Transport Canada Transports Canada

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AVIATION SAFETY LETTER

IN THIS ISSUE...

TP 185E

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Canada

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Articles, comments and suggestions are invited. The editor reserves the right to edit all published articles. The author's name will be withheld from publication upon request.

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TIPS AND TOOLS

Managing Aircraft Icing

by Wayne Woloshyn, Technical Team Lead, Flight Operations, Prairie and Northern Region, Transport Canada, Civil Aviation, Operations

Our Canadian winter returns with seasonal hazards and risks to be managed by the aviation world. The aircraft operator, flight and ground crews, and even clients have a role to play when it comes to ensuring compliance with aircraft icing regulations.

Responsible company owners and management understand that they have a critical role to play in preventing aircraft from taking off with frost, ice or snow adhering to any of its critical surfaces.

The following are a good reminder:

1. Ensure all staff are aware of management's enforcement of the icing regulations and on-going support for crews' sound decision making
2. Review company winter flying training and ground icing program (CASS 622.11)
3. Bring "Icing" case studies into annual crew resource management (CRM) training
4. Promote reporting of all relevant challenges within your safety management system (SMS) or safety meetings
5. Identify remote destination airports, and know what facilities and equipment are available
6. Try to collaborate with other operators in having facilities and equipment at remote locations
7. Ensure there is training for the de-icing and anti-icing aircraft

Suggestions for flight crews:

1. Complete all associated winter flying and ground icing program training
2. Always obtain complete and thorough weather information
3. Conduct a Threat–Error Management briefing prior to flight to ensure all potential threats are identified
4. Inform passengers early if there is a possibility of delays
5. Ensure management are informed of challenges, hazards and risks encountered by flight crews
6. Be professional and set the example

There are many challenges to manage; the onus is on the operator to ensure the risk of pilots taking off with contaminated surfaces is mitigated. Unfortunately, there will be cancelling, delaying or diversion of flights when ground icing conditions exist, as there are when maintenance issues arise and there is lack of infrastructure at destination airports.

In the final analysis, we must trust disciplined decision making by flight crews regarding de-icing and anti-icing no different than adhering to loading restrictions or carrying of minimum required fuel. Flight crews must be supported by the operator and compliance to regulation ensured by Transport Canada. Since the accident in Fond-Du-Lac in 2017, efforts made by all concerned to reduce the risk of pilots taking off with contaminated surfaces have shown to be effective. △

Credit: iStock

Quick Update on Our Newsletter Schedule

Just a heads-up—we are publishing three issues of the *Aviation Safety Letter* this year instead of our usual four. Our editor was away for a bit, so we had to shift things around a little.

We appreciate your understanding and continued support.

We're still lining up some great content, and we can't wait to share it with you. △

2025—2026 Transport Canada's Flight Crew Recency Requirements Self-paced Study Program

The Flight Crew Recency Requirements Self-Paced Study Program is no longer published in its entirety in the *Aviation Safety Letter*. Refer to paragraph 421.05(2)(d) of the *Canadian Aviation Regulations* (CARs), which is designed for pilots to update their knowledge on subjects such as human factors, meteorology, flight planning and navigation, and aviation regulations.

Completion of this questionnaire satisfies the 24-month recurrent training program requirements of CAR 401.05(2)(a). It is to be retained by the pilot.

If you have any questions or comments regarding the Flight Crew Recency Requirements Self-paced Study Program, please send an e-mail to the flight crew licensing group at: PilotLicensing-LicencesdePilote@tc.gc.ca △

NAV CANADA
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Using Published VFR Routes and VFR Checkpoints

by NAV CANADA

What Are VFR Routes and VFR Checkpoints?

Published visual flight rules (VFR) routes are recommended flight paths designed to guide VFR pilots safely into, out of or through high-traffic airspace. These routes help integrate VFR aircraft with other operations, such as instrument flight rules (IFR) procedures, reducing the risk of conflicts. VFR routes can be published as unidirectional or bidirectional, depending on the airspace requirements.

VFR checkpoints are geographical reference points with pronounceable names, typically tied to prominent landmarks. These checkpoints assist pilots in communicating their position during flight. To support modern navigation, each checkpoint is assigned a unique five-letter identifier starting with "VC" (e.g., VCXYZ) for use in global navigation satellite system (GNSS) equipped aircraft that have up-to-date databases. VFR checkpoints may be incorporated in VFR routes, or sometimes they can be standalone.

Why It Matters

The introduction of VFR routes and VFR checkpoints addresses some of the challenges of operating in busier airspace, where VFR pilots must navigate safely alongside other aircraft. By following published routes, pilots can avoid congested areas and align their flight paths with recommended procedures. Referring to published VFR checkpoints communalizes position reporting, improving communication with air traffic service and other pilots.

How to Use Them

Pilots are encouraged to consult VFR Terminal Area (VTA) charts and VFR Terminal Procedures Charts (VTPC) in the *Canada Flight Supplement* (CFS) to locate published VFR routes and VFR checkpoints. These charts provide detailed depictions of routes and checkpoints, including routes for entering or exiting control zones and routes for transiting airspace.

The following is an example VTPC with published unidirectional fixed wing VFR routes helping to organize entry and exit from the MONTRÉAL/MET control zone, along with a number of VFR checkpoints:

