MOUNTAIN WAVE CITED IN DHC-6 FATAL CRASH

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The U.S. National Transportation Safety Board has issued its report on the fatal crash of a U.S. commuter airline DHC-6 Twin Otter that occurred near Steamboat Springs, Colorado on December 4, 1978.

The aircraft, with two pilots and 20 passengers, departed Steamboat Springs on a scheduled flight to Denver. After encountering severe icing and downdrafts, the flightcrew decided to return to Steamboat Springs. On the return leg of the flight further icing and downdrafts combined to prevent the aircraft from maintaining sufficient altitude to clear the mountains. It crashed on a mountain ridge at the 10,530-foot level some eight nautical miles northeast of Steamboat Springs. Of the 22 persons on board, the captain and one passenger died, and 13 passengers were seriously injured. The aircraft was destroyed.

The Safety Board determined that the probable cause of this accident was "severe icing and strong downdrafts associated with a mountain wave which combined to exceed the aircraft's capability to maintain flight.

"Contributing to the accident was the captain's decision to fly into probable icing conditions that exceeded the conditions authorized by company directive."

The same flightcrew and aircraft had arrived at Steamboat Springs from Denver earlier that evening after a "long" but smooth flight of about two hours. However, the crew reported "high headwinds" en route and "heavy icing" during the descent into Steamboat Springs.

While on the ground during the turnaround for Denver, the two pilots removed three-quarters of an inch of rime ice from the front surfaces of the aircraft.

Shortly after takeoff from Steamboat Springs, the crew reported to Denver Air Traffic Control Center that it was climbing to its assigned altitude of 17,000 feet.

The first officer, who was flying the aircraft, stated that during the climb they flew through some light freezing rain but he could see the moon and stars overhead. However, after entering a cloud bank over the mountain ridge east of Steamboat Springs at about 12,500 feet, they encountered precipitation and severe icing. The de-icing equipment was working properly, but he was unable to make the aircraft climb to 13,000 feet at a normal climb powr setting and airspeed. The captain tried also but was also unsuccessful.

They then reported to Denver Center:

"... We're going to have to return to Steamboat."

Shortly after turning back, they encountered such severe icing conditions that the captain was unable to keep the aircraft at 13,000 feet even with maximum climb power. Finally, after an involuntary descent to 11,600 feet, they were able to hold that level.

According to the first officer, the engines were running well and ice was shedding from the propellers and wing deicer boots although the ice accumulation on unheated portions of the windshield was about two inches thick.

Subsequently, the aircraft entered another area of severe icing. Again, in a climb attitude, and with both engines at maximum power, it began to lose altitude at a rate of 800 to 1,000 feet per minute. The first officer saw the ground seconds before impact.

The DHC-6 struck first an electrical transmission tower and then the ground, plowing a 200-foot path in the snow.

A passenger with extensive winter survival training led the survival efforts after the crash. Although injured, with the help of another passenger, he managed to open the aft cabin door. It was snowing heavily with strong, gusty winds.

The passengers opened the baggage compartment, and from the luggage they assembled warm clothing for use by the passengers in the cabin. After emptying the compartment, they lined it with empty bags and moved four injured passengers and the seriously injured captain into the compartment.

They attempted to free the first officer who was trapped in his seat by compacted snow and wreckage. Finally, they built a shelter of empty

baggage containers to barricade him from the wind and snow. For the rest of the night, the passengers remained in the wreckage.

The Twin Otter was equipped with an ELT, and the first officer also carried a portable ELT in his flight kit. At least one of these ELT's activated during the crash, and its signal was received by a number of aircraft flying in the area.

The sheriff's department in Steamboat Springs was notified of the missing aircraft, and search and rescue teams were formed immediately to conduct a search with snowmobiles. One searcher, using a portable ELT receiver-direction finder, tracked the signal and was first to arrive at the crash site early the next morning.

The Safety Board said that the meteorological evidence indicates that a strong mountain wave existed over the north-south ridge of the mountain east of Steamboat Springs. Strong winds blowing across a mountain range create large waves of air downwind and resultant downdrafts. Calm wind on the ground would give no clue that a mountain wave existed.

The Board concluded that the captain of the DCH-6 was not aware of the "mountain wave and downdraft activity." He elected to fly to Denver because he considered the icing conditions not severe enough to be a hazard. The Board also noted the ice accumulated on the DHC-6 was "not sufficient alone" to have altered performance to the extent that the aircraft was unable to maintain flight.

In deciding to fly to Denver, the captain's evaluation of the weather was the crucial factor. The Board noted the clues associated with the existence of the mountain wave were subtle and obscured by other conditions that occupied the captain's attention, but there was no doubt he knew of the severe icing conditions existing between Denver and Steamboat Springs and that these conditions would exist on the return trip.

The Board pointed out that one of the most serious hazards associated with aircraft icing is that performance and control can be so degraded by icing that the introduction of "other complications" easily jeopardizes safe flight. Consequently, the Board concluded, the captain's decision to return to Denver "was contrary to the guidance provided in company directives and contrary to the interests of safe flight."

As the result of its investigation of this accident, the Board stated that it was preparing safety recommendations to the Federal Aviation Administration on the subject of shoulder harnesses and survivability training for flightcrews involved in Part 135 commuter operations.

The Board said it was also reviewing the new Part 135 as it relates to on-board navigational equipment for Instrument Flight Rule operations.

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