FLIGHT SAFETY FOUNDATION

Accident Prevention

Vol. 60 No. 4 *For Everyone Concerned With the Safety of Flight* April 2003

Sabreliner Strikes Mountain Ridge During Night Visual Approach

The flight crew did not brief a nonprecision approach procedure with several step-down segments and did not adhere to the published procedures while conducting the approach. The crew terminated the instrument approach and conducted a night visual approach over mountainous terrain in visual meteorological conditions.

—

FSF Editorial Staff

On the night of May 10, 2000, the crew of a Rockwell Sabreliner 65 canceled their instrument flight rules (IFR) clearance during a nonprecision instrument approach to Molokai (Hawaii, U.S.) Airport and conducted a visual approach to the airport in visual meteorological conditions. The aircraft struck mountainous terrain 3.3 nautical miles (6.1 kilometers) southwest of the airport at 2031 local time. The captain, copilot and four passengers were killed. The Sabreliner was destroyed by the impact and a post-impact fire.

The U.S. National Transportation Safety Board (NTSB) said, in its final report, that the probable cause of the accident was "inadequate crew coordination [that] led to the captain's decision to discontinue the instrument approach procedure and initiate a maneuvering descent solely by visual references at night in an area of mountainous terrain."

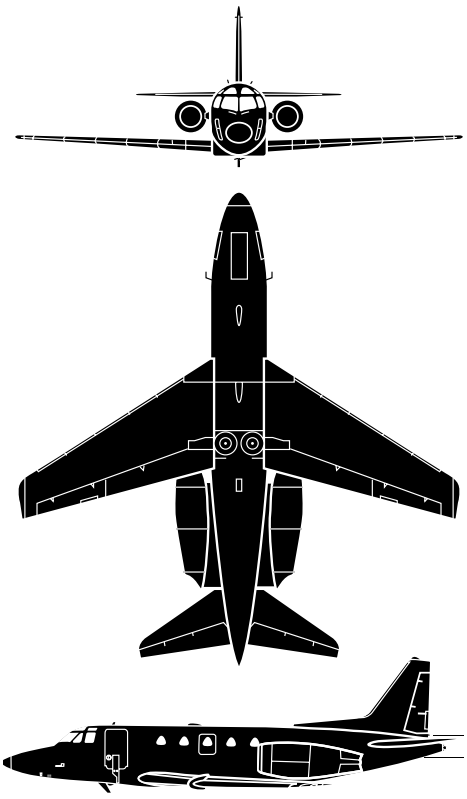
The report said, "The crew failed to review the instrument approach procedure, and the copilot failed to provide accurate information regarding terrain clearance and let-down procedures during the instrument approach."

The Sabreliner was owned and was being operated by Price Aircraft Co. of Broomfield, Colorado, U.S., on a personal transportation flight conducted under U.S. Federal Aviation Regulations Part 91, the general operating and flight rules. The aircraft's registration number was N241H.

The trip to Hawaii began April 23, 2000, with a flight from Boulder, Colorado, to San Carlos de Bariloche, Argentina. The aircraft was landed and refueled in Texas (U.S.), Panama and Peru during the approximately 13-hour flight. The copilot returned to the United States after the flight, and the accident copilot arrived in Argentina on May 7.

The captain, 63, held an airline transport pilot certificate and several aircraft type ratings. He had 12,775 flight hours, including 1,370 flight hours in Sabreliners, with more than 1,000 flight hours as a Sabreliner pilot-in-command.

The copilot on the flight to Argentina — who was the chief pilot for an operator that previously employed the captain — said that the captain did not like to use the challenge-response method of conducting checklists. The copilot said that during the approach to San Carlos de Bariloche, which is in mountainous terrain, they encountered "unexpected weather" and that he "took it upon himself" to brief the instrument approach. The captain told the copilot to direct him through the approach.



