Log 2522

National Transportation
Safety Board

Memorandum

Date: August 22, 1994

In reply refer to: A-94-151 through -156

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

On November 16, 1993, United Airlines flight 1049, a B-757-222, N557UA, experienced an uncommanded left rudder deflection shortly after touchdown at Orlando International Airport, Orlando, Florida. The airplane was making a practice autoland approach in visual meteorological conditions (VMC) to runway 18R. Runway 18R has a Category I instrument landing system (ILS).[1] The pilot notified the tower that a practice autoland was being conducted. The controller reported that he did not remember any air or ground traffic near the runway or the localizer antenna array during the B-757's landing and subsequent rollout.

The B-757's flight data recorder (FDR) data showed that about 1 second after touchdown, at an indicated airspeed of 115 knots, the rudder moved to the left 6.6 degrees, and the airplane subsequently yawed to the left about 1 degree. The

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[1]The lowest authorized ILS minimums, with all required operative components of ground and airborne systems, are: Category I - Decision Height (DH) of 200 feet and runway visual range (RVR) greater than 1,800 feet, depending on available touchdown zone and centerline lighting; Category II - DH of 100 feet and RVR of 1,200 feet; Category III - DH of 50 feet or alert height of 100 feet and RVR of 700 feet. Category IIIA allows autopilot-coupled guidance through touchdown. Category IIIB allows autopilot-coupled guidance through touchdown and rollout to a safe taxi speed.

captain immediately took control of the airplane as it veered about 30 feet from the runway centerline. The FDR data indicate that the autopilot was disconnected about 1 second after the airplane started to yaw. The captain reported that if he had not taken immediate action, he believed that the airplane would have departed the runway. There were no injuries to the people onboard, and the airplane was not damaged. Electrical power was maintained on the airplane until it could be examined by Safety Board investigators. The examination of the airplane, navigational electronics, and autopilot and control systems disclosed no discrepancies that could explain the cause of the rudder excursion.

On the day following the incident, a Federal Aviation Administration (FAA) flight check airplane performed a flight check of the ILS for the incident runway. Using the standard procedures for checking a Category I instrument approach, the flight test crew flew the airplane on the ILS approach to 50 feet above ground level (agl), leveled off, and then maintained that altitude for the length of the runway. A landing and rollout are not required by the standard inspection protocol for Category I instrument approach systems. The standard test procedures found no abnormalities with the localizer transmission, which provides left-right guidance to landing airplanes. The flight test crew reported that the system met all required parameters for a Category I approach.

The flight test crew conducted a second flight check of the approach signal but landed the airplane and continued recording ILS signal data during the landing roll. This procedure is used when checking a Category III approach system. About 4,000 feet beyond the landing threshold, a perturbation in the ILS signal was recorded. The flightcrew reported that this signal anomaly would have resulted in a lateral deviation indication in the cockpit localizer display of slightly less than half scale.

Another flight check with a landing took place 2 weeks later. The anomaly was not present either on the ground or at 50 feet agl. Again, the approach system to runway 18R passed all Category I signal requirements. The flight test engineers reported that except for some noise or roughness on the ILS signal, the approach system could have met Category III signal requirements.

On November 25, 1993, a United Airlines B-757 experienced a left-wing-down bank angle just before touchdown and then veered to the right shortly after touchdown on runway 25L at Los Angeles International Airport, Los Angeles, California. The flightcrew conducted a practice autoland approach during VMC to

the Category II-approved runway, but they did not inform the controller that an autoland approach was being performed. The captain reported that the approach was normal until just before touchdown when the left wing dropped. The captain stated that this was strange because there was a slight right crosswind. Therefore, the autopilot should have maintained a right-wing-down attitude. The airplane touched down to the left of the runway centerline, and the autopilot commanded a right rudder movement to return the airplane to the center of the runway. The captain believed that the initial autopilot steering command to return the airplane to centerline was reasonable until the airplane crossed the centerline and continued further right. The captain disconnected the autopilot and took control of the airplane. The remaining rollout was uneventful. Neither the pilots nor the tower controllers could recall any traffic within the ILS signal-protected area at the time of the event. Since the tower was not informed that an autolanding was in process, none of the ILS critical areas were monitored or protected.

On December 16, 1993, a Delta Air Lines B-757 experienced an uncommanded rudder deflection shortly after touchdown on runway 34L at Salt Lake City International Airport, Salt Lake City, Utah. The instrument approach to runway 34L is classified as Category III. The flightcrew decided to practice an autoland approach in visual flight rules (VFR) conditions to check the airplane's autoland system. The captain reported that the autoland system operation, all instrument indications, and the airplane's performance were normal during the approach and touchdown. The FDR data on the B-757 indicated that shortly after touchdown, the airplane received a fly left localizer indication, followed by a second fly left localizer indication, followed by a heading change of about 4.5 degrees to the left.

