BY MARK LACAGNINA

Fatal

The 737 captain continued an unstabilized approach despite numerous warnings.

The Air India Express aircraft was very high and fast during an approach to Mangalore, India.

Persistence

Sounds of snoring and deep breathing captured by the cockpit voice recorder (CVR) indicated that the captain of the Air India Express Boeing 737-800 was asleep until the last 25 minutes of the ill-fated flight. And during those last few moments, his judgment might have been impaired by sleep inertia, said an Indian court of inquiry.

With little time for planning and a late descent clearance because the air traffic control (ATC) radar was out of service, the aircraft arrived very high on the approach to Mangalore, India. Despite several warnings by the first officer and by the enhanced ground-proximity warning system (EGPWS), the captain continued the grossly unstabilized approach.

The 737 touched down long and fast. The captain deployed the thrust reversers and briefly applied wheel braking, but then attempted to reject the landing. The aircraft overran the runway, struck the instrument landing system (ILS) localizer antenna mounting structure, traveled through the airport boundary fence and plunged into a gorge. The impact and fire killed 152 passengers and all six crewmembers; seven passengers were seriously injured, and one passenger sustained minor injuries.

In a final report based on public hearings and the findings of an investigation by the Indian Directorate General of Civil Aviation (DGCA), the court of inquiry said that the cause of the May 22, 2010, crash was "the captain's failure to discontinue the unstabilized approach and his persistence in continuing with the landing despite three calls from the first officer to go around and a number of warnings from the EGPWS."

Quick Turnaround

The accident occurred during a daily "quick turnaround" trip conducted by Air India Express from Mangalore to Dubai, United Arab Emirates, and back to Mangalore.

The captain, 55, had 10,216 flight hours as a pilot-in-command (PIC) and 2,845 hours in type. He was hired as a 737 PIC by Air India Express in December 2008. Pilots who had flown with the captain described him as friendly and "ready to help the first officers with professional information," the report said, adding, however, that "some of the first officers mentioned that [the captain] was assertive in his actions and tended to indicate that he was always right."

The first officer, 40, was hired as a 737 copilot in April 2009. He had 3,500 flight hours, including 3,200 hours in type. Noting that the first officer "was due for command training" on the 737, the report said that he "was known to be meticulous in his adherence to procedures [and] to be a man of few words."

Indian Directorate General of Civil Aviation

The 737 was in pieces and engulfed in flame when rescuers arrived. Only eight passengers survived.

The report said that both pilots had been given adequate time to rest before beginning the trip. The captain had received 54 hours of rest after returning to Mangalore on May 19 from a two-week vacation at his hometown in Serbia. The first officer, an Indian national, had received about 82 hours of rest before the trip.

"Due to the non-availability of a medical officer, the crew was not subjected to any preflight medical check prior to departure from Mangalore," the report said. "However, the engineering personnel who interacted with the captain and the first officer … stated that both pilots appeared to be healthy and normal."

The aircraft departed from Mangalore at about 2135 local time and arrived in Dubai at 0114 (2344 Dubai time). The return flight to Mangalore began nine minutes ahead of schedule at 0236. "As indicated by the DFDR [digital flight data recorder], the takeoff, climb and cruise were uneventful," the report said.

No Radar

The first officer established radio communication with Mangalore Area Control at 0532. A notice to airmen published two days earlier advised of an ATC radar outage in the area. The first officer asked the controller if the aircraft was being tracked on ATC radar and was told that the Mangalore area radar was still out of service.

The controller also told the first officer that the airport was reporting calm winds, 6 km (4 mi) visibility, a few clouds at 2,000 ft and a surface temperature of 27 degrees C (80 degrees F).

The aircraft was at Flight Level (FL) 370 (approximately 37,000 ft) and about 130 nm (241 km) from Mangalore when the first officer requested clearance to descend. "This was, however, denied by the ATC controller, who was using standard procedural control to ensure safe separation with other air traffic," the report said.