Rockwell NA-265-65 Sabreliner

North American Aviation began designing a military jet trainer and utility airplane in 1956. Production of the airplane, designated the T-39 by the U.S. Air Force, began in 1958. A civilian version, the NA-265-40 Sabreliner, was introduced in 1964. The company merged with Rockwell-Standard Corp. in 1967 to form North American Rockwell, which was renamed Rockwell International in 1973.

The NA-265-60 Sabreliner was introduced in 1967 with a fuselage lengthened by 38 inches (97 centimeters) to accommodate 10 passengers (compared with eight passengers in earlier models). The NA-265-70 was introduced in 1971 with Pratt & Whitney JT12A-8 turbojet engines rated at 3,300 pounds (7,275 kilograms) thrust. Refinements included more cabin headroom and square cabin windows, rather than the previously triangular windows. In 1973, the NA-265-80 was introduced with General Electric CF700-2D-2 turbofan engines rated at 4,500 pounds (2,041 kilograms) thrust.

The NA-265-65, produced in 1980 and 1981, was the last production Sabreliner. The aircraft has triangular cabin windows, a supercritical wing developed by Raisbeck Engineering and Garrett TFE731-3 turbofan engines rated at 3,700 pounds (1,678 kilograms) thrust. In 1983, Rockwell sold the production rights to Sabreliner Corp.

Maximum takeoff weight is 24,000 pounds (10,886 kilograms). Maximum rate of climb is 4,500 feet per minute (fpm); maximum single-engine rate of climb is 1,050 fpm. Maximum operating altitude is 45,000 feet. Maximum cruise speed is 0.8 Mach. Stall speed in landing configuration is 89 knots. Maximum landing weight is 22,000 pounds (9,979 kilograms).♦

Source: *Jane's All the World's Aircraft* and *The Encyclopedia of Civil Aircraft*, Thunder Bay Press

"This [copilot] had also flown to Molokai with the captain on a previous occasion, and the captain had warned him prior to their arrival about terrain southwest of the airport," the report said.

The captain completed recurrent training in the Cessna Citation II at FlightSafety International (FSI) in March 2000.

"A review of the FSI simulator instructor's remarks revealed a comment that CRM [crew resource management] was one of the pilot's weak areas," the report said. "During the third simulator session, the instructor noted that the pilot needed additional training on landings from an ILS (instrument landing system [approach]). FSI instructors reviewed the weak areas and provided additional training."

The accident copilot, 28, held a commercial pilot certificate and a Sabreliner type rating. He had 1,991 flight hours, including 259 flight hours in Sabreliners, with 14 hours as a Sabreliner pilot-in-command.

"The copilot's employer said their records indicated [that] this crew flew together on three previous occasions, including a round-trip [flight] to Argentina in February [2000]," the report said. "Their total flight time together was about 30 hours."

On May 9, the crew conducted a round-trip flight between San Carlos de Bariloche and Esquel, Argentina, to pick up a passenger in Esquel. The crew then flew the aircraft to Tahiti, making fuel stops en route in Concepción, Chile; Easter Island, Chile; and Totegegie, French Polynesia. The report said that the trip was completed in more than 14 hours.

"The operator estimated [that] the flight arrived in Tahiti in the early evening hours," the report said. "Tahiti is in the same time zone as Hawaii."

The crew's duty times were not recorded, and the length of their rest period in Tahiti could not be determined precisely. The report said that the crew's rest period was about 18 hours.

"The copilot telephoned his dispatch office about 0800 on May 10, the day of the accident," the report said. "He said they originally planned to stay in Tahiti until Friday, May 12; however, the airplane's owner left his luggage in Argentina and wanted to continue to his home on Molokai."

The aircraft departed from Tahiti about 1300 and was landed on Christmas Island, Kiribati, to refuel. The aircraft departed from Christmas Island about 1600 and was landed at Kahului, Maui, Hawaii, about 1920 to clear customs and to refuel.

