Jazz

Air Canada Jazz submitted a revision to the *Training Program Manual* (TPM) for Transport Canada to review. It includes all requirements of section 725.124 of the *Commercial Air Service Standards* (CASS) and aligns the TPM with the aircraft operating manual and standard operating procedures. The training for stabilized constant descent angle (SCDA) approaches will now be done on an annual basis as opposed to following the previously approved matrix of 1 in 4 years.

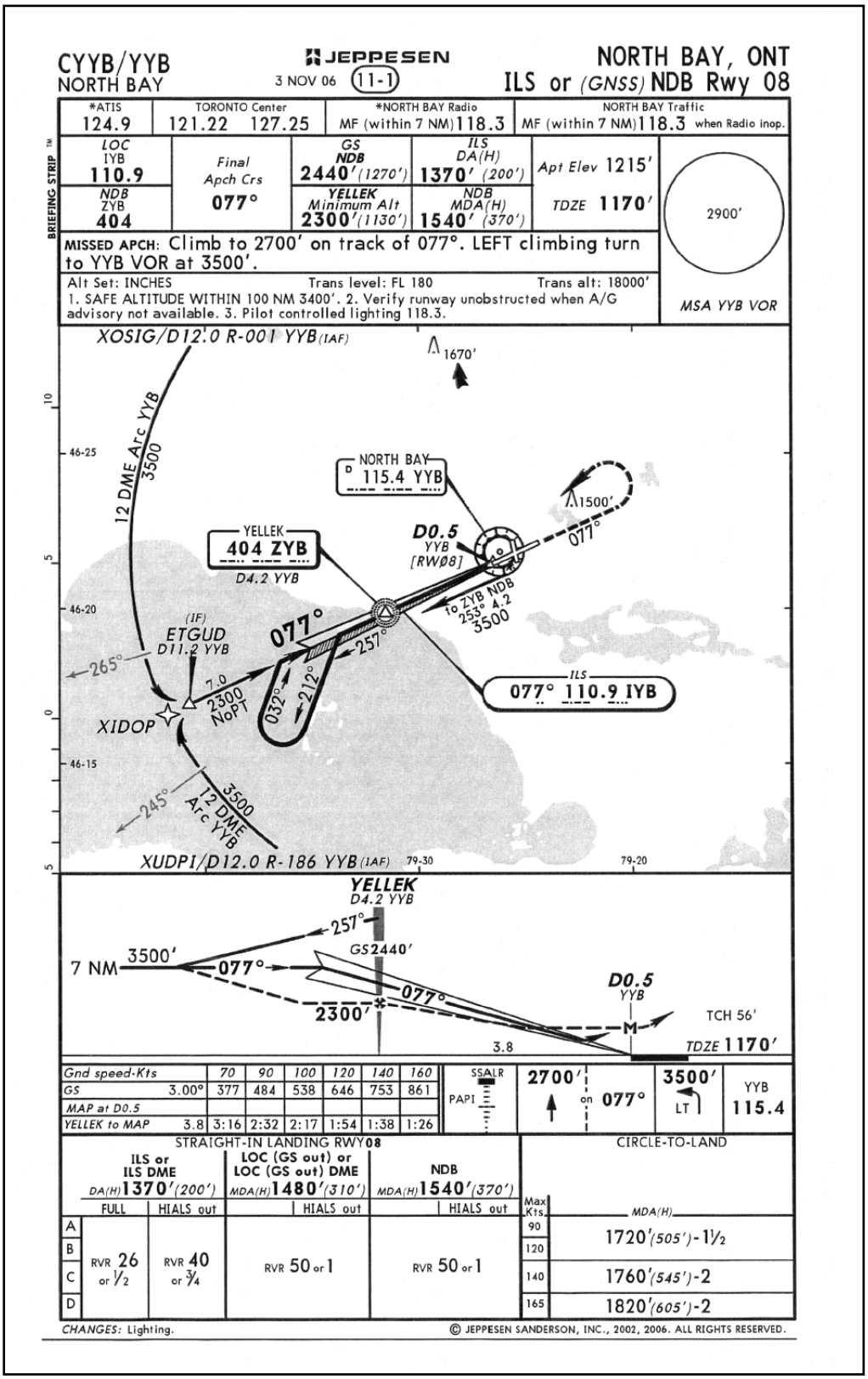
This report concludes the Transportation Safety Board's investigation into this occurrence. Consequently, the Board authorized the release of this report on 18 August 2010.

