Benefits of Cockpit Image Recorders From A User's Standpoint

Statement by Frank Hilldrup, NTSB Senior Investigator

Good morning.

I was asked to provide some comments on the benefits of cockpit image recorders. But before I discuss this, I think it's important to remember the history of flight recorders and how useful they have become to aviation accident investigation.

The Safety Board and its predecessor organization, the Civil Aeronautics Board (CAB), have been investigating aircraft accidents since back in the 1930s, and from most accounts I believe it has done a very good job. As much as we might like to think that nothing beats good old-fashioned investigating of physical or forensic evidence, also fondly known as "tin-kicking", the introduction of data recordings has become an invaluable tool to investigations.

The first on-airplane flight data recorder was mandated following recommendations by the CAB in the late 1950's. (As archaic as it sounds now today, these FDRs utilized foil as the recording medium for capturing its few parameters.) In 1960, following a recommendation by the CAB, the FAA conducted a study that established the feasibility of cockpit voice recorders. Subsequent regulations required incorporation of CVRs on certain airplanes by the mid-to-late 1960's.

FDR requirements remained essentially unchanged until 1972, when the rules for certain transport category airplanes were amended to require a digital flight data recorder system. The Safety Board continued to submit recommendations calling for such things as the replacement of the foil recorders, expansion of FDR parameters, and recorder requirements for some air taxi and corporate executive aircraft. In the late 1980's, the FAA issued rule changes encompassing these

and other areas, and in the 1990's it further expanded the list of required FDR parameters.

During the investigation of the crash of a Swissair MD-11 in 1998, the Safety Board and the Transportation Safety Board of Canada issued joint recommendations calling for dual FDR/CVR recorders and independent and separate power supplies.

My point in reviewing some of the history of onboard flight recorders is to show how government agencies and the aviation industry have continued to recognize and take advantage of available technologies for the benefit of safety. Which brings us to the issue of cockpit image recorders.

In 2000, the Safety Board made its first recommendations to the FAA for incorporation of cockpit video recorders in certain aircraft. This was prompted by several accidents in which the available data was insufficient to fully determine events in the cockpit environment and crew actions. The Board's recommendations also recognized that the technology for cockpit image recorders had become feasible and economical.

Some of the accidents referenced in the recommendation include:

- ValuJet flight 592 in Florida in 1996
- SilkAir flight 185 in Indonesia in 1997
- Swissair flight 111 near Nova Scotia in 1998
- Egyptair flight 990 near Massachusetts in 1999

The circumstances of these accidents should be well known to most, and so I'm not planning on discussing them in greater detail. Needless to say, it's likely that a cockpit image recorder would have aided each of these investigations and allowed more precise and timely findings. I might add that I am currently working

on a foreign air transport accident in which good data exist from both recorders, yet crucial questions remain about certain cockpit displays and settings.

The Safety Board has also investigated numerous accidents in recent history involving Part 135 and Part 91 flights in which neither data or voice recorders were required. I'd like to discuss a few of these to further illustrate the potential benefits of a cockpit image recorder.

Aviation Charter King Air 100, Eveleth, MN, 2002

On October 25, 2002, about 1022 in the morning, a Beech KingAir 100, operated by Aviation Charter, Inc., crashed while the flight crew was attempting to execute the VOR approach to Eveleth-Virginia Municipal Airport, Eveleth, Minnesota. The two pilots and six passengers, including Minnesota Senator Paul Wellstone, were killed, and the airplane was destroyed by impact forces and a severe postcrash fire. The airplane was being operated as an on-demand passenger charter flight as part of Senator Wellstone's reelection campaign. Instrument meteorological conditions prevailed for the flight. The airplane was not equipped with any flight recorders.

Because of the lack of available information, the investigation was unable to determine the crew's actions on the approach. The pilots failed to establish the proper course for the VOR approach, and the approach speed was never fully stabilized. Investigators were unable to determine the degree of coordination between the two pilots, or even who the flying pilot was. Furthermore, the investigation was unable to positively determine whether the pilots were able to establish adequate visual cues for continuing the approach. Investigators were also unable to precisely confirm the speed of the airplane just before the loss of control. These questions might have been answered if a cockpit image recorder had been installed.

Department of Interior, Montrose, CO, 1997

This was one of the accidents cited in the safety board's original recommendations on image recorders. On October 8, 1997, a Cessna 208 operated by the Department of Interior, experienced a loss of control and collided with terrain near Montrose, Colorado. The pilot and all eight passengers were killed. The flight was an on-demand air charter for the Bureau of Reclamation.

