BY MARK LACAGNINA

HIGH, HOT and FIXATED

Despite several warnings, the Garuda 737 pilot stayed focused on landing.

The copilot called twice for a go-around, and the ground-proximity warning system (GPWS) aboard the Garuda Indonesia Boeing 737-400 provided 15 alerts and warnings during the approach. But the pilot-in-command (PIC) was intent on landing the aircraft on the runway at Yogyakarta, Indonesia, and either did not hear or did not heed the warnings. He continued the steep and excessively fast approach, which resulted in an overrun, several fatalities and serious injuries, and the destruction of the aircraft.

The Indonesian National Transportation Safety Committee (NTSC) said, in its final report, that the causes of the March 7, 2007, accident were ineffective flight crew communication and coordination; the crew's failure to reject the approach when stabilized approach criteria were not met; the PIC's failure to act on the warnings from the copilot and the GPWS; the copilot's failure to take control of the aircraft; and the absence of pilot training by the airline on required responses to GPWS alerts and warnings.

The accident occurred during a scheduled flight from Jakarta, which is about 450 km (243 nm) west-northwest of Yogyakarta, both on the island of Java.

The PIC, 45, had 13,421 flight hours, including 3,703 flight hours in type. He was hired by Garuda in 1985. The copilot, 31, had 1,528 flight hours, including 1,353 flight hours in type. He was hired by Garuda in 2004.


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The GPWS provided 15 alerts and warnings during the approach.

The training records for the PIC and the copilot showed that they had attended enhanced GPWS (EGPWS) introductory seminars in August and October 2005, respectively. "However, the records showed no evidence that [they] had been checked or received simulator training in appropriate vital actions and responses (escape maneuvers) with respect to GPWS or EGPWS alerts and warnings," the report said.

The PIC had been off duty for more than 35 hours and the copilot had been off duty for more than 69 hours before reporting for the accident flight at 0430 local time. No significant weather was forecast for the route. The forecast for Yogyakarta's Adi Sucipto Airport called for surface winds from 240 degrees at 10 kt, scattered clouds at 2,000 ft and 8 km (5 mi) visibility, with visibility occasionally 5 km (3 mi) and a few cumulonimbus clouds with bases at 1,500 ft.

The aircraft was manufactured in 1992 and exported from the United States to Indonesia in 2002. It had accumulated 35,207 airframe hours and 37,360 cycles. "There was no evidence of any defect or malfunction with the aircraft or its systems that could have contributed to the accident," the report said.

The report noted, however, that recorded flight data indicated that only the right engine thrust reverser had been used during the previous two landings. "Further examination found that only the right thrust reverser had been used for the previous 27 sectors," the report said. "This indicated that the left thrust reverser may have been unserviceable for a considerable number of flights immediately prior to the accident flight."

While the aircraft was being pushed back from the gate, the PIC told ground engineers that the left thrust reverser fault light had illuminated. "The engineers reset the thrust reverser in the engine accessories unit, and the fault light extinguished," the report said. The 737 departed from Jakarta at 0617, 17 minutes behind schedule.

Cleared for a Visual

The aircraft was in cruise flight at 0647 when the PIC, the pilot flying, briefed the copilot on the instrument landing system (ILS) and localizer approaches to Runway 09, landing with 40 degrees of flap and the published missed approach procedure. Soon after the briefing, the crew began the descent to Yogyakarta.

The report said that the crew had communicated, mostly in their native Indonesian language, "in normal tones and in an orderly manner, [but] during the approach below 10,000 feet and prior to reaching 4,000 feet, the PIC was singing and there was some minor nonessential conversation, which was not in accordance with the Garuda Basic Operations Manual policy for a sterile cockpit below 10,000 ft."

The 737 was descending through 6,560 ft when the approach controller asked the crew if they were in visual meteorological conditions. The copilot replied "affirm," and the controller cleared the crew to conduct a visual approach and told them to establish the aircraft on a "long final" and to report the airport in sight. "Although the crew acknowledged the visual approach clearance, they continued with the ILS approach but did not inform the controller," the report said.

At 0655, the aircraft crossed the initial approach fix at 283 kt and at 3,927 ft — 1,427 ft higher than the published minimum crossing altitude of 2,500 ft (Figure 1, p. 44). The 737 tracked the localizer course from the initial approach fix inbound and crossed the final approach fix in clean configuration at 254 kt and at 3,470 ft — 970 ft above the published crossing altitude. Groundspeed was 286 kt; the tailwind component decreased as the aircraft descended.

'Focused on Landing'

The PIC twice expressed concern about the 737's vertical flight path. He later told investigators that he did not conduct a go-around because he was "focused on landing the aircraft." He also said that his actions were not influenced by Garuda's fuel-conservation policy, as had been reported by the media.