The first officer later was told to expect the VOR-DME (VHF omnidirectional radio/distance measuring equipment) arc transition to the ILS approach to Runway 24, which is 8,038 ft (2,450 m) long.

The report described the airport as being on a "tabletop" plateau that rises about 300 ft above the surrounding terrain. Airport elevation is 337 ft. The airport is classified as a "critical airfield" by the DGCA, requiring special qualification of flight crews operating there. Air India Express required all takeoffs and landings at the airport to be conducted by the PIC.

The captain, who was based in Mumbai, had conducted 16 flights at the Mangalore airport; the first officer, who was based in Mangalore, had made 66 flights there.

Incomplete Briefing

The captain awakened at 0540, shortly before the descent was begun. The first officer briefed him on the weather conditions and the expected approach procedure at Mangalore. "This was the first time that the CVR recording revealed limited communication between the flight crew," the report said. "However, the captain did not communicate effectively in response to this briefing. The approach briefing was incomplete and not in conformity with … SOP [standard operating procedure]."

The area controller had told the first officer to make a position report at 80 nm (148 km) on the 287-degree radial of the Mangalore VOR/DME. The first officer made that report at 0546 and was cleared to descend from FL 370 to 7,000 ft.

The aircraft was descending through 29,500 ft at 0550 when the captain deployed the speed brakes to increase the rate of descent. The pilots then conducted the "Descent" checklist. The report noted that company SOP requires flight

crews to begin this checklist about 150 nm (278 km) from the destination airport and to complete the checklist before beginning the descent from cruise altitude.

The aircraft was 25 nm (46 km) from the airport and descending through 18,400 ft when the crew was cleared to continue the descent to 2,900 ft, the minimum altitude for the published 10-nm (19-km) VOR-DME arc transition. The aircraft entered the arc at about 10,500 ft and 251 kt.

"Throughout the descent profile and DME arc approach for the ILS 24, the aircraft was much higher than the normally expected altitudes," the report said. "During the same time, the only sounds made by the captain were of exhaling, yawning and throat clearing."

'Runway Straight Down'

The CVR also recorded yawns by the first officer, a sign that he, too, was tired, the report said, noting that both pilots were operating in the "window of circadian low," a physiological period characterized by reduced performance and alertness.

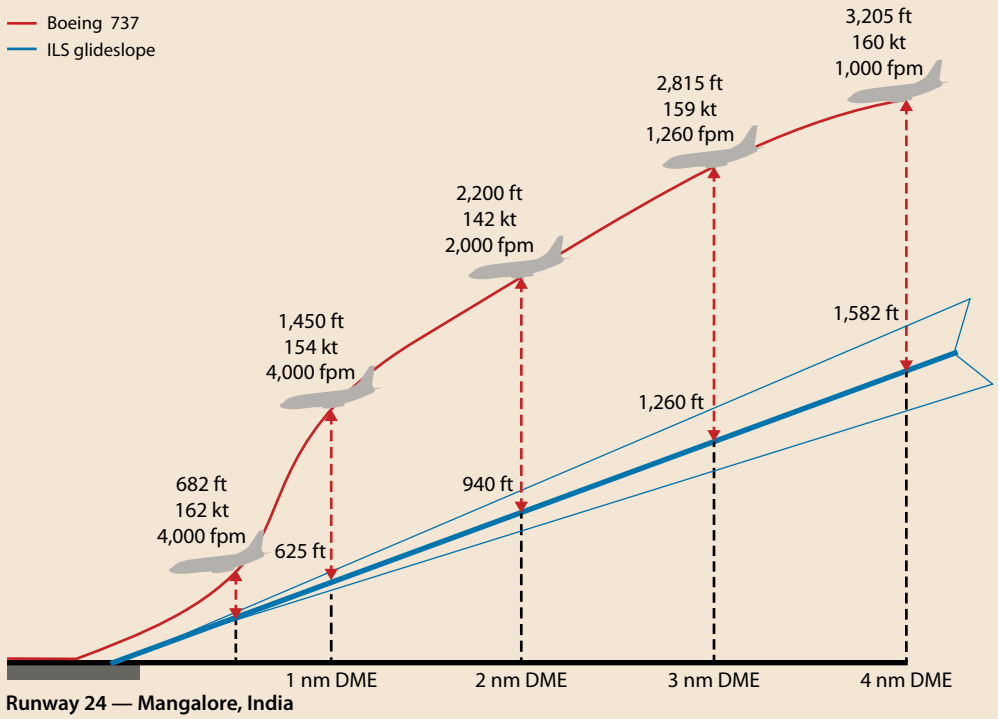
The flight was handed off at 0552 to the airport traffic controller, who asked the first officer to report when the aircraft was established on the DME arc. Shortly after the first officer made that report, "it appears that the captain realized that the aircraft altitude was higher than normal and selected the landing gear down at an altitude of approximately 8,500 ft, with the speed brakes still deployed, so as to increase the rate of descent," the report said.