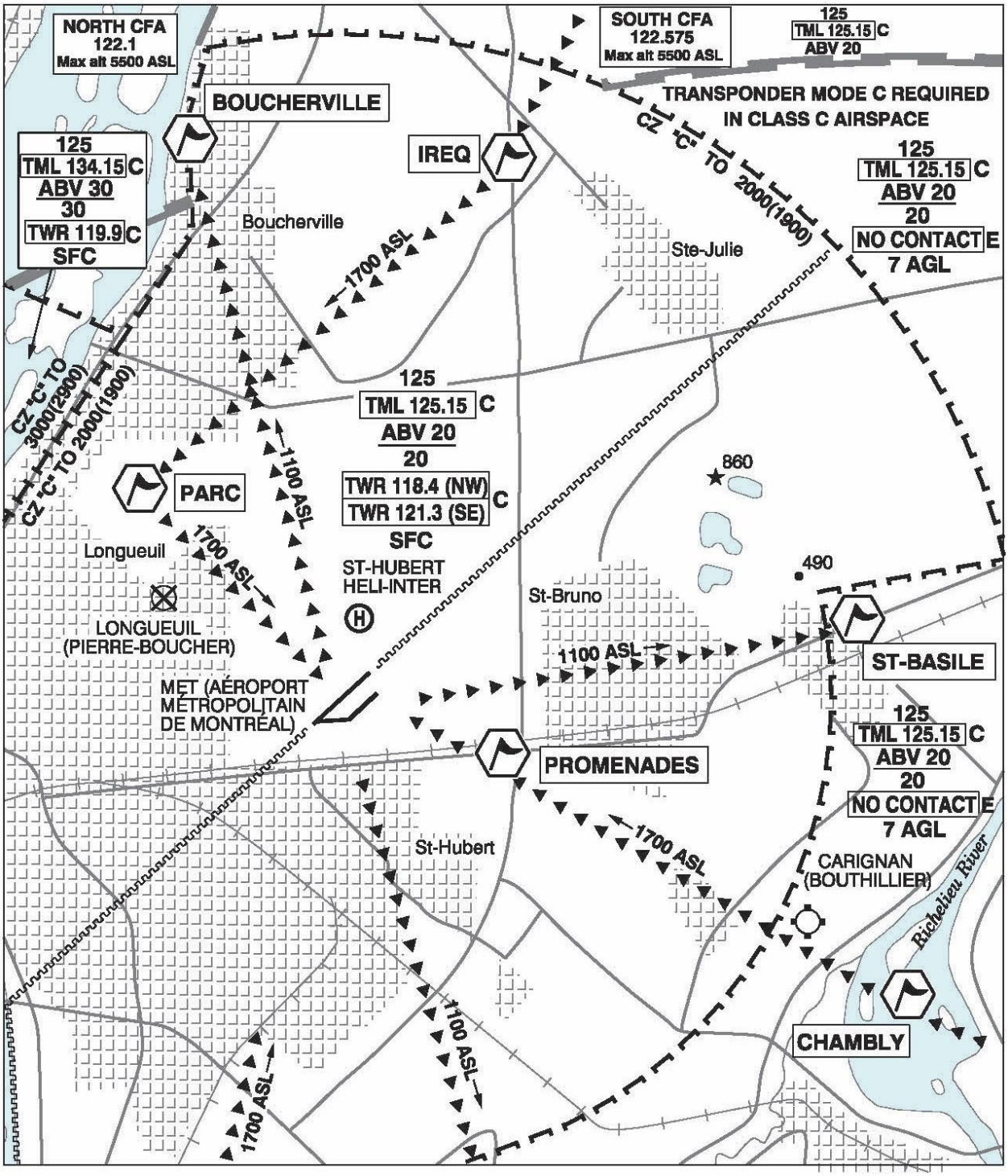

Figure 1

A table is also included with the VTPC showing the IDENT as well the latitude and longitude for each VFR checkpoint, and a textual description of the VFR routes:

NOM	IDENT	LAT/LONG
AUTOROUTE 10/RIVIERE L'ACADIE	VCACD	N45° 24′ 28″ W073° 22′ 06″
BOUCHERVILLE	VCBSV	N45° 36′ 48″ W073° 27′ 24″
CARRIERE VARENNES	VCCVS	N45° 39′ 55″ W073° 20′ 08″
CHAMBLY	VCBCY	N45° 27′ 40″ W073° 16′ 38″
IREQ	VCIRE	N45° 36′ 46″ W073° 23′ 02″
PARC	VCPRK	N45° 33′ 05″ W073° 28′ 11″
PROMENADES	VCPMM	N45° 30′ 19″ W073° 22′ 42″
ST-BASILE	VCSTB	N45° 31′ 36″ W073° 17′ 20″
ST-PHILIPPE	VCLPR	N45° 21′ 10″ W073° 28′ 29″

DEPARTURES

- All rwys, unless specified by ATC, not above 1100 ASL until outside the zone

ARRIVALS

Follow arrival routes, unless otherwise specified by ATC:

CHAMBLY arrival

- 24L: Proceed to PROMENADES, join mid-left downwind, not below 1700 ASL
- 06R: Proceed to PROMENADES, join mid-right downwind, not below 1700 ASL

ST-PHILIPPE arrival

- 24L: Proceed to PROMENADES, join left downwind, not below 1700 ASL
- 06R: join straight-in approach, not below 1700 ASL

VARENNES arrival

- 24L: Proceed to IREQ, then to PARC, join mid-right downwind, not below 1700 ASL
- 06R: Proceed to IREQ, then to PARC, join mid-left downwind, not below 1700 ASL

Safety First

VFR pilots are urged to incorporate these published routes and checkpoints into their flight planning and execution whenever feasible. By doing so, pilots contribute to safer, more efficient airspace operations, benefiting the entire aviation community.

For more details on VFR routes and VFR checkpoints, refer to RAC 4.7 of the Transport Canada Aeronautical Information Manual (TC AIM). △

Runway Incursions: No, That Wasn't for You

by Marcelo Cabral, Aviation SMS Expert

Canada continues to experience an elevated number of runway incursions annually. Although the collective efforts of our regulator, the air navigation services provider (ANSP), our independent safety investigation agency and industry stakeholders have reduced the number of high-risk occurrences compared to pre-COVID levels, the number of low-risk incursions has remained elevated[1]. Each incursion is a warning on our aviation system. These events, no matter how minor they may seem, demand our attention and must never be normalized[2].

Credit: Shutterstock

Assume Nothing

Data have shown that the single biggest cause leading to incursions is communication and the assumption that it has occurred. In the busy, high-stakes environment of an airport maneuvering area, assuming understanding is a risk no one can afford. Independent of the type of aircraft you operate, deliberate and purposeful briefings are essential[3].

Challenge all instructions and clearances with complete and correct readbacks and question when unclear. Expect the same from your crew, and reinforce it with your ground and air traffic control (ATC) partners. The cost of miscommunication is high. Committing to full, clear readbacks and mutual understanding is one of the most effective ways to avoid errors that can lead to incursions.