It was revealed that during the B-757's approach, an L-188 airplane was cleared for takeoff from the same runway. Radar data indicated that when the B-757 landed, the L-188 was approximately 100 feet agl, about 9,200 feet ahead of the B-757, and approximately 3,460 feet from the localizer antenna array. The data further indicated that when the B-757 first deviated on the runway, the L-188 was about 200 feet agl, and about 210 feet from the localizer array. About 4 seconds later, at an airspeed of 88 knots, the B-757 received a maximum fly right localizer indication followed by a rudder deflection of 20.35 degrees trailing edge left. Two seconds later, the rudder deflection indicated 8.7 degrees, trailing edge right. At that time, the captain disengaged the autopilot and took control of the airplane. At the time of the B-757's maximum localizer deviation indication, the L-188 was 923 feet beyond the localizer array at an altitude of 300 feet. FDR data showed that

the B-757's lateral deviation indications returned to near neutral when the L-188 was approximately 3,000 feet beyond the localizer array. During the entire event, the L-188 remained on a track consistent with the runway heading.

The Safety Board was informed about a B-757 that experienced an uncommanded rudder deflection and subsequent veer or swerve shortly after touchdown while conducting a practice autoland approach in VFR conditions at Charles de Gaulle International Airport, Paris, France. The flightcrew did not inform the tower controllers that they were conducting a practice autoland approach. The runway is approved for Category III operations.

Airplanes capable of performing Category IIIA ILS approaches are required by the FAA to requalify the autoland system at least once every 30 days. Operators can comply with the requirement by conducting practice autoland approaches in VFR conditions on any runway with an operating ILS, provided that the pilots monitor the airplane's instruments and are prepared to disconnect the autopilot during the autoland approach and landing. The airplane's system does not differentiate between Category I, II, or III ILS signals.

The operational requirements and signal standards for Category II and III ILSs are considerably more stringent than Category I. During operations when the weather is below Category I minimums, air traffic controllers are required to keep other airplanes and ground traffic away from the critical areas to prevent reflection or otherwise disrupt the ILS radio signals. When the weather is above Category I limits, the critical areas are not protected to the same standards as Category II or III operations. It should be noted that following the United Airlines B-757 incident, tests conducted on runway 18R at Orlando International Airport indicated that operations to and from runway 18L did affect the ILS signal at various locations. The effect is most pronounced when a propeller-driven airplane or helicopter is positioned near the ILS antenna array on runway 18L.

The FAA is responsible for periodically testing the ILSs for all Category I, II, and III runways. Discussions with FAA flight check personnel indicate that measurements of the approach signals at Category I runways are rarely accomplished below 50 feet because Category I systems are only required to provide guidance to 200 feet agl and for a missed approach. A Category I ILS signal is not required to provide guidance for landing or rollout. However, based on their experience in checking numerous instrument approaches, flight check personnel report that certain Category I approaches can meet the specifications for a

Category II or III approach system. On other days, with no apparent change in environmental conditions, aircraft, or surface traffic movements, distortions in the signal below 50 feet can be noted from the same ILS signal. Flight check personnel report that although their inspections certified these ILS systems to be adequate for Category I, they have found the ILS signals to be unsuitable for Category II or III operations.

FAA flight inspection personnel report that all ILSs and airports have their own unique operating considerations. They report that airport changes, aircraft activity, surface vehicle activity, environmental effects, as well as grass cutting near the antenna array, can sometimes cause significant distortion in the localizer signal. They report that signal distortion commonly occurs where an aircraft overflies the localizer antenna. The effect appears more pronounced with large propeller-driven airplanes and helicopters, but smaller general aviation airplanes can also significantly distort the signal. They also report that while there are general ILS critical areas, such as near or over the ILS antenna array, many ILSs have unique critical areas. When an ILS is installed at a particular site, local tower personnel are advised about the location of any unique critical areas so controllers can "protect" such areas when autolandings are being conducted.

Operators with autoland-capable airplanes routinely exercise the autoland systems. Since Category II and III runways are usually at larger and busier airports, relatively few Category II and III runways exist. Consequently, operators predominantly use Category I runways to requalify their autoland-capable airplanes. Discussions with representatives of several airlines indicate that they are aware of some Category I ILS approaches at certain airport runways that have inadequate signals to conduct practice autoland approaches. These airlines direct their flightcrews not to conduct practice autoland landings on these runways, but they have not apparently informed other airlines or the FAA about these inadequate signals.

The Airman's Information Manual (AIM) provides guidance regarding ILS signal distortion. Section 1-10(k) of the AIM states:

1. All pilots should be aware that disturbances to ILS localizer and glideslope courses may occur when surface vehicles or aircraft are operated near the localizer or glideslope antenna. Most ILS installations are subject to signal interference by either surface

vehicles, aircraft or both. ILS CRITICAL AREAS are established near each localizer and glideslope antenna.

