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New Strategies Prevent ATC Clearances For Operation on Closed Runways

In a few recent runway incursions, aircraft crews obtained an inadvertent clearance from air traffic controllers to take off or to land on a closed runway. Solutions have included revised procedures, improved communication and reevaluation of some memory aids.

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FSF Editorial Staff

Worldwide efforts to prevent runway incursions recently have included additional measures or increased emphasis on existing procedures to ensure that air traffic controllers (ATC) do not authorize departures or landings on closed runways. Although inadvertent operations on closed runways rarely have resulted in accidents, significant risk of a catastrophic accident exists. A fatal airline accident in October 2000 has been cited by safety professionals in air traffic services to underscore the potential severity of this risk.¹

Several incidents during the past five years, in which controllers influenced the flight crew's decision to conduct a takeoff or a landing on a closed runway, have raised the following safety issues for consideration by airport operators, air traffic services and pilots:

- Frequent closure of the same runway, or closure for extended periods, may influence the situational awareness of controllers and what they perceive as normal conditions and what they tell pilots about safety factors in the airport environment;
- Constant use of the same type of memory aids to show closure of a runway may reduce their effectiveness;



- Systems used by airport operators to communicate runway-closure information to controllers and pilots may allow the fact that a message was not received to be undetected;
- Operational errors have occurred although runway-closure information was included in briefings of relief controllers as they began their duty period;
- Flight crews may not be aware of a runway closure because of their own errors or communication failures of others. When pilots are aware of runway-closure information, they may not challenge ATC instructions that conflict with notices to airmen (NOTAMs) or with what they observe while at the departure end of a closed runway; and,
- Inconsistency among airport operators in the use of lighted/reflective barricades, signs and markings when runways are closed temporarily — and inconsistent illumination of the runway edge/threshold lights and approach lights of a closed runway — may eliminate one of the last defenses against inadvertent use of a closed runway.

Examples of these issues appear in various international incident reports. For example, in May 2001, a U.K. air traffic controller

cleared the crew of a Boeing 777 to land on Runway 09L, which was closed, at London Heathrow Airport. The occurrence report by the U.K. Civil Aviation Authority (U.K. CAA) said that apparent miscommunication of runway status among controllers, noncompliance with procedures for operation of lights and absence of a runway-closure strip — a visual aid that helps controllers to remember runway status — at a controller’s radar display bay contributed to the operational error.²

“Heathrow Runway 09L/27R was closed for night-time resurfacing work,” the report said. “It was a requirement that the [instrument landing system (ILS)] and approach lighting be switched off during [runway] closure, but the air controller on duty did not ensure that both were off when handover took place at 0440 hours. Ambiguity arose when the [controller beginning duty] believed that he had been told [that] the runway was open, whereas the [controller leaving duty] believed [that] he had said the runway should be available by 0500 hours. No runway blocking strip was in position in the [Runway] 09L/27R display bay. Subsequently, a Boeing 777 was cleared to land on Runway 09L while a vehicle was on the runway carrying out an inspection. The driver saw the arriving aircraft in the rear-view mirror and vacated the runway just before the aircraft landed.”

U.K. CAA said that an approach-monitoring aid has helped to reduced the risk that ATC would be unaware of an aircraft approaching to land on the wrong runway or on a closed runway.³

“Controllers at London Gatwick [Airport], for example, benefit from an approach-monitoring aid which monitors approach tracks from 5.0 [nautical] miles [9.3 kilometers],” U.K. CAA said. “At 2.0 miles [3.7 kilometers], if the aircraft is more than 2.5 degrees off centerline, it is sent around [instructed to conduct a missed approach].”

In one incident in the United States on April 25, 2000, at 0928 local time, pilots of a Boeing 777-223ER, operated as American Airlines Flight 90, were unaware that the runway they preferred to use at Chicago (Illinois, U.S.) O’Hare International Airport had been closed for electrical maintenance. ATC approved their request to depart on the closed runway. The incident occurred despite the airport’s issuance of a runway-closure NOTAM. The U.S. National Transportation Safety Board (NTSB) investigation of the incident found that ATC procedures were not followed to ensure awareness of the runway closure, to deny the crew’s runway request, and to broadcast the NOTAM. The flight’s dispatch contained the NOTAM but cited the runway status as open.⁴

NTSB said, in its final report, that the probable cause of the incident was “the flight crew not detecting the runway closure NOTAM and the air traffic control personnel on the metering, ground, and local positions giving an improper clearance to taxi to a closed runway. Factors were the closed runway, automated terminal information service (ATIS) information

not issued by air traffic control personnel, and insufficiently defined procedures of disseminating pertinent safety of flight information.”