Leveraging Just Culture for Early Detection

Just culture plays a critical role in how we respond to the runway incursions that occur each year. It examines them openly, without blame, and asks, "What conditions allowed this to happen?" By treating each minor incursion as a learning opportunity, we enhance our ability to identify and address weaknesses.

An Open Call to Collaborate

I encourage you, your chief pilot or your safety management system (SMS) team to reach out directly to the respective airport authorities' SMS teams. Why? Because runway incursions don't happen in isolation[4].

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[1] *NAV CANADA. (2024, August 31). Aeronautical Information Publication (AIP) Canada:* Annual Information Form *[PDF].*

[2] *Cabral, M & Liotscos. B. (2025, May). L-RST Best Practices—Vancouver Airport Authority–NAV CANADA Aviation Safety Forum, Ottawa, Canada*

[3] *Ochin. B (2025, May). Runway Incursion Data–NAV CANADA Aviation Safety Forum, Ottawa, Canada*

[4] *Cabral, M., & Dutta, P. (2025, June). How organisations can adapt and evolve their safety management systems to foster a culture that prioritises safety at every level. Journal of Airport Management, 19(3), 222–232.*

They involve people, procedures, infrastructure and weather. Let's meet at the local Runway Safety Action Team, bring the data, bring the ideas and collaborate on solutions together.

Break the Silence Around Safety Data

Aviation history has some hard lessons about what happens when safety data is not shared, such as the Boeing 737 MAX crashes and other times where a high volume of safety data normalizes an unsafe operation, and the Potomac River mid-air collision with thousands of loss-of-separation occurrences and numerous near-misses.

It is much easier to implement a complex change when you already have an integrated team collaborating on other less complex issues than trying to get buy-in when things are escalating, and you don't have the group ready to focus on the change and willing to listen to all perspective and change processes (and a few minds) to focus on enhancing safety.

Safety isn't just a checklist; it's a conversation: the kind where everyone gets a voice and everyone leaves smarter than they came in. △

Submission of *Aviation Safety Letter* (ASL) articles

Do you have an aviation safety topic you are passionate about? Do you want to share your expert knowledge with others? If so, we would love to hear from you!

General information and guidance

The ASL's primary objective is to promote aviation safety. It includes articles that address aviation safety from all perspectives, such as safety insight derived from accidents and incidents, as well as safety information tailored to the needs of all holders of a valid Canadian pilot licence or permit, to all holders of a valid Canadian aircraft maintenance engineer (AME) licence and to other interested individuals within the aviation community.

If you are interested in writing an article, please send it by e-mail to TC.ASL-SAN.TC@tc.gc.ca in your preferred language. Please note that all articles will be edited and translated by the Transport Canada Civil Aviation (TCCA) Aviation Terminology Standardization Division and will be coordinated by the ASL team.

Photos

In order to captivate our readers' interest, we recommend that you include one or two photos (i.e., photo, illustration, chart or graphic) for each article, if possible. Please send us your photos as an e-mail attachment (preferably as a jpeg).

We look forward to receiving your articles. △

ON THE RADAR

Air Taxi Safety Campaign (ATSC) Update

by ATSC Team, Technical Program & Evaluations, Safety Promotion & Education, Transport Canada, Civil Aviation

In response to the Transportation Safety Board (TSB)'s report *"Raising the Bar on Safety: Reducing the Risks Associated with Air-Taxi Operations in Canada,"* Transport Canada's Civil Aviation Branch (TCCA) launched a targeted air taxi safety campaign to directly address the TSB's recommendation A19-02.

Credit: iStock

The TSB emphasized the need to shift the mindset across the air-taxi industry—among clients, passengers, crews and operators—toward actively rejecting unsafe practices, even when operations appear to be within acceptable margins. Achieving this shift requires sector-specific strategies and educational efforts that promote behavioural and cultural change, ultimately fostering an environment where unsafe actions are no longer tolerated.

In light of this, TCCA created three working groups: human factors, clients and operational pressures. These working groups provide a platform for active engagement between TCCA and the aviation community. By collaborating on best practices and shared challenges, they contribute to reducing operational risks and advancing safety across the air-taxi industry.

Human Factors Working Group Update

CRM Training Content Development

The working group is currently developing PowerPoint training modules to address core crew resource management (CRM) topics, such as the acceptance/normalization of unsafe practices, where pilots may become desensitized to risk due to pressure or routine exposure. Emphasis is also placed on professionalism, particularly in leadership, communication and team coordination.

Additional topics address the five human performance principles, which include managing fatigue, effective use of automation and technology and sound decision-making under operational stress. Threat and error management (TEM) will provide frameworks for identifying and managing operational hazards. Finally, specific strategies are presented for single-pilot crew resource management, focusing on properly managing workload, fatigue and pressure.

Case Study Catalogue (CRM Learning Support)
To support scenario-based learning, a catalogue of real-world case studies is being developed. These include a runway excursion, a MEDEVAC flight, a controlled flight into terrain (CFIT) during a helicopter passenger operation, a loss of control in-flight (LOC-I) during a sightseeing flight, and a collision during takeoff involving a floatplane on a passenger flight. Each case is selected to illustrate specific human factors challenges, as well as human performance issues, linked directly to the CRM principles being taught, encouraging applied learning and critical thinking.

Clients Working Group Update

Client Education & Awareness Content
Content is also being tailored for two distinct audiences: company executives (such as CEOs and owners) and customer passengers.

For executives, the material focuses on how organizational decisions and culture influence safety outcomes. Topics include the normalization of unsafe practices, the challenges of single-pilot CRM, compliance with pilot duty time regulations, and understanding aircraft operational limitations such as weight and balance, maintenance requirements and weather-related risks.

For customers, the goal is to raise awareness around operational decisions without causing alarm. Educational materials will help passengers understand why delays, cancellations and operational limits are necessary safety measures rather than inconveniences.

Operational Pressures Working Group Update

Operational Pressures—Risk Identification & Mitigation
A separate presentation is being developed to help operators identify and mitigate key operational pressures that can compromise safety. These include weather-related go/no-go decisions, limitations in aerodrome infrastructure (such as availability of de-icing or weather reporting), and challenges in maintaining accurate weight and balance with cargo, baggage and passengers.

Additional pressures include fatigue management in relation to flight duty time limits, handling of unserviceable aircraft and maintenance delays, and staffing shortages that impact both flight crews and maintenance teams. Each of these pressure points will be addressed with suggested mitigation strategies to support safe operational decision-making.

