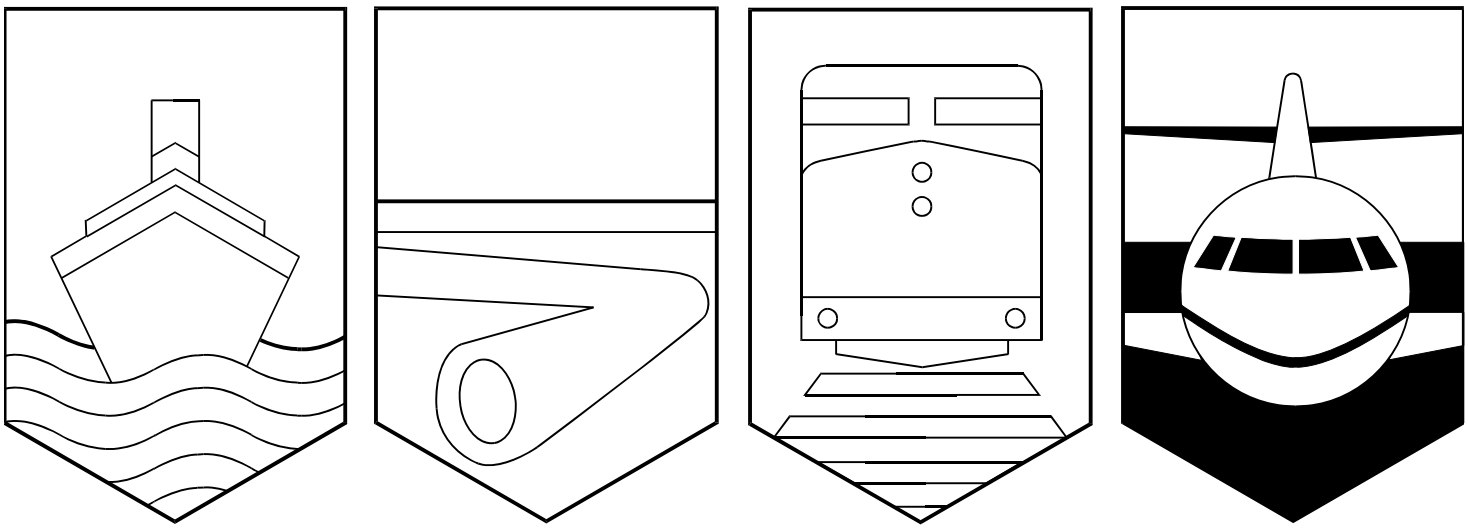
Transportation Safety Board of Canada

Bureau de la sécurité des transports du Canada



AVIATION OCCURRENCE REPORT

RISKS OF COLLISION
BETWEEN
FAIRCHILD SA-227AC METRO III C-GYHD
AND
FOKKER F-28 MK. 1000 C-GTUU

FAIRCHILD SA-227AC METRO III C-GYHD
AND
CESSNA 152 C-FGEK

FOKKER F-28 MK. 1000 C-GTUU
AND
CESSNA 414 C-FSAL

WINNIPEG INTL AIRPORT, MANITOBA
02 NOVEMBER 1994

REPORT NUMBER A94C0232

Canada

MANDATE OF THE TSB

The Canadian Transportation Accident Investigation and Safety Board Act provides the legal framework governing the TSB's activities. Basically, the TSB has a mandate to advance safety in the marine, pipeline, rail, and aviation modes of transportation by:

- conducting independent investigations and, if necessary, public inquiries into transportation occurrences in order to make findings as to their causes and contributing factors;
- reporting publicly on its investigations and public inquiries and on the related findings;
- identifying safety deficiencies as evidenced by transportation occurrences;
- making recommendations designed to eliminate or reduce any such safety deficiencies; and
- conducting special studies and special investigations on transportation safety matters.

It is not the function of the Board to assign fault or determine civil or criminal liability. However, the Board must not refrain from fully reporting on the causes and contributing factors merely because fault or liability might be inferred from the Board's findings.

INDEPENDENCE

To enable the public to have confidence in the transportation accident investigation process, it is essential that the investigating agency be, and be seen to be, independent and free from any conflicts of interest when it investigates accidents, identifies safety deficiencies, and makes safety recommendations. Independence is a key feature of the TSB. The Board reports to Parliament through the President of the Queen's Privy Council for Canada and is separate from other government agencies and departments. Its independence enables it to be fully objective in arriving at its conclusions and recommendations.

Transportation Safety Board of Canada | Bureau de la sécurité des transports du Canada

Aviation Occurrence Report

Risks of Collision
Between
Bearskin Lake Air Service Ltd.
Fairchild SA-227AC Metro III C-GYHD
and
Canadian Regional Airlines Ltd.
Fokker F-28 MK. 1000 C-GTUU

and Between
Bearskin Lake Air Service Ltd.
Fairchild SA-227AC Metro III C-GYHD
and
Private Operator
Cessna 152 C-FGEK

and Between
Canadian Regional Airlines Ltd.
Fokker F-28 MK. 1000 C-GTUU
and
Southern Aviation Ltd.
Cessna 414 C-FSAL

Winnipeg Intl Airport, Manitoba
02 November 1994

Report Number A94C0232

Synopsis

Three risk of collision incidents, involving four aircraft, occurred within a period of about two minutes. A Fairchild Metro III, on an instrument flight rules (IFR) flight arriving from the southwest and cleared for a visual approach to runway 31, passed with 0.7 mile horizontal and 500 feet vertical separation behind a Fokker F-28, which was one of two aircraft also on visual approach to runway 31. About one minute later, while in a left turn to rejoin the approach to runway 31, the Metro passed with 0.4 mile horizontal and no vertical separation to the left of a Cessna 152, the pilot of which was on a visual flight rules (VFR) flight conducting traffic observations east of the approach to runway 31. About 30 seconds later, the F-28 was cleared to land on runway 31 when a Cessna 414 was holding position for take-off on the runway. Shortly thereafter, the F-28 initiated a missed approach.

The Board determined that the first risk of collision incident occurred because the crew of the Fairchild Metro III misidentified the preceding aircraft on approach. Contributing factors were the confusing visual cues in the approach environment, the lack of separation standards other than visual separation for IFR aircraft on visual approaches, and the arrival controller's reluctance to intervene. Possible contributing factors were the lack of an approach sequence number, the reduced staffing level at the Area Control Centre, and that the annual refresher training for the controllers had not been carried out.

The second risk of collision incident occurred when the crew of the Fairchild Metro III altered course to the east of the approach path to increase separation from the F-28. Contributing factors were the airport controller's delay in issuing instructions to the crew of the Fairchild Metro III to turn, and the Cessna 152 pilot's arrangement with the Tower to turn down the volume on his radio.

