National Transportation Safety Board

Washington, D.C. 20594

Safety Recommendation

Date: February 8, 2000

In reply refer to: A-99-64 through -68

Honorable Bruce Babbitt
Secretary
Department of the Interior
Washington, D.C. 20240

On October 8, 1997, at 0723 mountain daylight time, N12022, a Cessna 208B operated by the Department of the Interior (DOI), experienced a loss of control and collided with terrain at the 9,900-foot level on the Uncompahgre Plateau, about 18 nautical miles (nm) southwest of Montrose, Colorado. The pilot and all eight passengers were killed. The flight was en route from Montrose to Page, Arizona, and was conducted under 14 Code of Federal Regulations (CFR) Part 135 as an on-demand air charter for the Bureau of Reclamation. The registered owner of the airplane was Scenic Airlines, Inc., of North Las Vegas, Nevada.

The flight departed from runway 17 of Montrose Regional Airport (elevation 5,759 feet mean sea level (msl)) in visual meteorological conditions on a company visual flight rules (VFR) flight plan about 0705. However, ground observers who were within a mile of the crash site on the day of the accident reported that Uncompahgre Plateau was obscured by fog throughout the day. Satellite and Doppler radar imagery for the day and approximate time of the accident confirmed that there were widespread clouds over the mountains west of Montrose.

As a single-engine, turbine-powered aircraft operating under 14 CFR Part 135, the accident airplane was not equipped (and was not required to be equipped) with a flight data recorder (FDR). National Transportation Safety Board investigators used National Track Analysis Program data from the Denver Air Route Traffic Control Center radar to analyze the motion of the airplane and to reconstruct the probable flightpath of the accident flight. These data indicated that, during the climb from 10,000 feet, the airplane's course changed from southwest to northwest, returned to southwest, and made a sharp turn to the right, which suggests that the pilot may have been attempting to avoid clouds. Climb performance was similar to data provided in the Pilot's Operating Handbook (POH). The recorded radar information indicated that the airplane climbed to a peak altitude of 15,400 feet msl and disappeared from radar. A ground search party located the airplane wreckage in the vicinity of the last recorded radar position.

Examination of the wreckage revealed evidence of a steep flightpath angle, an approximately flat pitch attitude, and little indication of forward speed, which is consistent with a stall/spin event. There was no evidence of a fire either in flight or postaccident. The investigation revealed no indication of airframe or flight control anomalies, and the damage to the powerplant and propeller was also consistent with a stall/spin event.

The maximum certificated gross weight of the Cessna 208B is 8,750 pounds. Safety Board investigators were unable to locate any record of the flight's weight and balance calculations[1] and were unable to confirm if the pilot attempted to determine the weight and balance of the airplane before the flight. However, after weighing the postcrash contents of the airplane, which included an unsecured Bureau of Reclamation test set and supporting equipment that weighed 212 pounds, investigators estimated that the takeoff weight was 8,874.5 pounds, which is 124.5 pounds over the maximum. The certificated center of gravity (cg) range at 8,750 pounds is 195.15 to 204.35 inches aft of the datum. The estimated takeoff cg for N12022 was 203.84 inches, which is within limitations; however, it is within an area that a note in the POH states "...should be used only if an accurate cg determination has been obtained for that loading." At the calculated weight and balance of the accident airplane, the pilot would have encountered lighter control wheel forces and a smaller stability margin, and spin recovery would have been more difficult than if the cg had been more forward.

The pilot of the accident flight was primarily employed as a pilot for sightseeing trips in and around the Grand Canyon area of Arizona, Utah, and Nevada. Scenic Airlines records indicate that he had logged 12,900 hours of total flying time. His most recent Part 135 proficiency check was administered April 18-22, 1997, in a Cessna 207. The handwritten statement, "instrument competency demonstrated," appeared on Federal Aviation Administration (FAA) Form 8410-3, "Airman Competency/Proficiency Check." The pilot's most recent Part 135 line check was administered in a Cessna 208B on May 30, 1997. Examination of the pilot's personal logbooks showed a total of 19.7 hours of flight time in instrument or simulated instrument conditions; this total was accumulated between 1987 and 1994. The pilot was not qualified under Part 135 operations as a pilot-in-command under instrument flight rules (IFR) nor was his Office of Aviation Services Pilot Qualification Card endorsed for IFR operations. He did not maintain instrument flying currency under 14 CFR 61.57, "Recent flight experience: Pilot in command," and was reported by his colleagues to avoid instrument meteorological conditions (IMC).

On the morning of the accident flight, the pilot talked by phone with the Scenic Airlines dispatch office regarding the weather before departing for the airport; however, there is no record of a weather briefing. The pilot and passengers arrived at the airport about 0630. Investigators were unable to determine if the pilot made further attempts to become familiar with the weather reports and forecasts, as required by 14 CFR 91.103(a).