After climbing at a normal rate of climb to 15,400 feet, the airplane abruptly disappeared from radar. The radar plot of the aircraft during the climb above 10,000 feet indicated course changes from the southwest to the northwest, back to the southwest and then a sharp turn to the right just prior to the rapid descent. The wreckage exhibited evidence of a steep flightpath angle and damage consistent with a stall/spin event. Investigation revealed no indication of airframe or flight control anomalies, and the powerplant and propeller damage was consistent with engine operation at moderate to high power. The National Transportation Safety Board determined the probable cause of this accident was the pilot's failure to maintain sufficient airspeed for undetermined reasons while maneuvering the airplane near the maximum gross weight and aft cg in or near instrument meteorological conditions, resulting in the loss of control and entry into a stall/spin.

Several different scenarios were considered as possible reasons for the pilot's loss of control. For example, the pilot may have induced a stall in an attempt to maintain altitude; he may have unintentionally entered cloud conditions and become disoriented; he may have entered clouds and accumulated sufficient ice to degrade the airplane's aerodynamic qualities and induce a stall; or his flying or decision-making skills may have become impaired due to the lack of oxygen. Unfortunately, no scenario could be verified with the available evidence. An image recorder may have provided information to help answer some of these questions.

Oklahoma State University Investigation

On January 27, 2001, a Beech King Air 200 crashed near Strasburg, Colorado. The accident aircraft carried a pilot, an inexperienced pilot/observer, and eight passengers---all members of the Oklahoma State University basketball team and staff. They were returning to OSU from an away game and all were fatally injured. The flight was being operated under Part 91, and the airplane was not equipped with any flight recorders.

The aircraft entered the clouds almost immediately after taking off. Radio transmissions and radar returns revealed nothing unusual until about 15 minutes later, when the mode C transponder returns ceased. The airplane's ground track then began to deviate, and the airplane experienced a descending spiral to the ground.

Examination of the wreckage revealed that a complete loss of a.c. electrical power occurred aboard the airplane for some reason. This would have disabled the pilot's flight instruments. In the highly fragmented and heavily burned wreckage, we found an altimeter reading stuck at 23,000 feet, an RMI card stuck on the last steady heading, and an a.c. volt meter at its lowest indication…all indications of an a.c. power failure that was not remedied at any time prior to impact. The question then became: why did the power fail?

Several possibilities existed:

- A single inverter failure that the pilot didn't remedy by switching to the good inverter
- A dual inverter failure
- An inverter switch failure
- An inverter select relay failure, or

- An avionics inverter select relay failure

A cockpit video recording of even the last few minutes of the flight might have allowed us to eliminate one or more of the possible power failure scenarios, perhaps by observing the annunciator panel or seeing whether the pilot activated the inverter switch or not. And very importantly, we could have answered questions about how the pilot interfaced with the other pilot in the right seat, who supposedly had an operating set of flight instruments in front of him. To this day, we do not know what the person in the right seat was doing. Was there a transfer of aircraft control? Did the right seater further exacerbate an existing problem? We will never know, but data from a cockpit image recording of the event may have allowed us to do so.

In the end, the Safety Board determined that the probable cause of the accident was the pilot's spatial disorientation after a loss of electrical power causing a partial loss of flight instrumentation. Although I believe that the evidence fully supports this probable cause, video of the cockpit environment would have allowed us to be more precise.

There continue to be numerous aircraft accidents in which investigations are hindered by the lack of flight recorder data. In fact, within the last two months the Safety Board has investigated 11 accidents involving turbine powered aircraft that were not equipped with any type of crash-survivable flight recorders. These accidents resulted in the loss of 13 lives and involved 7 Bell 206 helicopter accidents, 3 Eurocopter 350 helicopter accidents, and one MU-2 accident. While all of these accidents are currently under investigation, the Safety Board is severely hampered by the lack of recorded data.

Fortunately, however, two of the Eurocopter aircraft were fitted with an onboard videotape recorder unit, which provides the passengers with a tape souvenir of

their flight. The video recorder records a pilot-selectable image of either the passenger cabin or a view out of the front of the aircraft along with a pilot narration and passenger audio track. From these video/audio records, investigators have been able to document things such as the weather and wind conditions and the pilots' handling of the aircraft. This information may prove to be invaluable as the investigations continue.

In closing, I believe it's clear that cockpit image recorders would greatly enhance investigators' ability to more precisely and quickly determine the circumstances of aviation accidents and incidents. Of course, as with cockpit voice recordings, restrictions would have to be incorporated to ensure that these image recordings are not used for disciplinary purposes against individuals, are viewed only by those investigators who have a legitimate need, and are not made public. But these are not obstacles that cannot be overcome. The technology exists, the costs are low, and the need is here now.