NATIONAL TRANSPORTATION SAFETY BOARD
Public Meeting of September 25, 2018
(Information subject to editing)

Taxiway Overflight, Air Canada Flight 759, Airbus A320-211,
C-FKCK, San Francisco, California
July 7, 2017
NTSB/AIR-18/01

This is a synopsis from the NTSB's report and does not include the Board's rationale for the conclusions, probable cause, and safety recommendations. NTSB staff is currently making final revisions to the report from which the attached conclusions and safety recommendations have been extracted. The final report and pertinent safety recommendation letters will be distributed to recommendation recipients as soon as possible. The attached information is subject to further review and editing to reflect changes adopted during the Board meeting.

Executive Summary

On July 7, 2017, about 2356 Pacific daylight time (PDT), Air Canada flight 759, an Airbus A320-211, Canadian registration C-FKCK, was cleared to land on runway 28R at San Francisco International Airport (SFO), San Francisco, California, but instead lined up with parallel taxiway C.[1] Four air carrier airplanes (a Boeing 787, an Airbus A340, another Boeing 787, and a Boeing 737) were on taxiway C awaiting clearance to take off from runway 28R. The incident airplane descended to an altitude of 100 ft above ground level and overflew the first airplane on the taxiway. The incident flight crew initiated a go-around, and the airplane reached a minimum altitude of about 60 ft and overflew the second airplane on the taxiway before starting to climb. None of the 5 flight crewmembers and 135 passengers aboard the incident airplane were injured, and the incident airplane was not damaged.[2] The incident flight was operated by Air Canada under Title 14 *Code of Federal Regulations* (*CFR*) Part 129 as an international scheduled passenger flight from Toronto/Lester B. Pearson International Airport, Toronto, Canada. An instrument flight rules flight plan had been filed. Night visual meteorological conditions prevailed at the time of the incident.

The flight crewmembers had recent experience flying into SFO at night and were likely expecting SFO to be in its usual configuration; however, on the night of the incident, SFO parallel runway 28L was scheduled to be closed at 2300. The flight crew had opportunities before beginning the approach to learn about the runway 28L closure. The first opportunity occurred before the flight when the crewmembers received the flight release, which included a notice to airmen (NOTAM) about the runway 28L closure. However, the first officer stated that he could not recall reviewing the specific NOTAM that addressed the runway closure. The captain stated that he saw the runway closure information, but his actions (as the pilot flying) in aligning the

[1] All times in this executive summary are PDT unless otherwise noted.

[2] Similarly, no crewmembers and passengers aboard the airplanes on taxiway C were injured, and none of those airplanes were damaged.

airplane with taxiway C instead of runway 28R demonstrated that he did not recall that information when it was needed. The second opportunity occurred in flight when the crewmembers reviewed automatic terminal information system (ATIS) information Quebec (via the airplane's aircraft communication addressing and reporting system [ACARS]), which also included NOTAM information about the runway 28L closure. Both crewmembers recalled reviewing ATIS information Quebec but could not recall reviewing the specific NOTAM that described the runway closure.

The procedures for the approach to runway 28R required the first officer (as the pilot monitoring) to manually tune the instrument landing system (ILS) frequency for runway 28R, which would provide backup lateral guidance (via the localizer) during the approach to supplement the visual approach procedures. However, when the first officer set up the approach, he missed the step to manually tune the ILS frequency. The captain was required to review and verify all programming by the first officer but did not notice that the ILS frequency had not been entered.

The captain stated that, as the airplane approached the airport, he thought that he saw runway lights for runway 28L and thus believed that runway 28R was runway 28L and that taxiway C was runway 28R. At that time, the first officer was focusing inside the cockpit because he was programming the missed approach altitude and heading (in case a missed approach was necessary) and was setting (per the captain's instruction) the runway heading, which reduced his opportunity to effectively monitor the approach. The captain asked the first officer to contact the controller to confirm that the runway was clear, at which time the first officer looked up. By that point, the airplane was lined up with taxiway C, but the first officer presumed that the airplane was aligned with runway 28R due, in part, to his expectation that the captain would align the airplane with the intended landing runway.

The controller confirmed that runway 28R was clear, but the flight crewmembers were unable to reconcile their confusion about the perceived lights on the runway (which were lights from airplanes on taxiway C) with the controller's assurance that the runway was clear. Neither flight crewmember recognized that the airplane was not aligned with the intended landing runway until the airplane was over the airport surface, at which time the flight crew initiated a low-altitude go-around. According to the captain, the first officer called for a go-around at the same time as the captain initiated the maneuver, thereby preventing a collision between the incident airplane and one or more airplanes on the taxiway. However, at that point, safety margins were severely reduced given the incident airplane's proximity to the ground before the airplane began climbing and the minimal distance between the incident airplane and the airplanes on taxiway C.