For more information on the ATSC or to view educational products that were developed, please visit the campaign's Web page. △

INSTRUCTOR'S CORNER

Risk Management in Mountain Flying

by John Mader, P. Eng., ATPL, Class 1 Instructor, Calgary Flying Club

Flying through the mountains on a beautiful day is one of the great joys that we who are able to fly can experience. Like all other flying, mountain flying has associated risks, and doing so safely is a matter of identifying the hazards and either avoiding them or mitigating them so that the remaining risk is at an acceptable level. Knowing when not to go flying in the mountains is an important skill to develop.

By far the biggest risk area in mountain flying is the weather. Mountain topography itself plays a large part in this, as orographic lift, resulting in cloud and precipitation, can form whenever moist air crosses a mountain range, regardless of direction. Often, fair weather on the east side of the range will be accompanied by poor weather on the west side, and vice versa. Ideal weather occurs when a large, dry, high-pressure system covers the range, with low-pressure gradients giving light winds.

One of the challenges in developing a clear picture of the weather situation is the lack of weather reporting stations in mountainous areas and the variability of weather along any particular route. For example, if planning a flight from Calgary Springbank to Kamloops on collaborative flight planning services (CFPS), the only weather reporting stations that will come up in between are at Golden and Revelstoke, and neither of these have terminal forecasts. Public forecasts can help, but they often lack information like ceiling. Often, webcams along your planned route can be a great help in checking current weather. Make sure they are operating properly, however, and that you are not looking at a frozen picture from last week. Satellite images that can be selected from CFPS can also help in determining cloud cover along the route. Flight information centre (FIC) personnel can help with this, as they reportedly have access to better resolution images than are available on CFPS.

Expected turbulence should play a big role in determining your go/no-go decision. Nothing will turn off a passenger from ever flying with you again more than having to endure long stretches of turbulence waiting for the next airport to arrive. So, check the turbulence graphical forecast area (GFA) to see if any mountain wave is predicted, and check the winds at peak top level. In the Calgary area, this means the 9 000 and 12 000-ft levels. The rule of thumb used here is that if the winds at peak top level are forecast 25 kts or more, cancel your trip for today. If the winds are 20 to 25 kts, it may be okay for experienced flyers, but non-pilot passengers are probably not going to like it.

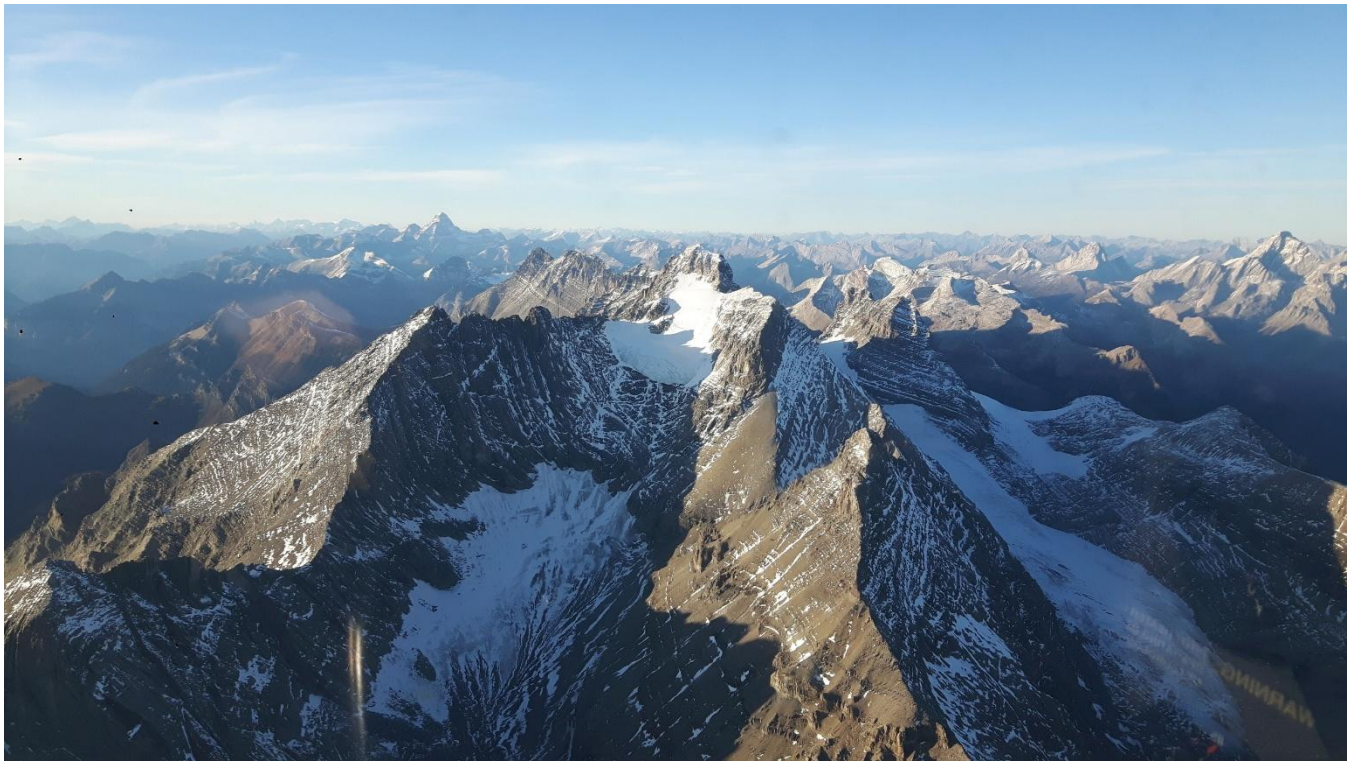
When flying in the mountains, make sure that you plan things so that you will be safely tied down at destination before dark. Flying at night single-engine visual flight rules (VFR) in the mountains is just a bad idea. Be aware that even before darkness falls, westbound flying may have poor visibility due to glare from the setting sun and growing darkness after the sun sets. It may be difficult to see obstacles, even though it is not yet night.

