FLIGHT SAFETY FOUNDATION

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Aviation Operational Safety Audit Appraises Aviation Department Safety, Efficiency

Includes: The Practice of Aviation Safety

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In This Issue

Cover: Darol V. Holsman, FSF manager of aviation safety audits, inspects a Citation X. (FSF photo)

Flight Safety Foundation is an international membership organization dedicated to the continuous improvement of aviation safety. Nonprofit and independent, the Foundation was launched officially in 1947 in response to the aviation industry's need for a neutral clearinghouse to disseminate objective safety information, and for a credible and knowledgeable body that would identify threats to safety, analyze the problems and recommend practical solutions to them. Since its beginning, the Foundation has acted in the public interest to produce positive influence on aviation safety. Today, the Foundation provides leadership to more than 830 member organizations in more than 150 countries.

Foreword

Flight Safety Foundation has conducted aviation operational safety audits as a safety service for its members and other aviation organizations since 1962. The safety audits are conducted by request and are client-confidential; the audit reports are the property of the clients.

Two articles in this issue of *Flight Safety Digest* provide insights into the safety audit process: The first article provides first-hand observations of an FSF safety audit of a U.S. corporate aviation department that granted permission to the Foundation to publish the information; the second article is an updated version of *The Practice of Aviation Safety,* which provides more in-depth information about the process.

The Practice of Aviation Safety also shares, in a nonattributive manner, some of the findings acquired from hundreds of safety audits conducted worldwide, from small corporate aviation departments to large international airlines. Although the safety audits revealed a satisfactory overall standard of safety, specific procedures or practices of individual operators sometimes were observed to be below industry norms.

The process of identifying and correcting these unsatisfactory situations has contributed to the high overall safety levels that the air traveler enjoys today.

The Practice of Aviation Safety is another resource through which the Foundation exerts a positive influence on aviation safety through the sharing of the experiences of its worldwide membership.

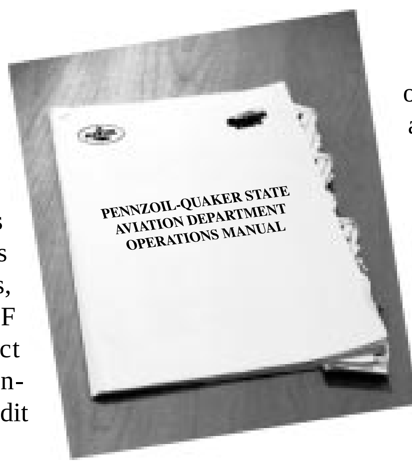
Stuart Matthews
President and CEO
Flight Safety Foundation

June 2001

Aviation Operational Safety Audit Appraises Aviation Department Safety, Efficiency

First-hand observations of a corporate aviation department audit show how an audit is conducted to develop recommendations for improvement and to identify existing policies, practices and procedures that provide desired levels of safety.

FSF Editorial Staff



In February 2001, Flight Safety Foundation conducted an aviation operational safety audit of the Pennzoil-Quaker State Aviation Department in Houston, Texas, U.S. FSF safety audits are strictly confidential, with the results provided only to the client. Nevertheless, Pennzoil-Quaker State permitted two FSF editors to observe the audit, conduct independent interviews with aviation-department personnel and report on the audit activities and findings.

The audit was conducted by Darol V. Holsman, the Foundation's manager of aviation safety audits, and Robert A. Feeler, an FSF auditor and administrator of the Foundation's Q-Star Charter Provider Verification Program.[1]

At the time of the audit, the Pennzoil-Quaker State Aviation Department employed 12 people, operated a Citation X owned by the company and managed and operated a Gulfstream IV owned by a private individual.

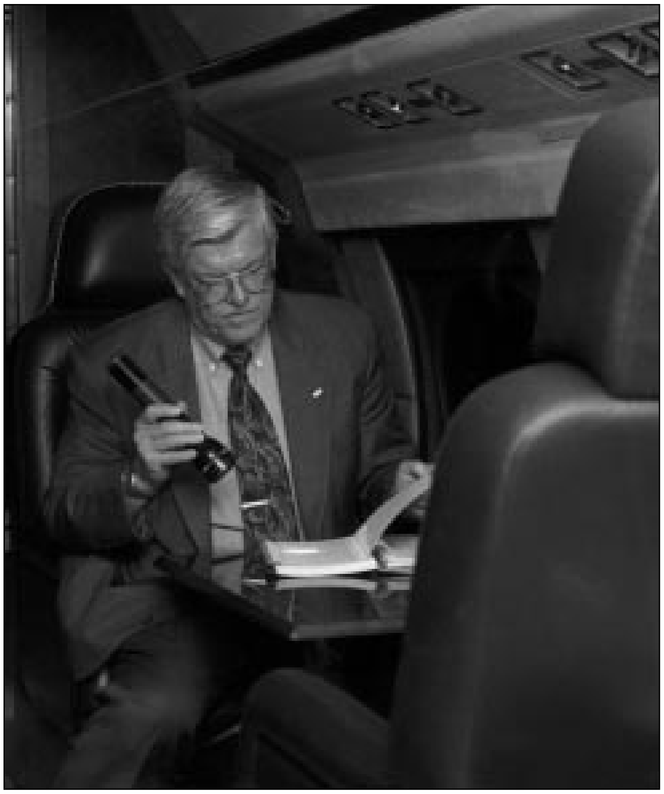
The Foundation had audited the department in August 1996, before Pennzoil merged with Quaker State. At the time, Pennzoil was involved primarily in the production and marketing of petroleum products and natural gas. The company owned and operated a Canadair Challenger and a G-IV. The Challenger was sold in August 1996.

After the merger in December 1998, the new company became involved primarily in marketing automotive-oriented consumer products. The company subsequently sold about half of its aviation-department office facilities and hangar area to another aircraft operator, sold the G-IV and purchased the Citation X. Quaker State did not have an aviation department before the merger.

The Foundation was asked to conduct the 1996 audit by Ken Brumfield, a 27-year employee of the aviation department who became department manager and chief pilot in February 1996.

Brumfield said that he requested the 1996 audit to obtain a baseline on which to make improvements.

"We had not had an audit before," he said. "I knew we had some problems, and the audit helped me focus on things we needed to do. I chose Flight Safety Foundation for the audit because of the [competitive] price and because of the Foundation's reputation in improving safety. We were pleased with the results; the audit did help us improve our organization. It helped a lot."



Currency and completeness are among the elements that Darol Holsman checks for while reviewing aircraft documents. Effective revision procedures are important in keeping documents up to date. (FSF photo)

Brumfield requested another audit in 2001 to obtain information on the effectiveness of the changes that were made after the first audit and to learn where further improvements could be made.

"If you want an organization that operates with the best practices, you have to have somebody come in to look at you every once in awhile," he said. "You have to find out what is not good, or you are going to find out about it sooner or later in some unpleasant way, like an accident."

Although Pennzoil-Quaker State conducts internal safety inspections, Brumfield believes that periodic audits by outside safety specialists are necessary.

"We do have regular inspections by our company safety inspectors, but they do not have a thorough knowledge of airplanes or aviation in general," he said. "The aviation department staff knows about aviation, but we do not want to depend on ourselves."

The audit team planned to conduct the audit in four days. Typical of an audit of an aviation department that operates two airplanes, the tentative itinerary for the audit of the Pennzoil-Quaker State Aviation Department included the following activities:

- Day one would begin with a pre-audit briefing with the aviation department manager to obtain information about the company and any specific problems encountered by the department. The audit team would check the company's flight schedule and make arrangements to observe as many flights as possible. The team would review the department's safety program and conduct interviews with key department personnel;

- Day two would include flight observations, interviews with pilots, inspections of aircraft, reviews of manuals and reviews of procedures for passenger security, passenger service, baggage handling, flight crew dispatch, flight documentation and record keeping;

- Day three would comprise more flight observations; inspections of maintenance facilities, hangars, storage areas, flight-planning facilities and crew-rest facilities; and reviews of maintenance procedures, maintenance records and training records; and,

- The final day would begin with a meeting of the audit team members to determine what activities had been accomplished and what activities remained to be accomplished. After completing the audit activities, the team members would assemble notes for reference during the oral preliminary briefing with key department personnel. During the briefing, the team members would discuss the major observations and recommendations that would be included in the audit report.

Holsman — who has more than 8,000 flight hours as a pilot and formerly served as chief of U.S. Air Force Strategic Airlift Operations, pilot-proficiency examiner for FlightSafety International and manager of the aviation safety program for Saudi Arabian Oil Co. — would focus on flight-operations issues and administrative issues. Feeler — a certified aircraft maintenance technician since 1952 and former senior manager for two U.S. airlines — would focus on facilities and maintenance issues.

Holsman said that the Foundation requests that aviation departments provide documents for the audit team to review before the on-site activities begin (see "The Practice of Aviation Safety," page 9).

"We ask every client to provide materials — such as safety-program documentation, the emergency-response plan, the operations manual, the maintenance-policy manual and the training manual — to the audit team before the on-site audit activities begin," he said.

The Pennzoil-Quaker State Aviation Department provided copies of its operations manual, which included the emergency-response plan, maintenance-policy manual and training manual.

Although many safety policies and procedures were documented in the operations manual and maintenance-policy manual, the department did not have a separate and comprehensive safety program. Among the aviation safety services provided by the Foundation is the development of such programs. Holsman and Brumfield discussed this service before the audit began, and Brumfield asked the Foundation to develop a safety program for the department.

"A proactive safety program is the basis of a safety culture within an organization," Holsman said. "A safety program includes the establishment of such things as a hazard-identification program and an in-house safety committee, with a designated safety coordinator who reports directly to the CEO."

The pre-audit reviews of the operations manual, maintenance-policy manual and training manual showed them to be of high quality. Holsman said that the manuals were impressive; Feeler said that the manuals were "among the best I have ever seen."

Quality control is a key safety factor in fueling, whether an operator has its own fuel facility or uses an outside vendor. Here, Robert Feeler (left) and Wade Davidson discuss fuel-quality-assurance procedures. (FSF photo)

After the review, the manuals brimmed with self-adhesive paper slips bearing hand-written notes. Many notes were congratulatory, saying simply "excellent" or "outstanding." Some notes contained recommendations for improvement; more substantive recommendations would be included in the written audit report.

The tentative schedule for the on-site audit activities was revised the morning of the first day, when the Citation X was dispatched to fly the company's CEO, James Postl, from Houston to Miami, Florida. Holsman went on the flight to observe two of the company's five pilots — Frank Smesny, who had been with the department for 17 years and served as assistant chief pilot, and Wayne Geffon, the department's newest employee, a three-year veteran.

Postl, to whom Brumfield reports directly, said that he welcomed the audit as a means to identify areas for improvement.

"We are proud of our aviation department and welcome this opportunity to identify actions that will make it even better," he said. "Our desire is to have a world-class operation, and our expectation [for the audit] is to see where we stand relative to the industry's best."

Postl was asked what the aviation department contributes to Pennzoil-Quaker State.

"Enhanced productivity," he said. "The department provides speed and efficiency in getting to out-of-the-way places, and the capability of covering several business locations in one day."

Holsman occupied the flight deck jump seat for most of the flight and spent some time in the cabin, checking placards for emergency equipment, dates on life vests and information on passenger-briefing cards.

He found the pilots' overall performance outstanding. He observed, however, that they used one flight instrument to confirm a positive climb rate before retracting the landing gear on takeoff. He recommended the use of two flight instruments.