"[U.S. Customs] agents reported that the crew was in good spirits; however, one pilot mentioned that it had been a long day," the report said.

At 1926, the copilot filed an IFR flight plan to Molokai Airport by radio with the Honolulu Automated Flight Service Station

(AFSS). [Molokai is one of the Hawaiian islands. Molokai Airport is in Kaunakakai, on the north central part of the island.] The copilot requested a cruising altitude of 3,000 feet and said that the estimated flight time was 15 minutes and that the aircraft had fuel sufficient for three hours of flight. The copilot did not specify a route of flight.

The AFSS specialist described the preferred route of flight to Molokai Airport and told the copilot that the minimum en route altitude was 6,000 feet. The specialist said, "Can you accept that?"

The copilot said, "OK, we can accept that. That'll work fine, six thousand feet, that routing."

The aircraft departed from Maui at 2008. The captain was the pilot flying; the copilot made all radio transmissions.

The report said that the verbal communication recorded by the aircraft's cockpit voice recorder (CVR) "does not indicate that the crew briefed or reviewed the route of flight or approach [to Molokai]."

At 2013, a Honolulu Center controller told the crew that weather conditions at Molokai Airport included surface winds from 060 degrees at eight knots, 10 statute miles (16 kilometers) visibility, a clear sky, temperature 23 degrees Celsius (73 degrees Fahrenheit) and dew point 18 degrees Celsius (64 degrees Fahrenheit). The controller told the crew to expect a visual approach to the airport.

During the next six minutes, the crew discussed flight-record keeping and an apparent autopilot course-capture problem.

"It really didn't grab it right," the captain said. "The autopilot just isn't capturing it."

At 2019, the copilot told the captain that they were 10 nautical miles (19 kilometers) [northeast] of the Molokai VOR (very-high-frequency omnidirectional radio). The VOR is 3.8 nautical miles (7.0 kilometers) west-southwest of the airport.

The captain said, "[Air traffic control (ATC) is] going to take us around to [runway] five, though. They may pass us over the top, then down. … I'm not watching where we're going here."

The copilot then asked the controller if they could begin a descent from 6,000 feet.

"Sabreliner two four one hotel, descend at pilot's discretion, maintain five thousand," the controller said.

The copilot told the captain, "[ATC will] probably let us down once we get to the other side of the airport."

"Oh, we just passed it?" the captain said.

"No," the copilot said. "Just keep doing what you're doing. You're all right. Stay on your heading. … Still going to the VOR."

At 2021, the controller told the crew that the airport was three nautical miles (six kilometers) from the aircraft at the 11 o'clock position to 12 o'clock position.

"Two four one hotel is looking," the copilot said.

"Where are we?" the captain said. "Seven miles out, to what?"

"That's the VOR," the copilot said. "The airport is this side of it, about three miles."

After about one minute, the copilot said, "We should be right over the airport. We could ask for the approach. There's still clouds below us."

"Yeah," the captain said. "Shoot for the approach now. Yeah, just go for the approach."

"OK," the copilot said. "You have to go outbound two fifty-four … left turn."

[The copilot referred to a requirement of the VOR/GPS (global positioning system) approach procedure that, after passing over the VOR from the northeast, an aircraft should be flown on an outbound course of 254 degrees for one minute before beginning the procedure turn, which comprises a right turn to a heading of 299 degrees, followed after a specific time by a left turn to a heading of 119 degrees; the minimum altitude for this segment is 2,500 feet (Figure 1, page 4). After intercepting the 074-degree inbound course to the VOR, the aircraft can be flown to 2,200 feet. After passing over the VOR inbound, a descent to 1,800 feet should be conducted after establishing the aircraft on the inbound course, 070 degrees. After passing the first step-down fix, which is 1.0 nautical mile (1.8 kilometers) from the VOR, a descent to 1,580 feet should be conducted. After passing the second step-down fix, which is 2.0 nautical miles (3.7 kilometers) from the VOR, a descent should be conducted to 1,080 feet, the published minimum descent altitude (MDA) for the Sabreliner, which was equipped with distance-measuring equipment (DME) and is a Category C aircraft. The missed approach point is 3.8 nautical miles from the VOR. The VOR/GPS approach is designated "Alpha" because landing requires a circling maneuver either to Runway 5-23, which is 4,494 feet (1,371 meters) long, or to Runway 17-35, which is 3,118 feet (951 meters) long.]