Credit: John Mader

It may not be obvious in the mountains with so much rock above you, but some mountain airfields can be at quite high altitudes. This, plus high summer temperatures, means high-density altitudes. Transport Canada defines density altitude as pressure altitude corrected for non-standard temperature. I prefer a definition that I think is a bit more meaningful:" Density altitude is a measure of air density, expressed as an equivalent altitude in the ICAO Standard Atmosphere." In Springbank in the summer, with temperatures in the +30°C range, we frequently have density altitudes above 6 500 ft. In other words, your airplane will act like it is above 6 500 ft in the standard atmosphere. This means lower engine power (unless turbocharged or supercharged), longer takeoffs and landing runs, lower climb rates and larger turning radii. Take this into account when planning landings and takeoffs at mountain airfields. In some cases, it may be better to reduce load and wait for cooler temperatures or more favourable winds before taking off. In addition, since most light aircraft need more room to take off than to land, make sure you don't land at an airfield you won't have enough room to take off from.

Pick your routings to reduce your risk in the event of mechanical problems. Aircraft engines are very reliable, as long as you give them fuel, air and ignition, but sometimes they do fail, and I would rather not be a long way from civilization if that happened. My preference is to stay within gliding distance of major roadways, just in case. If you can't land on the road, you can usually find some smaller trees beside the road, and help is more likely to be near. Also, consider taking survival gear with you when flying through the mountains.

Safe flying through the mountains also means having alternate plans and routes, should things not turn out as planned. Think about where else you could go, should your route to destination be blocked. Would you have sufficient fuel to get there? What if you had to go all the way back to your departure point from almost getting to your destination? Would you have the fuel to do that? Often there are few or no aerodromes along your route where



Credit: John Mader

fuel is available. Think these issues through ahead of time. Even if the *Canada Flight Supplement* (CFS) says there is fuel available at an aerodrome, it is a good idea to call the supplier and make sure of availability before you go.

With the popularity of GPS and Foreflight, getting lost in the mountains is becoming less and less likely. However, I still believe that charts are the ultimate backup, and knowing how to map read is an essential basic skill. Checking your charts beforehand can help you identify alternate routes to use if, for example, a thunderstorm is blocking your way. Making sure you always know where you are can help you avoid inadvertently turning up the wrong valley.

Flying through the mountains on a day with great weather can be an exhilarating experience for you and your passengers. Preparation, hazard identification and risk mitigation are the keys to a safe and successful trip. Pick your days and never commit to making a particular trip on a particular day. I have given mountain checkouts that have been done on the first try and others that had to be cancelled five times before we finally got a good day. Be patient and take your time. And if you have never flown in the mountains or would like to improve your skills, contact any flight school near the mountains, and they will be able to help you safely transition into mountain flying. △

Submission of Instructor's Corner Articles

The purpose of the *Aviation Safety Letter* instructor's corner is for instructors to share past instructing/teaching experience with the ASL readership.

Submitted articles can be addressed to a variety of readers, instructors, student pilots, private pilots, and glider, ultralight or commercial pilots. In fact, the article is for any type of student that an instructor may encounter in the course of their career, whether it be for a licence or a rating. The most important thing is that, at the end of the article, a lesson has been learned.

Your submissions can be as basic as attitude and movement for private pilot training, to night rating, multi-IFR or seaplane rating, teaching tips for instructors. It can also be tips to increase aviation safety or to be better prepared for a flight.

It's up to you, as long as you have your instructor's hat when you're writing your piece.

If you would like to submit an article or would like more information, please send an email to the following address: aviationsafetyletter-securiteaeriennenouvelles@tc.gc.ca △

Civil Aviation Documents Published Recently

Civil Aviation Safety Alerts (CASAs)

Document number (R-Revised)	Issue number (Date issued)	Subject
CASA 2025-12	Issue 01 2025-11-20	Applications for FAOC-FTA Authorizations Involving Restricted-category Foreign Experimental or Ex-military Aircraft Under Specialty Air Services – CUSMA
CASA 2025-11	Issue 01 2025-10-22	Part Number (P/N) MS20220-3 Pulleys with Corroded and Dislodged Bearings

Advisory Circulars (ACs)

Document number (R-Revised)	Issue number (Date issued)	Subject
AC 549-002	Issue 01 2025-11-25	Amateur-built aircraft major portion evaluation
AC 801-002	Issue 01 2025-11-20	Air Traffic Flow Management (ATFM) Procedures
AC 901-002	Issue 02 2025-11-04	Guidance on Manual Development for Remotely Piloted Aircraft System Operator Certificate (RPOC) Holders
AC 500-020	Issue 04 2025-10-28	Flight Management System (FMS) Barometric Vertical Navigation (VNAV) Temperature Compensation

RECENTLY RELEASED TSB REPORTS

TSB Report A23W0122—Runway Incursion and Risk of Collision

History of the occurrence

On the morning of October 6, 2023, the active runways at Calgary International Airport (CYYC), Alberta were Runway 17L and Runway 17R. At 1030, after the morning's peak of departing aircraft, air traffic controller positions in the Calgary control tower were reduced to the following three:

- combined east/west tower;
- west ground; and
- combined east ground, apron advisory and clearance delivery.

In addition, a decision was made at this time to shut down the advanced surface movement guidance and control system (A-SMGCS) to allow for a planned software update. The shutdown had been estimated to last 30 minutes. This meant the controllers would not be able to use the system for monitoring ground movements or activate the virtual stop bars to help mitigate the consequence of a runway incursion. The three controllers had to rely solely on visually scanning the areas for which they were responsible. To mitigate this loss of surveillance equipment, the air traffic control (ATC) unit moved to a simplified movement posture called Segregated Plus. By organizing the runways for separate purposes—Runway 17L for landings only and Runway 17R for takeoffs and landings, with increased spacing—the controllers had more time for the visual confirmation of movements on the airport surface. Operations at this time were considered moderate for traffic volume and medium complexity due to the A-SMGCS being shut down.

At 1059, the drivers of two aircraft tow vehicles (tugs), called the ground controller to ask for instructions on how to proceed from the main apron, Apron 1, where they were, to the south end of the airport to move an aircraft parked on Runway 26, which was closed, to Apron 5. In summary, the lead tug driver was given instructions by the ground controller to proceed south on taxiways C, C1 and Y and to hold short of Runway 26.

