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Propeller Injures Maintenance Technician During Apron Check of Deicing Boots

Inadequate coordination of airport police officers and other specialists hindered the emergency response and the accident investigation, said the Dutch Transport Safety Board. Investigators also found that the supervisor knew that the maintenance technician had worked only on turbojet airplanes and had limited line experience.

FSF Editorial Staff

On May 11, 2001, about 0815 local time, a recently hired maintenance technician (mechanic) was struck and seriously injured when he walked into the edge of rotating propeller blades on the right engine of a Fokker 27 Mark 50 (Fokker 50), operated as KLM Cityhopper Flight KL1172. The propeller strike occurred on the B Apron at Amsterdam Airport Schiphol, the Netherlands, during preflight operation.

None of the two pilots, two flight attendants or 26 passengers was injured; the aircraft received minor damage (a 1.0 centimeter/0.4 inch piece was missing from one propeller-blade tip), said the Dutch Transport Safety Board (RVTV; Raad voor de Transportveiligheid). In its final accident report, RVTV said that the following causal factors were identified:

- "The mechanic had to perform a task for which he was not properly trained;
- "The [supervising ground engineer] allowed the mechanic to dispatch the aircraft on his own;
- "The mechanic reacted on impulse to proceed to the aircraft tail; [and,]
- "Due to the light conditions, the mechanic did not see the propeller."

RVTV said that the following contributing factors were identified:

- "Neither [KLM Cityhopper] nor [Martinair Maintenance and Engineering (MME)] defined specific instructions for executing the visual deicing-boots check;
- "There was insufficient consideration by [the KLM Cityhopper] and MME organizations of the risks involved prior to the introduction of the deicing-boots check;
- "There was no formal system in place for the [ground engineer] to correctly assess the capability of the mechanic;
- "The mechanic did not have any line experience with propeller aircraft;
- "There were no visual warnings [on the aircraft] marking the danger areas of the propeller;
- "The APU [auxiliary power unit] was not allowed to be used to check the deicing-boots inflation system prior to engine start; [and,]
- "The light conditions may have made it difficult to see the tail section of the aircraft."

A superimposed arc shows the edge of rotating propeller blades on the Fokker 50. (Source: Dutch Transport Safety Board)

Underlying causes were the absence of a hazard inventory — including evaluation of departure services for Fokker 50 aircraft — in the air carrier's safety management system, and insufficient enforcement of the Dutch Occupational Safety and Health Act as applied to hazards of aircraft-departure services.

The 28-year-old maintenance technician had a certificate from London [England] City and Guilds in aircraft maintenance skills, and he had received ab initio training on Boeing 737-series airframe fuselage maintenance at Shannon Aerospace Ireland, where he had been employed from 1992 to 1998. He had no type ratings. He had worked on contract assignments from 1999 to 2000, and had been contracted to MME beginning in 2001. His experience comprised only work on turbojet aircraft, primarily heavy-maintenance duties, when he was hired for a five-month assignment by MME through PARC Aviation, an Irish aviation-personnel agency. He had performed base maintenance until one week before the propeller strike, and MME rated his performance as requiring direct supervision — in part because he did not speak Dutch.

The 38-year-old ground engineer involved in the accident was a licensed avionics ground engineer with type ratings on the Fokker 50, McDonnell Douglas MD-11 and Boeing 767, and he had been involved in aircraft base maintenance and aircraft line maintenance since 1993. MME did not have a procedure to inform him about the experience and knowledge of contract personnel; details of required levels of supervision during departure services also were absent from company procedures.

On the morning of the accident, the ground engineer knew that the maintenance technician had been hired through an employment agency and that he was unlicensed, but he received no instructions or information about him.

"They exchanged some general and technical background information during the 10-[minute] to 15-minute drive from the hangar to [B Apron]," the report said. "The mechanic stated [that] he mentioned during the drive that he had limited line-maintenance experience, that he had only worked on jet aircraft and that he had no experience with the Fokker 50."

The ground engineer and the maintenance technician then completed maintenance preflight checks on the accident aircraft at 0730 and on another Fokker 50 at 0805. The immediate area surrounding the accident aircraft was dry and had no fuel/oil spills.