"Two forty-five?" the captain said.

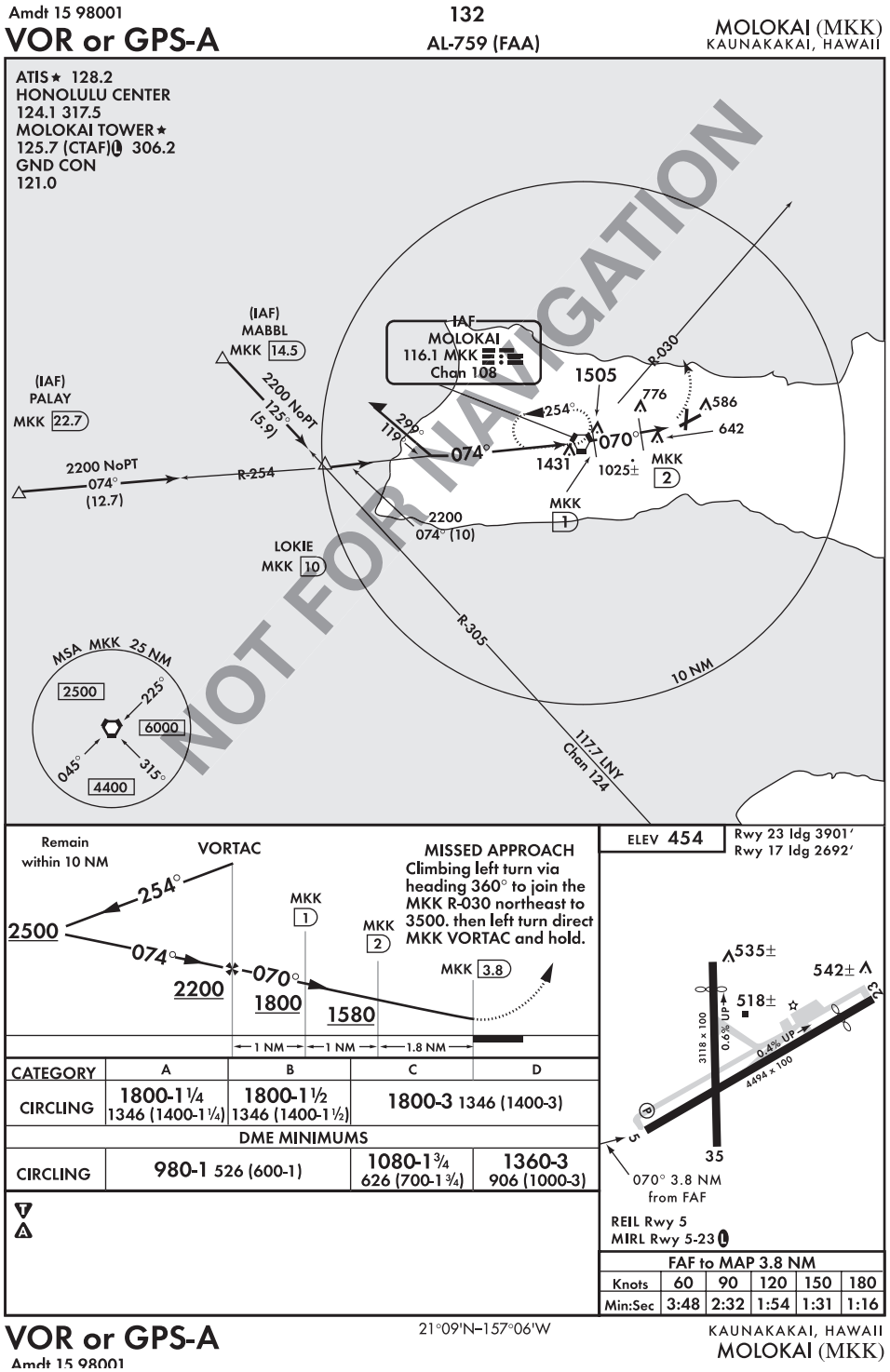
"Two fifty-four," the copilot said.