The third risk of collision incident occurred because the airport controller overlooked the Cessna 414 that was holding position for take-off on runway 31 when he cleared the F-28 to land. Contributing to the occurrence was the airport controller's preoccupation with the first and second risk of collision incidents.

Ce rapport est également disponible en français.

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1.0 Factual Information

1.1 History of Flight

This report pertains to three risk of collision incidents, which will be referred to as the first risk of collision (ROC)[1], second ROC, and third ROC respectively. The three ROCs occurred within the three minutes and 50 seconds that elapsed from the time Bearskin Lake Air Service flight 404 (BLS 404), a Fairchild Metro III, received its clearance for a visual approach, until the time Canadian Regional Airlines flight 1328 (TAF 1328), a Fokker F-28, initiated a missed approach.

The three occurrences took place at latitude 49°54'N and longitude 97°15'W, during the hours of daylight and approximately a half-hour before the official sunset for the day, which was at 1705 central standard time (CST).

1.1.1 History of Flight - First Risk of Collision

The Fairchild Metro III (BLS 404) arrived in the Winnipeg terminal control area on an instrument flight rules (IFR) flight from Brandon, Manitoba, to the Winnipeg International Airport, Manitoba. Air Canada flight 178 (ACA 178), a McDonnell-Douglas DC-9, was the first aircraft in sequence on approach for runway 31, followed by the Fokker F-28 (TAF 1328).

At 1617:31 CST, the Fairchild Metro III crew first called the arrival controller 37 nautical miles (nm) southwest of Winnipeg, at 15,200 feet above sea level (asl)[2]. At 1623:25 CST, at an altitude of 7,000 feet asl, the crew[3] reported that the airfield was in sight, and the arrival controller advised them to follow the F-28 traffic turning final just through their twelve o'clock position and about 8 nm, down low. The F-28 referred to was TAF 1328, whose altitude at the time was 3,800 feet asl. The Fairchild Metro III crew observed one aircraft on approach, at their 11:30 position[4], that fit the description of the F-28. They advised the arrival controller that they had the traffic in sight, and were cleared for the left hand visual approach to runway 31 to follow the F-28. The crew carried out the aircraft landing checks after receiving approach clearance, and were reportedly aware that traffic information was based on their ground track. The arrival controller did not provide the Fairchild Metro III crew with a sequence number, nor was he required by regulation to do so. The crew did not request one.

At 1624:41 CST, to draw the crew's attention to the fact that their aircraft was rapidly closing with the F-28, the arrival controller advised them that their groundspeed was 290 knots and that the F-28's ground speed was 160 knots. The aircraft that the crew was observing was on short final approach at a position left of 12 o'clock, and they believed they had ample spacing behind the traffic. The crew acknowledged the call and took no further action. The arrival controller was reportedly reluctant to interfere in the conduct of visual approaches because crews are responsible for maintaining their own separation with the aircraft they are following.

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1 See Glossary for all abbreviations and acronyms.

2 All distances and speeds are based on data from the Winnipeg RAMP radar system. The radar transmitter/receiver used by Arrival and Tower during the occurrences described in this report is located at the Winnipeg Airport.

3 The pilot flying the BLS 404 aircraft during the occurrences in this report was the first officer, flying from the right seat. The captain, in the left seat, made all the radio transmissions.

4 See Appendix A for diagram.

At 1625:49 CST, the arrival controller asked the Fairchild Metro III crew whether the F-28 was still in sight, and the crew responded that it was. The arrival controller then informed the Fairchild Metro III crew that their groundspeed was 70 knots greater than that of the F-28 which was at their 12 o'clock and at a distance of one mile[5]. The Fairchild Metro III crew acknowledged this, re-directed their attention to this last position and immediately saw the F-28. The Fairchild Metro III crew started a right turn to increase separation between the two aircraft, and passed through the runway 31 approach path .7 nm behind the F-28, with 700 feet of vertical separation.

1.1.2 History of Flight - Second ROC

The Cessna 152 (C-FGEK) had departed from the Winnipeg/St. Andrews airport about 50 minutes earlier and was on a visual flight rules (VFR) flight plan. The pilot's traffic watch duties consisted of observing street traffic in various parts of the City of Winnipeg, and periodically broadcasting reports to a public radio station with a portable radio. The Cessna 152 pilot advised the airport controller at 1622:16 CST that he would be going off Tower frequency in one minute to make several street traffic reports. The airport controller had approved, with the proviso that the Cessna 152 stay in the area between the approaches to runways 25 and 31.

As the Fairchild Metro III was passing behind the F-28 and through the approach path for runway 31, Arrival instructed the Fairchild Metro III crew to call Winnipeg Tower on their frequency. The crew called the airport controller at 1626:05 CST, and asked whether he wanted the flight to use runway 25. The airport controller discussed this request with the arrival controller and, at 1626:26 CST, advised the Fairchild Metro III crew of the Cessna 152 traffic watch aircraft, and instructed the crew to start a left hand 360-degree turn to rejoin the approach to runway 31. The Fairchild Metro III crew confirmed that the traffic was in sight and started the turn. Radar data shows the Cessna 152 northwest bound, turning left, at the time of the closest proximity between the Fairchild Metro III and the Cessna 152, while the Fairchild Metro III was northbound, and also turning left[6]. During the turn, the Fairchild Metro III passed the Cessna 152 with .4 nm horizontal and no vertical separation.

At 1626:50 CST, the airport controller broadcast an instruction to the Cessna 152 to turn north; however, no reply was received. The Cessna 152 pilot's next call to Tower was at 1628:54 CST, when he advised that he was again monitoring the frequency.

1.1.3 History of Flight - Third ROC

After the DC-9 landed, the pilot of C-FSAL, a Cessna 414, advised Tower that he was ready for take-off, and received clearance at 1625:48 CST to move to position and hold on runway 31. The Tower voice recording shows that the airport controller was then in almost continuous communication with the arrival controller and the crews involved in the second ROC, until the F-28 approached the runway[7]. At 1627:00 CST, the F-28 crew asked whether there was an aircraft on the runway, but this transmission was almost unintelligible because it coincided with a transmission between Tower and Arrival concerning the second ROC. The F-28 crew then received clearance to land on runway 31. Shortly thereafter, at 1627:10 CST, the F-28 crew advised Tower that they were carrying out a missed approach. The crew reported that they initiated the missed approach at about one-half mile from the runway from an altitude of about 300 feet above ground level (agl), when they visually confirmed that the Cessna 414 was on runway 31.

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[5] See Appendix B for diagram.

[6] See Appendix C for diagram.

[7] See Appendix C for diagram.