The 737 was at 7,700 ft when it passed through the localizer course at 217 kt. The first officer had not made the required call of "localizer alive" when the needle began to center. The captain steepened the right turn to correct the overshoot.

After intercepting the localizer course, the aircraft remained about two times higher than the published altitude required to intercept the glideslope from below, per normal procedure.

At 0601 and at a DME distance of 6.7 nm (12.4 km), the aircraft was descending through 4,630 ft with the speed brakes still deployed, when the captain told the first officer to extend the flaps to 15 degrees. The captain called for flaps 25 and then retracted the speed brakes as the aircraft was descending through 3,465 ft at 4.3 nm DME (7.9 km). At 2.5 nm DME (4.6 km), the EGPWS called out a height of 2,500 ft (Figure 1).

Flight Path



DME = distance measuring equipment; ILS = instrument landing system

Source: Adapted from DGCA report by Karen Ehrlich

Figure 1

"It is too high," the first officer said. "Runway straight down."

"Oh, my God," said the captain. He disengaged the autopilot, called for flaps 40, redeployed the speed brakes and moved the control column forward to increase the rate of descent. At 165 kt, the airspeed was above the 162-kt limit for flaps 40, and the flap load-relief system automatically reduced flap extension to 30 degrees.

Fixated on the Runway

"Go around?" the first officer asked.

"Wrong loc … localizer … glide path," the captain said.

"Go around," the first officer stated. "Unstabilized."

The report said that the captain was "fixated on the runway" and did not respond to the first officer's call to go around. Although company SOP empowered the first officer to assume control and discontinue the approach, he did not do so.

The captain had increased the aircraft's descent rate to nearly 4,000 fpm, and the first officer had made no callouts about altitude, airspeed or sink rate. Neither pilot responded to the nearly continuous "SINK RATE" and "PULL UP" warnings generated by the EGPWS.

Working without radar, the airport traffic controller had instructed the crew to report when they were established on the ILS approach. When the report was overdue, the controller asked the first officer if they were on the approach. "To this call, the captain forcefully prompted the first officer to give a call of 'affirmative,'" the report said. "The ATC tower gave landing clearance thereafter and also indicated 'winds calm.'"

The 737 crossed the runway threshold at 200 ft and with an indicated airspeed in excess of 160 kt. The report said that the crossing height should have been 50 ft, and the proper airspeed for the aircraft's weight was 144 kt.

"Despite the EGPWS warnings and calls from the first officer to go around, the captain had persisted with the approach in unstabilized conditions," the report said. "Short of touchdown, there was yet another (third) call from the first officer, this time on the VHF [radio] channel: 'Go around, captain,' followed by, 'We don't have runway left' on the intercom." This call, too, was not heeded by the captain.

When airspeed decreased below 158 kt, the flap load-relief system extended the flaps to the selected 40 degrees. "This extension during the flare, close to the ground, resulted in a prolonged float and a late touchdown," the report said.

The aircraft touched down about 5,200 ft (1,585 m) from the approach threshold of Runway 24, with about 2,800 ft (853 m) of runway remaining.

The captain deployed the thrust reversers. The autobrake, which had been set to

'Flight Safety Watchdog' for India?