"According to the ground engineer, they had discussed aspects of the departure service for the Fokker 50, and the mechanic had specifically asked if it required a pushback or a rollout," the report said. "It appeared to the ground engineer that the mechanic had done departure services before, however, not on propeller aircraft. Although the ground engineer was familiar with the [Fokker 50] deicing-boots check, he did not discuss this check with the mechanic."

The deicing-boots check was a standard operating procedure (SOP) for KLM Cityhopper pilots. The Fokker 50 ice-protection system includes inflatable deicing boots to remove ice from the leading edges of the wings and tail section. The SOP is based on guidance in a 1992 Fokker service letter and on a 2000 company directive that flight crews "inflate the deicing boots prior to the first flight of the day so that warm air would be blown into the system to remove moisture." At Schiphol and Rotterdam Airport, the SOP further required pilots to request that a ground engineer conduct a visual inspection after aircraft deicing. The SOP did not specify phraseology for the pilots and ground engineers to use in conducting the deicing-boots check.

Normally, cycling deicing boots with bleed air from the APU is preferable to using bleed air from a running engine because of the hazard of rotating propellers, the report said. In response to airport-noise-abatement policies, however, KLM Cityhopper in 1998 had prohibited operation of Fokker 50 APUs on B Apron at Schiphol.

A short time before the propeller strike, the ground engineer gave his headset to the maintenance technician, then drove to another Fokker 50. The maintenance technician walked to the accident aircraft, plugged the headset into the external service/interphone panel located on the right side of the fuselage below the first officer's cockpit sliding window, and remained in this position during a delay imposed by air traffic control (ATC), the report said. Conversations were conducted in English.

The headset jack was located 4.04 meters (13.25 feet) from the six-blade propeller, which had a diameter of 3.66 meters (12.01 feet) and a minimum clearance to the fuselage of 0.59 meters (1.94 feet). The propeller's approximate ground clearance was 1.13 meters (3.71 feet).

The flight crew started both engines, and after both engines were stabilized at about 0813, the maintenance technician used hand signals to relay to a ground handler an instruction to disconnect

the ground-power plug of a ground power unit (GPU). The first officer then activated the deicing boots.

"The captain and first officer both visually checked the proper inflation of the deicing boots on their respective wings, and the first officer [said that he was selecting 'manual 1' and] asked the mechanic to look at the tail section. A short reply was given, and the captain had the impression that the mechanic was not expecting this request." The ground handler moved to remove the nose-wheel chocks, but the maintenance technician signaled to leave these chocks in place.

Shortly afterward, the pilots and cabin occupants heard a strange noise, apparently from the engine, caused by the propeller strike.

"The clockwise direction of rotation of the propeller (as viewed from behind) meant that a propeller blade struck the left shoulder of the mechanic first, followed by the left side of his head," the report said. "The initial strike to the shoulder knocked him towards the fuselage away from the propeller."

The ground handler who disconnected the GPU saw the maintenance technician unplug his headset and walk directly toward the propeller. The maintenance technician did not hear the ground handler's warning shouts or whistles from a few meters away, however, because he was wearing the headset.

The ground handler then ran toward the duty officer seated in a van parked to the left-front of the airplane nose, and "signaled frantically" while shouting to the duty officer and pointing under the aircraft. The duty officer immediately gave the stop-engines hand signal to the captain, and the captain shut down both engines.

Later analysis of the cockpit voice recorder revealed that about three seconds to four seconds had elapsed from the time the maintenance technician disconnected his headset until he was struck. Another 17 seconds elapsed until the captain shut down the engines. The ground engineer had heard the sound of the engine start, and he was returning to the aircraft parking position.

The captain reported to ATC what happened and requested an ambulance. The duty officer simultaneously activated the alarm button on his handheld radio and called the airport emergency services. ATC requested an emergency-medical-services helicopter. Meanwhile, ground personnel assisted the maintenance technician.

The captain entered the cabin and told passengers what had happened; some passengers appeared to be in shock. Passengers were transferred from the aircraft to a bus, and the helicopter landed in front of the aircraft before the bus departed.