The report said that the crew conducted a takeoff from Runway 32R, a closed runway, and later landed without further incident at the destination airport. None of the three flight crewmembers, 12 cabin crewmembers or 152 passengers was injured; the aircraft was not damaged; and no injuries or damage occurred at the departure airport. The scheduled international passenger flight under U.S. Federal Aviation Regulations (FARs) Part 121, *Operational Requirements: Domestic, Flag and Supplemental Operations*, was operating on an instrument flight rules (IFR) flight plan. Visual meteorological conditions prevailed at the time of the incident.

Airport operations personnel at O’Hare Airport at 0830 issued NOTAM 0004206, which said that Runway 14L/32R was closed from 0830 to 1030 April 25, 2000. This NOTAM was cancelled at 1000 the same day.

NTSB investigators reviewed the dispatch documents for Flight 90. The NOTAM section of the dispatch listed NOTAM 04/156, which said that O’Hare Airport Runway 14L/32R was closed from 0830 to 1030 April 25, 2000 (shown as coordinated universal time in the NOTAM). The field report section of the dispatch said that the status of O’Hare Airport Runway 14L/32R was open with dry conditions and normal braking action at 0740 local time.

NTSB said that the runway-closure information contained in NOTAM 04/156 was not broadcast on O’Hare Airport ATIS information whiskey, which was current at the time of the Flight 90 departure.

During the investigation, the first officer said, “After normal preflight and gate departure, we advised metering [control] that we were ready for taxi and would prefer [Runway] 32R if available. Ground [control] gave us clearance to taxi to [Runway] 32R. Tower [control] first had us hold short, and then position and hold, awaiting the departure of two aircraft from intersecting runways. We were then cleared for takeoff. Three days later, we were advised that we may have taken off on a closed runway.”

NTSB said that U.S. Federal Aviation Administration (FAA) air traffic control personnel did not inform the pilot that the runway was closed, as required by FAA Order 7110.65, *Air Traffic Control*. The team found that use of a Runway 18/36 closure strip had become ineffective because of the extended time that the runway had been closed, and recommended a prohibition against using this runway for arrivals and departures and discontinuation of using the closure-strip memory aid for this runway. The team also recommended development of facility procedures that would prescribe appropriate actions if ground control intentionally directs an aircraft to a closed runway. The finding said, “For example, this might include the

requirement to verbally advise local [control position] that the aircraft is currently at a closed runway.”

FAA memorandums about the operational error, in the NTSB factual report, provided the following additional details about the incident:

- The supervisor on duty did not detect the omission of the NOTAM broadcast while reviewing several ATIS messages that were prepared during the time of the runway closure;
- Before the incident, the flight-data position and the clearance delivery/metering position did not receive runway-closure strips as a standard operating procedure. Additional runway-closure strips subsequently were placed in the control tower to “provide two more positions [controllers] the opportunity to prevent issuing [takeoff clearance for] a closed runway to a departure [aircraft crew]”;
- Before the incident, briefings of relief controllers did not include information about runway closures as a standard operating procedure;
- The clearance/metering position wrote “pilot requested runway” on the Runway 32R runway-closure strip and forwarded the strip to the outbound control position. The finding said, “[The] outbound [control position] had an appropriate runway-closure strip on his board, but seeing the pilot requested runway [message] on the strip, the aircraft was issued instructions to the closed runway. ... The aircraft was told to monitor the tower.” The local controller had the appropriate runway-closure strip but was using runway-closure strips as [separators for other strips that represented aircraft] departures off different runways rather than placing the runway-closure strip in a visually prominent place on the podium to attract constant attention.