1.2 Injuries to Persons

1.2.1 Injuries to Persons - Fairchild Metro III (BLS 404)

	Crew	Passengers	Others	Total
Fatal	-	-	-	-
Serious	-	-	-	-
Minor/None	2	4	-	6
Total	2	4	-	6

1.2.2 Injuries to Persons - F-28 (TAF 1328)

	Crew	Passengers	Others	Total
Fatal	-	-	-	-
Serious	-	-	-	-
Minor/None	4	28	-	32
Total	4	28	-	32

1.2.3 Injuries to Persons - Cessna 152 (C-FGEK)

	Crew	Passengers	Others	Total
Fatal	-	-	-	-
Serious	-	-	-	-
Minor/None	1	-	-	1
Total	1	-	-	1

1.2.4 Injuries to Persons - Cessna 414 (C-FSAL)

	Crew	Passengers	Others	Total
Fatal	-	-	-	-
Serious	-	-	-	-
Minor/None	1	2	-	3
Total	1	2	-	3

1.3 Damage to Aircraft

There was no reported damage to any of the aircraft involved.

1.4 Other Damage

Nil.

1.5 Personnel Information

All flight crew members were certified and qualified for their respective flights in accordance with existing regulations. There was no evidence that incapacitation or physiological factors affected the performance of any of the flight crew members.

Both air traffic controllers were certified and qualified in accordance with existing regulations.

1.5.1 Personnel - Fairchild Metro III (BLS 404)

	Captain	First Officer
Age	33	27
Pilot Licence	ATPL	ATPL
Medical Expiry Date	30 Nov 94	1 July 1995
Total Flying Time	6,200 hr	4,400 hr
Total on Type	120 hr	2,200 hr
Total Last 90 Days	120 hr	230 hr
Total on Type Last 90 Days	100 hr	230 hr
Hours on Duty Prior to Occurrence	7.5 hr	7.5 hr
Hours Off Duty Prior to Work Period	10.5 hr	10.5 hr

The Fairchild Metro III crew started their duty day in Brandon, Manitoba at 0900 CST and had flown about three hours before the occurrence. After their arrival in Winnipeg, scheduled for about 1630 CST, the crew planned to carry out a return flight to Brandon at 1740 CST and complete their duties for the day at about 1900 CST.

The first officer had flown eight hours in the previous three days, and 80 hours in the previous 30 days. The captain had flown 7.5 hours in the previous three days, and 70 hours in the previous 30 days. The crew's previous duty day ended at 2215 CST.

Transport Canada regulations limit flight crew duty days to 15 hours, and limit flight hours to 120 in the previous 30 days, and 300 in the previous 90 days.

1.5.2 Personnel - F-28 (TAF 1328)

	Captain	First Officer
Age	48	N/A
Pilot Licence	ATPL	ATPL
Medical Expiry Date	31 Dec 94	N/A
Total Flying Time	14,935 hr	6,300 hr
Total on Type	3,380 hr	2,000 hr
Total Last 90 Days	124 hr	170 hr
Total on Type Last 90 Days	47 hr	170 hr
Hours on Duty Prior to Occurrence	7.1 hr	11 hr
Hours Off Duty Prior to Work Period	10 hr	13 hr

1.5.3 Personnel - Cessna 152 (C-FGEK)

	Pilot
Age	33
Pilot Licence	CPL
Medical Expiry Date	31 Oct 95
Total Flying Time	7,800 hr
Total on Type	7,600 hr
Total Last 90 Days	230 hr
Total on Type Last 90 Days	230 hr
Hours on Duty Prior to Occurrence	10 hr
Hours Off Duty Prior to Work Period	12 hr

1.5.4 Personnel - Cessna 414 (C-FSAL)

	Pilot
Age	33
Pilot Licence	ATPL
Medical Expiry Date	31 Mar 95

	Pilot
Total Flying Time	5,500 hr
Total on Type	40 hr
Total Last 90 Days	250 hr
Total on Type Last 90 Days	40 hr
Hours on Duty Prior to Occurrence	8 hr
Hours Off Duty Prior to Work Period	14 hr

1.5.5 Air Traffic Controller - Arrival

Controller Position	Arrival
Age	45
Licence	Air Traffic Controller - IFR
Medical Expiry Date	1 April 1995
Experience - as a Controller - as an IFR Controller - in Present Unit	 22 years 21 years 19 years
Hours on Duty Prior to Occurrence	1 1/2 hr
Hours Off Duty Prior to Work Period	22 hr

1.5.6 Air Traffic Controller - Airport

Controller Position	Airport
Age	38
Licence	Air Traffic Controller - VFR
Medical Expiry Date	1 November 1995
Experience - as a Controller - as an IFR Controller - in Present Unit	 12 years none 2 years

Hours on Duty Prior to Occurrence	3 1/2 hr
Hours Off Duty Prior to Work Period	13 hr

1.6 Aircraft Information

1.6.1 Aircraft Information - Fairchild Metro III (BLS 404)

Manufacturer	Fairchild Aircraft Corporation
Type	SA227AC Metro III
Year of Manufacture	1989
Serial Number	AC-739B
Certificate of Airworthiness (Flight Permit)	Valid
Total Airframe Time	1,600 hr
Engine Type (number of)	Garrett TPE 331-11U-612G (2)
Propeller/Rotor Type (number of)	McCaulley 4HFR34C652-F (2)
Maximum Allowable Take-off Weight	16,100 lb
Recommended Fuel Type(s)	Jet A, Jet B
Fuel Type Used	Jet B

1.6.2 Aircraft Information - F-28 (TAF 1328)

Manufacturer	Fokker
Type	F-28 Mk. 1000
Year of Manufacture	1969
Serial Number	11006
Certificate of Airworthiness (Flight Permit)	Valid
Total Airframe Time	43,500 hr
Engine Type (number of)	Rolls Royce Spey 555-15 (2)
Propeller/Rotor Type (number of)	none
Maximum Allowable Take-off Weight	66,500 lb
Recommended Fuel Type(s)	Jet A, Jet B
Fuel Type Used	Jet A

1.6.3 Aircraft Information - Cessna 152 (C-FGEK)

Manufacturer	Cessna
Type	152
Year of Manufacture	1983
Serial Number	152-85694
Certificate of Airworthiness (Flight Permit)	Valid
Total Airframe Time	7,400 hr
Engine Type (number of)	Avco Lycoming O-235-N2C (1)
Propeller/Rotor Type (number of)	McCaulley IA103/TCM6958 (1)
Maximum Allowable Take-off Weight	1,671 lb
Recommended Fuel Type(s)	100 LL
Fuel Type Used	100 LL

1.6.4 Aircraft Information - Cessna 414 (C-FSAL)

Manufacturer	Cessna
Type	414
Year of Manufacture	1974
Serial Number	414-0497
Certificate of Airworthiness (Flight Permit)	Valid
Total Airframe Time	5,500 hr
Engine Type (number of)	Teledyne Continental TSIO-520N (2)
Propeller/Rotor Type (number of)	McCaulley 3AF32C93 (2)
Maximum Allowable Take-off Weight	6,349 lb
Recommended Fuel Type(s)	100 LL
Fuel Type Used	100 LL

1.6.5 DC-9 and F-28 Configuration and Paint Scheme

The DC-9 (ACA 178) and the F-28 (TAF 1328) are both twin-engine turbojet, T-tail configured aircraft with rear fuselage-mounted engines, and are of a similar size. The DC-9's fuselage was painted mostly white, and the tail was mostly dark green. The F-28's fuselage was blue on the lower half and light grey on the upper half, and the tail was painted blue.