The 737 was about 4 nm (7 km) from the runway and about 2,800 ft above ground level (AGL) — 1,262 ft above the glideslope — when the PIC began a steep descent. "The PIC descended the aircraft steeply in an attempt to reach the runway, but

Boeing 737-400

Produced from 1988 to 2000, the 737-400 is 10 ft (3 m) longer than the 737-300, has strengthened landing gear and can accommodate 146 to 168 passengers. Powered by CFM56-3B2 or -3C turbofan engines, maximum operating speed is 0.82 Mach, and maximum range is 2,808 nm (5,200 km). Maximum standard weights are 138,500 lb (62,824 kg) for takeoff and 121,000 lb (54,886 kg) for landing.

Source: *Jane's All the World's Aircraft*

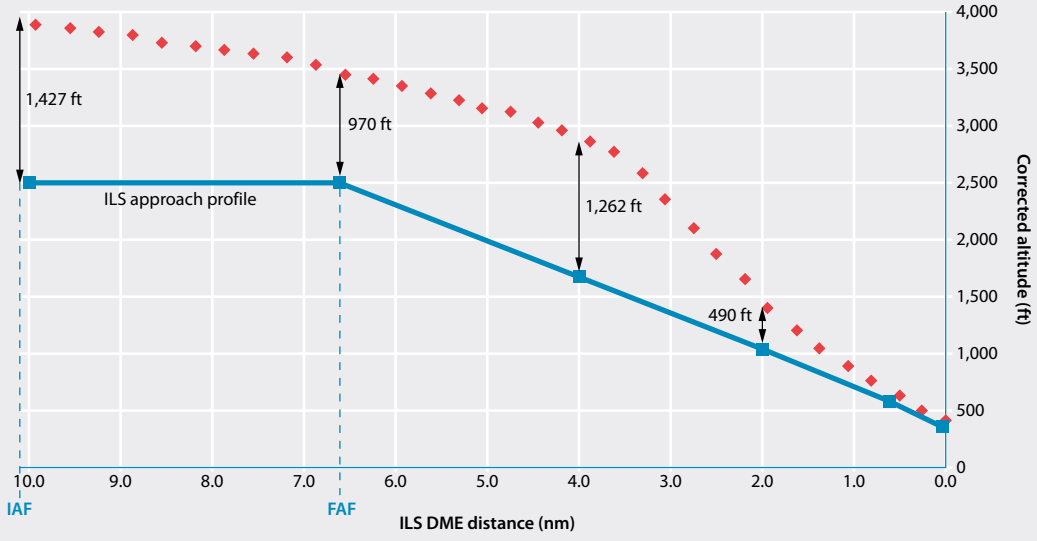
in doing so, the airspeed increased excessively," the report said. He did not deploy the speed brakes, and over the next two minutes airspeed increased to 293 kt before decreasing to 243 kt.

The copilot established radio communication with the airport air traffic control tower at 0656 and was told that the surface winds were calm. He then extended the landing gear at the PIC's command; maximum extension speed is 270 kt. Airspeed was 252 kt, and the aircraft was 2,596 ft AGL when the PIC told the copilot, "Check speed, flaps fifteen."

"Because the aircraft was being flown at speeds that were in excess of the wing flaps operation speed [205 kt for 15 degrees], the copilot elected not to extend the flaps as instructed by the PIC," the report said. The PIC repeated the instruction three more times. The copilot did not comply and did not caution the PIC about the excessive airspeed. The report said that the tone of communication between the pilots changed during this time.

Rate of descent was 3,520 fpm at 0657, when the GPWS generated the first of several "SINK RATE" alerts; several "TOO LOW TERRAIN" alerts also were generated. The aircraft was descending at 245 kt about 953 ft AGL when the copilot selected 5 degrees of flap; the maximum flaps 5 extension speed is 250 kt. He called out the action but "did not inform the PIC that the reason he only selected flap 5 was that the airspeed … exceeded the flap 15 degrees maximum operating speed by 35.5 knots," the report said. The PIC again called for flaps 15.

Aircraft Flight Path



DME = distance measuring equipment ; FAF = final approach fix; IAF = initial approach fix; ILS = instrument landing system

Source: Indonesian National Transportation Safety Committee

Figure 1

'Go Around, Captain'

The 737 was about 153 ft AGL when the GPWS generated the first of two "WHOOP, WHOOP, PULL UP" warnings. The copilot said, "Oh, captain. Go around, captain." The PIC did not acknowledge the warning; instead, he said, "Landing checklist completed, right?"

The airline's operations manual states that the pilot monitoring must take control of the aircraft from the pilot flying and conduct a go-around if the PIC fails to respond appropriately to an unstabilized approach. The report said, however, that there was no record that the copilot had received training on the "vital actions" that would be required in this situation.

The aircraft was near the runway threshold and descending at about 1,400 fpm when it reached glideslope altitude. With the flaps still extended only 5 degrees, it crossed the threshold at 232 kt — 98 kt faster than the landing reference speed of 134 kt. This landing reference speed was appropriate for the aircraft's landing weight — 53,366 kg (117,651 lb) — with flaps extended 40 degrees. Airspeed was 221 kt when the aircraft touched down about 860 m (2,822 ft) from the runway threshold. The runway is 2,200 m (7,218 ft) long and 45 m (148 ft) wide.

