



National Transportation Safety Board

Washington, D.C. 20594
Safety Recommendation

Log. 2569

Date: SEP 21 1995

In reply refer to: A-95-86 through -97

Honorable David R. Hinson
Administrator
Federal Aviation Administration
Washington, D.C. 20591

On November 22, 1994, at 2203 central standard time,¹ Trans World Airlines (TWA) flight 427, a McDonnell Douglas DC-9-82 (MD-82), N954U, collided with a Cessna 441, N441KM, at the intersection of runway 30R and taxiway Romeo, at the Lambert-St. Louis International Airport (STL) in Bridgeton, Missouri. The MD-82 was operating as a regularly scheduled passenger flight from STL to Denver, Colorado. The flight was conducted under the provisions of Title 14 Code of Federal Regulations (CFR) Part 121. There were 132 passengers, five flight attendants, and three flightcrew members aboard the airplane. The MD-82 sustained substantial damage during the collision. The Cessna 441, operated by Superior Aviation, Inc., as a 14 CFR Part 91 positioning flight, was destroyed. The commercial pilot and the passenger, who was rated as a private pilot, were the sole occupants on board the Cessna and were killed. Of the 140 persons on board the MD-82, eight passengers sustained minor injuries during the evacuation.²

The National Transportation Safety Board determined that the probable cause of this accident was the Cessna 441 pilot's mistaken belief that his assigned departure runway was runway 30R, which resulted in his undetected entrance onto runway 30R, which was being used by the MD-82 for its departure. Contributing to the accident was the lack of Automatic Terminal Information Service (ATIS) and other air traffic control (ATC) information regarding the occasional use of runway 31 for departure. The installation and utilization of Airport Surface Detection Equipment (ASDE-3), and particularly ASDE-3 enhanced with the Airport Movement Area Safety System (AMASS), could have prevented this accident.

During the investigation of this accident, the Safety Board's laboratory examination of the

¹All times herein are central standard time unless otherwise noted.

²For more detailed information, read Aircraft Accident Report--"Runway Collision Involving Trans World Airlines Flight 427 and Superior Aviation Cessna 441, Bridgeton, Missouri, November 22, 1994" (NTSB/AAR-95/05).

light bulbs from the Cessna 441 indicated that filaments were stretched on the left wing tip-mounted navigation, white tail cone-mounted navigation, nose gear-mounted taxi, and the left wing-mounted landing lights. Filament stretch indicates that the filament was hot at the time of impact (an illuminated bulb). The Safety Board believes that the right wing tip-mounted navigation light and the right wing-mounted landing light filaments were not stretched because the right side of the airplane was subject to lesser impact forces. The Safety Board concludes that the Cessna 441 taxied from the Midcoast ramp with the nosewheel taxi, white tail cone-mounted navigation, and red and green wing tip-mounted navigation lights illuminated. Based on Superior Aviation company policy and common pilot practice, the Safety Board believes that the Cessna 441 wing-mounted landing lights were not illuminated until the airplane was in position on runway 30R at its intersection with taxiway Romeo.

The STL ground and local controllers reported that they did not observe any exterior lights illuminated on the Cessna 441. They stated that from the time the Cessna 441 taxied from the well-lighted Midcoast ramp, they were unable to maintain visual contact. ATC personnel acknowledged that it was not unusual to lose visual contact with general aviation airplanes operating on that part of the airport at night.

The need to enhance conspicuity for controllers as well as other pilots reinforces the Safety Board's belief that the Federal Aviation Administration (FAA) should revise the Federal Aviation Regulations to require pilots to illuminate all taxi, landing, and logo lights, or otherwise enhance the conspicuity of their aircraft when operating on an active runway (including runway crossing and position-and-hold operations). Further, the Safety Board notes that requiring pilots to turn on aircraft anticollision/strobe lights when holding in position on active runways would assist air traffic controllers, as well as pilots of other aircraft in detecting runway incursions.