Visit the Transportation Safety Board's Web site (www.bst-tsb.gc.ca) for information about the Transportation Safety Board and its products and services. There you will also find links to other safety organizations and related sites.

Appendix A – Weather

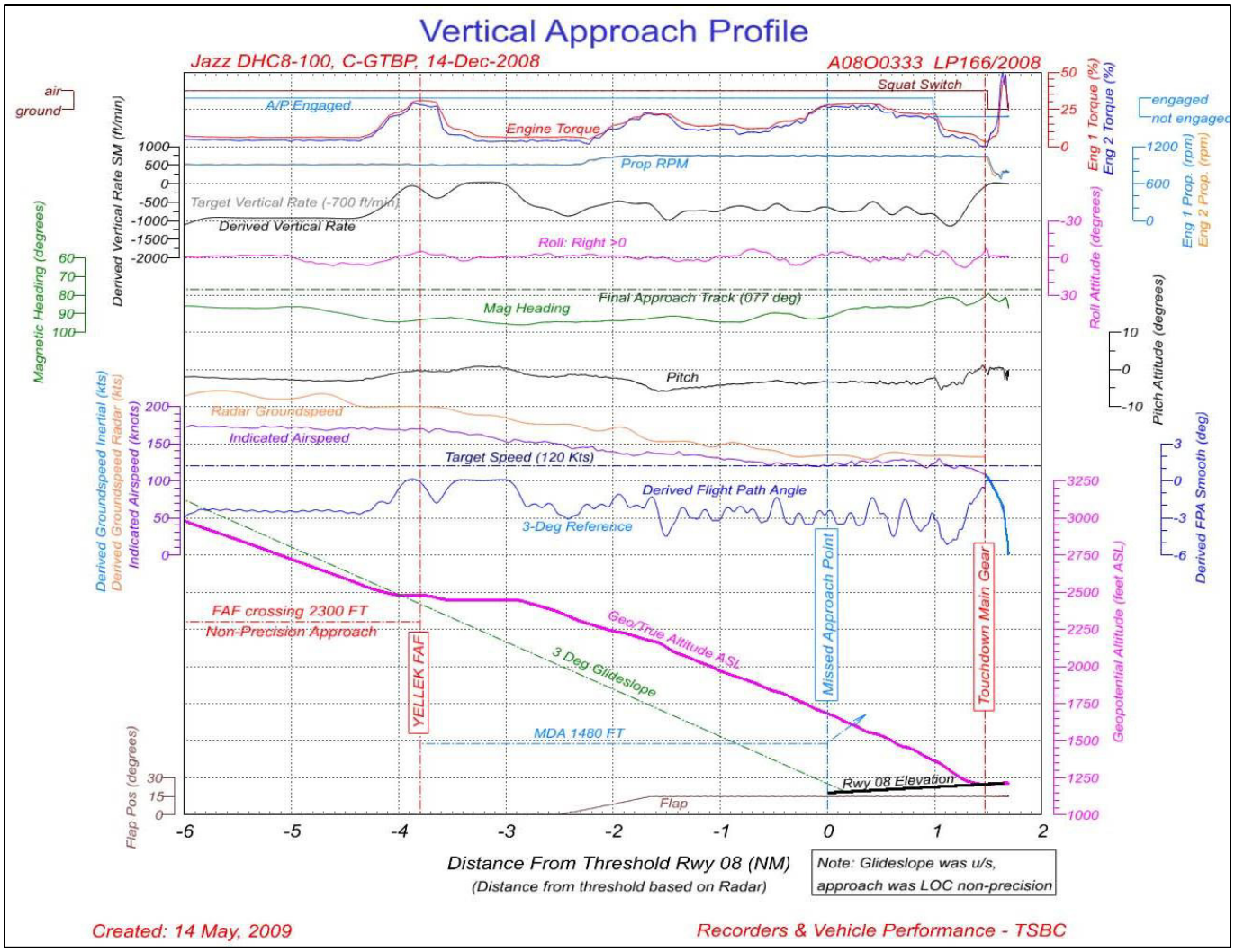
- 2145: Wind from 180°T at 12 knots, visibility 1 ½ sm in light drizzle and mist, ceiling overcast 100 feet above ground level (agl)
- 2200: Wind from 180°T at 11 knots, gusting 17 knots, visibility 1 ½ sm in light drizzle and mist, ceiling overcast 100 feet agl, temperature 1°C, dewpoint 1°C
- 2218: Wind from 180°T at 11 knots, visibility ¾ sm in light drizzle and mist, ceiling overcast 100 feet agl
- 2246: Wind from 170°T at 10 knots, visibility ½ sm in light drizzle and fog, ceiling indefinite 100 feet agl
- 2300: Wind from 170°T at 11 knots, gusting 16 knots, visibility ¼ sm in light drizzle and fog, ceiling indefinite 100 feet agl, temperature 2°C, dewpoint 2°C
- 2329: Wind from 170°T at 12 knots, gusting 19 knots, visibility ¾ sm in light drizzle and mist, ceiling overcast 100 feet agl
  (last weather report received by the flight crew before the occurrence)
- 2353: Wind from 160°T at 11 knots, gusting 16 knots, visibility ½ sm in light drizzle and fog, ceiling overcast 100 feet agl
- 2400: Wind from 160°T at 13 knots, visibility ½ sm in light drizzle and fog, ceiling overcast 100 feet agl, temperature 2°C, dewpoint 2°C
- 0005: Wind from 170°T at 11 knots, visibility ¼ sm in light drizzle and fog, ceiling indefinite 100 feet agl

