National Transportation Safety Board

Washington, D.C. 20594

Safety Recommendation 3224

Date: April 4, 1990

In reply refer to: A-90-40 thru -48

Honorable James B. Busey
Administrator
Federal Aviation Administration
Washington, D.C. 20591

Runway overruns following high speed rejected takeoffs (RTOs) have resulted and continue to result in airplane incidents and accidents. Although most RTOs are initiated at low speeds (below 100 knots) and are executed without incident, the potential for an accident or an incident following an RTO initiated at high speed remains high.[1] In 1988, for example, three RTO-related accidents, two overseas and one in the United States, resulted in injuries to several passengers and crewmembers, in substantial damage to a Boeing 757, a Boeing 747, and in the destruction of a McDonnell Douglas DC-10.

Evidence gathered from previous investigations conducted from the late 1960s suggests that pilots faced with unusual or unique situations may perform high speed RTOs unnecessarily or may perform them improperly. Evidence also indicates that deficiencies exist in (1) pilots' understanding of the risks associated with high speed RTOs, (2) the training pilots receive in RTOs, and (3) the procedures airlines establish for executing RTOs.

The Safety Board conducted a special investigation of RTO-related issues to determine how the safety of RTOs can be enhanced and how the rate of RTO-related accidents and incidents may be reduced. During this investigation, the Safety Board examined a variety of data on RTO accidents and incidents. The safety issues relevant to operational procedures and FAA regulations concerning recognition of the need for and training in the execution of RTOs are discussed in detail in the special investigation report.[2] A copy of the report is enclosed.

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[1] Throughout this recommendation letter, a low speed RTO refers to one initiated below 100 knots whereas a high speed RTO refers to one initiated at or over 100 knots.

[2] National Transportation Safety Board. 1990. Special investigation report: Runway overruns following high speed rejected takeoffs. NTSB/SIR-90-02. Washington, DC. 38 p.

The safety issues include:

Pilot training in RTOs.--Some airlines may be conveying misinformation or insufficient information to their pilots during training in RTO procedures and in airplane stopping capabilities. Some of the misinformation may arise from the FAA's definition of V_1 in 14 CFR 1.2 and 14 CFR 25.107 (2).

Simulator Cues.--Pilot training and checking sessions almost always present RTOs as V_1, engine failure-related maneuvers despite the fact that RTO-related accident and incident data indicate that tire failures lead to more high speed RTOs than do engine-related anomalies. As a result, pilots may not be fully prepared to recognize cues of other anomalies during takeoff.

False or Noncritical Warnings.--False or noncritical cockpit warnings have activated as an airplane was approaching or had reached V_1, and have lead to a high speed RTO that resulted in an accident or incident. In response to the number of false warnings, manufacturers have incorporated into newer airplanes internal system logic that inhibits all but the most important warnings just before and just after rotation. However, most airplanes operating in revenue service today and those that will operate in the near future do not have such systems and cannot reasonably be redesigned or retrofitted to incorporate them. Without changes in pilot training, pilots may continue to initiate high speed RTOs in response to warnings in the older model airplanes that may be false, noncritical, or both.

Takeoff Scenarios.--Some airlines may be using takeoff scenarios in which the simulator can be stopped with runway distance remaining, even though the pilot's execution of the RTO may not be optimal. As a result, pilots may inadvertently learn that an airplane can stop on a runway in a shorter distance and with greater ability than is true under actual operating conditions.

Crew Coordination in Performing RTOs.--In many of the RTO-related incidents or accidents, the first officer was the pilot flying. This suggests that a delay may have occurred when control of the airplane was transferred from the first officer to the captain, the crewmember authorized by most airlines to initiate an RTO.

Callouts.--Most airlines require callouts for engine or thrust settings and callouts for V_1, V_r, and V_2. However, the Safety Board found variation among airlines in the callouts required during takeoffs, particularly during rejected takeoffs.

Autobrakes.--Many airplanes in service today have been equipped with braking systems known as autobrakes, which automatically establish wheel braking upon landing or upon a predetermined throttle reduction once past a certain speed during takeoff. However, not all airlines require autobrakes to be set to the RTO mode during takeoff.

As a result of this special investigation, the National Transportation Safety Board recommends that the Federal Aviation Administration:

Redefine V_1 in 14 CFR 1.2 and 14 CFR 25.107 (2) to clearly convey that it is the takeoff commitment speed and the maximum speed at which rejected takeoff action can be initiated to stop the airplane within the accelerate-stop distance. (Class II, Priority Action)(A-90-40)

Require Principal Operations Inspectors to review the accuracy of information on V_1 and rejected takeoffs that 14 CFR 121 operators provide to flightcrews to assure that they provide correct information about pilot actions required to maximize the stopping performance of an airplane during a high speed rejected takeoff. (Class II, Priority Action)(A-90-41)

Require 14 CFR 121 operators to present to flightcrews the conditions upon which flight manual stopping performance is predicated and include information about those factors which adversely affect stopping performance. (Class II, Priority Action)(A-90-42)

Require that simulator training for flightcrews of 14 CFR 121 operators present, to the extent possible, the cues and cockpit warnings of occurrences other than engine failures that have frequently resulted in high speed rejected takeoffs. (Class II, Priority Action)(A-90-43)

Require that simulator training of 14 CFR 121 operators present accurately the stopping distance margin available for a rejected takeoff initiated near or at V_1 on runways where the distance equals or just exceeds balanced field conditions. (Class II, Priority Action)(A-90-44)

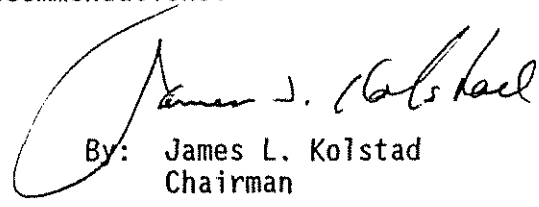
Require that simulator training for flightcrews of 14 CFR 121 operators emphasize crew coordination during rejected takeoffs, particularly those rejected takeoffs that require transfer of control from the first officer to the captain. (Class II, Priority Action)(A-90-45)

Require 14 CFR 121 operators to review their policies which permit first officers to perform takeoffs on contaminated runways and runways that provide minimal rejected takeoff stopping distance margins, and encourage the operators to revise those policies as necessary. (Class II, Priority Action)(A-90-46)

Require that the takeoff procedures of 14 CFR 121 operators are standardized among their airplane types to the extent possible, and that the procedures include appropriate callouts to alert flightcrew members clearly and unambiguously when the airplane is entering the high speed takeoff regime and when a rejected takeoff is being initiated. (Class II, Priority Action)(A-90-47)

Require 14 CFR 121 operators to require pilots to adopt a policy to use the maximum brake capability of autobrake systems, when installed on the airplane, for all takeoffs in which runway conditions warrant and where minimum stopping distances are available following rejected takeoff. (Class II, Priority Action)(A-90-48)

KOLSTAD, Chairman, COUGHLIN, Acting Vice Chairman, LAUBER and BURNETT, Members concurred in these recommendations.



By: James L. Kolstad
Chairman