Another area of concern uncovered during this investigation was the usage of officially undefined terminology by air traffic controllers. The initial taxi clearance that the Cessna pilot received from the ground controller was, "One Kilo Mike, roger, back-taxi into position hold runway three one, let me know this frequency when you're ready for departure." The Safety Board notes that the term "back-taxi," while commonly used, and apparently understood, by pilots and controllers, is not officially defined in either the Airman's Information Manual (AIM) or FAA Order 7110.65, "Air Traffic Control." The Safety Board believes that the FAA should officially define the commonly used term "back-taxi" in the Pilot-Controller Glossary, and provide an explanation of the use of the term and application of the procedure in the AIM and FAA Order 7110.65, "Air Traffic Control."

Also of concern to the Safety Board was the intensity of the air traffic controller workload at the time of the accident. Ground and local controllers indicated that the workload was moderate. The night of the accident, the ground controller was working four positions,³ each of

³The ground controller was working ground control for both the north and south sides of the airport, clearance delivery, and flight data.

which is staffed by a separate controller when the tower is operating at full complement during peak traffic. When working these positions, the controller was monitoring seven different frequencies. These combined positions with multiple frequencies created a situation in which a pilot transmitted and received on a specific frequency, depending on the service required, while the controller transmitted on all of the frequencies for which he was responsible.

Interviews with the MD-82 flightcrew members indicated that the use of combined positions/multiple frequencies occasionally resulted in difficulties. These reported problems included incomplete communications due to pilots' transmissions being "stepped on" by other pilots, increased controller workload, communication delays and confusion, and potential decreased pilot situational awareness. A review by the Safety Board of 1½ hours of ATC tapes from the evening of the accident revealed several instances of simultaneous transmissions.

The Safety Board concluded that the use of combined positions with multiple frequencies was not a factor in this accident. However, the Safety Board does not believe it is in the interest of safety to create a situation in which there can be simultaneous transmissions and potentially decreased pilot awareness. The Safety Board believes that, when positions are combined, ATC personnel should make every effort to use as few frequencies as possible. Those frequencies in use should be broadcast on the ATIS to enable flightcrews to communicate with the controllers.

The Safety Board is aware of several procedures and services that are being developed and used at airports throughout the country in an attempt to reduce radio frequency congestion. These procedures include standard coded taxi routes (currently in effect only at O'Hare International Airport, in Chicago, Illinois), and automated flight clearance delivery. At the time of this accident, the STL airport had the capability to deliver automated flight clearances, but the MD-82 did not have the onboard equipment to use the service. Since the accident, TWA has acquired the capability to receive automated flight clearances. Had the automated clearance delivery service been used the night of the accident, the ground controller's workload would have been significantly reduced. Thus, the Safety Board believes that the FAA should continue to develop, publish, and encourage the implementation of procedures such as automated flight clearances and standard taxi routes to reduce radio frequency congestion during ground operations.

During the Safety Board's April 19-20, 1995, public hearing on this accident, the Safety Board heard testimony from ATC personnel and air carrier pilots indicating that additional training should be undertaken to ensure that pilots are familiar with airport ground operations, including airfield markings, signs, and lighting.

A study/survey of pilots entitled, "Reports by Airline Pilots on Airport Surface Operations"⁴ indicated a need for pilot training on surface operations. A solution proposed in that

⁴Docket No. SA-513, Exhibit No. 14B, MITRE Corporation Report on Airport Surface Operations -- May, 1994; pg xxvi, Exhibit Pg 28.

study recommends "That the airlines develop and implement training in cockpit procedures and communications for surface operations, emphasizing the timing and integration of all cockpit tasks and the requirement for structured verbal coordination on surface orientation, and navigation."