Appendix B – Jeppesen Approach Plate North Bay



NOT TO BE USED FOR NAVIGATION PURPOSES

Appendix C – Vertical Approach Profile



Appendix D – Stabilized Constant Descent Angle (SCDA) Procedures vs. Pilot Monitored Approach (PMA) Procedures

Procedure		SCDA NON-PMA (required procedures)		ILS CAT 1 PMA (procedures used)	
Location		PNF	PF	PNF	PF
Positive localizer movement		"Track Alive"	"Check"	"Localizer alive"	"Check"
PMA	Positive glideslope movement			"Glideslope alive"	"Check"
SCDA	Prior to step-down fix	"Confirm___(new altitude) ALT SEL, after" (fix)	"Confirmed"		
FAF		"___beacon (or fix)___" (altitude indicated),"timing" "Check"	"Check" "VS ____ set" (1)	"___beacon (or fix)___ "(altitude indicated),"timing"	"Check"
500 feet HAA		"Bleeds off landing checklist complete"	"Check"	"Bleeds off landing checklist complete"	"Check"
100 above DA		"100 above"	"Check"		"100 above"
				"Check"	
DA		"Visual decide or No Contact decide"	"Landing or Go around power"		"Decide"
PMA	No contact			"Go around"	"Go around power"
PMA	Delayed handover No later than 100' AGL			"Continue" "Landing my control"	 "Your control"
PMA	With visual contact			"Landing my control"	"Your control"
PMA	After handover call RAD ALT at 50 feet and down (optional if briefed				"50, 40, 30, 20, 10"

Appendix E – Procedure for Setting Airspeed Bugs

Note: Airspeed bugs are moveable markers that can be set to different speeds on the airspeed indicator.

- Approach speed – inner rotatable orange delta bug, Vref + 5 KIAS (plus ½ the gust factor to a maximum of 10 knots).

- The top end of the delta bug represents the correct Vref speed. However, if there is an adjustment for the gust factor, set outer rotatable white airspeed bug to Vref. In this case, 104 knots.

- To ensure correct bug settings are set, this is verbalized in the approach briefing.

Appendix F – Regulations and Standards

Subsection 705.48(1) of the Canadian Aviation Regulations (CARs)

For the purposes of subsections (2) to (4), the visibility with respect to an aeroplane is less than the minimum visibility required for a non-precision approach, an APV or a CAT I precision approach if, in respect of the advisory visibility specified in the *Canada Air Pilot* and set out in column I of an item in the table to this section,

(a) where the RVR is measured by RVR "A" and RVR "B", the RVR measured by RVR "A" for the runway of intended approach is less than the visibility set out in column II of the item for the approach conducted;
(b) where the RVR is measured by only one of RVR "A" and RVR "B", the RVR for the runway of intended approach is less than the visibility set out in column II of the item for the approach conducted;
(c) where no RVR for the runway of intended approach is available, the runway visibility is less than the visibility set out in column II of the item for the approach conducted; or
(d) where the aerodrome is located south of the 60th parallel of north latitude and no RVR or runway visibility for the runway of intended approach is available, the ground visibility at the aerodrome where the runway is located is less than the visibility set out in column II of the item for the approach conducted.