1.7 Meteorological Information

The surface weather report for the airport at 1600 CST was as follows: 4,000 feet scattered, visibility 15 miles, temperature four degrees Celsius, dew point minus three degrees Celsius, winds 280 degrees at 20 knots, altimeter setting 29.68 inches of mercury. The scattered layer of cloud was reported as strato-cumulus covering 3/10 of the sky. In the weather report at 1700 CST, the ceiling was listed as 3,500 feet broken, visibility 15 miles, and the broken layer of cloud was reported as strato-cumulus covering 7/10 of the sky. The forecast upper winds for Winnipeg at 3,000 feet asl were 270 degrees true at 24 knots; at 6,000 feet they were 260 degrees true at 29 knots.

1.8 Aids to Navigation

Runway 31 is served by an instrument landing system (ILS), which was reportedly operating normally at the time of the occurrences. The final approach track is 313 degrees magnetic (°M).

The Winnipeg Air Traffic Control (ATC) Radar Modernization Project (RAMP) radar system was commissioned in February 1993, and was the sole radar system in use at both Winnipeg Terminal and Winnipeg Tower during the occurrences. The radar system was reportedly operating normally throughout the time of the occurrences.

1.9 Communications

Aircraft approaching Winnipeg while operating under IFR are initially controlled by Winnipeg Centre during en route flight. Air traffic control of incoming flights is then handed over to Winnipeg Arrival control (Arrival) on frequency 119.5 megahertz (MHz), and then to Winnipeg airport control (Tower) on frequency 118.3 MHz. Winnipeg Tower is also able to receive and transmit on 125.4 MHz.

1.10 Aerodrome and Airspace Information

The Winnipeg Area Control Centre (ACC) provides air traffic control services for airspace in the vicinity of Winnipeg. One of the units within the ACC, the Terminal specialty (TCU), provides air traffic control for the airspace at Flight Level (FL) 240 and below, within a 35 nm radius of the Winnipeg Airport, as well as the area between the 230 and 305 degree radials of the Winnipeg very high frequency omni-directional range (VOR) transmitter, between 35 and 55 nm at 6,000 feet and below. The Terminal specialty is further divided into Arrival, Departure, and Terminal Radar Service Advisory (TRSA) positions. The TRSA is a part-time VFR radar advisory position which is combined with the Departure position during periods of low traffic levels.

The Winnipeg airport control zone extends 7 nm from the centre of the airport, from the ground to 3,000 feet asl. The control zone is categorized as Class D airspace; flights within it must establish two-way communication with the appropriate ATC facility unless prior approval is received from ATC.

1.11 ATC - Arrival

A Transport Canada Resource Alignment Project was carried out in 1993, and a Transport Canada Unit Evaluation was conducted from 19 to 29 September 1994. The Resource Alignment Project results, as adjusted by the Unit Evaluation, were that 27 controllers were required on staff for the Winnipeg Terminal specialty. At the time of the occurrences, 22 licensed controllers were on staff, of whom 16 were available for work.

The Arrival position was staffed by one controller, who was assisted at the time of the occurrences by another controller in the Terminal Data (Data) position. The data controller, who was also qualified at the Arrival position, managed the flight data board, updated data strips, and performed other related tasks. The level of traffic at the time of the occurrences was light to moderate, with normal complexity.

The arrival controller was a team leader (supervisor) in the Terminal specialty, and worked a 36-day schedule consisting of three sets of five days on, four days off, and one set of six days on and three days off. At the time of the occurrences, he was working his fourth day after one day off, and had worked 11 of the previous 12 days, and 25 of the previous 30 days, including seven overtime shifts. The controller's supervisory duties include "stand-back" supervision of air traffic control services in the

Terminal specialty, preparing the work schedules of other controllers and carrying out performance reviews and appraisals of other controllers.

The arrival controller was working a regular controller position; a shortage of available controllers reportedly prevented him from conducting stand-back supervision. The controller also reportedly had difficulty in finding time to complete his supervisory tasks on schedule. The controller reported that his on-the-job efficiency may have been affected by the amount of time he was required to spend at work lately.

Fatigue is subjective in nature and each individual varies in his or her ability to maintain stability and control under conditions which are generally regarded as conducive to fatigue, such as poor health, inadequate sleep or rest, excessive working hours, and stressful or physically tiring work. Studies have shown that excessive controller workload resulting from understaffing presents a potential for controller fatigue[8], and several previous safety recommendations have been issued as a result.

1.12 ATC - Tower

The airport controller completed his qualification training in the Winnipeg Tower in July 1993, after transferring from a controller position in Thunder Bay. At the time of the occurrences, the airport controller was working his second day after three days off. He had worked 8 of the previous 14 days, and 16 of the previous 30 days. He was reportedly well rested at the time of the occurrences.

The level of traffic at the time of the occurrences was considered moderate. Tower communications congestion was moderate initially, increasing to heavy as the occurrences progressed.

1.13 ATC Recurrent Training

The Air Traffic Services Administration and Management Manual (ATSAMM) provides that operational personnel shall demonstrate that their performance of operational duties meets unit proficiency standards on an ongoing basis. This performance is assessed by a Performance Review and Assessment of Potential (PRAP). In addition, annual refresher training is to be provided to all operational personnel (Section 551). Critical tasks that are not performed on a regular basis are to be included in the refresher training. In addition, new topics and topics of interest are brought up for discussion as they arise.

The last refresher training session provided to the arrival controller was completed 07 May 1993. Since that date, two routine reviews were carried out that indicated that the arrival controller was able to perform independently at all times, and with superior skill in many instances.

The last refresher training course at the Tower was held in February and March, 1992. The airport controller received no refresher training between the time of his qualification as an airport controller at the Tower and the time of the occurrences. However, a routine review was carried out that indicated that the Tower controller was able to perform independently at all times.

1.14 Approach Control Procedures and Separation Criteria

[8] Canadian Aviation Safety Board (CASB), *Report on a Special Investigation into Air Traffic Control Services in Canada*, Report No. 90-SP001, Ottawa, Minister of Supply and Services Canada, 1990. (See Recommendations 90-15 and 90-16, for example.)

1.14.1 Terminal Area

Approach control procedures are governed by the Transport Canada Air Traffic Control Manual of Operations (MANOPS). MANOPS specifies that aircraft in the terminal area operating under IFR in the circumstances of the occurrence aircraft shall have at least three miles horizontal or 1,000 feet vertical separation.