At 2023, the copilot told the controller, "Center, two four one hotel. We're going to need the approach, sir, at Molokai."

The controller asked the crew if they had the airport in sight.

Continued on page 5

VOR-A Approach Procedure, Molokai (Hawaii, U.S.) Airport, May 10, 2000



Source: U.S. Department of Defense

Figure 1

"Negative," the copilot said. "We're going to need the VOR GPS alpha approach."

"Sabreliner two four one hotel, cleared GPS alpha approach, Molokai airport," the controller said.

"Two four one hotel, VOR alpha approach, thanks," the copilot said.

The copilot told the captain, "Follow that radial outbound."

"Follow this radial," the captain said. "Two five four. OK. … I bet the tower is closed, isn't it?"

The copilot's response was unintelligible. The report said that the airport control tower had closed at 1830.

The captain said that the airport had pilot-controlled lights. The approach chart and the airport chart indicate that the pilot-controlled lights are activated by keying the microphone for a radio tuned to the common traffic advisory frequency (CTAF), 125.7 megahertz (MHz).

"That's why we didn't see it [the airport]," the captain said. "What's the frequency?"

The copilot said, "Eighteen seven [118.7 MHz]."

"Eighteen seven?" said the pilot.

"Yeah," the copilot said. "I saw clouds below us, too, so watch your radial."

At 2024, the CVR recorded a sound similar to a microphone being keyed seven times. (With the correct radio frequency tuned, this would have activated the pilot-controlled lights to maximum intensity.)

The captain said, "Now, there it is."

The copilot told the captain that a right turn was required to begin the procedure turn.

"OK," the captain said. "Where are we?"

"And once we're inbound, we go down to twenty-two hundred," the copilot said.

"Yeah," the captain said. "OK."

"Actually, we go down to twenty-five hundred now," the copilot said.

The captain said "OK," and the CVR recorded a sound similar to a decrease in engine speed. Recorded ATC radar data indicated that the aircraft was at 5,000 feet at this time.

At 2024, the copilot said, "We're cleared for the approach."

"Down to twenty-five hundred?" the captain said.

"There's your radial," the copilot said.

"What?" the captain said. "Just direct me around. You kind of got me confused here."

Recorded ATC radar data indicated that the aircraft was at 4,600 feet at this time.

"Three hundred degrees," the copilot said. "Right, now, for a minute. Procedure turn."

"And we're down to twenty-five hundred?" the captain said.

"Yep," the copilot said.

"OK," the captain said. "Give me flaps ten then. … OK, three zero zero. What's our inbound course?"

"Going to be the opposite of two fifty-four," the copilot said.

"Is this right, three zero zero heading?" the captain said.

"No, you're doing the procedure turn here."

"I can probably come around, can't I?" the captain said.

"Coming back around," the copilot said. "One nineteen, one twenty."

"Oop," the captain said. "Not too far. Coming the other way. There you go."

At 2026, the CVR recorded a sound similar to an altitude alert. The captain said, "Out of twenty-five hundred. What's the elevation here?"

"It's four hundred feet," the copilot said.

The approach chart shows that the airport elevation is 454 feet.

The CVR recorded a sound similar to Morse code for the letters M, K and K, which is the identification of the Molokai VOR.