"Most organizations use the barometric altimeter and the radio altimeter; some use the barometric altimeter and the vertical velocity indicator [VVI]," Holsman said. "We recommend the radio altimeter, because the VVI indication can lag."

Holsman also found that the pilots adhered to an altitude-callout procedure recommended during the 1996 audit and subsequently included in the department's operations manual. The auditors in 1996 had found that the pilot not flying was saying "one to go" when the airplane was 1,000 feet above or below the assigned altitude during climb or descent. The Foundation had recommended that the pilot flying say, and the pilot not flying acknowledge, a more definitive callout, such as “leaving 14,000 feet for 13,000 feet.”

The Citation X pilots adhered to the altitude-callout procedure during most of the flight to Miami. Nevertheless, when the pace of flight deck duties intensified during the approach to Miami, they reverted to saying “one to go.” Holsman discussed this finding with the pilots and with Brumfield.

Holsman conducted an exterior inspection of the Citation X on the apron at Miami.

“You can tell a lot about an aviation department by the appearance of its airplanes,” he said. He pointed to the bottom of an engine nacelle, which was spotless. “Most engines leak a little oil, and many airplanes show a little residue. This one shows meticulous care.”

After inspecting the Citation X, Holsman conducted interviews with the pilots, who were to remain in Miami overnight and fly the airplane back to Houston the next day. While Smesny was being interviewed, Geffon, who was participating in his first audit, shared his thoughts on the process.

“I think that this is great,” he said. “It gives us a chance to see what we are doing well and what we may not be doing so well.”

When told that some pilots do not welcome audits, believing them to be job-threatening, Geffon said, “Well, what do they have to hide?”

This positive attitude toward the audit was characteristic of comments received from other Pennzoil–Quaker State Aviation Department employees.

“I think we all welcome the opportunity for improvement,” said Scott Mills, pilot and director of training. “I think you have to have somebody external to your own department come in and look at it. Trying to self-evaluate all the time is difficult at best; you need an outside opinion, an objective opinion.”

Joe Sauter, director of maintenance, said, “Sometimes, when you have worked at a place long enough, you tend to accept things that are not right; you see these things every day, and you do not take notice of them. I think it is good to have a safety audit from time to time, to have people come in with a different set of eyes to point things out to you, so you continue to improve.”

The audit team conducted interviews with 11 department employees. One maintenance technician was away on vacation, and the auditors made arrangements to follow up later with a telephone call.

Flight observations are among FSF audit activities that gauge adherence by personnel to published policies and procedures. Citation X pilots Frank Smesny (left) and Wayne Geffon received high marks for crew coordination, compliance with standard operating procedures and use of checklists. (FSF photo)

In addition to asking for specific information on safety policies and procedures during the interviews, Holsman and Feeler asked open questions such as the following:

- “If I gave you a magic wand, what changes would you make to create the perfect aviation department?”
- “Are you impressed with the credentials and professionalism of the [pilots/maintenance technicians/ flight scheduler]?”
- “Are you having any problems with the aircraft?”
- “Are there any policies or procedures that you believe should be changed?”
- “Do you have any other comments or thoughts?” [and,]
- “On a scale of one to 10, with 10 being the highest, how would you rate the morale of the department staff?”

The auditors found that morale ratings were high: They ranged from seven to nine, which was higher than the ratings typically found in aviation-department audits.

Sauter said, “Morale has gone straight up because of some of the new policies and procedures we have initiated. Ken [Brumfield] has given me authority to get anything we need. He said, ‘If you need it, get it. I know you are not going to buy something just to be buying it.’ That is one of the things, I think, that has this place running so smoothly now.”

Nevertheless, several employees told the auditors that they were concerned that the aviation department had fewer employees and fewer airplanes than in the past, and that flight activity in the Citation X and G-IV had decreased in recent months. There also was concern about how the economic slowdown in the United States might affect their company and the aviation department.

Concern also was expressed that some aviation department facilities were not set up or maintained to the desired standards. For example, an office shared by three pilots — Geffon, Mills and Fred Cesnik — had furniture and furnishings of lesser quality than other offices, and some ceiling tiles in offices and in hallways were water-stained and deteriorated.

During their inspections of the department's facilities, the auditors found other discrepancies, including the absence of a dedicated and adequately equipped flight-planning office for the pilots, and storage areas that contained spare parts for aircraft no longer operated by the department.

The auditors also found that the training of employees in identifying and safely handling hazardous materials (HAZMAT) was deficient. For example, while inspecting the department's fuel-storage facility, Feeler observed Wade Davidson, a utility-service technician, replenishing a dispenser's supply of a toxic fuel additive. Although Davidson was wearing rubber gloves, Feeler recommended that he also wear a protective face mask.

Overall, the auditors found that the employees were adhering to the standard operating procedures (SOPs) documented in the manuals and that several of the department's SOPs exceeded the norm for corporate operations.

For example, the maintenance technicians practiced what they call a "buddy system," in which almost all maintenance actions receive double inspections (i.e., the work is checked and signed off by two technicians with inspection authority).

By the conclusion of the on-site audit activities, Holsman had observed only the flight from Houston to Miami on Monday. Because of a schedule change, the Citation X did not return to Houston on Tuesday, as planned, and a flight on Wednesday was canceled. The G-IV was scheduled for a flight to Mexico on Thursday, but FSF auditors typically do not observe international flights by corporate operators because of the time involved.

"We try to fly with as many pilots and aircraft as possible, but we really have to work within the company's flight schedule," Holsman said. "The audit report will say that an FSF audit team member flew as an observer on one flight segment involving two of the five pilots and that a second flight, with two other pilots, was scheduled but canceled."

On Thursday morning, the audit team conducted an oral preliminary briefing with Cesnik and Mills, who were scheduled to depart at noon for the flight to Mexico. The audit team discussed with Cesnik and Mills, who maintain the training records, the operating manual and the training manual, the audit team's findings about those documents. Brumfield also attended the morning briefing.

Among the items discussed was the absence of procedures to ensure that pilots balance their flight time in the Citation X and G-IV, to maintain proficiency in flying both airplanes.

Holsman said that, when asked how pilots are assigned to flights, Maricela Freeman, the flight scheduler, said that she usually asks the pilots who wants to take the flight. He said that, although the department's records showed that flights in the Citation X and G-IV were divided fairly evenly among the pilots, the department should have a procedure for providing Freeman with pilot-currency information, so that she can ensure that pilots get equal experience in the Citation X and G-IV.

FSF auditors look for supervision and control of aircraft servicing by pilots or maintenance personnel. Here, maintenance technician Steve Ogden prepares to fuel a Gulfstream IV. (FSF photo)

The operations manual requires the pilot flying to occupy the left seat on the flight deck, but there is no requirement for pilots to maintain proficiency in performing landings while occupying the right seat. Holsman said that proficiency in right-seat landings is important as a safeguard, if the pilot flying becomes incapacitated.

"Also, the manual provides no guidance on conducting circling approaches," Holsman said. "Many companies operating high-speed, turbine-powered airplanes have told their pilots that they will not conduct circling approaches. We are not recommending that you eliminate circling approaches. We believe that, if circling approaches are approved, you should increase the required weather minimums; rather than requiring pilots to adhere to the circling-approach weather minimums published on the instrument approach chart, require at least '1,000 and three' [a ceiling of 1,000 feet and visibility of three statute miles]."

Holsman said that the operations manual also should provide more definitive guidance about checklists.

"You say that the checklist may be used as a work list, using the challenge-and-response procedure, or as part of a flow-check procedure," he said. "We do not believe that you should give your pilots a choice. Be specific; choose a procedure and tell your pilots to use that procedure."

He recommended using the auxiliary verb "must," rather than "should," when an action is required. He provided the following example from the operations manual: "The aviation manager/chief pilot should be notified any time a pilot makes a blood donation."

"Donating blood can adversely affect a pilot's performance, so the boss 'must' be notified," he said.

Holsman discussed recommendations about the section of the operations manual that covers visual flight rules (VFR) procedures.

"The information on VFR procedures in the manual is good, but I would add a comment to the effect that a flight plan will be filed on *all* flights, even those conducted VFR," he said. "That way, if something happens on a VFR flight, they will begin searching for the airplane much sooner."

Ken Brumfield said an FSF audit in 1996 gave him a baseline for improvement. He requested the 2001 audit to check the department's progress and to learn where further improvements could be made. (FSF photo)

Holsman said that the department's training records were "excellent, among the most thorough we have seen." Nevertheless, he had a few recommendations for improvement.

He said that the training records should include copies of the pilots' restricted radiotelephone operator permits. Although the U.S. Federal Aviation Administration no longer requires the permits, the International Civil Aviation Organization (ICAO) recommends that pilots be qualified to use "the radio telephone" when radio communications are required during flight.

"The biggest problem I saw in your record keeping, and this is minor, is that only one person's radiotelephone operator permit was listed," he said. "In the United States, you do not have to have a permit; but, if you are flying outside the U.S. in airspace governed by ICAO rules, you must have a radiotelephone operator permit. That document should be on file. Replacement copies can be obtained from the FCC [U.S. Federal Communications Commission]."

The second part of the oral preliminary briefing was conducted in the afternoon, with Brumfield, Sauter and André Chassé, maintenance supervisor, in attendance. Smesny joined the group later, after returning from a flight.

Holsman began the briefing with a review of the auditors' activities during the on-site visit.

"As we report to you our observations, it is going to be very obvious that there are many positive things that we have encountered in your organization and that those negative ones are, well, not too serious," he said.

Holsman then discussed the department's actions regarding the 1996 audit recommendations. Of the 67 recommendations made in the 1996 audit report, the department had acted on 50 recommendations (75 percent of the total). Holsman said that the recommendations not acted upon would be repeated in the 2001 audit report.

"You really have made some improvements since the last time we were here, but there are still some things that need to be done," he said.

Brumfield said that some recommendations from the 1996 audit were not a good "fit" for the aviation department. For example, the Foundation had recommended that the department use contract flight attendants — rather than its maintenance technicians — for cabin service and safety duties on long-distance flights and international flights.

After the 1996 audit, the department elected to continue dispatching maintenance technicians as "flight engineers" on such flights. The operations manual includes specific flight-engineer duties, such as preflight airplane inspections; catering and restocking; preparing the galley, cabin and lavatory for flight; conducting passenger briefings; monitoring radio communications and assisting the pilots.

When the issue was discussed during the 2001 audit, Brumfield said, "I feel very comfortable having those guys on the airplanes, and our passengers have said that they like having the mechanics aboard. They have done a good job."

Feeler said that having maintenance technicians fly as flight engineers or flight mechanics was common years ago, but that modern aircraft are so reliable that "flight mechanics on routine flights do not do much in the way of maintenance anymore."

"We do not believe that it is an efficient use of your resources to have a maintenance technician go on a flight, rather than a contract flight attendant who is trained in emergency passenger services, as well as routine passenger services," he said.

Feeler said that the training records showed that only one of the two maintenance technicians assigned flight-engineer duties had completed a formal flight-attendant training program. He said that, if the department continues using flight engineers, the other maintenance technician also should receive formal flight-attendant training.

Feeler also recommended that the department conduct as soon as possible a training session for company executives who are flown in the Citation X. The company in 2000 had scheduled such training — to provide executives with "hands-on" familiarization with safety equipment aboard the airplane and detailed briefings on emergency procedures — but the training was canceled.