The flight crewmembers stated, during postincident interviews, that the taxiway C surface resembled a runway. Although multiple cues were available to the flight crew to distinguish runway 28R from taxiway C (such as the green centerline lights and flashing yellow guard lights on the taxiway), sufficient cues also existed to confirm the crew's expectation that the airplane was aligned with the intended landing runway (such as the general outline of airplane lights—in a straight line—on taxiway C and the presence of runway and approach lights on runway 28R, which would also have been present on runway 28L when open). As a result, once the airplane was aligned with what the flight crewmembers thought was the correct landing surface, they were likely

not strongly considering contradictory information. The cues available to the flight crew to indicate that the airplane was aligned with a taxiway did not overcome the crew's belief, as a result of expectation bias, that the taxiway was the intended landing runway.

The flight crewmembers reported that they started to feel tired just after they navigated through an area of thunderstorms, which radar data indicated was about 2145 (0045 eastern daylight time [EDT]). The incident occurred about 2356, which was 0256 EDT according to the flight crew's normal body clock time; thus, part of the incident flight occurred during a time when the flight crew would normally have been asleep (according to postincident interviews) and at a time that approximates the start of the human circadian low period described in Air Canada's fatigue information (in this case, 0300 to 0500 EDT). In addition, at the time of the incident, the captain had been awake for more than 19 hours, and the first officer had been awake for more than 12 hours. Thus, the captain and the first officer were fatigued during the incident flight.

Cockpit voice recorder (CVR) information was not available for this incident because the data were overwritten before senior Air Canada officials became aware of the severity of this incident. Although the National Transportation Safety Board (NTSB) identified significant safety issues during our investigation into this incident, CVR information, if it had been available, could have provided direct evidence about the events leading to the overflight and the go-around. For example, several crew actions/inactions during the incident flight demonstrated breakdowns in crew resource management (CRM), including both pilots' failure to assimilate the runway 28L closure information included in the ATIS information, the first officer's failure to manually tune the ILS frequency, and the captain's failure to verify the tuning of the ILS frequency. However, without CVR information, the NTSB could not determine whether distraction, workload, and/or other factors contributed to these failures.

The NTSB identified the following safety issues as a result of this accident investigation:

- **Need for consistent flight management system (FMS) autotuning capability within an air carrier's fleet.** The FMS Bridge visual approach to runway 28R was the only approach in Air Canada's Airbus A320 database that required manual tuning for a navigational aid, so the manual tuning of the ILS frequency was not a usual procedure for the flight crew. Identifying other approaches that require an unusual or abnormal manual frequency input and developing an autotune solution would help preclude such a situation from recurring. Further, the instruction on the approach chart to manually tune the ILS frequency was not conspicuous during the crew's review of the chart. An action to mitigate this situation for other approaches would be to ensure sufficient salience of the manual tune entry on approach charts.

- **Need for more effective presentation of flight operations information to optimize pilot review and retention of relevant information.** The way information is presented can significantly affect how information is reviewed and retained because a pilot could miss more relevant information when it is presented with information that is less relevant. Although the NOTAM about the runway 28L closure appeared in the flight release and the

ACARS message that were provided to the flight crew, the presentation of that information did not effectively convey the importance of the runway closure information and promote flight crew review and retention. Multiple events in the National Aeronautics and Space Administration's aviation safety reporting system database showed that this issue has affected other pilots, indicating that all pilots could benefit from the improved display of flight operations information.

- **Need for airplanes landing at primary airports within class B and class C airspace to be equipped with a system that alerts pilots when an airplane is not aligned with a runway surface.** A cockpit system that provides an alert if the system predicts a landing on a surface other than a runway would provide pilots with additional positional awareness information. Although the Federal Aviation Administration (FAA) has not mandated the installation of such a system, the results of a simulation showed that such technology, if it had been installed on the incident airplane, could have helped the flight crew identify its surface misalignment error earlier in the landing sequence, which could have resulted in the go-around being performed at a safer altitude (before the airplane was dangerously close to other airplanes). Flight safety would be enhanced if airplanes landing at primary airports within class B and class C airspace were equipped with such a cockpit system and/or a cockpit system that alerts when an airplane is not aligned with the specific runway for which it has been cleared.