Currently, pilot initial and recurrent training programs are directed primarily at airborne operations. However, public hearing testimony indicated that many pilots believed the most difficult part of any trip occurred between the runway turnoff and the gate. This accident reinforced the need for pilot training on surface operations, including airfield markings, signs, and lighting. Although air carrier training was not a factor in this accident, the Safety Board believes that initial and recurrent air carrier pilot training programs should include training in airport surface movement operations and familiarization with airport markings, signs, and lighting. The Safety Board also believes that similar training on airfield surface operations, including airport markings, signs, and lighting should be provided for all general aviation pilots during initial training and biennial flight reviews.

The Safety Board's concern about the runway incursion problem was heightened by three fatal accidents that preceded the STL accident. These accidents were the collision in Atlanta, Georgia, on January 18, 1990;⁵ the collision in Romulus, Michigan, on December 3, 1990;⁶ and the collision in Los Angeles, California, on February 1, 1991.⁷ As a result of these accidents, the FAA generated several informational/educational handouts and flyers, which it intended to distribute to certificated pilots through a variety of methods (i.e., safety seminars, operations bulletins, etc.). The Safety Board notes that this distribution has not reached its entire intended audience. The Safety Board believes that the FAA should mass-mail all currently certificated pilots FAA publications on reducing runway incursions and airport improvement information, such as airport signage changes.

These accidents also highlighted the urgent need for improved preventive measures, and redundancy. The Safety Board is aware that, in addition to the more advanced ASDE-3 and AMASS airport surface traffic detection equipment, there are ongoing research and development efforts into alternative, cost-effective airport surface traffic detection systems, such as the ground induction loop.

The Safety Board found that the lack of ATIS and other ATC information regarding the occasional use of runway 31 for departure contributed to this accident. The ATIS is a recorded

⁵Eastern Airlines flight 111 and Epps Air Service King Air A100, Atlanta Hartsfield International Airport, Atlanta, Georgia, January 18, 1990. (NTSB/AAR-91/03.)

⁶Northwest Airlines flights 299 and 1482, Detroit Metropolitan Wayne County Airport, Romulus, Michigan, December 3, 1990. (NTSB/AAR-91/05.)

⁷USAir flight 1493 and Skywest Airlines flight 5569, Los Angeles International Airport, Los Angeles, California, February 1, 1991. (NTSB/AAR-91/08.)

message repeatedly broadcast to provide noncontrol airport and terminal area information to aircraft. FAA Order 7110.65, "Air Traffic Control," section 2-142, enumerates the required contents of the ATIS message. Paragraphs (c) and (d) state:

- c. Instrument/visual approach/s in use. Specify landing runway/s unless the runway is that to which the instrument approach is made
- d. Departure runway/s (to be given only if different from landing runway/s or in the instance of a "departure only" ATIS).

Arrival and departure information for STL is contained in a single ATIS. The broadcast in effect for the Cessna 441's arrival and through the time of the accident was ATIS information "Delta." No mention was made of the occasional use of runway 31 as a departure runway in this ATIS recording. Public hearing testimony from ATC personnel revealed that they did not normally include information about the use of runway 31 on the ATIS, because runway 31 was considered a secondary runway, and it was not active the entire time. The controllers testified that they limited the information included in the ATIS recordings in an attempt to keep the ATIS "brief and concise" as requested by airport user groups (i.e., TWA, ALPA, other air carriers).

The ATIS that was current during the time the pilot operated in the STL area listed runways 30R and 30L as the active runways for arrivals and departures at STL. The STL controllers did not typically list runway 31 as an active runway on the ATIS, as runway 31 was only occasionally used as a departure-only runway. Also, the STL controllers did not typically treat runway 31 as if it were an active runway; for example, when the Cessna 441 pilot cleared runway 30R on his inbound flight, his taxi clearance to the Midcoast ramp did not include a clearance to cross runway 31. The Safety Board believes that if runway 31 had been referenced as a runway for occasional general aviation departures on the ATIS broadcast, the pilot may have been more attentive to the controller's taxi clearance and runway assignment.