"The training is especially important because you are operating a Citation X and a G-IV without flight attendants to assist the passengers if an emergency occurs," Feeler said.

The auditors then discussed their findings about the aviation department's facilities.

"One thing that is definitely having an impact on you, and I am sure you are aware of it, is that some of the facilities being used by the aviation department are not being maintained to company standards," Holsman said. "We recommend a complete reassessment of all your facilities."

He said that, although morale was high among department personnel, the failure to maintain all department facilities to company standards could have a negative effect on morale.

Darol V. Holsman says that an airplane's appearance tells much about an aviation department. Here, he inspects a Gulfstream IV managed and operated by the Pennzoil-Quaker State Aviation Department. (FSF photo)

The auditors also recommended that the department publish a quarterly newsletter or a monthly newsletter, to keep department employees informed about the company's financial condition and plans for the future, and to reinforce the company's commitment to safety.

"You should ask corporate management to provide information that can be shared with department employees to minimize the spread of negative rumors that may adversely impact morale," Holsman said. "Employees can deal with the difficulty of the current business environment for a corporation as long as management provides some straight talk about plans for the future and the likely impact on the employees.

"A newsletter also is an ideal vehicle to reinforce the company's safety culture."

Feeler, who was an audit team member during the 1996 audit, said that significant improvements were made in the department's use of computers and telephone equipment. He recommended further improvements.

"Each pilot and technician who has an administrative assignment or support assignment should have a personal computer that is interconnected through an intranet system," he said.

The auditors recommended that the department re-evaluate a policy that could result in pilots being on duty for 16 hours and flying 12 hours in a 24-hour period. They recommended that the department adopt the duty-time guidelines and flight-time guidelines developed by the FSF Fatigue Countermeasures Task Force.[2]

"The task force set 14 hours as their recommended standard duty-time limit and 10 hours as the standard flight-time limit," Holsman said. "Flight time can be extended to 12 hours under specific conditions, which include restrictions on the number of landings that are conducted."

A 1996 audit recommendation, about meals consumed by pilots in flight, was repeated.

"The records show that three times in 2000, pilots ordered the same meal, and that twice the meal was seafood," Holsman said. As a safeguard against incapacitation of both flight crewmembers as a result of food poisoning, he recommended that the operations manual require pilots to order different meals and to consume the meals 30 minutes apart.

Feeler then discussed findings about maintenance programs and records.

"We commend you for having one of the best systems for maintenance-discrepancy records that we have seen in corporate flight operations," he said.

Among recommendations for improvement was that maintenance technicians be required to have health assessments at least every two years.

"This is something that is frequently overlooked," he said. "But, when you think about it, eyesight and hearing are just as important in maintenance as they are in flight operations."

Brumfield said, "The company offers a free physical exam every year, but it is not mandatory. Maybe we should make it mandatory for the technicians."

Feeler said that the audit report would include several recommendations about hazardous material HAZMAT training and handling.

"There are no requirements for your stockroom personnel or maintenance technicians to receive HAZMAT training, yet you do handle hazardous materials," Feeler said. "Although you do not intend to carry hazardous materials aboard your airplanes, your pilots also should receive HAZMAT training, so that they will be able to identify hazardous materials."

Feeler discussed several recommendations about the operation and maintenance of the fuel facility and the training of employees assigned those duties.

"The actual operation of the fuel farm is good, and the end result is good," he said. "But the procedures are not documented, formal training is not required, and there is no record-keeping system to show what in-house training has been done."

As Holsman and Feeler discussed their findings and recommendations, several department employees made notes and asked questions, mostly seeking guidance on effecting recommended changes. At the conclusion of the preliminary oral briefing, Holsman told Brumfield that he would receive the audit report in March 2001.

Asked in June 2001 for comments about the 65-page audit report, Brumfield said: "They did a good job. All the suggestions were good, although — like some of the 1996 recommendations — some may not fit our operation."

Brumfield said, "We got everybody together and went through the entire report. Each of us picked up on issues that were germane to us. We already have resolved several of the discrepancies, and we probably will have 75 percent or 80 percent of the discrepancies resolved by the time we have our next audit."♦

Notes and References

1. For more information on the Flight Safety Foundation Q-Star Charter Provider Verification Program, see "Q-Star Verification Process Provides Safety Assessment of Aircraft Charter Providers," *Flight Safety Digest* Volume 20 (January 2001); 1–13.

2. FSF Fatigue Countermeasures Task Force. "Principles and Guidelines for Duty and Rest Scheduling in Corporate and Business Aviation." *Flight Safety Digest* Volume 16 (February 1997): 1–11.

The Practice of Aviation Safety

Observations From Flight Safety Foundation Safety Audits

Capt. E.R. Arbon

Capt. L. Homer Mouden

Robert A. Feeler

Safety Audits and Operator Goals

Safety Audit Defined

One dictionary defines an audit as a "formal examination of an organization's or an individual's financial situation." By usage, this definition has expanded beyond the financial accounting aspect to safety practices and includes "a methodical examination and review of a situation or condition, concluding with a detailed report of findings." The terms "review" or "evaluation" are preferred by some safety organizations.

Regardless of the terminology applied, an aviation operational safety audit is a process whereby highly qualified aviation specialists observe systematically and objectively the activities of an aviation organization in the context of that organization's operating plans as well as in relation to the industry's best practices and applicable government regulations. Observations and findings, together with recommendations to resolve issues and problems identified, then are reported to the organization's management for consideration and action. Aircraft operators are the context for most of the following discussion of FSF safety audits. Nevertheless, the Foundation believes that similar auditing principles and techniques are applicable to airports, maintenance facilities and other aviation organizations.

"Operation" comprises the total system: safety management; policies and procedures; flight operations; flight crew training; maintenance training; cabin crew training; crew fitness for duty; maintenance and engineering; aircraft design and equipment; aircraft support equipment; airport, hangar and ramp facilities; ramp servicing; ground safety; and security.

A safety audit sometimes is perceived — incorrectly — as having negative overtones (e.g., criticism or a punitive purpose) but more commonly is recognized as providing valuable information for management to act upon in the interests of improved safety.

A company's desire for periodic safety audits of its aviation operation reflects a healthy and positive attitude toward improving its safety performance. The purpose of any safety audit is to enhance safety; the process also can improve operational efficiency. A safety audit may cover only specific departments, divisions, stations, etc., but usually covers comprehensively all activities of the aviation organization, focusing on the safety aspects in each area.

Management may employ an outside consultant to advise on organizational restructuring and adjustments to staffing to achieve desired operating efficiencies. Such examinations often are referred to as audits, and they depend heavily upon quantifiable factors or measures of a company's operations — for example, financial, production, work unit efficiencies, product rejects, etc. The Foundation's safety audits normally do not include this type of advice.

Two types of safety audits are predominant in civil aviation:

- *Internal audits* (self-audits) are conducted by designated personnel within the company. Ideally these safety auditors are not a part of the unit being audited, so that they can be more objective than employees working in the unit under review. Internal audits provide normal ongoing surveillance, which should be conducted for each unit; and,

- *External audits* (independent audits) are conducted typically by outside auditors to identify safety problems and issues during a complete review of a flight operation. The safety auditors also submit recommendations to resolve these problems and issues.

Safety can be measured to some extent but usually does not have the benefit of quantifiable measures. The process is largely qualitative, dependent upon subjective human actions and responses, as well as individual skills in interpersonal relationships. Effective communication — in assimilating information and in disseminating information — is paramount in aviation safety.

The quality of a safety audit depends upon the skills and competence of the audit team in properly observing individual actions and interpersonal interactions, and conducting interviews with individuals across the entire organizational spectrum. Just as manufacturers and operators of machines and equipment test their products to determine if they continue to meet their standards of quality and performance, a safety audit is an objective quality-assurance check of people — how they perform in accordance with company policies, established standards or industry best practices, as well as their use of equipment, facilities and human resources.

Independence of the Internal Audit Team

Every unit within an organization continually should review and analyze its activities, equipment, facilities and use of personnel. Nevertheless, experience has shown that additional benefits accrue from periodic audits — either within the organization or by qualified people from outside the company.

An internal safety-audit team must be able to function independently and without fear for any recrimination or for job security. The team should report to senior management, but each safety auditor must have a background of experience that enables recognition of any conditions or situations that could affect safety in the various units under review. The team must function independently to ensure objectivity.

In one airline, the internal safety-audit team reported to the person who directed both flight operations and maintenance. Any reported deficiencies were interpreted as reflecting adversely on this individual, so the results of the team's findings were presented so mildly that very few of the reported items were corrected. The audit team had identified what required correction, but the team leader failed to serve the airline because he did not report objectively the team's observations and findings, or make specific recommendations.

FSF External Audits

Management personnel at all levels must recognize that the purpose of any audit is to identify situations and factors that affect safety and efficiency, regardless of what people in the organization believe about current safety or what they want to achieve. An audit must not be conducted to yield, or to substantiate, a predetermined result.

The Foundation recognizes that the client has the prerogative and the responsibility to evaluate the information presented and to take whatever action is considered to be appropriate.

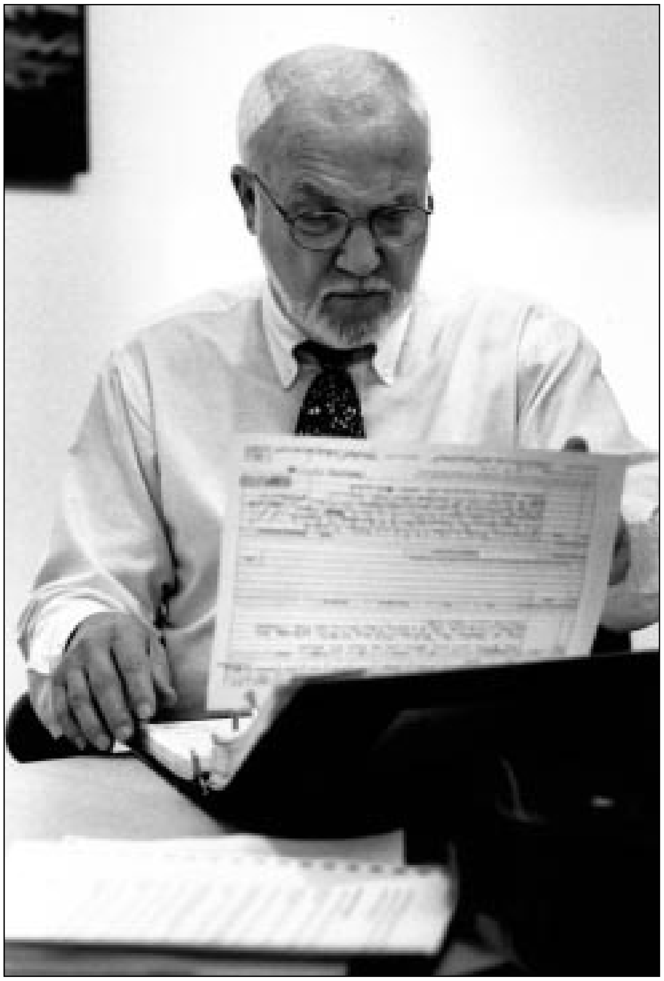
The head of one aviation organization told an FSF audit team on the first day of a safety audit that he wanted a favorable safety report to "negotiate a lower insurance rate." He was told that the team's observations and findings would be reported without consideration of whether insurers would utilize the report as justification for a reduced premium.