An aircraft that had recently landed, a De Havilland Aircraft of Canada Limited DHC-8-402, had exited Runway 17R on Taxiway C3 and was making its way north on Taxiway C. Due to line painting being conducted on Taxiway U between Taxiway C and Runway 29, Taxiway Y was inaccessible to aircraft.

Therefore, at 1101:45, the ground controller instructed the two southbound tugs to give way to this aircraft by moving onto Taxiway C2, and to hold short of Runway 17R while remaining clear of Taxiway C (Figure 1). The driver of the lead tug asked the ground controller for clarification, which he received and then correctly read back.

At 1102:25, a different aircraft, another DHC-8-402, was preparing for departure and was instructed to taxi from Apron 1 and hold short of Runway 17R. Meanwhile, around this time, the drivers of the tugs had entered Taxiway C2 to give way to the first aircraft, which was travelling north on Taxiway C.

By 1103:00, the two tugs were on Taxiway C2 and stopped on the centreline, just short of the runway holding position marking for Runway 17R. For the lead tug driver, this was a typical position at which to stop when told to hold short of a runway, because of the fact that when a driver is told to hold short of a runway, the next instruction from ATC is usually to continue across the runway holding position marking and onto the runway rather than to turn around. Once the first aircraft had passed north of Taxiway C2 on Taxiway C, the tugs were instructed by the ground controller, at 1103:47, to proceed onto Taxiway C and hold short of Runway 26, which the lead aircraft tug driver read back. It was at approximately this time that the departing aircraft, which had been holding short of Runway 17R, was given the instruction by the tower controller to line up and wait on that runway, followed by a clearance to take off at 1104:00.

At this time, the lead tug was positioned close to the Runway 17R runway holding position marking on Taxiway C2. The driver of the lead vehicle had never turned around on a taxiway before and believed this was not allowed. In the absence of an explicit instruction to turn around in the ground controller's last communication, the lead driver also believed that doing so on Taxiway C2 to join Taxiway C

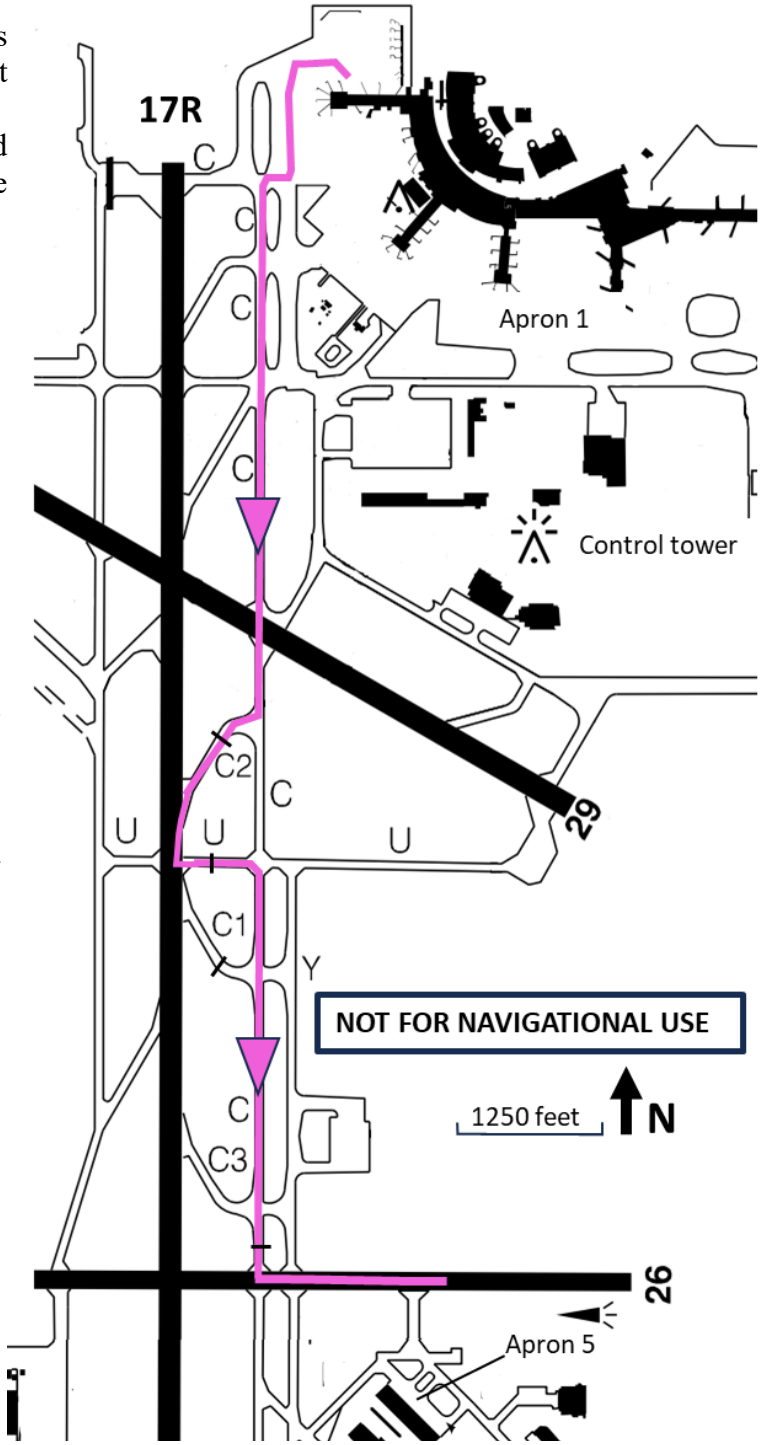


Figure 1: Tugs' path (solid magenta line with directional arrows) at Calgary International Airport (Source: NAV CANADA, Canada Air Pilot [CAP], CAP 3: Alberta, Saskatchewan and Manitoba, effective July 11, 2024 to September 5, 2024, with TSB annotations)