(2) No person shall continue a non-precision approach or an APV unless

(a) the air operator is authorized to do so in its air operator certificate;
(b) the aeroplane is equipped with
    (i) if the flight crew does not use pilot-monitored-approach procedures, an autopilot capable of conducting a non-precision approach or an APV to 400 feet AGL or lower, or
    (ii) a HUD capable of conducting a non-precision approach or an APV to 400 feet AGL or lower;
(c) the instrument approach procedure is conducted to straight-in minima; and
(d) a visibility report indicates that
    (i) the visibility is equal to or greater than that set out in subsection (1),
    (ii) the RVR is varying between distances less than and greater than the minimum RVR set out in subsection (1), or
    (iii) the visibility is less than the minimum visibility set out in subsection (1) and, at the time the visibility report is received, the aeroplane has passed the FAF inbound or, where there is no FAF, the point where the final approach course is intercepted.

(3) No person shall continue an SCDA non-precision approach unless

(a) the air operator is authorized to do so in its air operator certificate;
(b) the aeroplane is equipped with
(i) if the flight crew does not use pilot-monitored-approach procedures, an autopilot capable of conducting a non-precision approach to 400 feet AGL or lower, or
(ii) a HUD capable of conducting a non-precision approach to 400 feet AGL or lower;
(c) the instrument approach procedure is conducted to straight-in minima with a final approach course that meets the requirements of section 725.48 of Standard 725 — *Airline Operations — Aeroplanes of the Commercial Air Service Standards*;
(d) the final approach segment is conducted using a stabilized descent with a planned constant descent angle specified in section 725.48 of Standard 725 — *Airline Operations — Aeroplanes of the Commercial Air Service Standards*; and
(e) a visibility report indicates that
(i) the visibility is equal to or greater than that set out in subsection (1),
(ii) the RVR is varying between distances less than and greater than the minimum RVR set out in subsection (1), or
(iii) the visibility is less than the minimum visibility set out in subsection (1) and, at the time the visibility report is received, the aeroplane has passed the FAF inbound or, where there is no FAF, the point where the final approach course is intercepted.

Section 725.48 of the Commercial Air Service Standards (CASS)

In order to conduct a stabilized constant-descent-angle (SCDA) non-precision approach, the following requirements shall be met:

(a) the air operator's flight crew training and qualifications program includes SCDA non-precision approach in accordance with section 705.124 of the *Canadian Aviation Regulations*;

Section 705.124 of the CASS

(1) Every air operator shall establish and maintain a training program that is

(a) designed to ensure that each person who receives training acquires the competence to perform the person's assigned duties;
(b) approved by the Minister in accordance with the *Commercial Air Service Standards* and, in respect of flight attendants, in accordance with the *Commercial Air Service Standards* and the *Flight Attendant Training Standard*.

Subsection 725.124(54) of the CASS

(54) **Stabilized Constant-Descent-Angle (SCDA) Non-Precision Approach Training**

The air operator shall ensure that the pilot-in-command and the second-in-command, in order to be able to conduct a stabilized constant-descent-angle (SCDA) non-precision approach, receive ground and simulator or flight training that addresses the following subjects within their initial and recurrent training programs:

(a) factors that affect altitude loss during the initiation of a missed approach;

(b) the relationship between the published missed approach point (MAP) and the position where a missed approach is commenced following a stabilized final approach descent to minimum descent altitude (MDA);

(c) the requirement to initiate a missed approach if the required visual reference necessary to continue to land has not been established, at the latest on reaching the earlier of: (i) the minimum descent altitude, and (ii) the MAP;

(d) the requirement to commence the horizontal (lateral) navigation portion of the published missed approach procedure at the MAP;

(e) the requirement to ensure that any altitudes at step-down fixes between the final approach fix (FAF) and the MAP are respected;

(f) the operation of any aircraft computer-generated approach slope systems or other methods of computing stable approach paths to the target touchdown point;

(g) the requirement to verify any altitude and waypoint information from a navigation database against an independent source;

(h) crew coordination upon reaching MDA and during the execution of a missed approach; and

(i) utilization of temperature corrections to MDA and other published altitudes and remote altimeter correction factors, when required.