After submitting a written audit report, FSF safety auditors have received subsequent action-item reports from some clients, but the Foundation recognizes that the client has the prerogative and the responsibility to evaluate the information presented and to take whatever action is considered to be appropriate. Some corporate aviation departments and airlines have requested repeat audits at two-year intervals to three-year intervals. This has enabled the Foundation to determine how the client evaluated the observations, findings and recommendations, and to analyze the results of the client's actions.

Operator Goals

Every organization involved in aviation operations must identify its safety objectives and establish methods to measure how effectively the objectives are being met. Because safety has immediate effects and long-term effects on the efficiency and the economic aspects of any organization, the establishment and communication of safety objectives and goals should receive high priority from all levels of management.

Each operator must respond to the following safety questions:



A review of records is essential to gauge compliance with standard operating procedures. (FSF photo)

- Do our policies, procedures and practices provide us with the level of safety and efficiency that we want?
- Are we doing what our manuals, procedures and standards say we will do?
- Are the manuals, procedures and standards valid for current operations and projected operations?
- Is the support provided by other departments, outside organizations and contractors contributing to the safety, efficiency and economy of our operations?
- Is the coordination and support of the overall safety program the best that it can be?
- How can we monitor the operation to assure continued adherence to the established policies, procedures and standards?

Many leading aviation organizations have determined that an external safety audit provides objective answers to the first five questions and can assist the organization in developing an ongoing program of safety surveillance and analysis to answer the last question.

Depending on the size and structure of the aviation organization, some of the answers to the six basic questions also can be obtained through internal audits conducted by qualified personnel with appropriate experience. Nevertheless, they must separate from the process their personal opinions of the unit being audited. Internal auditors must be permitted to evaluate objectively the operation and to report their observations and findings without any concern about jeopardizing their own position within the organization.

In reviewing aviation department internal audit reports conducted by corporate safety departments, the Foundation has found that many reflected an industrial orientation and that the safety auditors frequently lacked sufficient aviation expertise to effectively audit flight operations. The backgrounds of the audit personnel did not prepare them to analyze the specific problems and issues affecting safety of flight operations. Some organizations successfully have included — as a member of the internal audit team — an auditor from outside the company who is experienced in flight operations. This is one means of providing objective flight operations experience on the internal audit team to assure consideration of the relevant activities in the overall safety evaluation.

A Typical Aviation Safety Audit

An organization providing safety-audit services should obtain appropriate information about the client's organization, personnel, equipment, facilities and training, and any other data that will help determine the size and composition of the audit team and the length of time required to complete on-site audit activities. The team members must be highly qualified personnel with overall operational experience relevant to the client's aviation activities. The audit must be planned carefully so that the client's needs are identified and accommodated during the preparation of an audit contract.

The client's manuals — containing policies, standard operating procedures (SOPs) and practices for the safety program, flight operations, maintenance, ground support and cabin services (where applicable) — should be reviewed in advance of on-site audit activities. The manuals are an indispensable reference throughout the audit. One of the primary functions of the safety audit is to determine the effectiveness of compliance with the established policies and SOPs in actual practice, as well as the effectiveness of compliance with applicable government regulations. The audit team must be familiar with the appropriate documents for each department. When manuals cannot be reviewed prior to the on-site visit, time must be planned and allocated at the beginning of the audit to review the manuals on-site.

Safety auditors ask many questions about preparedness for ground emergencies as well as in-flight emergencies. (FSF photo)

The key benefit provided by an external audit team is its review and analysis of policies and SOPs from an experienced, unbiased viewpoint. This not only provides a firm base from which to evaluate each aspect of the operation, but also ensures that the team recognizes and assimilates new or improved methods and procedures that are observed in the course of their work. Typically, experience gained during each FSF safety audit provides the audit team members with insights and ideas, which are shared non-attributively with other operators through subsequent FSF safety audits, publications, workshops, seminars and other programs.

One of the most important audit activities is conducting confidential interviews with employees at all levels within the organization. The approval and support of top management are essential to the success of these interviews and to the safety audit. Management should prepare the organization for the safety audit by conducting advance briefings and providing written notification about the presence and purpose of the audit team. All employees should be encouraged to speak openly and candidly with team members. They must be assured that they are not being disloyal to the company when they discuss problems and issues as they perceive them.

Interviews provide insight into problems, issues or areas that may require further review by auditors because of their effect on safety. Interviews also enable an evaluation of morale as it affects safety and the identification of the underlying factors.

An FSF audit team's activities and emphasis will vary to accommodate the needs of the organization being audited. Nevertheless, as a minimum, audit activities should include:

- Examination of organizational structure and lines of communication;
- Review and evaluation of all manuals and published policies, procedures and practices;
- Review of current safety programs;
- On-site inspections of facilities, equipment, working conditions, operating procedures and practices, and supervision;
- Evaluation of integrated training programs, curricula, staff qualifications and documentation;
- Review of training records;
- In-flight observations (not proficiency checks) of application of SOPs and practices; crew resource management (CRM), communication and coordination; and a comparison with company standards, procedures and applicable regulations;
- Inspection of all available company aircraft, including configuration, emergency equipment, safety equipment and documentation;
- Review of policies, procedures and practices of the maintenance operation and supporting units, on all work shifts (if applicable);
- Evaluation of maintenance program documentation and forms;
- Evaluation of safety equipment and industrial safety programs applicable to hangars, shops and ramps; and,
- As the audit progresses, reviews of each safety auditor's observations and findings to determine if all areas are being covered, if there are some areas requiring further consideration, or if new areas of concern have been identified by the audit team.

Upon completion of the on-site activities, the team should present an oral preliminary briefing of its observations, findings and recommendations to the client. A formal written report should be prepared as soon as possible so that the client can evaluate further the audit team's recommendations and assign action items.

A safety audit should encompass all aspects of operations, maintenance, equipment, facilities and personnel as they might influence operational safety. This normally includes review, observation and analysis of the following areas, as applicable:

1. **Administration and Organization**
   - Organizational structure;
   - Management/staff qualifications, selection and training;

- Management policies and practices;
- Technology application;
- Communication tools;
- Training program; and,
- Documentation, records and follow-up programs.

2. **Safety Management**

- Management safety policies and practices;
- Safety organizational architecture;
- Safety staff qualifications, selection and training;
- Safety program goals and objectives;
- Documentation, records and follow-up programs; and,
- Emergency-response planning.

3. **Operational Policies and Implementation**

- Operations records, manuals and related documents;
- Normal SOPs and emergency operating procedures;
- Dispatching and flight tracking;
- Communications equipment and procedures;
- Navigation equipment and procedures;
- Aircraft crew scheduling;
- Flight crew training and ground crew training (both contract training and in-house training); and,
- Accident/incident reporting and investigation procedures.

4. **Flight Operations**

- Preflight procedures and postflight procedures;
- Facilities and procedures for weather briefings and flight planning;
- Aircraft-specific SOPs;
- In-flight crew coordination and procedures;
- Crew briefings;
- Cabin/flight deck safety and emergency procedures;
- Cargo compartment safety and emergency procedures; and,
- Coordination with ground services.

5. **Personnel**

- Employee morale issues;
- Pilot-distraction factors;
- Policies on assignments and promotions;
- Communications;
- Staffing level; and,
- Salary and benefits.

6. **Aircraft Maintenance**

- Manuals, policies and procedures;
- Records;
- Quality control, inspection and quality assurance;
- Servicing and ground handling;
- Stockroom, spare parts certification and inventory-control procedures; and,
- Handling and storage of flammable materials and toxic materials.

7. **Airport Facilities**

- Hangars, ramps and company-owned facilities or company-leased facilities;
- Obstructions, obstacles and prevention of foreign-object damage;
- Aircraft rescue and fire fighting (ARFF) facilities and procedures; and,
- Fuel storage, fuel handling and fuel quality control procedures and records.

8. **Aircraft Configuration**

- Documentation (certificates, airplane flight manual, checklists, etc.);
- Passenger information cards that show the location of safety equipment and explain how to operate the equipment;

- Safety equipment (e.g., traffic-alert and collision avoidance system, terrain awareness and warning system, head-up display, emergency vision-assurance system, smoke hoods, life rafts, life vests, automated external defibrillator [AED] and first aid kit); and,

- Cleanliness and sanitation program.

9. Aircraft Support Equipment

- Emergency equipment, procedures and practices;

- Servicing and loading equipment; and,

- Tooling, stands and lighting.

10. Ground Operations Support

- Ground handling, including towing and marshaling;

- Airport condition and ramp condition; and,

- Operation at uncontrolled airports.

11. Security

- Facilities;

- Aircraft procedures and personnel procedures; and,

- Flight operations.

Lessons Learned From Safety Audits

The following categories summarize most activities in which problems/solutions have been identified during FSF safety audits:

- Safety programs;
- Organizational characteristics;
- Policies and procedures;
- Communication;
- Morale issues;
- Organization of safety activities;
- Training;
- Flight operations;
- Cabin services;
- Maintenance and engineering;
- Inspection and quality control;
- Ramp activities and ground operations; and,
- Aircraft, facilities and equipment.

An "experience pool" of ideas, procedures and practices derived from many safety audits has contributed significantly to the validity of FSF audit team recommendations.

Organizational Characteristics

When auditing airlines and corporate aviation departments, FSF audit teams occasionally have found that the operation has outgrown the current organizational structure; structure that was valid for many years no longer may be effective for an expanded scope of operations.

For example, at one major airline many individuals had been retained in redundant positions following a series of corporate mergers and acquisitions. No one was terminated, transferred or demoted, nor were the departments reorganized to use effectively the available talent and to manage the expanded operation. Compassionate management inadvertently created a chaotic situation in the flight operations department and the maintenance department. In the flight operations department, for example, there were seven levels of management and supervision between the senior vice president of flight operations and the line pilots. There were no well-defined communication channels or assigned responsibilities for specific functions. Although FSF safety audits normally do not address such managerial aspects, in this instance, the organizational structure adversely affected safety, because of confusion about authority and ineffective communication. The Foundation recommended an organizational evaluation to address the safety shortcomings.

In corporate aviation departments, the most prevalent organizational problems are overlapping responsibility and excessive responsibility. Many departments do not have a large personnel pool from which to select in making job assignments. In one situation, an individual assumed the positions of director of aviation, chief pilot and safety coordinator (this was not a one-person or two-person aviation department). This individual also felt obligated to fly a line captain's normal share of the flight hours. The scope of responsibility was excessive and affected adversely the individual's managerial responsibilities and the department's flight operations monitoring and safety program. Department directors/managers must delegate responsibilities — assign line pilots to assist with administrative duties, for example — and must limit their flight time to fulfill their leadership role.

Management's Influence on Employee Effectiveness

Some management personnel fail to realize how corporate policies, procedures or practices can create unsafe situations or that their personal actions might contribute to an accident. Many organizations do not recognize what effect their managerial/supervisory employees' actions can have on safety.

For example, the manager of a corporate aviation department explained to FSF safety auditors how every member of the department was important to the safety program. He interrupted his explanation and used the hangar public address system to announce that an executive would be arriving in three minutes. A minute later, the FSF safety auditors observed a maintenance technician standing by a boundary gate in drizzling rain, waiting to open the gate so that the executive could be driven directly to the aircraft. The expected three minutes elapsed and the mechanic continued to stand by the gate.