The local controller said that the practice of using runway-closure strips in this manner “contributed to this oversight” in clearing the incident aircraft crew to depart on the closed runway. The memorandum said, “Also contributing to the oversight was the fact that a Runway 18/36 closure strip has been active for more than a year, which tends to decrease the effectiveness of the memory jogger [aid]. ... While not mandated, a good operating practice is to use the memory joggers only for [their intended] purpose.”

Other recommendations issued by the FAA investigative team that reviewed this operational error included the following measures:

- “Add the suggestion to our list of good operating procedures that [runway-closure] strips should not be used as departure-strip runway separators;
- “[Runway-closure] strips should be placed and left in a prominent position on the podiums;
- “In addition to [local-control positions] and [ground-control positions] receiving runway-closure strips, both flight-data [positions] and ground-metering [positions] should have closure strips as well;
- “Revise flight-data [position], clearance-delivery [position] and ground-metering position relief checklists to include runway-closure information;
- “Brief operational personnel that runway closures must be broadcast on the ATIS;
- “Brief operational personnel that pilots must be informed that a runway is closed when it is requested for takeoff/landing; [and,]
- “Brief operational supervisors of the requirement to ensure [that] ATIS broadcasts are correct and contain pertinent information.”

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Following the incident, the air traffic manager for O’Hare Airport also revised procedures for preventing errors during extended repairs and environmental clean-up activity on Runway 18/36. The runway was restricted temporarily to aircraft/vehicle ground-movement purposes only (prohibiting runway use for landing aircraft or departing aircraft), use of Runway 18/36 closure strips was discontinued, and all ATIS broadcasts carried information about the status of the closed runway.

Except for this incident, limited analyses of the safety factors involved in ATC operational errors involving closed runways have been publicly available, although the issue has been part of discussions in regional forums such as the Runway Safety/Incursion Conference conducted in October 2002 in Mexico City, Mexico, by the International Civil Aviation Organization.

In another U.S. incident, the runway closure had been coordinated between the airport operator and the control tower during a construction project that continued for several nights. The crew of the incident aircraft did not receive a NOTAM about the runway closure because of a failure in the communications system between the airport operations office and the FAA automated flight service station that disseminated the NOTAM to the public.

NTSB said that on Sept. 25, 2001, about 0348 local time, the crew of a Boeing 757, a cargo flight operated as United

Parcel Service Flight 896, conducted a takeoff from Runway 08, a closed runway, at Denver (Colorado, U.S.) International Airport and later landed the aircraft uneventfully at Reno/Tahoe International Airport, Nevada. No injuries to two crewmembers or people on the ground were reported during the flight. The takeoff was conducted in visual meteorological conditions under IFR as a Part 121 operation.⁵

“The airplane passed within 32 feet [10 meters] of a temporary light fixture near an adjacent taxiway (Taxiway R7) that was undergoing construction,” NTSB said. “The construction area on Taxiway R7 was clearly marked, lighted and barricaded. Runway 8 and the runway entrances (other than those at [Taxiway] R7) were not marked as closed or obstructed in any way, and the lights on Runway 8 were illuminated.”

During taxi to Runway 35L according to the controller’s instructions, the crew requested a change to Runway 08 because they did not have the necessary departure data to use Runway 35L, NTSB said. The controller approved the runway change, and when the crew reported that they were ready for departure, the controller cleared the flight for takeoff on Runway 08. The controller was charged with an operational error because authorizing Flight 896 to depart on the closed runway was contrary to FAA procedures for air traffic control, NTSB said.⁶ Both crewmembers told investigators that they were unaware that Runway 08 was closed until the following day when the company told them that their aircraft had nearly struck a barricade during the takeoff. Nevertheless, the closure was included in the ATIS broadcasts that were current at the time of the takeoff, NTSB said.

“[During investigation of the incident, the crew said that] they noticed the construction activity on Taxiway R7 as they approached Runway 8, and [they] estimated that the activity was about 5,000 feet [1,524 meters] away,” NTSB said. “While the aircraft was moving into position on the runway, the captain asked the first officer ‘what all the lights were about.’ ... The crewmembers indicated that the runway appeared to be clear, so they proceeded with the takeoff.”