- **Need for modifications to airport surface detection equipment (ASDE) systems (ASDE-3, ASDE-X, and airport surface surveillance capability [ASSC]) to detect potential taxiway landings and provide alerts to air traffic controllers.** The SFO air traffic control tower was equipped with an ASSC system, which was not designed to predict an imminent collision involving an arriving airplane lined up with a taxiway; thus, the ASSC system did not produce an alarm as the incident airplane approached taxiway C. If an airplane were to align with a taxiway, an automated ASDE alert could assist controllers in identifying and preventing a potential taxiway landing as well as a potential collision with aircraft, vehicles, or objects that are positioned along taxiways. An FAA demonstration in February 2018 showed the potential effectiveness of such a system.[3]

- **Need for a method to more effectively signal a runway closure to pilots when at least one parallel runway remains in use.** A runway closure marker with a lighted flashing white "X" appeared at the approach and departure ends of runway 28L when it was closed. The runway closure marker was not designed to capture the attention of a flight crew on approach to a different runway, and the marker did not capture the attention of the incident flight crew as the airplane approached the airport while aligned with taxiway C. Increased

[3] On March 2, 2011, the NTSB recommended that the FAA "perform a technical review of Airport Surface Detection Equipment—Model X to determine if the capability exists systemwide to detect improper operations such as landings on taxiways" (A-11-12). The NTSB also recommended that the FAA, "at those installation sites where the technical review recommended in Safety Recommendation A-11-12 determines it is feasible, implement modifications to Airport Surface Detection Equipment—Model X to detect improper operations, such as landings on taxiways, and provide alerts to air traffic controllers that these potential collision risks exist" (A-11-13). The NTSB classified these recommendations "Closed—Unacceptable Action" on September 14, 2011.

conspicuity of runway closure markers, especially those used in parallel runway configurations, could help prevent runway misidentification by flight crews while on approach to an airport.

- **Need for revisions to Canadian regulations to address the potential for fatigue for pilots on reserve duty who are called to operate evening flights that would extend into the pilots' window of circadian low.** The flight crew's work schedule for the incident flight complied with the applicable Canadian flight time limitations and rest requirements; however, the flight and duty time and rest requirements for the captain (a company reserve pilot) would not have complied with US flight time limitations and rest requirements (14 *CFR* Part 117). Transport Canada indicated that its current flight and duty time regulations have been in effect since 1996. Transport Canada also indicated that it released a draft of proposed new flight and duty time regulations in 2014 and issued revised draft regulations in 2017. According to Transport Canada, the proposed regulations would better address the challenge of fatigue mitigation for pilots on reserve duty who are called to operate evening flights extending into their window of circadian low. However, Transport Canada has not yet finalized its rulemaking in this area.[4]

Findings

1. None of the following were factors in this incident: (1) flight crew qualifications, which were in accordance with Canadian and US regulations; (2) flight crew medical conditions; (3) airplane mechanical conditions; and (4) airport lighting, which met US regulations.

2. The first officer did not comply with Air Canada's procedures to tune the instrument landing system (ILS) frequency for the visual approach, and the captain did not comply with company procedures to verify the ILS frequency and identifier for the approach, so the crewmembers could not take advantage of the ILS' lateral guidance capability to help ensure proper surface alignment.

3. The flight crew's failure to manually tune the instrument landing system (ILS) frequency for the approach occurred because (1) the Flight Management System Bridge visual approach was the only approach in Air Canada's Airbus A320 database that required manual tuning of a navigation frequency, so the manual tuning of the ILS frequency was not a usual procedure for the crew, and (2) the instruction on the approach chart to manually tune the ILS frequency was not conspicuous during the crew's review of the chart.

4. The first officer's focus on tasks inside the cockpit after the airplane passed the final waypoint reduced his opportunity to effectively monitor the approach and recognize that the airplane was not aligned with the intended landing runway.

[4] Title 14 *CFR* Part 117, "Flight and Duty Limitations and Rest Requirements: Flightcrew Members." described the window of circadian low as 0200 through 0559 (body clock time zone).

5. The flight crew-initiated, low-altitude go-around over the taxiway prevented a collision between the Air Canada airplane and one or more airplanes on the taxiway.

6. The controller responded appropriately once he became aware of the potential conflict.

7. Errors that the flight crewmembers made, including their false assumption that runway 28L was open, inadequate preparations for the approach, and delayed recognition that the airplane was not lined up with runway 28R, reflected breakdowns in crew resource management and led to minimal safety margins as the airplane overflew taxiway C.

8. The flight crewmembers' lack of awareness about the runway 28L closure and the crewmembers' previous experience seeing two parallel runways at San Francisco International Airport led to their expectation to identify two runway surfaces during the approach and resulted in their incorrect identification of taxiway C instead of runway 28R as the intended landing runway.

9. Although the notice to airmen about the runway 28L closure appeared in the flight release and the aircraft communication addressing and reporting system message that were provided to the flight crew, the presentation of the information did not effectively convey the importance of the runway closure information and promote flight crew review and retention.