1.14.2 Visual Approaches

Visual approaches may be requested by pilots or initiated by controllers to gain an operational advantage. MANOPS section 547.1(b) provides that controllers may clear an IFR aircraft for a visual approach if the crew of the aircraft being vectored is instructed to maintain visual separation from preceding aircraft arrivals. MANOPS section 547.1(c) provides that an approach clearance is not issued until the crew reports sighting the aircraft that they will be instructed to follow and from which they will be maintaining visual separation. Once the aircraft is cleared for the visual approach, the arrival controller is no longer responsible for maintaining separation from the preceding aircraft; therefore, no minimum separation standards (e.g. altitude or distance) apply, other than the visual separation maintained by the crew. Controllers often provide approach sequence numbers to aircraft on visual approaches, and point out their traffic using the "o'clock" system, although they are not required to do so.

The arrival and data controllers reported that they controlled Fairchild Metro aircraft differently than other aircraft. Crews flying Metros reportedly fly faster and steeper approaches than those in other types of aircraft, and they prefer visual approaches to avoid delays resulting from ATC guidance. The Approach controller offered the Fairchild Metro III (BLS 404) crew a visual approach without waiting for a request from the crew.

1.14.3 Terminal/Tower Inter-Unit Agreement

The current inter-unit agreement between the Winnipeg Tower and the Winnipeg ACC establishes procedures for the handling of air traffic between Tower and TCU. It provides that Tower shall operate within the airport control zone and TCU shall operate outside the control zone, and:

> D.1.5: Communications and control transfer between Tower and TCU positions shall not be effected until pertinent conflictions at the transferring position have been resolved; and
>
> D.1.6: Arrival shall provide minimum separation involving VFR aircraft as follows: a. same runway - 2 nm.

The conflict that arose from the first ROC had not been resolved when Arrival passed control of the Fairchild Metro III (BLS 404) to the airport controller on Tower frequency as that flight was about 1 nm behind and closing with the F-28 (TAF 1328).

1.15 Recognition of Visual Targets

The Winnipeg airport is located in the northwest part of the City of Winnipeg, at an elevation of 783 feet asl. Aircraft crews arriving from the west and planning to use runway 31 will see aircraft already on approach for that runway against a backdrop of the buildings (lighted at night) of the City of Winnipeg,

when the preceding aircraft are at a lower altitude. Studies have shown that aircraft viewed against an urban background are unusually difficult to recognize.[9]

Empirical studies have been carried out to determine the ability of human observers to see and recognize visual target forms at various distances. One such study[10] measured the time required by observers with normal vision to recognize targets of various angular sizes, and their error rate in doing so. It found that "...when the maximum dimension of the target is less than 12 minutes of visual angle (MOA), there is a precipitous rise in both the search time and errors," and concluded that: "It may be presumed that 12 minutes of angle is the lower limit that is acceptable for target recognition for the type of forms used in this study."[11] Controllers reportedly do not receive training concerning human physiology as it relates to target recognition.

The aircraft that the Fairchild Metro III crew had initially seen and had been following was the DC-9 (ACA 178). When the Fairchild Metro III (BLS 404) crew received approach clearance, the F-28 (TAF 1328) subtended 4.5 MOA, at a range of 11.5 nm in the 12:30 position relative to the Fairchild Metro III. The DC-9 subtended 6.2 MOA at a range of 9.7 nm in the 11:30 position relative to the Fairchild Metro III. When the arrival controller advised the Fairchild Metro III crew of the relative speed difference between the F-28 and themselves, the DC-9 subtended 8.6 MOA, and the F-28 subtended 11.8 MOA. The Fairchild Metro III crew was at this time watching the DC-9, and the F-28 was 55 degrees to the right of the DC-9.

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9 James L. Harris, Sr. *Role of the Human Eye in Air Collision Avoidance*, Southwest Flight Crew Association, Pacific Southwest Airline, San Diego, 1979.

10 William C. Steedman and Charles A. Baker, Aerospace Medical Laboratory, Wright Air Development Division, "Target Size and Visual Recognition", *Human Factors*, August 1960, pages 120 to 127.

11 ibid., pages 124 and 125.

2.0 Analysis

2.1 Fairchild Metro III (BLS 404) - Flight Planning

The Fairchild Metro III (BLS 404) crew was within the allowable scheduling limits regarding their maximum duty day, and was within the limits for the maximum flying time for the previous 30- and 90-day time periods. Because the station stops during the day enabled the crew to recoup time lost to unforeseen delays, the crew was not required to rush their approaches to make up for lost time.

The arrival controller was aware of the preferences of various aircraft crews, and tried to anticipate their needs. The arrival controller believed that, compared to some aircraft, the Fairchild Metro III aircraft type normally flies faster on approach and is able to maintain that approach speed until closer to the runway. He was, therefore, not initially alarmed when the Fairchild Metro III converged with the F-28. Faster, steeper approaches compress crew duties during the approach phase of flight into a shorter time, leaving less free time for the crew to scan the sky ahead for other traffic.

2.2 Fairchild Metro III (BLS 404) - Arrival and Traffic Identification

Throughout the approach, the DC-9 (ACA 178) and the F-28 (TAF 1328) were difficult to identify because of their similar paint schemes and the urban background. Because the upper air winds created a slight crosswind from the left for the Fairchild Metro III as it was flying the base leg of the visual approach, the nose of the aircraft was oriented slightly into the wind, and to the left of the ground track observed by the arrival controller on radar. When the Fairchild Metro III crew received visual approach clearance, scattered to broken cloud existed in the vicinity of the airport at an altitude between that of the Fairchild Metro III and the F-28, and may have obscured the F-28 from view.

Because the Fairchild Metro III crew members were not aware of the number of aircraft in sequence ahead of them when they received the clearance for the visual approach, they were not looking for more than one aircraft. The crew saw the DC-9 at their 11:30 position, where their traffic could be expected to appear. Both the F-28 and the DC-9 were probably too far away for reliable visual identification. Because the DC-9 and the F-28 are similar in appearance, the crew misidentified the DC-9 (ACA 178) as the F-28 (TAF 1328) and accepted the DC-9 as their assigned traffic to follow. As the Fairchild Metro III continued the approach, the distance between it and the DC-9 decreased, but the angle increased, so that the fuselage of the DC-9 probably never presented an image large enough for reliable visual identification. When the arrival controller advised the Fairchild Metro III crew of their aircraft's relative groundspeed, the crew saw no discrepancy, and simply acknowledged the call. By then, the F-28 may have been visually recognizable; however, because the F-28's position was about 55 degrees to the right (two o'clock position), the Fairchild Metro III crew did not see the F-28.

Because a mental image of a situation, once formed, is very resistant to change, the Fairchild Metro III crew did not interpret the arrival controller's hint about the aircrafts' relative speed to mean that something was wrong with their assessment of the traffic pattern. It was only when they learned that the position of their actual preceding traffic was greatly different than they believed, that they were able to re-evaluate their situation.