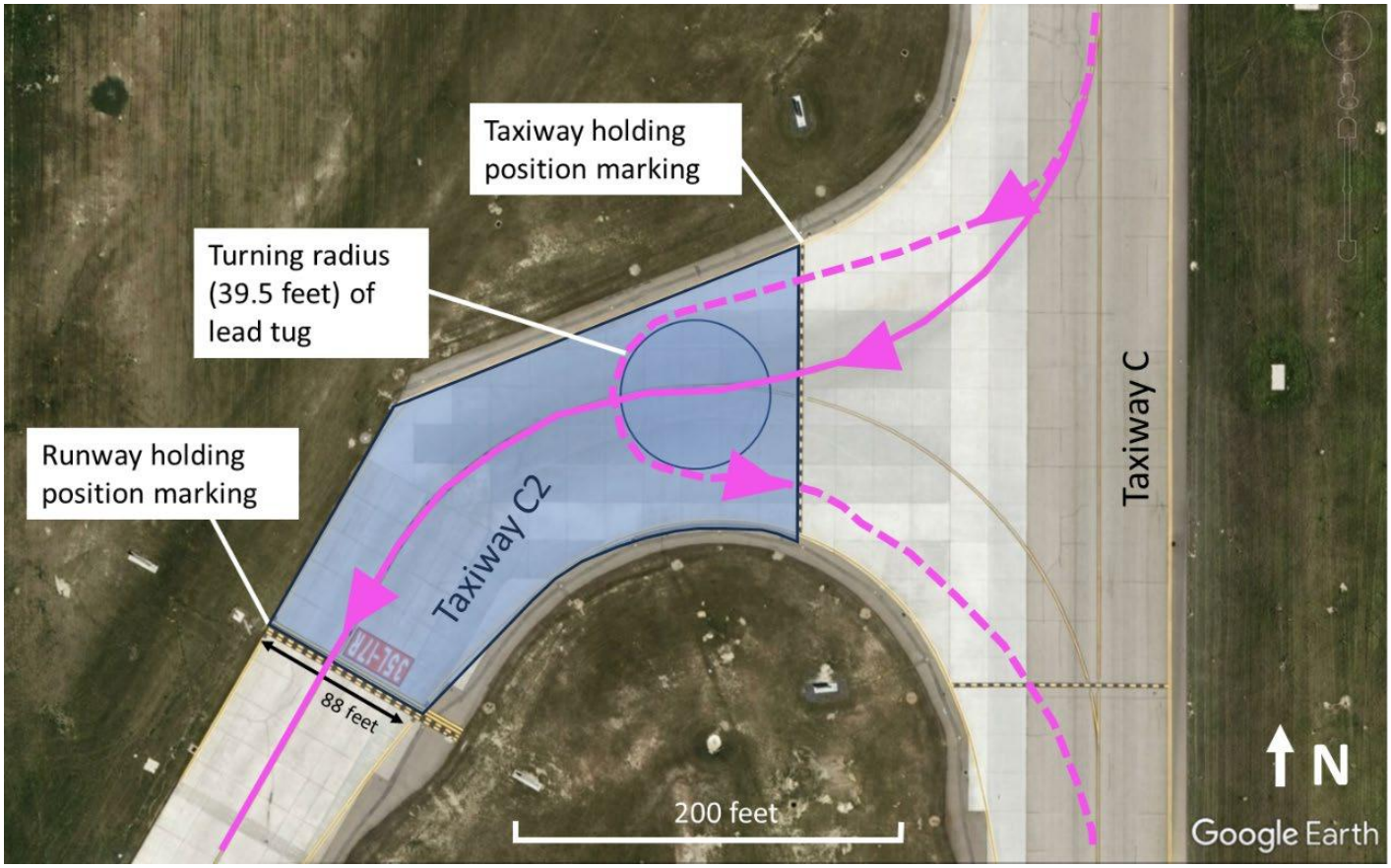


Figure 2: Path that the ground controller had intended for the two tugs (dashed magenta line) and the actual path taken (solid magenta line). The shaded area is where the ground controller had wanted the tugs to hold until the aircraft taxiing on Taxiway C in the opposite direction had passed
(Source: Google Earth, with TSB annotations)

would not be possible because he perceived that there was not enough space for both vehicles to turn around, given each vehicle's turning radius (Figure 2).

He did not deem backing up an option because it would have required both drivers to exit their vehicles; disconnect the towbar from the second tug, which would have taken time; and coordinate the tugs' movements. In addition, during the summer, the lead tug driver had taken similar detours onto Runway 29 during construction work on and near Runway 29. Consequently, at 1104:04, the two tugs crossed the runway holding position marking and entered Runway 17R from Taxiway C2, resulting in a runway incursion. The lead tug driver had reasoned that if this was an incorrect action, the ground controller would intervene and stop him and the other driver. Shortly afterwards, at 1104:16, the flight crew of the departing aircraft began its takeoff roll.

At 1104:25, the tugs were on the runway surface for Runway 17R, resulting in a risk of collision with the aircraft that had just begun its takeoff roll. The vehicles continued to travel along the runway with the intent of exiting onto Taxiway U.

At 1104:30, the ground controller, unaware of the lead tug driver's intentions, observed the tugs on Runway 17R. At that time, the ground controller was controlling four other aircraft. He asked the tower controller to abort the aircraft's takeoff, and the tower controller gave the abort command at 1104:36 using non-standard phraseology (see Section 1.18.2.3, Phraseology for safety-critical situations of this report). The flight crew of the departing aircraft did not recall hearing the abort takeoff instruction from the tower controller.

A few moments later, the flight crew saw the vehicles on the runway. They continued the takeoff, given that the aircraft was near the decision speed (V1) and they considered this option to be the safest course of action. At 1104:39, in summary, the ground controller instructed the tugs to exit Runway 17R onto Taxiway U, to proceed onto Taxiway C and hold short of Runway 26. The driver of the lead tug read back the instructions.

At 1104:43, the departing aircraft was crossing Runway 29 and had accelerated past V1. At an approximate lateral distance of 3 700 ft from the tugs, the aircraft became airborne. At 1104:53, while the vehicles were exiting Runway 17R via Taxiway U, the aircraft passed over them at a height of approximately 350 ft, and the flight crew continued the flight without further incident.

Meteorological information

The aerodrome routine meteorological report (METAR) issued at 1100 for CYYC was as follows:

- winds from 220° true at 4 kts
- visibility 40 statute miles
- scattered clouds at 25 000 ft above ground level
- temperature 10°C and dew point −3°C

Weather was not considered to be a factor in this occurrence.