"Radial's alive," the copilot said. "Inbound, we go down to twenty-two hundred feet." The aircraft was at about 3,000 feet at this time.

At 2027, the captain told the pilot to activate the pilot-controlled lights.

"Give me some clicks," he said. "I think it went off. Let's see where the runway is. So the runway is five?"

The CVR recorded a sound similar to seven microphone clicks. The copilot said, "Runway five, yes."

The captain told the pilot to verify the radio frequency for the pilot-controlled lights.

"Eighteen seven?" he said.

"Clear on twenty-two fifty-one," the copilot said.

At 2027, the controller terminated radar service and told the crew to report their arrival at Molokai Airport to the center or to a flight service station. The aircraft was at 2,400 feet.

The copilot said, "Can we get you on the ground [on] this frequency?"

"You may be able to get me on the ground," the controller said. "If unable, go and cancel through flight service."

The copilot then requested and received the radio frequency for flight service from the controller.

At 2028, the copilot told the captain, "Radial on your side there. Watch your radial."

"Oop," the captain said. "Thanks."

"I clicked seven times several times there," the copilot said.

"Well, we're six miles out here from the runway," the captain said.

"We're six miles out from the VOR," the copilot said. "Then we go down to a thousand feet."

"That's another thousand feet," the captain said.

The copilot said, "Four one miles. We're ten miles out of the airport. … Correction, thirteen eight, fourteen."

The captain then reduced power and told the copilot to extend the flaps to 20 degrees.

At 2029, the copilot said, "Missed approach is climbing left turn via three-sixty heading."

"OK," the captain said. "This wasn't supposed to be difficult." The CVR recorded the sound of a chuckle.

"I know," the copilot said. The CVR recorded the sound of a chuckle.

"Check to be sure that we got the right frequency for the pilot-controlled lighting," the captain said.

"We don't," the copilot said.

"We don't?" the captain said. The copilot said no, and the captain said. "Oh, neat."

The CVR recorded a sound similar to seven microphone clicks. The aircraft was at 2,200 feet.

"What is it?" the captain said. "One twenty-five seven?"

"Yeah," the copilot said.

"What's one eighteen?"

"I don't know," the copilot said. "There's the runway." The CVR recorded the sound of a chuckle.

The report said that the aircraft was at 2,100 feet, 1.3 nautical miles (2.4 kilometers) from the VOR and right of the inbound course to the VOR.

At 2030, the captain reduced power and said, "OK, landing gear coming down."

"Want me to cancel?" the copilot said.

"Yeah," the captain said. "You can cancel." He then told the copilot to select full flaps.

The copilot told the captain that airspeed was below V_{REF}, the landing reference speed.

The captain said, "I got eighteen [118 knots] right now. It says ref eighteen, isn't it?"

"One twenty," the copilot said.

At 2030, the copilot canceled their IFR clearance and told the controller that they had the airport in sight. At this time, the aircraft was 0.7 nautical mile (1.3 kilometers) south of the VOR at 1,800 feet.

At 2031:13, the copilot broadcast on the CTAF radio frequency that the aircraft was inbound on the VOR approach and would land on Runway 5.

A security guard at the airport heard the copilot's radio transmission and observed an airplane in a right turn low over the mountains.

"The airplane was still far away and appeared low over the mountains," the report said. "[The witness] said it was a very clear night and she could see the outline of the mountains. The airplane turned toward her left. She thought [that] this was to align with the runway, but this was farther away from the airport than normal. She stopped watching and went to open a gate."

Security guards patrolling the ranch on which the accident occurred observed the aircraft over ridges at an altitude lower than normal for aircraft conducting approaches to the airport.

At 2031:26, the captain told the copilot, "Getting down here a little bit." The report said that the captain's statement meant that he intended to fly the aircraft to a lower altitude.

The last radar return from the aircraft was recorded by ATC about 2031:30; the aircraft was 2.1 nautical miles (3.9 kilometers) southeast of the VOR at 1,300 feet.