[1] Title 14 CFR Part 135 requires weight and balance record-keeping for multiengine aircraft only.

The Safety Board determined that the probable cause of the accident was the pilot's failure to maintain sufficient airspeed for undetermined reasons while maneuvering the airplane near maximum gross weight and aft cg in or near IMC, which resulted in a loss of control and entry into a stall/spin. Factors contributing to the accident were the pilot's improper in-flight planning and decision-making and his failure to use proper stall/spin recovery techniques.

Reconstructing the events that led to the accident was difficult for investigators because of limited data. As already noted, the accident airplane was not required to be, nor was it, equipped with an FDR or a cockpit voice recorder (CVR). Further, there were no recorded communications between N12022 and air traffic control or other aircraft, and users of the airport common traffic advisory frequency did not recall having any communications with N12022.

During the past 2 years, the Safety Board's investigations of several accidents involving Cessna 208s and similar turbine-powered aircraft have been hampered by the lack of FDR and CVR information. In some instances, radar data were available but did not provide sufficient detail concerning the aircraft's flightpath or flight conditions. The Safety Board notes that, although the installation of conventional FDRs and CVRs on these types of aircraft has been economically impractical, recent technological advancements have made video recorders technically and economically viable recording devices. A typical video recording system, which has an estimated cost of less than $8,000, consists of a camera and a microphone located in the cockpit to continuously record cockpit instrumentation, the outside viewing area, engine sounds, radio communications, and ambient cockpit noises. The entire system is similar to a conventional FDR or CVR in that the data are stored in a crash-protective unit to assure survivability. Such a video recording system likely would have significantly aided investigators in determining the cause of the accident in question and other accidents involving turbine-powered aircraft.

The Safety Board's accident statistics indicate that turbine-powered aircraft not equipped with a conventional CVR or FDR have, on average, 140 accidents or incidents per year, resulting in more than 100 fatalities per year. According to the FAA's aircraft registry, approximately 6,000 turbine-powered aircraft are not currently equipped with a CVR or FDR. This fleet is composed of 60 percent single-engine helicopters, 18 percent single-engine airplanes, 10 percent agriculture airplanes and helicopters, 7 percent multiengine airplanes and 4 percent multiengine helicopters; 63 percent of these aircraft are operated under 14 CFR Part 91 general aircraft operations, and 24 percent are operated as Part 135 air taxi operations.

The Safety Board is currently participating in a working group with the European Organization for Civil Aviation Equipment (EUROCAE), which is developing minimum manufacturing standards for the use of such video recording systems in aircraft. These standards will establish the unit's crash/fire survivability requirement, stipulate the recording duration and the video frame rate and resolution, and establish the minimum acceptable cockpit view. To facilitate the introduction of this new technology in commercial aviation, the Safety Board has recommended that the FAA incorporate the EUROCAE's proposed standards for a crash-protective video recording system into a technical standard order (TSO). Therefore, the Safety Board believes that the DOI should require all internally owned and vendor-contracted, turbine-

powered aircraft to be equipped with an FAA-approved, crash-protective video recording system once an applicable TSO has been issued.

Investigators were also unable to confirm the pilot's attempts to determine the airplane's weight and balance before the accident flight. The Safety Board notes that Part 135 operators of multiengine aircraft are required by Section 135.63(c) to prepare an accurate load manifest in duplicate before each takeoff. The manifest must include, among other things, the number of passengers, the total weight of the aircraft, the maximum allowable takeoff weight for a flight, the cg limits, and the actual cg. The Board also notes that, since these multiengine weight and balance record-keeping requirements were adopted in 1978, the weight and loading characteristics of single-engine aircraft have changed to include a turbine-powered fleet with larger cabin volume and cargo load zones. For example, the CE-208B airplane can exceed its certificated gross weight and cg limit with full fuel tanks and either a full complement of passengers or cargo load zones filled to the maximum capacity of 3,400 pounds. Because the circumstances of this accident suggest that weight and balance may have played a role in its occurrence and because of the increased weight and loading capacity of single-engine airplanes, the Safety Board is concerned that Part 135 single-engine operators may not consistently give weight and balance calculations the attention necessary to ensure safe flight. Therefore, the Safety Board believes that the DOI should require operators of all internally owned and vendor-contracted aircraft to prepare a complete weight and balance computation, passenger-loading manifest, and cargo-loading manifest for each flight conducted on single-engine as well as multiengine aircraft and that these records be retained for a period of 30 days.