2.3 Fairchild Metro III (BLS 404) - Tower

After the Fairchild Metro III crew acknowledged the position of the F-28 and changed to Tower frequency, the airport controller conferred with the arrival controller about the crew's request to use

runway 25. During the 20-second period in which the controllers were co-ordinating, the Fairchild Metro III was closing with the Cessna 152. By the time the Fairchild Metro III crew received the instruction to execute a 360-degree turn to the left to rejoin the approach to runway 31, the Metro was at a position such that separation between the two aircraft during the turn was reduced to 0.4 nm horizontal with no vertical separation.

The airport controller had cleared the Cessna 414 (C-FSAL) to taxi to position and hold on runway 31 just before the first call to Tower from the Fairchild Metro III. The controller's attention was then directed to the approach area during the first ROC and the second ROC, and when the F-28 crew called Tower on short final, the airport controller was preoccupied with the first two incidents and did not issue the appropriate direction to the F-28.

2.4 Separation and Control

The requirements of the inter-unit agreement were not met when control of the Fairchild Metro III (BLS 404) was transferred to Tower before its conflict with the F-28 (TAF 1328) was resolved.

Because both the Fairchild Metro III and the F-28 were being flown on an IFR flight plan, the arrival controller was not required to provide a minimum of 2 nm separation between them, as required by the inter-unit agreement for VFR aircraft. Because the crews were carrying out visual approaches, terminal area IFR separation standards also did not apply to them as the crew would maintain visual separation from the aircraft they were following. Separation between IFR aircraft in the vicinity of an airport during visual approaches can therefore decrease below the 2 nm standard applicable to VFR aircraft without any requirement on the part of the approach controller to advise the crews or take other action.

The arrival controller was reluctant to intervene because the Fairchild Metro III was cleared for a visual approach, and the crew was responsible for its own separation from other aircraft.

2.5 Visual Approach Procedures

Arrival controllers are not required by MANOPS to provide traffic sequence numbers when issuing visual approach clearances. Given that the Fairchild Metro III crew saw only one aircraft on approach to runway 31, traffic sequence information might have led them to inquire about the other aircraft on approach, and more quickly acquire correct traffic information.

2.6 Tower Procedures

The pilot of the Cessna 152 (C-FGEK) had, by prior arrangement with the airport controller, turned down the volume control on his radio. He was, therefore, unable to hear the controller's instruction to him, transmitted on the Tower 118.3 MHz frequency, to turn north. Although such an approval by Tower to turn down the volume momentarily conforms to airspace use regulations, handling the Cessna 152 on a discrete frequency, such as the 124.5 MHz frequency available in the Tower, would have allowed the pilot to make his traffic broadcasts while maintaining contact with Tower.

2.7 ACC Training and Staffing

ATSAMM requires annual refresher training to be provided to all operational personnel; although no such training had been carried out at either the Tower or the ACC within the 12 months previous to the occurrences, it cannot be determined whether refresher training would have affected the controller's handling of the occurrence aircraft.

Controller training regarding the limitations of human physiology in the visual identification and recognition of other aircraft is not currently provided. Such training might help controllers recognize situations in which aircraft crews have misidentified traffic from which visual separation must be maintained.

Staffing at the ACC was less than the operational strength required by the Transport Canada guidelines. Because of the understaffing, controllers were required to work extra duty shifts to make up for the shortfall. However, it is difficult to assess precisely how much the arrival controller's increased recent workload may have affected his on-the-job efficiency.

Because of the shortage of operational staff, Terminal supervisors were required to work operational shifts, and therefore stand-back supervision was not being provided in the Terminal specialty at the time of the occurrences.

3.0 Conclusions

3.1 Findings

1. The scattered to broken cloud condition observed in the vicinity of the airport may have obscured the F-28 from the view of the crew of the Fairchild Metro III.

2. The arrival controller did not provide the Fairchild Metro III crew with an approach sequence number, nor did the ATC MANOPS require that he do so.

3. Approach sequence information might have helped the Fairchild Metro III crew to correctly recognize air traffic on approach to runway 31.

4. When the Fairchild Metro III crew was initially advised of their traffic, the aircraft was probably too far away for a reliable visual identification.

5. The similar configuration and paint schemes of the DC-9 (ACA 178) and the F-28 (TAF 1328) made them difficult to differentiate, especially against an urban background.

6. The Fairchild Metro III's high speed on initial approach reduced the time available for the crew to scan for traffic.

7. The crew's correction for the upper winds pointed the nose of the Fairchild Metro III slightly in the direction of the DC-9.

8. The Fairchild Metro III crew misidentified the DC-9 (ACA 178) as the F-28 (TAF 1328).

9. Because the Fairchild Metro III was on a visual approach and its crew was responsible for its own separation, the arrival controller was reluctant to intervene.

10. The Fairchild Metro III approached within .7 nm horizontal and 500 feet vertical separation from the F-28 (TAF 1328) during the first ROC.

11. The requirement of the Air Traffic Control inter-unit agreement, to resolve conflicts before aircraft handoffs, was not met.

12. During the turn to rejoin final approach to runway 31, the Fairchild Metro III passed with 0.4 nm horizontal separation and no vertical separation from the Cessna 152 (C-FGEK).

13. When the F-28 (TAF 1328) called Tower on short final approach, the airport controller was preoccupied and did not issue the appropriate direction.

14. There is no separation standard other than visual separation for IFR aircraft on visual approaches.

15. Terminal supervisors were required to work operational shifts; therefore, stand-back supervision was not being provided in the Terminal specialty.

16. The arrival controller's workload may have decreased his on-the-job efficiency.

17. Required annual refresher training for controllers had not been carried out at either the Tower or ACC within the 12 months before the occurrences.

18. There is reportedly no controller training provided concerning the limitations of human physiology, and the limitations of pilots in identifying other airborne aircraft during visual approaches.

19. The Cessna 152 (C-FGEK) pilot was not monitoring Tower frequency during the occurrences, with permission from the airport controller.

3.2 Causes

The first risk of collision incident occurred because the Fairchild Metro III crew misidentified the preceding aircraft on approach. Contributing factors were the confusing visual cues in the approach environment, the lack of separation standards other than visual separation for IFR aircraft on visual approaches, and the arrival controller's reluctance to intervene. Possible contributing factors were the lack of an approach sequence number, the reduced staffing level at the Area Control Centre, and that annual refresher training for controllers had not been carried out.

The second risk of collision incident occurred when the Fairchild Metro III crew altered course to increase separation from the F-28. Contributing factors were the airport controller's delay in issuing instructions to the Fairchild Metro III crew to turn, and the Cessna 152 pilot's arrangement with Tower to turn down the volume on his radio.

The third risk of collision incident occurred because the airport controller overlooked the Cessna 414 that was holding position for take-off on runway 31 when he cleared the F-28 to land. Contributing to the occurrence was the airport controller's preoccupation with the first and second risk of collision incidents.