At 0351:51, a person on the airport called the tower controller by radio and asked, “Why did a plane take off from [Runway] 8/26?” The controller did not respond, but the investigation found that the control tower personnel had been notified directly by the airport when the runway closure went into effect, NTSB said. After analysis of this operational error, NTSB recommended that FAA take the following actions:

- “Require the use of physical devices or other means to clearly indicate to flight crews of arriving and departing

aircraft that a runway is closed [Recommendation A-03-05]; [and,]

- “Study the safety and design of existing safety barrier and lighting equipment intended for placement on or near runways during closures and establish safety standards for frangibility, as well as other properties (including, but not limited to, wind resistance and conspicuity of lights and markings under various weather, lighting and visibility conditions). If existing equipment does not meet these standards, new equipment should be developed. (Recommendation A-03-06).”

In its June 2003 response to these recommendations, FAA said that its standards for marking of closed runways were clarified in January 2003, and that U.S. airports have been encouraged to use a lighted ‘X’ device during hours of daylight and darkness. The response said, in part, “In this [incident], the tower was notified of the runway closure, and that information also was part of the ATIS broadcast. ... Due to the emphasis on construction safety, along with the issuance of the revised [advisory circular], the FAA does not believe that there is a need to require the use of physical barriers at this time.”⁷

In the United States, there were 268 million aircraft operations during fiscal years 1999–2002 and 1,480 runway incursions. Of 10 Category A runway incursions in fiscal year 2002 — in which “separation decreases, and participants take extreme action to narrowly avoid a collision, or the event results in a collision” — two events were ATC operational errors/deviations. Neither event involved a closed runway but FAA’s definition of an operational error, in part, is a controller error that includes “an aircraft landing or departing on a runway closed to aircraft.” FAA said, “Runway incursions attributed to operational errors/deviations [of all severity categories in fiscal

year 2002] ranged from the loss of separation between two aircraft on the same runway to improper clearances granted by controllers or incorrect readbacks by pilots for operations on closed runways that went undetected by the controller.”⁸

The following examples of incidents that involved ATC communication about runway status also were identified in the Australian Transport Safety Bureau (ATSB) incident database and the FAA accident/incident database:

- An October 2000 incident involved a Cessna 210N at the Alice Springs (Northern Territory, Australia) Airport. The ATSB incident report said, “The aircraft was instructed to land on a runway that was designated by NOTAM as being unserviceable due to a soft, wet surface. The aircraft landed on the sealed section of the runway and taxied clear

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without difficulty. ATC later stated that the processing error resulted from an incomplete handover between ATC staff, and inadequate scanning of the console display.”⁹

- A November 1998 incident involved a McDonnell Douglas DC-8 at the James M. Cox Dayton (Ohio, U.S.) International Airport. The FAA incident report said, “The aircraft was on approach to Dayton. The controller cleared the aircraft to land on Runway 24R. The runway was NOTAMed closed [i.e., the closed status was published in a NOTAM] on the ATIS. The flight crew did not question the controller. The controller cleared the aircraft to land on a closed runway. At the time of the incident, the edge lights on Runway 24R were inoperative due to the fact that they were disconnected. The aircraft landed without further incident. The flight crew [said] that since the controller cleared them to land, [they believed] that the runway had been reopened. Airport operations [personnel said] that there was an ‘X’ [marking] on the runway; however, the flight crew [said] that they did not see anything indicating that the runway was closed. ... The investigation was closed with submission of this report.”¹⁰
- An August 2001 incident involved a Eurocopter EC120B 1.0 kilometer (0.5 nautical mile) west-southwest of Sydney [New South Wales, Australia] Airport. The ATSB incident report said, “[ATC] cleared the helicopter for a visual approach and landing on the threshold of Runway 07. At the time, the ATIS was not quoting Runway 07 as the runway in use. The pilot noticed that a crane, located near the runway threshold, was in the raised position. By receiving a landing clearance on Runway 07, the pilot may have assumed that obstacle clearance was implied by the landing clearance. NOTAM 0819/01 was current at the time. The NOTAM warned of several cranes in the vicinity of the Runway 07 threshold that could be in the raised position when Runway 07 was not in use.”¹¹