While the captain and first officer continued to conduct emergency communication with a mobile telephone and one aircraft radio powered by the aircraft batteries, a military police officer entered the cockpit, requested crewmember names and addresses, and requested a statement about what had occurred. The captain asked the police officer to return at a later time, but the police officer remained in the cockpit, and the captain provided a brief statement. An aviation police officer then arrived and assumed command of the police investigation.

"The cockpit crew was still trying to perform their duties while various people entered the cockpit," the report said. "The responsibilities of the cockpit crew were not respected. This interference added to the pressure that the crew was already under. … The captain and first officer were questioned four times and the cabin attendants [were questioned] twice by different authorities."

Inadequate coordination also resulted in failure to activate the airport's established emergency-response system, confusion about which organizations had been notified and duplication of efforts to assist passengers and crewmembers.

"When the [KLM Cityhopper] platform coordinator first arrived at the scene, he reported that there was no coordination, so he then assumed that role," the report said. "The headset which was worn by the mechanic was left on the ground. … Not aware of the possible value of these items to the investigation team, Martinair personnel subsequently discarded the headset."

RVTV's investigation found that existing procedures did not make clear which personnel — ground engineers and/or maintenance technicians — were authorized to conduct the visual deicing-boots check, and whether this check was covered by work rules as a departure service or as a maintenance task.

Nevertheless, the Dutch Occupational Health Act required all departure-services personnel to be informed about hazards such as exposure to rotating propellers or jet blast, and to be protected from apron hazards by specific safety measures.

"The potentially hazardous nature of the [Fokker 50 deicing-boots] procedure was probably not fully envisaged by either [KLM Cityhopper] or MME," the report said. "At no time did either party suggest an assessment of the hazard inventory and evaluation; for example, low sun restricting visibility, night time, slippery conditions underfoot or a running engine in lieu of the APU. Neither company warned personnel of any possible dangers."

Time pressure included the ground engineer's knowledge that three more aircraft were due to arrive and his inability to find out when or if the other scheduled ground engineer would arrive.

"It is believed that when the [ground engineer] asked the mechanic if he (the mechanic) could do the departure service of [the accident airplane] by himself, it was very difficult for the mechanic to refuse this," the report said. "Because the mechanic had no previous experience with propeller aircraft, he was in no position to judge

if he was able to perform the dispatch of [this flight] alone. He willingly accepted the task presented to him. The week before, he had performed a departure service on a Fokker 70 [a turbojet airplane with tail-mounted engines] under supervision."

If the rotating propeller of the accident aircraft had been lighted from the front, the yellow tips of the black propeller blades would have created a readily visible yellow arc.

"Shadows caused by the aircraft fuselage, dorsal fin, vertical tail, right wing and right stabilizer were considered as relevant," the report said. "Looking from this position [the interphone panel] towards the deicing boot on the fin, he would have looked from the shaded area against a brightly lit background with high contrasts. If he had moved sideways into the light to look at the tail, he would have looked straight into the sun."

RVTV's report included the following recommendations:

- That MME and KLM Cityhopper evaluate in their safety management systems the actual hazards and confine them to "a level as low as reasonably achievable," including the requirement for personnel to work near rotating propellers or an APU. They also should "establish an emergency response for smaller accidents";

- That MME define the authorities, responsibilities and restrictions of all contract employees; provide complementary training to all contract employees; and ensure that company personnel are fully aware of the authorities, responsibilities and restrictions of any contract staff under their supervision;

- That KLM Cityhopper evaluate additional measures required to conduct safe deicing-boot checks on propeller airplanes; and,

- That Amsterdam Airport Schiphol establish an emergency-response plan suitable for "smaller-scale accidents," including coordination of requests for witness statements; that the Labor Inspectorate of the Dutch Ministry of Social Affairs and Employment increase its knowledge of all hazards to personnel conducting aircraft-departure services; and that the European Joint Aviation Authorities consider introducing safety regulations for departure services.♦

[FSF editorial note: This article, except where specifically noted, is based on the English version of the Dutch Transport Safety Board (RVTV; Raad voor de Transportveiligheid) *Final Report: Propeller strike during start-up with the KLM Cityhopper Fokker F27 Mk.050, registration PH-KXM, at Amsterdam Airport Schiphol, 11 May 2001,* Occurrence no. 2001053, December 2003. The 81-page report — published in English and Dutch — contains photographs, illustrations and appendixes.]

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