4.0 Safety Action

4.1 Action Taken

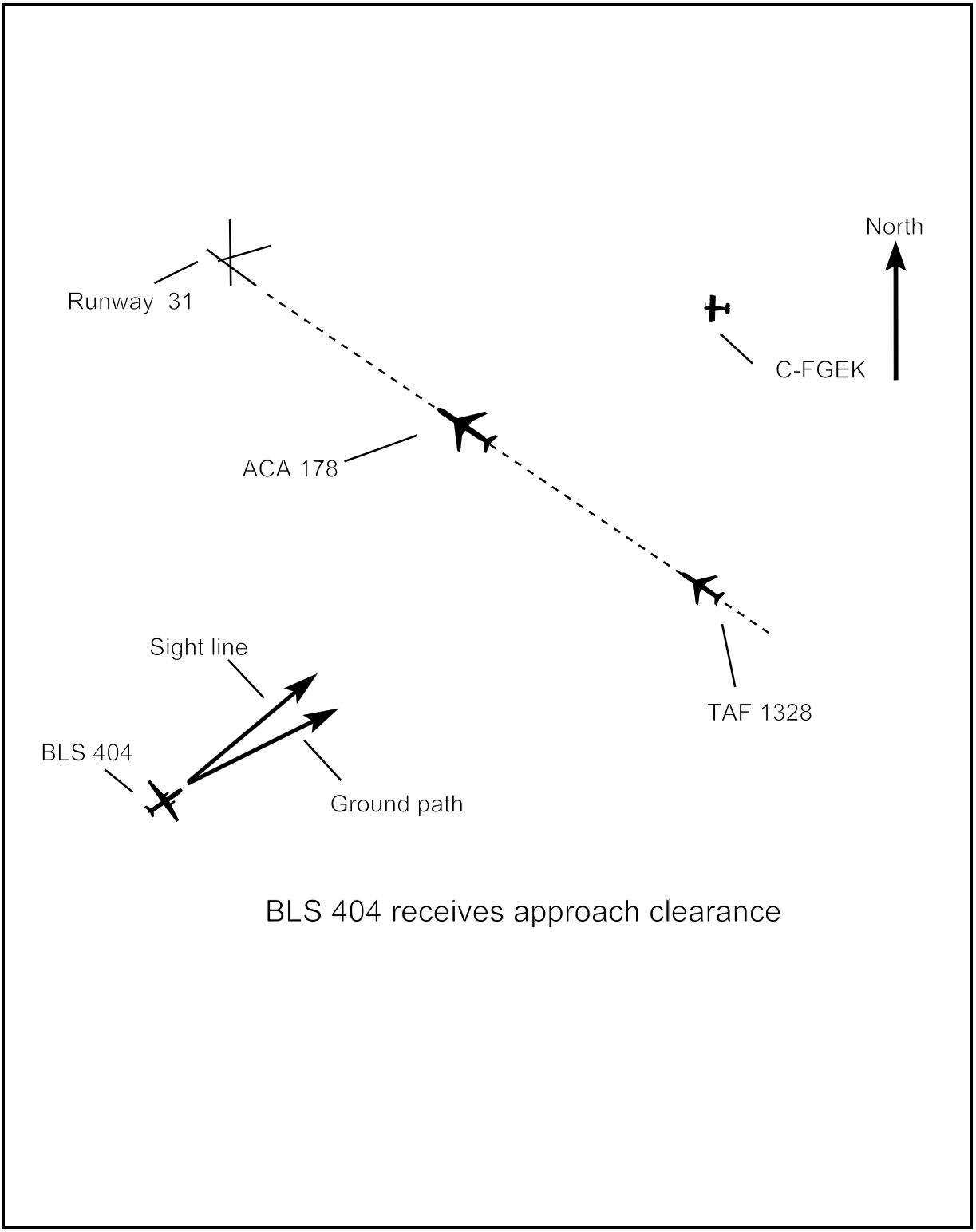
4.1.1 Controller Training and Staffing

Transport Canada indicates that refresher training was conducted for Tower personnel in February 1995, and training regarding the limitation of human physiology in the visual identification and recognition of aircraft will be included on the next refresher course.

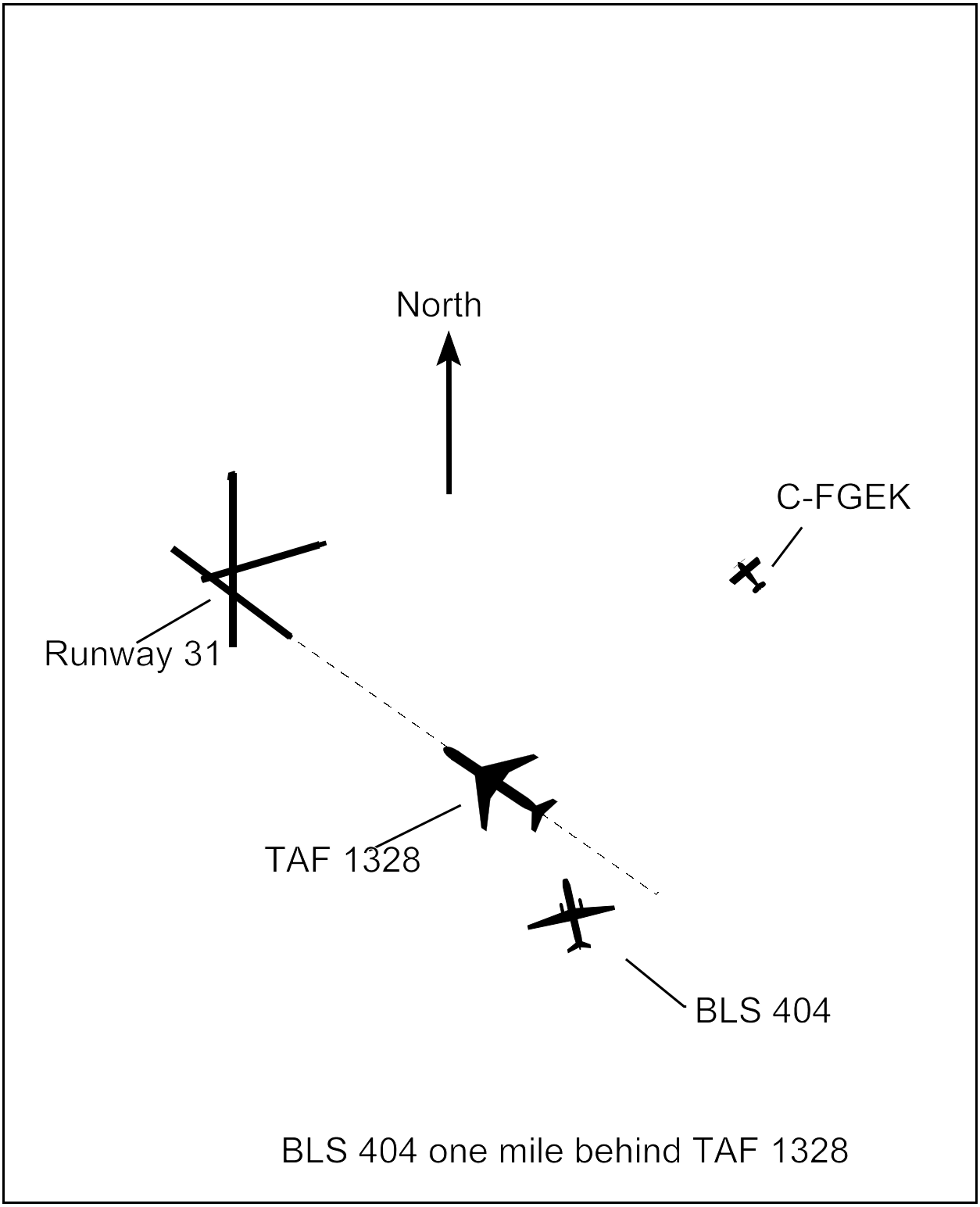
A training program is now in place to correct personnel shortfalls in the Terminal specialty. Transport Canada anticipates that standback supervision for the terminal specialty will be introduced in the fall of 1995, and the Terminal specialty will be fully staffed by the summer of 1996.