Public hearing testimony by MITRE Corporation personnel indicated that the FAA should consider addressing the runway incursion problem in two arenas. One suggested arena was the basic surface system in which human performance issues require corrective action on a near-term basis; the other arena was surface technology, which is more long term. It was also disclosed that MITRE's "Reports by Airline Pilots on Airport Surface Operations" study contained 40 proposed solutions for the reduction of pilot error during airport surface operations. According to the testimony, most of these solutions were not costly and were "doable"-- for example, pilot and controller communications. The Safety Board believes that the FAA, in conjunction with industry, should develop mechanisms to implement these solutions.

The second part of the MITRE report is expected to be completed during September 1995. The Safety Board believes that the FAA should employ an independent source to conduct a survey, similar to that conducted by MITRE, of its terminal ATC staff to determine their concerns and views of the scope and magnitude of the runway incursion problem and their recommendations for the reduction of runway incursions.

Therefore, the National Transportation Safety Board recommends that the Federal Aviation Administration:

Revise the Federal Aviation Regulations to require pilots to illuminate all taxi, landing, and logo lights, or otherwise enhance the conspicuity of their aircraft when operating on an active runway (including runway crossing and position-and-hold operations) (Class II Priority Action) (A-95-86)

Examine the feasibility of requiring pilots to use aircraft anticollision/strobe lights when holding in position on active runways (Class II Priority Action) (A-95-87)

Define the commonly used term "back-taxi" in the Pilot-Controller Glossary, and provide an explanation of the use of the term and application of the procedure in the Airman's Information Manual and FAA Order 7110.65, "Air Traffic Control." (Class II Priority Action) (A-95-88)

Require air traffic control personnel to make every possible effort to use as few frequencies as possible when positions are combined, and to provide notice of such on the Automatic Terminal Information Service where applicable. (Class II Priority Action) (A-95-89)

Continue to develop, publish, and encourage the implementation of procedures such as automated flight clearances and standard taxi routes to reduce radio frequency congestion during ground operations. (Class II Priority Action) (A-95-90)

Mass-mail to all currently certificated pilots FAA publications on reducing runway incursions and airport improvement information. (Class II Priority Action)(A-95-91)

Require flight instructors to stress airport surface operations, including airport markings, signs, and lighting; situational awareness; clearance readbacks; and proper phraseology during initial training and biennial flight reviews. (Class II Priority Action) (A-95-92)

Require that initial and recurrent air carrier pilot training programs include training in airport surface movement operations, and familiarization with airport markings, signs, and lighting. (Class II Priority Action) (A-95-93)

Continue research and development efforts to provide airports that are not scheduled to receive Airport Surface Detection Equipment with an alternate, cost-effective system, such as the ground induction loop, to bring controller and pilot attention to pending runway incursions in time to prevent ground collisions. (Class II Priority Action) (A-95-94)

Require that Automatic Terminal Information Service broadcasts at Lambert-St. Louis International Airport reference runways that are being used as secondary or occasionally active runways. (Class II Priority Action) (A-95-95)

Convene a joint FAA/industry task force on human performance initiatives to produce human performance-related airport surface operation improvements that could be readily implemented, are not cost prohibitive, and would provide additional safety measures during surface operations by mitigating human error. In identifying those initiatives, consider the recommendations contained in the MITRE Corporation study, "Reports by Airline Pilots on Airport Surface Operations." (Class II Priority Action) (A-95-96)

Employ an independent source to conduct a survey of the terminal air traffic control staff, similar to the MITRE Corporation study, "Reports by Airline Pilots on Airport Surface Operations," to determine from the staff's perspective, their concerns and views of the scope and magnitude of the runway incursion problem and their recommendations toward the reduction of runway incursions with a view toward ultimate implementation of those recommendations. (Class II Priority Action) (A-95-97)

Chairman HALL, Vice Chairman FRANCIS, and Members HAMMERSCHMIDT and GOGLIA concurred in these recommendations.

By: 
Jim Hall
Chairman