The maintenance technician was outside in inclement weather for 22 minutes until the executive arrived. The FSF safety auditors believed that he would not return immediately to the same level of mental concentration and efficiency as before his regular tasks were interrupted. Later that day, they found that the maintenance technician had been working on a hard stand, replacing component seals in an aircraft engine, when he was called to open the gate. The manager apparently did not view this interruption of a highly technical task as having an effect on the department's safety practices.

Deficiencies in adhering to organizational structures and chain-of-command have been found at all levels, from senior executives to below middle management. In some corporate aviation operations, there was a tendency for some senior executives to bypass the chain-of-command and to deal directly with individual members of the aviation department.

In one instance, FSF safety auditors found that the chief executive officer (CEO) preferred a pilot who did not use SOPs. The pilot did not understand why he needed to use the SOPs since "his boss did not object." The pilot also did not recognize that he was a negative influence, not only in failing to promote and follow company standards, but also in detracting from good morale within the aviation department.

The CEO was unaware that his favoritism and his tacit acceptance of non-standard operating procedures were affecting safety.

In several airlines, department heads or mid-level managers were observed circumventing the first-level supervisor. Bypassing the chain-of-command causes confusion and frequently disrupts planned activities or work in progress. This practice undermines the entire purpose of policies and procedures. As a result, operations are exposed to a greater risk of error or omission.

During the safety audit of a small corporate aviation department, the director consistently injected himself into contract-maintenance work-schedule priorities and, in some instances, even changed the instructions on work projects that were issued previously by the maintenance coordinator. The director's disruptions caused problems between the contractor and the department and, ultimately, cost the corporation more money than necessary.

Inter-department Working Relationships

The personnel of some corporate aviation departments and small airlines tend to become isolated from other industry activities. A director or a maintenance manager may attend a few industry seminars and conferences, but the exposure of other personnel to new developments and to other operators' experiences often is less than adequate. Rotating assignments to attend training and safety seminars, followed promptly by having the attendees conduct in-house reviews or discussions of the seminar subjects, provides greater benefits in transferring industry experience to everyone.

In most aviation organizations, the level of education, specialized training and experience required to service and maintain increasingly complex aircraft, engines and components has elevated the status of maintenance personnel. Nearly everyone in aviation recognizes that maintenance technicians are key members of the organization and are as important to safety as pilots. Among the most serious problems now facing all operators are retaining highly experienced personnel and recruiting newly qualified maintenance technicians.

FSF safety audits have confirmed that organizations that deliberately foster an attitude of mutual respect among employees enjoy a higher level of morale. Increasing interaction between groups, such as pilots and maintenance technicians, is beneficial in increasing operational reliability and maintenance reliability.

FSF safety audits have confirmed that organizations that deliberately foster an attitude of mutual respect among employees enjoy a higher level of morale.

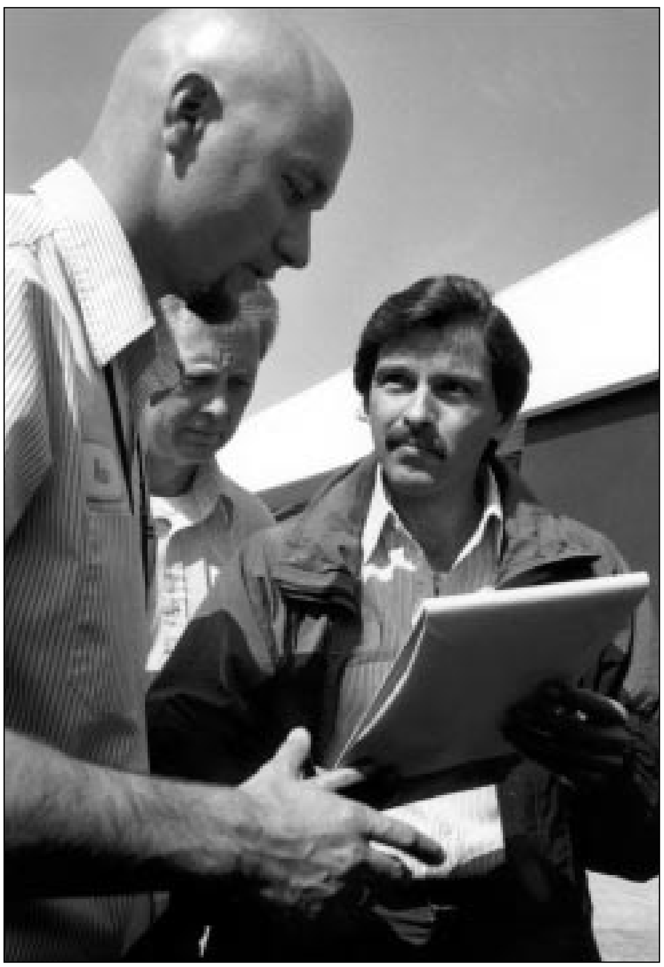
For example, including pilots and maintenance personnel in training sessions and/or periodic meetings has been effective in preventing minor disagreements from becoming major issues. Social activities in which pilots and technicians participate together further fosters positive interaction.

Large organizations may have more difficulty in combining functions such as training meetings or social activities. Where group size precludes combined meetings or training sessions, assignment of a few key individuals to participate on a rotating basis in each other's meetings can be effective in promoting cooperation. Procedures that require a face-to-face interchange during working activities — rather than just using written memorandums, forms and e-mail — have been effective in breaking down barriers. One corporate aviation department conducted a predeparture meeting for every flight — involving management, pilots, maintenance technicians, cabin attendants and dispatchers to discuss all facets of a scheduled flight. At the conclusion of the flight, the department conducted a postflight meeting to review the complete status of the aircraft down to the "chipped varnish on the decor" and any and all problems in scheduling or coordination of duties.

FSF safety auditors have observed situations in which one aggressive, opinionated individual set the tone for the relationship between different departments, usually to the disadvantage of everyone. In most instances, calling the situations to the attention of responsible managers was sufficient to prompt corrective actions.

Supervision and Delegation of Authority

Identifying qualified personnel for promotion to supervisory positions and management positions was found to be a nearly universal problem. FSF safety auditors also found that many companies do not make the best use of their available resources; they fail to provide evaluation/training opportunities to management candidates; responsibilities should be delegated to such candidates when appropriate.



Communication among aviation department personnel is vital to safety. (FSF photo)

Opportunities for training and evaluation also exist when the director/manager is absent for a planned period of time. Many operators simply leave the job undone when the person is absent, or the director/manager tells administrative personnel "call me if you have a problem" rather than delegate the authority and responsibility. FSF safety auditors believe that the high-tech aviation environment is providing fewer opportunities for such management training and succession planning than in the past. This issue requires industrywide attention.

Many FSF safety audit reports have included a recommendation to incorporate a program of formal delegation of responsibilities and the authority to act, during every absence of a director, manager or supervisor. Such a program gives both the employee and the company an opportunity to evaluate each other and to consider a possible promotion without making a long-term commitment.

Policies and Procedures

Policies and procedures are the basic guidelines for any organization. Without specific policies, an organization cannot develop the required SOPs for ensuring that operations are producing the desired results. After policies have been established and SOPs are written in the various operational manuals, the organization must establish methods for ensuring that personnel comply with the policies and procedures. Policies and SOPs must be reviewed periodically and updated when necessary. Ongoing safety surveillance and periodic safety audits of the organization will help management to determine the effectiveness of procedures and practices.

Manuals

Manuals set forth the priorities and goals of the organization, and specify the methods to be used by the various units in supporting them. Manuals document the organization's policies and procedures with which employees are expected to comply. Manuals also provide the standards to which actual practices can be compared. In conducting a safety audit, each auditor must become familiar with the organization's policies and procedures — in manuals and other documents — before attempting to evaluate and analyze the organization's practices. A well-organized, unambiguous and comprehensive manual — understood and accepted by the organization's personnel — not only minimizes the likelihood of mistakes resulting from lack of guidance, but also provides protection to the organization in the event of litigation arising from an operational anomaly.

FSF audit teams have reviewed manuals ranging in quality from outstanding to useless. Recent experience reflects significant improvements in the material contained in flight operations manuals, maintenance-policy manuals and cabin service manuals of most operators. In particular, FSF safety auditors have found improvement in manuals used by corporate aviation departments.

In reviewing policy-and-procedures manuals, FSF audit teams have found that a common fault is the tendency to try to cover every detail of the organization's operation. The result is that manuals become bulky, cumbersome and difficult to understand.

Editorial style also is a factor in the effectiveness of manuals. Some manuals are vague and ambiguous, and often use terminology such as "the pilot should" or "the maintenance technician should." This writing style leaves doubt, and presents a risk of error or omission in what might be critical functions. FSF audit reports have encouraged operators to develop and publish procedures that state "who does what."

One airline's manuals were found to be confusing — as if each part of the organization had written its portion without regard to the others. Overlapping procedures were not coordinated, and there were conflicts and omissions among departments.

One serious deficiency was identified during the FSF safety audit of an airline's emergency evacuation procedures for pilots and flight attendants. The flight crew operations manual and the cabin crew operations manual had been prepared by separate offices and had not been coordinated adequately. While comparing the two manuals, the FSF audit team discovered a conflict in duties that might have resulted in a failure to perform certain critical steps of an emergency evacuation. Because the emergency-procedures training of flight deck crews and cabin crews was conducted separately, these conflicts had not been recognized by the instructors, flight crews or cabin crews. When these conflicts were identified, the company took immediate steps to correct them.

Operations manuals are not mandatory for corporate aviation departments operating under U.S. Federal Aviation Regulations (FARs) Part 91; nevertheless, most corporate operators have developed and published policy-and-procedures manuals tailored to their particular operating requirements. Others have purchased basic "boilerplate" manuals (containing typical wording) but have neither modified the contents to meet their operations nor operated in compliance with the manual. These types of manuals do not provide realistic guidance to aviation department personnel, and they undermine essential operational discipline.

FSF audit teams have found procedures — used on a daily basis — that evolved from experience and seemed appropriate but were not documented in the manual.

Some companies may begin with good, relevant procedures but do not revise their manuals to account for changes in personnel, organization, operating limitations, type of equipment or managerial philosophies. FSF audit teams have found procedures — used on a daily basis — that evolved from experience and seemed appropriate but were not documented in the manual. Policies and procedures in the manual must be in agreement with those actually being used. All departments should review annually their policies and procedures to ensure that the desired practices, procedures and regulations are in compliance with each other. Manuals should be a loose-leaf type and include a method of ensuring that revisions are received and recorded. Key to tracking required changes is the recording of deviations and waivers to the policies and procedures, and an annual review to determine the effects on the organization. If changes are warranted, they should be made in the manual.

The Foundation audited one organization with an operations manual and a maintenance-policy manual that had not been revised in 11 years. During this time, one aircraft referred to in the manuals was removed from the inventory; another aircraft had come and gone without ever being referenced in the manual. The organization was operating jet airplanes, but the manual still contained references to piston-powered aircraft.

Risk Management

The increasing use of leased aircraft and contract crews has exposed many operators to nonstandard flight deck configurations and system differences among aircraft in their fleets — as well as to differences in SOPs among crewmembers. Maintenance standards and approved programs also have been found to differ when leased aircraft are brought into the fleet. Some operators have not understood these differences and mistakenly have accepted the premise that another operator's approved standards will meet all of their own requirements and standards.