This report concludes the Transportation Safety Board's investigation into this occurrence. Consequently, the Board, consisting of Chairperson John W. Stants, and members Zita Brunet and Hugh MacNeil, authorized the release of this report on 16 August 1995.

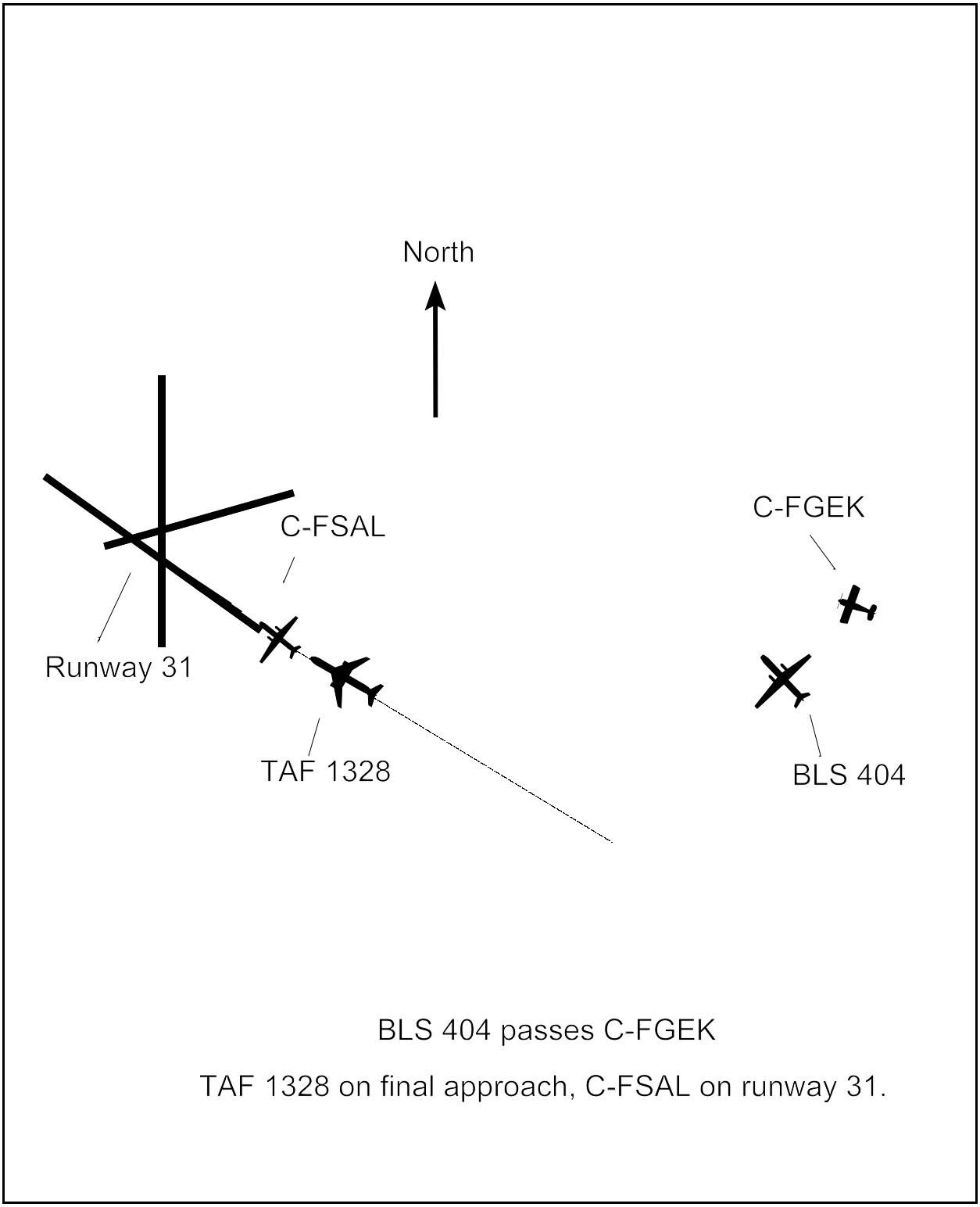
Appendix A - Aircraft Relative Position at 1623:25



Appendix B - Aircraft Relative Position at 1625:49



Appendix C - Aircraft Relative Position at 1626:48



Appendix D - Glossary

ACA 178	Air Canada flight 178
ACC	Area Control Centre
agl	above ground level
asl	above sea level
ATC	air traffic control
ATPL	Airline Transport Pilot Licence
ATS	Air Traffic Services
ATSAMM	Air Traffic Services Administration and Management Manual
BLS 404	Bearskin Lake Air Service flight 404
CPL	Commercial Pilot Licence
CST	central standard time
FL	Flight Level
hr	hour(s)
IFR	instrument flight rules
ILS	instrument landing system
lb	pound(s)
MANOPS	Manual of ATC Operations
MHz	megahertz
MOA	minutes of angle (1 minute = 1/60 of one degree)
nm	nautical miles
PRAP	Performance Review and Assessment of Potential
RAMP	Radar Modernization Project
ROC	risk of collision
TAF 1328	Canadian Regional Airlines flight 1328
TCU	Terminal Control Unit
TRSA	Terminal Radar Service Advisory
TSB	Transportation Safety Board of Canada
UTC	Coordinated Universal Time
VFR	visual flight rules
VOR	very high frequency omni-directional range transmitter
'	minute(s)
"	second(s)
°	degree(s)
°M	degrees of the magnetic compass
°T	degrees true

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