At 2031:33, the captain said, "Oop."

The copilot said, "That's the clouds."

"Let me have that again," the captain said. "That's the cloud, huh? Oh. … Ooh, what do you … ."

The CVR ceased recording at 2031:39. Witnesses heard a loud boom and observed a bright orange flash when the aircraft struck a 1,400-foot mountain ridge 100 feet (31 meters) below the crest of the ridge.

"The principal impact crater was about 13 feet [four meters] long and seven feet [two meters] wide in soft dirt," the report said. "It was approximately 100 feet below the crest of a 25-degree upslope in sparsely vegetated, hilly terrain. … A charred area began near the end of the [principal impact crater] and fanned out up the hill. Most of the components were close to the debris path centerline and contained within an area 275 feet [84 meters] long and 110 feet [34 meters] wide.

"The cabin was about 150 feet [46 meters] from the [principal impact crater]. … The cockpit area was a few feet past the cabin. … About 80 feet [24 meters] past the cockpit were the last large pieces of debris. A section of the inboard leading edge of the left wing, a battery and a battery cover were along the crest of the hill. … Fire consumed the majority of the wreckage. Rivulets of shiny molten metal cascaded down through the debris field. Local fire units responded and extinguished the fire."

The report said that the crew "exhibited various cognitive task deficiencies" during the approach.

"These cognitive task deficiencies included selection of the wrong frequency for pilot-controlled lighting, concluding that the airport was obscured by clouds despite weather information to the contrary, stating inaccurate information regarding instrument-approach headings and descent altitudes, and descending below appropriate altitudes during the approach," the report said. "This resulted in the crew's lack of awareness regarding terrain in the approach path."

The report said that the crew's performance during the approach was consistent with fatigue-related impairment.

"Based on available information, [NTSB] was unable to determine to what extent the cognitive task deficiencies exhibited by the flight crew were attributable to fatigue and decreased alertness," the report said.

The report said that pilots conducting a visual approach over dark, featureless terrain might experience an illusion that the aircraft is at a higher altitude that the actual altitude.

"In response to this illusion, referred to as the featureless-terrain illusion or black hole phenomenon, a pilot may fly a lower-than-normal approach, potentially compromising terrain-clearance requirements. The dark visual scene on the approach path and the absence of a visual glide [path] indicator are conducive to producing a false perception that the airplane is at a higher altitude."

The aircraft was not equipped with a ground-proximity warning system (GPWS).

"[Investigators] made no determination whether and to what extent various ground-proximity warning devices would have provided the crew with information and alerts regarding terrain proximity during their approach to Molokai," the report said. "As a result of investigations of similar accidents, [NTSB] recommended some form of terrain-warning capability on turbine-powered airplanes.

"In response to these safety recommendations, the FAA [U.S. Federal Aviation Administration] issued its final rule[1] on March 23, 2000, requiring that all U.S.-registered, turbine-powered airplanes configured with six or more passenger seats be equipped with a terrain awareness and warning system (TAWS).[2] The final rule requires that new production airplanes be equipped with TAWS by March 29, 2002, and existing airplanes by March 29, 2005."♦

[FSF editorial note: This article, except where specifically noted, is based on U.S. National Transportation Safety Board (NTSB) Brief of Accident report LAX 00FA191 (two pages) and NTSB Factual Report, Aviation, LAX 00FA191 (268 pages with illustrations).]

Notes

1. U.S. Federal Aviation Regulations Part 91.223, "Terrain awareness and warning system."

2. *Terrain awareness and warning system (TAWS)* is the term used by the European Joint Aviation Authorities and the U.S. Federal Aviation Administration to describe equipment meeting International Civil Aviation Organization standards and recommendations for ground-proximity warning system (GPWS) equipment that provides predictive terrain-hazard warnings; *enhanced GPWS* and *ground collision avoidance system* are other terms used to describe TAWS equipment.

Accident Prevention

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