Corporate operators often receive requests to provide executive transportation that exceeds their in-house capability. To accommodate such requests, many organizations use charter operators. FSF audit teams have found, however, that although a corporate operator may have very high standards for its own pilots and equipment, the company often has no policy or method to assure that charter operators meet the same standards.

One corporation, operating a well-equipped aircraft to high operational standards, allowed personnel to be transported on occasion in marginally equipped aircraft. Another corporation, which had a requirement for considerable experience for its pilots, used a charter operation that hired relatively inexperienced pilots as captains and first officers.

Corporate operators must establish policies and procedures requiring inspection and approval of charter operators to ensure that they meet minimum standards equivalent to those of their own aviation departments. One of the more encouraging developments in the industry has been the charter-verification services now available for corporate operators. These services fill a major void in the corporate environment. Such services are designed to provide objective information to subscribers about charter providers that meet high safety standards.

The FSF Q-Star Charter Provider Verification program, for example, provides the following benefits for subscribers: convenient access to a database of current information on the verified aircraft and verified pilots of Q-Star charter providers; assurance that the charter providers have received objective on-site verifications by specialists using conservative FSF standards and guidelines developed from current industry best practices; a significant reduction in cost in terms of staff time and resources expended to conduct individual charter provider verifications or external safety audits; and a discount in program fees for FSF members. Charter providers receive assurance of an objective and practical verification, are recognized for meeting standards that are more conservative in some respects than regulatory requirements and may avoid repetitive inspections by a variety of independent agencies.

Corporate operators must establish policies and procedures requiring inspection and approval of charter operators to ensure that they meet minimum standards equivalent to those of their own aviation departments.

Although the corporate segment of the aviation industry has a good overall safety record, prudent risk management requires limiting the number of key executives traveling on the same airplane. This principle has been overlooked by many corporations. Some corporations tend to do just the opposite, intentionally using the aircraft as a mobile conference room for a group of key executives. Several accidents have demonstrated the risk exposure; entire management teams have been lost.

An even greater exposure to risk exists during ground transportation prior to the flight or following the flight. Some companies, which had a policy limiting the number of key executives on the same aircraft, would transport several key executives from different aircraft in the same limousine.

One corporation had a strict policy of not flying certain key executives on the same company jet airplanes. Nevertheless, during the FSF safety audit, two jet airplanes transported the six most senior executives to an airport. The six executives then boarded a less-sophisticated, piston-powered aircraft and were flown together to a remote unimproved landing strip, where they all boarded the same bus for a trip over a local mountain road. The Foundation recommends that companies evaluate risks and establish a strict policy relative to the number and classification of key executives who may travel together in any aircraft or ground vehicle.

Minimum Equipment Lists

The minimum equipment list (MEL) provides airlines and other aircraft operators worldwide with a means of knowing that they could operate their aircraft within controlled parameters, even with some components inoperative, by meeting certain additional limitations or restrictions. Technical representatives of the manufacturer, regulatory authorities and aircraft operators cooperate in developing a master minimum equipment list (MMEL) for each new aircraft. The MMEL covers the equipment, systems and components that the manufacturer has incorporated into the aircraft at the time it is certified and establishes the limitations for continued operation. The individual airline or corporate operator then can apply to the regulatory authorities for approval of an MEL, which incorporates the MMEL but is tailored to include the auxiliary equipment, systems or components that were installed for the specific needs of the operator.

Safety can be affected adversely if procedures are not closely monitored and if restrictions are not observed. The problem most often found among airlines is multiple open MEL items — that is, inoperative systems or components for which repairs have not been accomplished — which go uncorrected for too long a period. FSF audit teams found that some pilots-in-command did not take the initiative to demand prompt corrective action. At one airline, the FSF audit team found several instances of violations of the MEL provisions that resulted in confusion between the flight crew and maintenance staff.

As more sophisticated electronic systems and equipment are installed in an aircraft, the MEL becomes more complex. Many pilots and maintenance technicians lack a clear understanding of the interrelated functions of these complex systems and the intended application of the MEL provisions. A simple, yet mandatory, part of the MEL procedure calls for installing a placard that says “INOPERATIVE” on the affected switch, control, instrument, etc., on the flight deck. This regulatory requirement has been enforced loosely or has been ignored by several operators, which resulted in aircraft being operated outside MEL parameters. Specific training of flight crews and maintenance personnel, covering the use and application of MELs, should be conducted by operators to ensure compliance with technical requirements and regulatory requirements. Many corporate operators contract for the development of their MEL manuals and include a chapter on the essential training needed for pilots and maintenance technicians.

Since MEL components can affect and do affect the operational capability of the aircraft, coordination between flight dispatch, pilots and maintenance functions in monitoring MELs must be ensured. In many instances, records of the current status of the MEL items are not available in the dispatch office for use by the pilots and the dispatcher to plan flights. For example, pressurization items or instrumentation items may restrict altitude; fuel-system items may restrict range and reduce available alternate airports; anti-skid items may restrict runway performance. Application of proper compensation factors established by the MEL ensures that safety is maintained.

In one situation, the FSF audit team found that an aircraft should have been restricted to visual flight rules (VFR) because of an instrument malfunction, but the aircraft was operated for several days under instrument flight rules (IFR). Such practices are unsafe and must not be condoned. Management must be alert to any unintentional, implied or perceived pressure, or evidence of complacency, in the administration and control of MELs.

Most corporate operators have approval for use of an MEL in their operations. Application for approval of an MEL under FARs Part 91 is optional, but without an approved MEL, all equipment is required to be operational at all times. The use of an approved MEL in a corporate operation should be viewed as a beneficial tool, not as a restriction.

A basic difference between Part 91 and Part 121/Part 135 operations under the provisions of an MEL is that of a deadline for corrective action of open MEL items. The preamble to the MMEL specifies that these limitations on corrective action do not apply to Part 91 operators, but most corporate operators have been found to be conservative in applying the MEL; items usually are corrected promptly.

In several instances, FSF audit teams noted that corporate operators deferred corrective action with a notation such as “awaiting parts.” An open MEL item reduces the backup capability or redundant-system capability of the aircraft, and each open MEL item should be considered the same as a potential aircraft-on-the-ground (AOG) situation. The Foundation recommends a system to ensure that the required part(s) are ordered expeditiously and that delivery is monitored closely.

Several instances have been observed in which operators continued to use a malfunctioning system although it had been entered on the MEL. The MMEL preamble says, “INOPERATIVE means that a system and/or component has malfunctioned to the extent that it does not accomplish its intended purpose and/or is not consistently functioning normally within its approved operating limits or tolerances.” This means that a system that has an intermittent fault or is operating outside its normal tolerance must be considered inoperative, placarded as required by the MEL and rendered safe by pulling circuit breakers, etc., as required by the specific maintenance procedures and/or specific operations procedures that must be accomplished before operation with the listed item inoperative. A comprehensive training program often is recommended to aid in understanding and properly using the MEL.

Communication

Perhaps the single most important factor in any organizational structure is effective communication. Virtually every audit conducted by the Foundation has revealed problems in communication. Indeed, communication deficiencies may be the impetus for a client to request an audit.

Effective Two-way Communication

Effective communication is particularly important in the aviation industry, where many functions cannot be carried out under direct supervision. Communication is effective only when the intended message is conveyed and understood, and produces the desired result.

Virtually every audit conducted by the Foundation has revealed problems in communication.

For example, management that issues edicts and directives from the top down is not benefiting from the knowledge and experience in the lower levels of the organization. This has been a chronic problem in many organizations, and its remedy requires ongoing management awareness and attention. All too often, the upper levels of management do not know how their organization is functioning because they have not succeeded in establishing effective two-way communication.

FSF audit teams have found many examples where written communication was not understood or interpreted as intended by the writer, thus confirming the need for a continuing review of all written material for clarity.

Benefiting from Subordinates’ Suggestions

The director of one airline operations department told FSF safety auditors that he assembled all available chief pilots for a meeting at least once a week but never received any suggestions from them. During subsequent confidential interviews with each chief pilot, the FSF audit team was told repeatedly that the director had not implemented any of their suggestions. The chief pilots also said that if they initiated any direct information exchange with the other chief pilots, the director accused them of attempting to undercut his authority. The line pilots also said that the director did not accept any idea unless he could make it appear that he had originated the idea. He wanted all communication between chief pilots to be in writing and to pass through his office “so

I know what is going on." His procedures were stifling intradepartmental communication. This department had an extreme communication problem, and the director did not recognize it.

Effective communication requires that managers and supervisors listen to the people who report to them. During interviews, FSF audit teams often heard complaints from employees about not receiving any response to their suggestions; therefore, they saw no use in making further suggestions. Experience has shown that more than half of all problems identified by FSF audit teams already had been identified by employees, but no action had been taken to correct the problems.

The Foundation frequently has recommended that a formal suggestion program be established and that each suggestion from an employee be acknowledged. Each suggestion should be given an objective evaluation and the submitter should be advised of the results of the evaluation. If the idea is accepted, the submitter should be advised when action will be taken. If the suggestion is not accepted, the submitter should receive an objective and courteous explanation of the reasons for the rejection. Every employee is entitled to a response to each suggestion, ideally in writing. This provides a record of the proposed action and the means for a manager to review how effective the unit has been in carrying out its commitments.

Morale Issues

Morale has been a significant factor in every safety audit that the Foundation has conducted. In some audits, high morale was evident in all aspects of the employees' work. In others, morale was so low that it produced an adverse effect on safety and efficiency. Morale also was found to vary in different groups within the same organization. For example, pilots' morale was acceptable, while maintenance technicians' morale was very low, or vice versa.

Communication as a Factor in Morale

During confidential interviews, the underlying factors involved in the level of morale often would surface. FSF audit teams repeatedly heard that the inability to effectively communicate with upper levels of management, and the failure of management to carry out commitments, were two significant factors in low morale.

The nature of aviation activities demands that only above-average performance, and near perfection, be considered acceptable. While employees may understand this, the FSF audit teams often found that a client's employees believed that they were "taken for granted" or "not appreciated."

FSF safety audit findings indicate that companies that have a program to recognize and publicize the individual contributions of employees enjoy a higher level of morale, less employee turnover and reduced absenteeism. The successful programs usually are not financially significant, and more importantly, they provide a means for recognition among one's peers, with resultant strengthening of self-esteem.

Personnel undergoing a safety audit typically are receptive to suggestions based on the experiences of others. (FSF photo)

The FSF safety audit teams frequently have observed the beneficial effects of providing a receptive ear. Many times at the end of confidential interviews, employees said that, for the first time since they joined the company, someone had taken the time to listen to their concerns. Although the interviewees were aware that, because of the confidentiality of the interviews, the team members could not help them individually, they indicated very frequently that they felt better after having had the opportunity to discuss problems and issues. FSF audit teams have seen examples where beneficial effects of the interview sessions were evident in the improved attitude and morale of certain individuals during the remainder of the on-site visit.

All aviation personnel benefit from participation in technically oriented associations or professional organizations, which bond people through their common expertise and professional pride. Many airlines and corporations also have developed programs that utilize in-house resources for input to their managerial, operational, maintenance or promotional policies and procedures. Examples include safety committees, professional standards committees, quality groups, speakers' organizations and participation in community projects. The Foundation has found that companies providing strong support for such groups enjoy better working relationships and higher morale within the entire staff than companies that have no such support. The support must be highly visible and ongoing to be successful.

Employee Relationship to the Corporation

The unique relationship of an aviation department to an overall corporate structure — in which the airport and flight operations facilities are isolated from most other corporate facilities — has been a strong factor affecting morale and perception of job security among aviation department employees.