Decision to enter Runway 17R

Before the runway incursion occurred and while the two tugs were travelling south on Taxiway C toward their destination, the ground controller instructed the lead tug driver to move onto Taxiway C2, hold short of Runway 17R, remain clear of Taxiway C while an aircraft travelling north on that taxiway passed by, and then proceed on Taxiway C again. During this series of instructions, the lead driver's mental model of the situation was in conflict with the ground controller's mental model and, by extension, with the ground controller's expectation of what the lead driver would do based on these instructions.

The lead driver's mental model consisted of several elements that made entering Runway 17R, for the purposes of rejoining Taxiway C, appear to be the right choice in that moment. When he received the instruction from the ground controller to enter Taxiway C2 and hold short of Runway 17R, his interpretation of this instruction was that the two tugs were required to proceed all the way to the runway holding position marking and stop immediately short of it. This action was inconsistent with the procedure in the Calgary Airport Authority's Airside Vehicle Operator's Permit (AVOP) Airside Traffic Directives for approaching runway holding position markings, which stipulates that a driver must stop in a position in which there is enough space to turn around. However, the driver's action was likely a practice that logically arose from the fact that an instruction to hold short of a runway is almost always followed by an instruction to continue on that route onto the runway and not to turn around. Additionally, the driver had never turned around on a taxiway before and believed this was not allowed. It therefore made sense to the lead tug driver to wait immediately short of the runway holding position marking, based on, and in anticipation of, what he typically experienced after this kind of instruction from ATC.

As a result of where he had stopped while waiting for the taxiing aircraft to pass, he did not feel he was able to turn around once the instruction to proceed on Taxiway C was received. The area on Taxiway C2 around the runway holding position marking is a narrow space (approximately 88 ft wide) and given the lead tug driver's turning radius while in two-wheel steering mode (39.5 ft), the space appeared inadequate to the lead driver for the purposes of accomplishing the manoeuvre. Furthermore, he did not deem backing up an option because it would have required both drivers to exit their vehicles and disconnect the towbar from the second tug. The lead tug driver also had a strong belief that, unless explicitly instructed by the controller to do so, drivers were not supposed to turn around while driving on controlled airport surfaces, such as taxiways and runways, and that this would require specific instructions from the controller. Therefore, all of these elements resulted in his conclusion that turning around was not a viable option.

The route that did appear to make sense to the lead tug driver was to enter Runway 17R and immediately navigate back onto Taxiway C via Taxiway U. This option was all the more reasonable to him because it involved making a short detour onto a runway, a manoeuvre with which he was familiar, having done something similar on several occasions during the summer while construction was being conducted near Runway 29. He also felt that the ground controller would be able to see what he and the other driver were doing and stop them if their actions were not acceptable.

The ground controller's mental model of the same situation was different. He believed that the tug drivers would follow instructions exactly as provided. In addition, when the lead tug driver gave the ground controller a correct readback of the instruction that had been communicated, this confirmed to the ground controller that the instruction had been understood. Together, both of these shaped the controller's expectation that the subsequent instruction to proceed onto Taxiway C would be followed.

It is difficult for controllers to monitor every movement to its conclusion, but they check the movements they are managing to ensure compliance with their instructions. In this case, the ground controller's expectation that his instruction to the lead tug driver would be followed allowed the ground controller to shift his focus to other aircraft and vehicles.

Finding as to cause and contributing factors

The ground controller's mental model was that the lead tug driver would continue the route the controller had instructed. This was contradictory to the lead tug driver's mental model in which the only way to continue the route was to enter Runway 17R; this mental model had been shaped, in part, by his proximity to the runway holding position. Consequently, the driver misinterpreted the instructions of the ground controller and entered Runway 17R while the departing aircraft was beginning its take-off roll, resulting in a risk of collision.

Air traffic control phraseology for safety-critical situations

The takeoff and landing phases of a flight are periods of high workload for a flight crew. During periods of high workload, individuals focus most of their attention on the most critical tasks and, as a result, filter or ignore sensory input that they deem less relevant or important.

When the tower controller was alerted to the vehicles on the runway, the abort takeoff instruction given to the flight crew, but was not heard. This was likely due in part to the high workload the flight crew was experiencing during the takeoff. The instruction given by the tower controller was not consistent with the NAV CANADA manual of air traffic services. Although it is impossible to determine what would have happened had the correct phraseology

been used, what was said was ineffective as neither flight crew member recalled hearing the instruction to abort the takeoff.

It could not be determined why the controller did not use the current phraseology.

Finding as to risk

If air traffic controllers do not use the correct phraseology for safety-critical situations, there is a risk that the consequences of these situations could be more severe.

Findings as to causes and contributing factors

These are the factors that were found to have caused or contributed to the occurrence.

1. Due to procedural drift over time from an absence of recurrent training and oversight, the lead tug driver stopped too close to the Taxiway C2 runway holding position marking, which did not leave enough room for the vehicle to turn around as required by the AVOP Airside Traffic Directives.

2. The ground controller's mental model was that the lead tug driver would continue the route the controller had instructed. This was contradictory to the lead tug driver's mental model, in which the only way to continue the route was to enter Runway 17R; this mental model had been shaped, in part, by his proximity to the runway holding position. Consequently, the driver misinterpreted the instructions of the ground controller and entered Runway 17R while the departing aircraft was beginning its takeoff roll, resulting in a risk of collision.

Findings as to risk

1. If the authority gradient between an air traffic controller and a ground vehicle operator is not proactively managed, a ground vehicle operator may not feel comfortable asking for clarification if they consider an instruction to be unclear or erroneous. This could potentially result in an operator taking actions that differ from those intended by an air traffic controller.
2. If NAV CANADA relies primarily on additional time and aircraft spacing when A-SMGCS is disabled and key safety features are unavailable, there is an increased risk that hazardous situations such as runway incursions will occur and be detected too late to recover the situation.
3. If air traffic controllers do not use the correct phraseology for safety-critical situations, there is a risk that the consequences of these situations could be more severe.

There is no such thing as an insignificant amount of ice!

The deicing with fluids process is not completed until the aircraft's critical surfaces are completely free from frozen contamination.

Deice properly or don't go!

canada.ca/air-taxi-safety

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