Prompt adoption of legislation that would establish an independent organization to investigate aviation accidents and serious incidents in India was among numerous recommendations issued by a court of inquiry convened to investigate the fatal Air India Express Boeing 737 accident at Mangalore.

Currently, aviation investigations are conducted mainly by the Directorate General of Civil Aviation (DGCA), which serves primarily as the aviation regulatory authority in India. Shortly after the 737 crashed in Mangalore on May 22, 2010, the DGAC's governing body, the Ministry of Civil Aviation, announced that it was considering originating legislation that would transfer the directorate's accident-investigation responsibilities to an independent body and would give the DGCA total autonomy as the aviation regulator, according to media reports.

The court told the Ministry of Civil Aviation that an Indian Civil Aviation Safety Board should be patterned after the "independent safety organizations [that] have been set up in the United States, United Kingdom, Canada, France and Indonesia, to name a few."

Autonomy is a key to the successful functioning of such a body, the court indicated, citing a previous attempt, in 1987, to establish an independent investigative organization in India similar to the U.S. National Transportation Safety Board. "However, it did not have independence as a statutory body, and, therefore, it did not fructify into a permanent setup," the court said.

The court urged the ministry to proceed with legislation that would create an Indian Civil Aviation Safety Board. Citing the rapid growth of civil aviation in the last decade, the court said, "With further growth projected in this vital means of transportation, there is an urgent need for an independent body which will function as a watchdog in the matters of flight safety [and] help in formulating proactive strategies to reduce accidents and incidents."

The 737 touched down about two-thirds of the way down the runway and plunged into a gorge during a last-minute attempt to reject the landing at the 'tabletop' airport in Mangalore, India.

position 2, the second of four settings providing progressively higher wheel braking, activated briefly before the captain applied manual wheel braking.

Six seconds later, the captain "made the grave mistake" of stowing the thrust reversers and applying full thrust to initiate a go-around, the report said. Shortly thereafter, he exclaimed, "Oh, my God. … Aww, big one."

The aircraft overshot the runway and the 300-ft/90-m runway end safety area (RESA). The right wing "sheared into pieces" and the right engine separated when they struck the non-frangible, concrete localizer antenna mounting structure 279 ft (85 m) from the end of the RESA, the report said. "The remaining portion of the aircraft fell into the gorge, broke into three parts and caught fire."

The report said that "a large number of fatalities were due to burns" and that toxicological tests revealed no sign that the captain or the first officer had consumed any drugs, alcohol or medications.

Dozing on Deck

During the hearings conducted by the court of inquiry, several senior pilots said they often wish that they could take a short nap during cruise flight. Most of the pilots admitted to having taken naps on the flight deck or having seen other crewmembers nap during cruise flight.

"There are dangers of such a nap prolonging into a deep sleep, causing effects of sleep inertia," the report said. "There is also a possibility of induced sleep, which affects the other crewmembers, who may also doze off."

The DGCA had investigated two incidents in which both flight crewmembers were sleeping at the same time. As a result, the directorate in 2009 issued an air safety circular requiring cabin crew "to interact with pilots on intercom every 30 minutes," the report said, adding: "Although such a procedure is useful, it is possible that only one of the pilots, who is awake all the time, would reply and the other crew[member] could go into deep sleep."

Indeed, the CVR in the accident aircraft had recorded the first officer responding to queries by the cabin crew, as well as radio transmissions from ATC, while the captain was asleep.

The report noted, however, that several airlines have established SOPs for controlled rest in the cockpit, recognizing that a 45-minute nap can refresh a pilot prior to descent and landing. Accordingly, the court recommended that the DGCA determine whether Indian airlines should be allowed to adopt such procedures.

This article is based on a report of the DGCA's investigation and the findings of the court of inquiry entitled "Report on Accident to Air India Express Boeing 737-800 Aircraft VT-AXV on 22nd May 2010 at Mangalore." The full report is available on the Aviation Safety Network Web site at <aviation-safety.net/database/record.php?id=20100522-0>.