Poor morale was cited as a major problem within the aviation department of one multi-national corporation. One of the reasons was that some employees at the airport were not included in the normal personnel department functions, and they also were unaware of their benefits and privileges under the corporate policies. Aviation department management had overlooked this aspect of their managerial duties. Management had focused only on engaging employees in productive work and thereby contributed to poor morale.

Coordinated Safety Programs

The Foundation has encouraged formal safety programs for many years. FARs Part 119, issued in 1996, requires every U.S. airline operating large aircraft to have an identified director of safety and a safety program. The FARs are not specific, however, in defining how a safety department is to be organized and operated.

Organizing Safety Activities

The safety organizations of airlines and corporate aviation departments have been found to vary from well-organized independent departments — staffed with qualified safety personnel reporting directly to high levels of management — to no safety organization at all. The Foundation has encountered safety departments that were only "paper" organizations with minimal effectiveness.

Solutions to safety problems in one area could be contributing to a problem elsewhere.

A key factor in developing an effective safety program is a positive commitment by senior management. Many corporate operators publicly have confirmed this commitment by including a preface page to the aviation department's flight operations manual, clearly stating the corporation's support of the policies and procedures in the manual and emphasizing the authority and responsibility of the pilot-in-command in decisions regarding the operation, delay or cancellation of a flight.

A coordinated safety program requires that one office be responsible for the overall administration and direction of safety activities throughout the company, with specific procedures for coordinating safety-related activities among affected units or departments. Some companies assigned safety personnel in maintenance, flight operations, cabin services, ramps and terminals but were unaware how much the activities of one department interrelate with safety and affect safety in another department. Solutions to safety problems in one area could be contributing to a problem elsewhere. The sharing of safety-related information in a coordinated safety program contributes significantly to an organization's efficiency and reduces duplicated activities or uncoordinated activities.

Accident/Incident Investigation

An essential aspect of a good safety program is an accident/incident/anomaly-reporting system that investigates all abnormal/emergency in-flight events or ground events. Some operators neglect investigations and follow-up activity if no damage or injury occurred in events, and ignore "the accident that almost happened." Such an occurrence was discovered during an FSF safety audit of a large airline. A taxiing wide-body jet left the paved surface and came within a few meters of going over an embankment because of loss of brake hydraulic pressure. Prompt action by a crewmember to restore hydraulic pressure averted a major accident. Because there was no damage or injury, the occurrence was not investigated.

Such a situation — in which all the participants and witnesses are available, none of the data are lost or distorted by subsequent damage and no individual is personally at risk — can be an excellent source of potential safety improvements. All such occurrences should be investigated and analyzed fully, not to find fault, but rather to determine the contributing factors and to recommend actions to preclude similar occurrences.

One international company's employees were so reluctant to report any incident for fear of recrimination that the Foundation recommended a well-publicized internal "immunity" program for all involved parties — unless there was evidence of outright fraud or deliberate negligence — to obtain information about incidents and unsafe situations. The recommendation was presented to the chief pilot, who said, "I expect all pilots to report their errors to me, and then I will determine their penalty." Such management philosophies are counterproductive in promoting safety. Leading aviation organizations currently foster an environment of non-attribution for reported operational anomalies.

Usually, multiple contributing factors are involved in an accident/incident. The difference in whether a situation results in a minor incident or in a major accident can depend on the last link in a long chain of events. The events that contributed to each situation, even though they may not have resulted in an accident, should be investigated and analyzed, and the information should be distributed to all parties who potentially could be in a similar situation. Effective communication, along with objective and thorough investigation, often are the keys to preventing accidents/incidents.

Identifying and Eliminating Root Causes of Safety Problems

A vital part of the corrective actions or preventive actions by any safety organization is the identification of basic contributing factors to each event and the dissemination of information to all affected parties. The Foundation has observed that the most effective safety organizations have a system of bulletins and routine information, which are distributed directly to individuals in each affected group. Nevertheless, a weakness commonly found in such bulletin systems is in maintaining current information. All bulletins should have an effective date as well as an expiration date.

An effective program among corporate operators is commonly referred to as a pilot information file (PIF), a temporary repository for current information of vital interest to flight crews. Items logged into the PIF should not be considered permanent. Each item should have an entry/effective date and should be posted with a removal date. Once an item in the PIF is transferred to a permanent record — i.e., flight operations manual, SOPs, etc. — it should be removed from the PIF. Documents placed in the PIF should follow conventional practices for designating their period of validity, such as a letter valid only for 30 days to 60 days, a memorandum valid for 30 days maximum, etc. A well-developed and correctly administered PIF program can be a valuable communication tool.

An example of identifying the underlying causes of a problem was found during an FSF audit of an airline's ramp environment. One busy station had experienced a large number of aircraft dents and damage by ramp vehicles. When the accident/incident reports were reviewed, FSF safety auditors noticed that several aircraft had been struck by belt-loaders that had been driven to the cargo doors without coming to a complete stop before approaching the aircraft, contrary to published ramp procedures.

The Foundation has observed that the most effective safety organizations have a system of bulletins and routine information.

While observing the ramp operations during a peak-activity period, FSF safety auditors found that only two belt-loaders were used to load nine airplanes. Further review revealed that a third belt-loader was undergoing repair and three others had been parked for periods of from three weeks to five months waiting to be repaired. In an attempt to get flights out on time, ramp personnel were driving faster than the posted speed limit and were not complying with the procedure for stopping and slowly approaching an aircraft.

When the FSF safety auditors visited the repair shop for ground-support equipment and spoke with the two maintenance technicians working there, they found that the shop staff was attempting to maintain more than 100 vehicles. The maintenance technicians said that they usually prioritized their maintenance schedule in accordance with the amount of pressure from various equipment users. They said that the ramp supervisor never had told them that more belt-loaders were needed during peak periods. No systematic preventive maintenance program had been established for any of the belt-loaders. Although these two maintenance technicians were conscientious workers, they could not maintain so much equipment.

The airline's management had failed to recognize that inadequate maintenance capability in this single, small and remote shop was contributing to equipment damage and potential injury on the ramp, as well as significantly affecting on-time operation.

One of the FSF audit team's recommendations was to assign the highest possible priority to returning all belt-loaders to service and then to emphasize the reasons for the established ramp procedures. A second recommendation was to increase the overhaul capabilities and maintenance capabilities of the repair shop for ground-support equipment, either in-house or through contract agencies.

Safety Organizations and Personnel

The responsibility for monitoring safety at some organizations has varied from very effective, well-organized safety departments reporting directly to senior management, to one person being assigned as safety officer as a collateral duty to other primary responsibilities — without a budget, resources or training to carry out safety responsibilities.

When the FSF audit team attempted to identify the safety organization in one corporate aviation department, the chief pilot said, "Well, I guess I'm the safety officer."

The safety audit progressed without finding a safety bulletin board or any safety information resources such as publications or videos. No one ever had attended a safety workshop or seminar, and FSF safety auditors wondered if the chief pilot might be occupying the safety officer's space in an organizational chart just for the benefit of higher management. The Foundation has been aware of several instances in which such a casual assignment of this important function has led to false expectations by corporate management, and blame has been assigned unfairly when an accident occurred.

A chief pilot is not necessarily qualified to be an effective safety officer. In a small aviation department, the chief pilot might be an effective monitor of safety, if the time and training are available. A much better situation is to have a defined safety program handled by someone who receives safety training and is allocated specific time and a budget for safety activities. Senior management must support actively and visibly the safety organization's activities if the activities are to be effective.

Safety personnel also need training in management skills to be most effective. An effective safety department or safety officer is able to establish comprehensive safety awareness programs by developing a reputation for integrity and gaining the confidence of workers and management, without creating opposition or resentment. The most effective safety personnel have, first of all, a genuine interest in promoting safety and a willingness to work hard. They must be trained in safety analysis, accident prevention, accident investigation, safety management, etc. They must develop an objective philosophy of "what if" when looking at the many situations involving the aviation activities. Safety is a career that can be rewarding, stimulating and sometimes frustrating, but never dull.

FSF audit teams have seen aviation departments that rotated the responsibilities of the safety officer among pilots. In one company, the responsibility was assigned for a two-year period, then passed to another pilot. One of the deficiencies identified in this procedure was that by the time individuals were trained and experienced sufficiently to feel effective in the safety program, they were reassigned.

During confidential interviews, FSF safety auditors learned that some safety personnel considered their responsibilities to be a chore rather than a challenge. Invariably, these people did not believe that they had the commitment or active support of senior management; they were ineffective and unable to correct identified safety problems; and they lacked an adequate budget. Quite often, these safety professionals were unable to participate in safety seminars, industry activities or courses to keep current with changes in aviation.

A unique and highly effective tool used by some airlines in promoting flight safety is the routine analysis of flight data for deviations from normal practices and procedures. The Foundation has advocated the wide adoption of flight operational quality assurance (FOQA) programs. FOQA uses quick-access recorders (QARs) to obtain data for many flight parameters, including data captured for accident-investigation purposes by the digital flight data recorder. The QAR data are retrieved during routine station stops and processed by computer software to identify any deviations or exceedances from the expected flight parameters.

FOQA programs have been highly successful among the airlines that have adopted them. Key to the success of FOQA is confidentiality of the data and protection for the crewmembers from any punitive action based on the data. Typically, identifiable data can be accessed only by the safety officer and data use is restricted to revising training programs, improving operational practices, coordinating with air traffic control (ATC) facilities, etc.

Corporate Safety Awareness

All successful aviation organizations recognize that safety is essential to an effective and efficient operation.

The Foundation has found that most senior executives believe that they are promoting the necessary safety programs within the company; in reality, they may be doing little or nothing in direct support of the safety program. Sometimes difficulty arises in determining how effectively the safety program espoused or mandated by this level of management is functioning in actual practice.

An effective safety program must work to eliminate incidents, which invariably increase the risk of accidents. With proper emphasis on the importance of safe practices and programs from each manager and supervisor, a genuine concern for safety should permeate the organization. FSF audit teams seldom found such environments.

In some organizations, the FSF audit teams found that senior management did not support actively their safety personnel. While speaking with the president and CEO of one airline, FSF safety auditors found that he did not know personally anyone in the safety department although administratively the department reported directly to him. This contributed to safety department personnel's feelings of frustration and ineffectiveness.

Visible participation by senior management is invaluable in building the prestige of, and respect for, the safety department.

Conversely, FSF audit teams have observed other organizations in which the CEO occasionally attended safety meetings to show active support for the program. One highly motivated and effective executive vice president was a very active chairman of the company's safety-promotion committee. Such visible participation by senior management is invaluable in building the prestige of, and respect for, the safety department.

One reason for management ineffectiveness is that upper levels of management may not realize what is required, in both manpower and funding, for an effective safety program.

Another reason is that the rank-and-file employees do not see sufficient evidence of dedicated personal interest among the higher levels of management in the specific activities necessary to maintain a safe working environment.

For example, the president of one airline was a strong advocate of safety programs at all levels. Nevertheless, the FSF audit team found the vice presidents and directors in the operating departments to be involved heavily with the airline's expansion and the introduction of a new type of aircraft. Safety responsibilities were delegated to a single individual in each department. Interviews with supervisors and line employees showed that they had perceived little emphasis on safety policies, procedures or practices, but there had been much information and pressure to introduce the new aircraft into service.