"Immediately after touchdown, the copilot called with high intonation, 'Go around,' but the PIC did not respond orally or with actions to comply," the report said.

The aircraft bounced twice. Vertical accelerations during the three touchdowns were +1.86 g — that is, 1.86 times standard gravitational acceleration — +2.26 g and +2.96 g, respectively. After the second bounce, the nosewheel assembly touched down hard on the runway before the main landing gear, and the left nosewheel tire burst. Both thrust reversers were deployed for seven seconds. The PIC said that he shut down both engines when he realized that the aircraft was going to run off the end of the runway.

"The delay in extinguishing the fire may have significantly reduced survivability."

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The 737 was 10 m (33 ft) right of the centerline when it overran the runway at 110 kt at 0658. It crossed three ditches and a road, and struck two fences and an embankment before stopping in a rice paddy 252 m (827 ft) from the end of the runway. The nosewheel assembly had separated from the aircraft on the runway. "The engines and landing gear separated from the aircraft and were destroyed," the report said. "The right wing was severed from the fuselage, swung around the fuselage and came to rest on top of the left wing."

There were 140 people aboard the aircraft. One flight attendant and 20 passengers were killed. One flight attendant and 11 passengers sustained serious injuries, and two flight attendants and 98 passengers sustained minor injuries. The two pilots, a flight attendant and four passengers were not injured. The aircraft was destroyed by the impact and a post-impact fire.

'Reduced Survivability'

Two aircraft rescue and fire fighting (ARFF) vehicles had been mobilized after firefighters saw the 737's nosewheel tire burst. "The fire fighting vehicles were dispatched in a timely manner to the crash site, but they stopped … behind the airport perimeter fence," the report said. There was no access road to the accident site.

"The airport rescue services' personnel were not familiar with the area surrounding the airport, and the airport fire service vehicles were not suitable for, or capable of, traversing swampy or soft ground such as the rice field," the report said.

ARFF personnel attempted to spray foam on the burning aircraft but were too far away. They deployed a flexible extension hose, but the hose was rendered ineffective by damage from rescue and onlookers' vehicles driving over it.

"There was no appropriate rescue coordination at the crash site, due to the AEP [airport emergency plan] not being followed, and too many unqualified people [were] giving instructions," the report said. "About 45 minutes after the accident, two city fire fighting vehicles arrived and were ordered by an unqualified person to start hosing the fire. However, the city vehicles did not have foam, only water."

Because of the inability of the ARFF personnel to reach the accident site and the inappropriate suppressant agent used by city firefighters, the fire was not extinguished until two hours and 10 minutes after the accident. "The delay in extinguishing the fire and the lack of appropriate fire suppressant agents may have significantly reduced survivability," the report said.

Rescue operations continued until late afternoon. "The airport operator did not establish a collecting area, care area or holding area at the accident site, as required in the AEP," the report said.

Nonstandard Safety Area

The report said that the runway end safety area (RESA) for Runway 09 did not meet International Civil Aviation Organization (ICAO) standards and was a factor in the accident. A RESA is intended to "reduce the risk of damage" to aircraft that overshoot or undershoot the runway, according to ICAO.

The airport chart identifies a 60-m (197-ft) stopway at the end of Runway 09 as the RESA. "An additional grassed area, not defined on the aerodrome chart as a RESA, is 98 meters [322 ft] long," the report said.

In Annex 14, *Aerodromes*, ICAO says that a RESA must extend 90 m (295 ft) from the end of the "runway strip," which is defined as a designated area that includes the runway and stopway. In addition, "[ICAO] recommends that for a Category 3 airport such as Yogyakarta, a RESA should, as far as practicable, extend from the end of a runway strip to a distance of at least 240 meters [787 ft]," the report said.

Based on these findings, NTSC recommended that the Indonesian Directorate General of Civil Aviation "ensure that airline operators have published procedures that take into consideration the RESA requirement when calculating performance specifications for operations into airports with runways having a RESA that does not meet the ICAO Annex 14 standard."

Among 18 other recommendations generated by the investigation (*ASW*, 12/07, p. 8), NTSC said that Indonesian airline operators should provide initial and recurrent pilot training in approach and landing accident reduction (ALAR) and controlled flight into terrain (CFIT) prevention, using materials developed by Flight Safety Foundation. The accident report contains copies of the *Approach-and-Landing Risk Reduction Guide* and the *CFIT Checklist*, two elements of the Foundation's CD-based *ALAR Tool Kit*.

The report noted that, among several actions taken after the accident, Garuda issued a notice assuring its pilots that the company will not take disciplinary measures for a go-around executed in response to any unsafe or unstabilized approach. The notice also repeated that the pilot monitoring must take control and conduct a go-around when the pilot flying does not respond appropriately to an unstabilized approach. ●

This article is based on NTSC Aircraft Accident Investigation Report KNKT/07.06/07.02.35: "Boeing 737-497, PK-GZC, Adi Sucipto Airport, Yogyakarta, Indonesia, 7 March 2007."