The circumstances of the accident flight suggest that a pilot unqualified to operate in IFR conditions encountered IMC or lost control while maneuvering to avoid IMC. The Safety Board notes that Federal aviation missions typically transport passengers at all times of the year and in various climates, which makes encounters with IMC very likely. Therefore, the Safety Board believes that the DOI should require vendors that are contracted to provide on-demand, passenger air transportation to provide pilots that meet the requirements of 14 CFR 61.57(c) "Instrument experience" or (d) "Instrument proficiency check" regardless of whether their flight plans are VFR or IFR.

Local search and rescue personnel searching for N12022 reported that no automatic emergency locator transmitter (ELT) signal was received from the crash site even though the accident airplane was equipped with an FAA TSO C91-compliant, Pointer, Inc., ELT. Without the aid of an ELT signal, it took ground and air search teams 50 hours to locate the crash site. Examination of the accident airplane revealed that the ELT had separated from its mounting bracket and was lying loose inside the aft fuselage. One end of the ELT's antenna coaxial cable was secured to the ELT antenna receptacle and the other end was secured to the fuselage antenna. The antenna remained intact at its mounting located on top of the tailcone. The ELT master switch was found in the "AUTO" position. When the master switch was placed in the "ON" position, the transmitter annunciator light did not illuminate, and no signal was transmitted.

The ELT was taken to the manufacturer where disassembly and examination revealed that the electrical power connector between the battery pack and the solid-state circuitry of the

transmitter was loose, presumably as a result of the impact. The adhesive on the connector and the wall of the unit was brittle and the application of the adhesive was not uniform. The ELT operated intermittently when the connector was moved slightly during functional testing. The ELT was then examined at the Safety Board's Metallurgical Laboratory Division. During this examination, electrical continuity within the connector was verified; however, the electrical continuity from the power source to the circuit board was intermittent. The examination revealed that the seven strand conductors within the connector were tinned, crimped, then soldered. The crimped area had nonuniform crimp impressions, solder extended into the insulation area, some of the insulation was melted or cracked, and the connector was twisted.

The Safety Board acknowledges that, in N12022's case, the ELT's performance would not have been instrumental in saving lives because all occupants were killed upon impact; however, the 50-hour search effort likely would have been reduced with the aid of an ELT signal. The Safety Board must emphasize that a reliably functional ELT not only aids in rapidly pinpointing crash sites but also reduces search teams' exposure to potential hazards, the expense of rescue efforts, and the amount of time family members must wait for survivor information.

The investigation could not determine whether the ELT did not function as a result of the impact, its design, or a manufacturing flaw. Since the TSO for C91 ELTs was issued in 1971, unsatisfactory performance associated with TSO C91 units has included dislodgment from aircraft because of impact, inaccurate position determination because of wide frequency tolerance, inadequate requirements for case construction, and inadequate inertia switch design specifications that lead to activation failure or nuisance activations. In recognition of these flaws, the FAA published TSO C91a in April 1985 to correct earlier deficiencies. However, the FAA allowed TSO C91-compliant ELTs to remain in use, requiring that they be tested annually and, if found to be irreparable, that they be replaced with an ELT built to the updated standards of TSO C91a. Further, the FAA mandated that TSO C91-compliant ELTs not be used for new installations after June 21, 1995. Consequently, all new installations must now comply with either TSO C91a or TSO C126.[2]

The Safety Board notes that although superior to its predecessor, the C91a unit operates only on 121.5/243 Mhz.[3] The operating frequency and power output for a TSO C126-compliant ELT, however, is 406 Mhz and 5 watts,[4] which enhances its alerting reliability. Moreover, TSO C126-compliant ELTs have an improved design that appears to be more impact-resistant and likely would not have suffered a failure similar to that of the accident ELT. Therefore, it is possible that if a TSO C126-compliant ELT had been installed on the accident aircraft, it may have provided a usable signal.

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[2] TSO C126 was issued December 23, 1992.

[3] The International Civil Aviation Organization (ICAO) solicited all member states in May 1998 to discontinue satellite processing of 121.5 Mhz signals by January 1, 2005. The U.S. reply in September 1998 recommended an effective date of January 1, 2008.

[4] The ICAO solicited all member states in 1992 requesting comments on ELT carriage requirements. The U.S. reply in October 1992 recommended the use of 406 Mhz for search and rescue purposes.

The Board notes that in addition to the more efficient frequency, increased power output and improved crashworthiness, TSO C126-compliant ELTs offer many other advantages over the TSO C91- and C91a-compliant units. These advantages include increased coverage, reliability, position information, and target location. For example, TSO C126-compliant ELTs offer global coverage whereas older units offer only about 1/3 of that coverage. The alerting process of the new units also allows near-instantaneous detection by geostationary satellites that compose the Search and Rescue Satellite-Aided Tracking System (COSPAS-SARSAT); the older units are ground station-dependent and are not COSPAS-SARSAT-compatible. In addition, the position accuracy with new units is 1 to 3 nm compared to 12 to 16 nm for older units. This target accuracy yields search areas of about 12.5 square nm for new units compared to 450 square nm for older units. Further, TSO C126-compliant units are currently being delivered as standard equipment on commercial transport airplanes delivered for foreign registration. Domestic deliveries of some business and commercial airplanes also include TSO C126-compliant ELTs, and the FAA has recommended such installation since 1994.[5]