Appendix G – Required Visual References

The visual references required by the pilot to continue the approach to a safe landing should include at least one of the following references for the intended runway, and should be distinctly visible and identifiable to the pilot by:

- the runway or runway markings;
- the runway threshold or threshold markings;
- the touchdown zone or touchdown zone markings;
- the approach lights;
- the approach slope indicator system;
- the runway identification lights;
- the threshold and runway end lights;
- the touchdown zone light;
- the parallel runway edge lights; or
- the runway centreline lights.

Appendix H – North Bay Jack Garland Airport – Winter Operations Plan

Areas and Priorities – General

Airside Areas

Priority 1 areas consist of only the absolute minimum aircraft manoeuvring surface required to maintain a basic level of air carrier operations. This includes sufficient parts of the manoeuvring area to permit take-offs and landings, a direct taxi route between the main apron and the active runway, and a small aircraft parking area on the main apron. Additionally, the glide path "Area A" becomes Priority 1 when snow depth reaches 20 cm.

The idea of the Priority 1 area is to permit the airport to continue to offer a basic level of air carrier operations even under the most adverse weather conditions. It is the airports goal to constantly maintain the Priority 1 areas during all winter storms.

Areas and Priorities – Specific

Priority 1A – Is normally used when runway 08/26 is the active runway, due to either favourable winds or use of the Instrument Landing System (ILS). This information is presented graphically in Annex A. Priority 1A areas are:

- Runway 08-26
- Hotel Taxi
- ½ ATB Apron – sufficient areas to accommodate air carrier operations
- "Glide Path Area A" when snow reaches 20 cm (Annex D)
- Emergency Access Road from Gate 2 (Maintenance Garage) to ATB Apron
- Runway 08-26 and Taxiway Hotel lighting and signage

Appendix I – Glossary

AC	Advisory Circular
ACARS	aircraft communications addressing and reporting system
AFM	aircraft flight manual
agl	above ground level
AIM	*Aeronautical Information Manual*
AIS	aeronautical information services
AMSCR	aircraft movement surface condition report
AOM	aircraft operating manual
APV	approach with vertical guidance
asl	above sea level
ATIS	automatic terminal information service
ATS	air traffic services
CAP	*Canada Air Pilot*
CARAC	Canadian Aviation Regulation Advisory Council
CARs	*Canadian Aviation Regulations*
CASS	*Commercial Air Service Standards*
CBAAC	Commercial and Business Aviation Advisory Circular
CDFA	continuous descent final approach
COM	company operations manual
CRFI	Canadian Runway Friction Index
CVR	cockpit voice recorder
DA	decision altitude
DME	distance measuring equipment
FAA	Federal Aviation Administration (United States)
FAF	final approach fix
FDR	flight data recorder
FIC	flight information centre
FMS	flight management system
FO	first officer
FPA	flight path angle
fpm	feet per minute
FSS	flight service station
GNSS	global navigation satellite system
HAA	height above altitude
HSI	horizontal situation indicator
ICAO	International Civil Aviation Organization
IFR	instrument flight rules
ILS	instrument landing system
KIAS	knots indicated airspeed
km	kilometres
LOC	localizer
MAP	missed approach point
MDA	minimum descent altitude
MF	mandatory frequency
nm	nautical miles

NOTAM	notice to airmen
NPA	non-precision approach
Ops Spec	Operations Specification
PANS-OPS	Procedures for Air Navigation Services – Aircraft Operations
PF	pilot flying
PMA	pilot monitored approach
PNF	pilot not flying
RSC	runway surface condition
RVR	runway visual range
SCDA	stabilized constant descent angle
sm	statute miles
SOP	standard operating procedure
TC	Transport Canada
TP	Transport Canada publication
TP 308	*Standard Criteria for the Development of Instrument Procedures*
TPM	*Training Program Manual*
TSB	Transportation Safety Board of Canada
UASC	Universal Avionics System Corporation
VNAV	vertical navigation
VOR/LOC	very high frequency omnidirectional range/localizer
Vref	landing reference speed or threshold crossing speed
VS	vertical speed
°	degrees
°C	degrees Celsius
°T	degrees true