10. The cues available to the flight crewmembers to indicate that the airplane was aligned with a taxiway were not sufficient to overcome their belief, as a result of expectation bias, that the taxiway was the intended landing runway.

11. Multiple salient cues of the surface misalignment were present as the airplane approached the airport seawall, and one or more of these cues likely triggered the captain's initiation of a go-around, which reportedly occurred simultaneously with the first officer's call for a go-around.

12. The captain and the first officer were fatigued during the incident flight due to the number of hours that they had been continuously awake and circadian disruption, which likely contributed to the crewmembers' misidentification of the intended landing surface, their ongoing expectation bias, and their delayed decision to go around.

13. Current Canadian regulations do not, in some circumstances, allow for sufficient rest for reserve pilots, which can result in these pilots flying in a fatigued state during their window of circadian low.

14. Flight safety would be enhanced if airplanes landing at primary airports within class B and class C airspace were equipped with a cockpit system that provided flight crews with positional awareness information that is independent of, and dissimilar from, the current instrument landing system backup capability for navigating to a runway.

15. Although the investigation into this incident identified significant safety issues, cockpit voice recorder information, had it been available, could have provided direct evidence

regarding the flight crew's approach preparation, cockpit coordination, perception of the airport environment, and decision-making.

16. Once the flight crewmembers perceived lights on the runway, they decided to contact the controller to ask about the lights; however, their query was delayed because of congestion on the tower frequency, which reduced the time available for the crewmembers to reconcile their confusion about the lights with the controller's confirmation that the runway was clear.

17. Although the use of line up and wait (LUAW) procedures during single-person air traffic control operations was not a factor in this incident, the tower controllers should have delayed consolidating local and non-local control positions until LUAW procedures were no longer needed.

18. If an airplane were to align with a taxiway, an automated airport surface detection equipment alert would assist controllers in identifying and preventing a potential taxiway landing as well as a potential collision with aircraft, vehicles, or objects that are positioned along taxiways.

19. Increased conspicuity of runway closure markers, especially those used in parallel runway configurations, could help prevent runway misidentification by flight crews while on approach to an airport.

Probable Cause

The NTSB determines that the probable cause of this incident was the flight crew's misidentification of taxiway C as the intended landing runway, which resulted from the crewmembers' lack of awareness of the parallel runway closure due to their ineffective review of NOTAM information before the flight and during the approach briefing. Contributing to the incident were (1) the flight crew's failure to tune the ILS frequency for backup lateral guidance, expectation bias, fatigue due to circadian disruption and length of continued wakefulness, and breakdowns in CRM and (2) Air Canada's ineffective presentation of approach procedure and NOTAM information.

Recommendations

As a result of this investigation, the NTSB makes safety recommendations to the FAA and Transport Canada:

To the Federal Aviation Administration:

1. Work with air carriers conducting operations under Title 14 *Code of Federal Regulations* Part 121 to (1) assess all charted visual approaches with a required backup frequency to determine the flight management system autotuning capability within an air carrier's fleet, (2) identify those approaches that require an unusual or abnormal

manual frequency input, and (3) either develop an autotune solution or ensure that the manual tune entry has sufficient salience on approach charts.

2. Establish a group of human factors experts to review existing methods for presenting flight operations information to pilots, including flight releases and general aviation flight planning services (preflight) and aircraft communication addressing and reporting system messages and other in-flight information; create and publish guidance on best practices to organize, prioritize, and present this information in a manner that optimizes pilot review and retention of relevant information; and work with air carriers and service providers to implement solutions that are aligned with the guidance.

3. Establish a requirement for airplanes landing at primary airports within class B and class C airspace to be equipped with a system that alerts pilots when an airplane is not aligned with a runway surface.

4. Collaborate with aircraft and avionics manufacturers and software developers to develop the technology for a cockpit system that provides an alert to pilots when an airplane is not aligned with the intended runway surface and, once such technology is available, establish a requirement for the technology to be installed on airplanes landing at primary airports within class B and class C airspace.

5. Modify airport surface detection equipment (ASDE) systems (ASDE-3, ASDE-X, and airport surface surveillance capability) at those locations where the system could detect potential taxiway landings and provide alerts to air traffic controllers about potential collision risks.

6. Conduct human factors research to determine how to make a closed runway more conspicuous to pilots when at least one parallel runway remains in use, and implement a method to more effectively signal a runway closure to pilots during ground and flight operations at night.

To Transport Canada:

7. Revise current regulations to address the potential for fatigue for pilots on reserve duty who are called to operate evening flights that would extend into the pilots' window of circadian low.