A 1996 independent study of Air Force Rescue Command Center mission data[6] indicated that the number of C91 ELT units in use at the time was 140,000. The study also indicated that the population of C91 units in use would decrease by about 10,000 units per year. As a result, it is estimated that 100,000 units will still be in use in the year 2000. On the basis of their performance record, the Safety Board considers such a quantity of in-service C91 units to be potentially detrimental to many search and rescue efforts. In 1998, the referenced study also concluded that the TSO C126, 406 Mhz ELT reduced the search and rescue duration by 6 to 8 hours and conservatively estimated that 134 lives could be saved annually by using 406 Mhz ELTs.

The Safety Board considers the welfare of passengers to be of primary concern for this issue. Therefore, on the basis of the benefits that state-of-the-art ELTs offer, the Safety Board believes the DOI should require all internally owned and vendor-contracted aircraft that carry passengers be equipped with automatic ELTs that meet the requirements of TSO C126 or equivalent alternative technology within 1 year.

The Safety Board is also concerned about the use of TSO C91 and C91a ELTs for flights that are not passenger carrying. Because 14 CFR Part 91.207, "Emergency Locator Transmitters," specifies only an "approved" ELT and given the latitude of operator choice in the repair, replacement, or upgrade of older C91 and C91a units, it is very possible that these older units will stay in service for many years. Therefore, the Safety Board believes that the DOI should require all internally owned and vendor-contracted aircraft be equipped with automatic ELTs that meet the requirements of TSO C126 or equivalent alternative technology within 3 years.

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[5] In Federal Register 59 FR 32050, June 21, 1994, "Emergency Locator Transmitters, Automatic ELT Replacement, Integration of 406 Mhz ELT's," the FAA stated, "Therefore, the FAA recommends, but does not require, carriage of 406 Mhz ELT's. Voluntary use of the 406 Mhz ELT's would provide a definite enhancement over the minimum requirements of the Federal Aviation Regulation. There may be even more life-saving benefits derived from the 406 Mhz ELT for those operations conducted over water and in remote areas; therefore, the FAA encourages installation of the 406 Mhz ELT although the 121.5/243 Mhz will continue to be used."

[6] Information provided by Computer Sciences Corporation, 1100 West Street, Laurel, Maryland 20707.

Therefore, the National Transportation Safety Board recommends that the Department of the Interior:

> Require all internally owned and vendor-contracted, turbine-powered aircraft to be equipped with a Federal Aviation Administration-approved, crash-protective video recording system once an applicable technical standard order has been issued. (A-99-64)
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> Require operators of all internally owned and vendor-contracted aircraft to prepare a complete weight and balance computation, passenger-loading manifest, and cargo-loading manifest for each flight conducted on single-engine as well as multiengine aircraft and that these records be retained for a period of 30 days. (A-99-65)
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> Require vendors that are contracted to provide on-demand, passenger air transportation to provide pilots that meet the requirements of 14 Code of Federal Regulations 61.57(c) "Instrument experience" or (d) "Instrument proficiency check" regardless of whether their flight plans are visual or instrument flight rules. (A-99-66)
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> Require all internally owned and vendor-contracted aircraft that carry passengers be equipped with automatic emergency locator transmitters that meet the requirements of Technical Standard Order C126 or equivalent alternative technology within 1 year. (A-99-67)
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> Require all internally owned and vendor-contracted aircraft be equipped with automatic emergency locator transmitters that meet the requirements of Technical Standard Order C126 or equivalent alternative technology within 3 years. (A-99-68)

Also as a result of its investigation, the Safety Board issued Safety Recommendations A-99-59 through -63 to the FAA, A-99-69 through -73 to the General Services Administration (GSA), and A-99-74 through -78 to the National Association of State Aviation Officials. A copy of the recommendations addressed to the GSA was also sent to each member agency of the Interagency Committee for Aviation Policy.

The National Transportation Safety Board is an independent Federal agency with the statutory responsibility "to promote transportation safety by conducting independent accident investigations and by formulating safety improvement recommendations" (Public Law 93-633). The Safety Board is vitally interested in any actions taken as a result of its safety recommendations and would appreciate a response from you regarding action taken or contemplated with respect to the recommendations in this letter. Please refer to Safety Recommendations A-99-64 through -68 in your reply.

Chairman HALL, Vice Chairman FRANCIS, and Members HAMMERSCHMIDT, GOGLIA and BLACK concurred in these recommendations.

[Original Signed]

By: Jim Hall
Chairman