2. ATC issues control instructions to avoid interfering operations within ILS critical areas at controlled airports during the hours the Airport Traffic Control Tower is in operation as follows:

   (a) Weather Conditions--Less than ceiling 800 feet and/or visibility 2 miles. (1) LOCALIZER CRITICAL AREA--Except for aircraft that land, exit a runway, depart or miss approach, vehicles and aircraft are not authorized in or over the critical area when an arriving aircraft is between the ILS final approach fix and the airport. Additionally, when the ceiling is less than 200 feet and/or the visibility is RVR [runway visual range] 2,000 feet or less, vehicle and aircraft operations in or over the area are not authorized when an arriving aircraft is inside the ILS middle marker (MM). (2) GLIDESLOPE CRITICAL AREA--Vehicles and aircraft are not authorized in the area when an arriving aircraft is between the ILS final approach fix and the airport unless the aircraft has reported the airport in sight and is circling or side stepping to land on a runway other than the ILS runway.

   (b) Weather Conditions--At or above ceiling 800 feet and/or visibility 2 miles. (1) *No critical area protective action is provided under these conditions* (emphasis added). (2) If an aircraft advises the tower that an AUTOLAND or COUPLED approach will be conducted, an advisory will be promptly issued if a vehicle or aircraft will be in or over a critical area when arriving aircraft is inside the ILS middle marker.

The section advises, "pilots are cautioned that vehicular traffic not subject to ATC may cause momentary deviation to ILS course or glideslope signals." Additionally, the section provides that "aircraft conducting coupled or autoland operations should be especially alert in monitoring automatic flight control systems."

During the investigations of the above incidents, a number of pilots were asked to identify the ILS critical areas on an airport. The most common response given was the area near and over the ILS antenna array and inside the Category II and III hold lines on the taxiway. However, as previously stated, discussions with the FAA flight check personnel and ILS installation engineers indicated that there may be considerably more critical areas, depending on the airport and the ILS installed.

The Safety Board is aware that the FAA has completed an evaluation of the feasibility of using aircraft autoland systems for 1,800 RVR operations at airports that have Category I ILS approaches that are not equipped with touchdown zone and centerline lighting. Current Category I landing minimums at airports without touchdown zone and centerline lighting are limited to 2,400 RVR. The evaluation was conducted using the FAA's B-727 Phase II flight simulator in Oklahoma City, Oklahoma. The FAA reported that the simulator tests satisfactorily demonstrated the capability to conduct Category I precision autolandings. The report discussed 16 airports that had been evaluated and may be authorized for autolandings. The authorization is contingent upon the operator providing documentation of at least 30 satisfactory autolandings with 5 or more landings on each runway by the first aircraft type intended for such operations. Of interest to the Safety Board is the fact that two of the airports considered for autolanding authorization had been mentioned by FAA flight inspectors as having ILS approach signals that they consider unreliable and unsuitable for autolandings.

The FAA has provided flight inspection area offices with a list of candidate runways at specific airports for Category I autoland evaluation. These offices have been assigned the task of researching the performance history and trends for these approaches and of performing Category II and III inspections of the facilities at the next periodic check.

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

> Require Principal Operations Inspectors to review the operations manuals for their air carriers, and ensure that the manuals specify that prior to commencing practice autoland approaches and landings in VMC, pilots inform controllers of their intentions. (Class II, Priority Action) (A-94-151)

Issue an Air Carrier Operations Bulletin to inform pilots that ILS signals at Category I runways are not inspected below 50 feet agl and that guidance signal anomalies may be encountered below that altitude. (Class II, Priority Action) (A-94-152)

Revise the Airman's Information Manual to include a notice that ILS signals to Category I runways are not inspected below 50 feet agl and that guidance signal anomalies may be encountered below that altitude. (Class II, Priority Action) (A-94-153)

In conjunction with operational information provided by the Flight Inspection Area Offices and the All Weather Operations Branch, issue an Air Carrier Operations Bulletin that provides information on where ILS critical areas can exist on an airport. (Class II, Priority Action) (A-94-154)

In conjunction with the Flight Inspection Area Offices and the airlines, develop a list of airports and runways where experience has indicated that the Category I ILS signal allows autoland-capable aircraft to perform autoland operations, and provide this list to all operators of autoland-capable aircraft. (Class II, Priority Action) (A-94-155)

In conjunction with the Flight Inspection Area Offices and the airlines, create a method of documenting and reporting Category I ILS anomalies for use in updating a list of Category I ILS approaches that are suitable for autoland operations. (Class II, Priority Action) (A-94-156)

Acting Chairman HALL, and Members LAUBER, HAMMERSCHMIDT and VOGT concurred in these recommendations.

By: Jim Hall
Acting Chairman