Based on these incidents, strategies to reduce the risk of a controller inadvertently contributing to an accident on a closed runway have focused on appropriate use of memory aids and revision of control-tower procedures. Nevertheless, measures that reduce the risk of pilots using a closed runway — such as switching off the associated lighting system — may provide additional defensive cues about runway status to controllers before they issue a clearance. ♦

Notes

1. The Aviation Safety Council (ASC) of Taiwan Accident Report no. ASC-AAR-02-04-001, *Crashed on a Partially Closed Runway During Takeoff, Singapore Airlines Flight 006, Boeing 747-400, 9V-SPK, CKS Airport, Taoyuan, Taiwan, October 31, 2000*, said that Singapore Airlines Flight SQ006, a Boeing 747-400, struck concrete barriers, runway construction pits and construction equipment during takeoff on Runway 05R, which was partially closed for maintenance, at

Chiang Kai-Shek International Airport, Taoyuan, Taiwan, on Oct. 31, 2000. Four cabin crewmembers and 79 passengers were killed; four cabin crewmembers and 35 passengers received serious injuries; and one flight crewmember, nine cabin crewmembers and 22 passengers received minor injuries. The airplane was destroyed by collision forces and post-accident fire. ASC findings related to probable cause said, in part, that heavy rain and strong winds from a typhoon prevailed when the takeoff clearance for Runway 05L was issued; that a notice to airmen (NOTAM) about Runway 05R construction had been issued and that the flight crew was aware that Runway 05R was available only for taxi; and that the flight crew incorrectly taxied the aircraft to Runway 05R and began the takeoff roll. The pilots of the accident aircraft were not cleared by air traffic controllers to conduct the takeoff on the closed runway.

2. Safety Regulation Group, U.K. Civil Aviation Authority (U.K. CAA). Occurrence report no. 200103371, May 21, 2001.
3. Chapple, Mike. E-mail communication with Setze, Patricia. Alexandria, Virginia, U.S., April 9, 2003. Flight Safety Foundation, Alexandria, Virginia, U.S. Chapple is head of the Safety Investigation and Safety Department, Safety Regulation Group, U.K. CAA.
4. U.S. National Transportation Safety Board (NTSB). NTSB Accident/ Incident Database Report no. CHI00IA125 and factual report. April 25, 2000.
5. NTSB. Safety Recommendations A-03-05 and A-03-06, March 3, 2003.
6. U.S. Federal Aviation Administration (FAA). Order 7110.65, *Air Traffic Control*, Section 3, “Airport Conditions,” paragraph 3-3-2, “Closed/Unsafe Runway Information,” said, “If an aircraft [crew] requests to take off, land or touch-and-go on a closed [runway] or unsafe runway, inform the pilot that the runway is closed or unsafe, and (a) if the pilot persists in his/her request, quote him/her the appropriate parts of the [notice to airmen (NOTAM)] applying to the runway and inform him/her that a clearance cannot be issued; (b) then, if the pilot insists and, in your opinion, the intended operation would not adversely affect other traffic, inform him/her that the operation will be at his/her own risk; (c) except as permitted by paragraph 4-8-7, “Side-step Maneuver,” where parallel runways are served by separate [instrument landing system (ILS)/microwave landing system (MLS)] systems and one of the runways is closed, the ILS/MLS associated with the closed runway should not be used for approaches unless not using the ILS/MLS would have an adverse impact on the operational efficiency of the airport.” Paragraph 3-3-3, “Timely Information,” said, in part, “Issue airport-condition information necessary for an aircraft’s safe operation in time for it to be useful to the pilot. Include the following, as appropriate: (a) construction work on or immediately adjacent to the movement area.”
7. FAA National Aviation Safety Data Analysis Center. NTSB Safety Recommendation A-03-5. FAA letter dated June 5, 2003.
8. FAA Office of Runway Safety. *FAA Runway Safety Report: Runway Incursion Trends at Towered Airports in the United States: FY 1999-FY 2002*. July 2003.
9. Australian Transport Safety Bureau (ATSB). Aircraft incident report no. 200005098, Oct. 27, 2000.
10. FAA. Accident and Incident Database report no. 199811011043559C, Nov. 1, 1998.
11. ATSB. Aircraft incident report no. 200104088, Aug. 14, 2001.

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