FSF safety auditors saw considerable evidence throughout the airline of the reduced emphasis on safety practices. As an example, while FSF safety auditors spoke with a maintenance supervisor in the hangar, they observed two hoses that were not in use, but were releasing water across the floor. Maintenance technicians stepped on the hoses or over the hoses, and in the water on the floor, while they worked on an airplane's wing flaps. At the same time, FSF safety auditors also observed three maintenance technicians working on the horizontal stabilizer of a wide-body airplane without any guard rails on their high stand.

As the supervisor discussed the pressure of the work, he reached back and struck a match on the hangar wall (to light a cigarette) just below one of the many "NO SMOKING" signs in the hangar.

Apparently, the emphasis on safety had deteriorated through each level of management to the point that the supervisor was not aware that he, or his workers, were involved in unsafe practices. Yet, the CEO believed that the airline's first priority was safety.

Unless all levels of management are involved personally in ensuring that safety practices and procedures are maintained, safety gradually and insidiously begins to erode.

Overall appearance — as well as equipment, documents and placards — are assessed during an aircraft inspection.
(FSF photo)

Management and Employee Relations

Everyday relationships between the managers and line employees, and the management styles of key executives, have a profound effect on employee attitudes, morale and their interest in safety. Although there may be differences of opinion and opposing forces, such as those that occur during industrial disputes, negotiations, etc., the Foundation has found that a properly structured and adequately staffed safety department can function effectively in these environments.

During an FSF safety audit of an international airline, the pilot group was negotiating a new wage agreement with management. Although relations were strained somewhat between management and pilots, the professional posture of the personnel in the safety division and the respect accorded the safety programs by all parties enabled safety programs to continue functioning.

Very few organizations make the most effective use of employees' safety recommendations. Of all the items affecting safety that typically are found during an FSF safety audit, the majority usually are known to someone within the organization; they had been identified for supervisory management and lower-level management, but often information had not reached effectively the attention of higher management or had not generated corrective action. A comment often heard in confidential interviews was, "What is the use, they never do anything about it anyway." Frustration with such failures to effect change must be of concern to management.

Another example involved an international airline. Many flight attendants had reported that the overloading of galley service carts was unsafe, but they were unable to convince management to end the practice. The FSF audit team learned that maintenance personnel had determined that the deterioration of aisle floor panels and excessive maintenance of the service carts were caused by overloading the carts.

During a landing, a service cart disengaged from its floor-locking device in a wide-body airplane and traveled halfway down the aisle before striking a passenger-seat armrest. The seat was unoccupied, and no one was injured. On other flights during the FSF safety audit, cabin crews were observed to be struggling to push the overloaded carts in the aisle when cabin service was begun during the climb to the initial cruise flight level.

No one in management seemed to recognize that by exceeding the cart manufacturer's weight limitations by more than 150 percent, unsafe conditions were created, the risks to passengers and cabin crews were increased, and the cost of maintenance and operations were increased. Instead, management believed that the airline could expedite service and increase duty-free sales by increasing the load on the service carts.

Personal involvement in safety programs and personal compliance with safety rules, regulations and practices by all levels of supervision and management are essential to developing good safety habits in all employees. One aviation department had prominent signs that said, “Please pick up FOD [objects that can cause foreign-object damage].” Nevertheless, during one week of on-site observations, FSF safety auditors never saw anyone pick up anything. Supervisors, managers and vice presidents were observed to step over debris without picking it up and placing it in the empty, conveniently placed refuse containers. The time-proven principle of setting an example was ignored.

Internal Surveillance and Analysis

A critical element in safety is conducting internal checks and monitoring functions to assure compliance with the published standards. Very few of the operators audited by the Foundation have had a totally effective internal audit program, and most had no program at all. Of those having an internal audit program, a common weakness was insufficient support of the internal activities by higher levels of management. Although deficiencies were identified and reported, these surveillance-and-analysis groups lacked the authority and support of upper management to initiate prompt and effective corrective action.

FSF audit teams take advantage of internal audit reports if the reports exist, and conduct a follow-up review of previously reported deficiencies to assess the effectiveness of the program. Often, items that were reported several times by internal audits were not corrected. When these same items were brought to the attention of upper management by the “outside” FSF audit team, however, the deficiencies received prompt attention. This suggests that more authority and support must be given to the internal audit process.

Many operators lacked any documented policies or procedures for investigating the errors of maintenance technicians or accidents/incidents that occurred in the maintenance area.

Many operators lacked any documented policies or procedures for investigating the errors of maintenance technicians or accidents/incidents that occurred in the maintenance area. One large airline had a procedure for investigating an accident, but only if someone was injured and required hospital treatment. In some instances, FSF safety auditors learned that such investigations were perceived as only a procedure to determine who was to be blamed and subsequently fired.

Every aviation organization should develop a formal accident/incident investigation procedure with representatives from the affected departments and management, as well as the representative of the safety program. These procedures should be published and include an analysis of findings and actions to prevent recurrence of similar incidents, regardless of the severity of the original occurrence.

Training

The Foundation has observed continued improvement in the training of flight crews. Pilot training syllabuses usually are modified to incorporate the latest procedures for approach-and-landing accident reduction, preventing controlled flight into terrain, and coping with such phenomena as wind shear, microbursts, icing, etc., as knowledge of these hazards expands. Simulator training is used extensively by airlines and corporate aviation for those aircraft for which simulators are available. Line-oriented flight training (LOFT) has been incorporated into many airline and corporate aviation department curricula. More companies are including periodic line checks as a fundamental component of the continuing evaluation of flight crews. Many organizations include the various concepts of CRM as a part of their training programs. While training is improving, human error continues to contribute to most aviation accidents.

Training of flight attendants also has continued to improve. Many airlines have added cabin mockups or realistic cabin simulators, some with motion capability, to their training capabilities. Increased emphasis is placed on flight attendant training to cope with in-flight emergencies and ground emergencies, although FSF safety auditors have found that passenger service and onboard sales also have received considerable attention. The Foundation has found that most corporate aviation departments that utilize flight attendants are providing them with initial training and recurrent training to cope with emergencies. One important development has been mobile training contractors that conduct training near the home bases of corporate operators. This greatly facilitates regular recurrent training of flight attendants.

FSF audit teams also have observed an increase in emergency training and evacuation drills for executives and other regular travelers on corporate aircraft.

Maintenance and Engineering

The Foundation has found that airline maintenance departments and corporate aviation maintenance departments operate airworthy aircraft. The formal training of maintenance personnel is often less frequent when an airline holds the maintenance certificate and not all technicians are required to have the equivalent of an airframe license or powerplant license to work on the aircraft or its components. FSF safety auditors also found that although maintenance personnel in corporate aviation departments are well-qualified, frequently there is an inconsistent pattern of recurrent training.

Although aviation maintenance technicians are exposed to more health hazards than ever before in the course of their normal work, very few of the audited operators have a program of medical-monitoring examinations for maintenance personnel. Turbine aircraft present potential problems to hearing; higher work stands increase the risk of injuries from falls; and hazardous chemicals threaten health.

From a business perspective, operators have a threefold interest in assuring that their maintenance technicians' health remains good:

- The employer has a financial investment in the highly trained maintenance technician;
- The proper functioning of the physical senses of maintenance technicians is critical to the performance of their duties; and,
- There may be liability to the employer if the maintenance technician fails to perform properly because of a physical deficiency.

Maintenance technicians should receive an appropriate health assessment at least every 24 months. Those engaged in aircraft engine run-up operations or taxi operations should receive annual health assessments.

Maintenance technicians should receive an appropriate health assessment at least every 24 months.

The importance of regular health assessments was demonstrated when a maintenance technician became unconscious while working inside an opened wing fuel tank. The initial assumption was that he had been overcome by residual fumes. From a medical examination, however, physicians determined that he had not disclosed a known condition that caused occasional fainting. This individual also conducted aircraft engine run-up checks and taxi checks. Under these circumstances, there was a safety risk for both the company and the individual.

The training of maintenance technicians has improved steadily; nevertheless, the standards of training lag behind those of flight crewmembers. Airline training is generally more thorough than corporate training because of regulatory requirements. Yet, FSF safety auditors have observed considerable variation in the stringency of airline maintenance training programs throughout the world. In several instances, the maintenance training requirements of non-U.S. airlines exceeded those of many U.S. airlines.

Recurrent training of maintenance technicians is probably the weakest link in aviation operations. Most operators take advantage of initial training offered by aircraft manufacturers, but many do not provide a regularly scheduled recurrency program for their maintenance technicians.

Avionics training and electronics training are areas most in need of improvement. Modern aircraft have more electronic systems than ever before, and maintenance technicians trained in the 1980s and 1990s need recurrent training to be updated technically. The lack of recurrent training contributes to a lowering of overall quality and efficiency and to resultant economic penalties, including the increased risk of an accident/incident.

Training for maintenance technicians in aircraft engine run-up operations and taxi operations has been less inadequate at many operators. FSF safety auditors have observed that much of this training is conducted by maintenance personnel and does not include adequate emergency-procedures training. Where possible, this training should be provided in the aircraft simulator and training captains or check pilots should conduct periodic recurrent checks of the maintenance technicians to ensure proficiency. The Foundation recommends that two qualified individuals be on the flight deck whenever the aircraft engines are operated.

Engine run-up operations in helicopters pose some special problems, because any operation of the rotor system above idle speed can result in a lift-off. One operator suffered a costly ground accident when the helicopter became light on the skids during a maintenance run-up and moved off the dolly. The Foundation recommends that engine run-up of rotary-wing aircraft be restricted to idle power when an engine is being operated by maintenance technicians.

Management Training

Most large corporations have programs to provide management training and career-advancement opportunities for their employees. The aviation department, however, sometimes is not included in these programs. In some instances, FSF audit teams observed that the physical isolation of aviation personnel from other corporate facilities was the primary reason. In other instances, the aviation department management was aware of company resources to train employees but neglected to urge employees to take advantage of them. While most airlines provided adequate technical training of employees, FSF audit teams have learned that the same manager who demands a high level of technical training often overlooks managerial training of pilots, maintenance technicians and employees who are moving into supervisory positions or management positions. Management training is essential to develop and maintain competent supervisory and management personnel, and aviation managers should strive to place eligible individuals in programs sponsored by the corporation.

Contract Training

Nearly every operator audited by the Foundation has used outside contractors to provide training of pilots, flight attendants and maintenance technicians. In many instances, however, the operators tended to accept whatever the contractors provided on the basis that the contractors are "approved." From analysis and observation of actual training sessions, FSF safety auditors have found that the most effective training can be provided if the operator takes the initiative to provide constructive criticism and to require custom tailoring of the programs to suit individual configurations, circumstances and environments. Among the corporate aviation departments visited by FSF audit teams, there has been a definite improvement in tailoring training requirements to their actual flight operations.

FSF reviews of operator records and flight records frequently have pinpointed areas of weakness or repetitive problems that should have been addressed in recurrent training sessions. Outside training contractors may be unaware of an operator's specific problems and depend upon operators to keep them up-to-date on current problems and trends occurring in actual flight operations. The operator can benefit from interacting constructively with the training contractor to ensure maximum benefit from the training.

Flight Operations

Flight operations is the most visible aspect of any airline or corporate aviation department. Difficulty often arises in determining whether personnel comply with policies, procedures and practices, because many flight operations are conducted without direct supervision. This is particularly true of flight crews; therefore, procedures and practices must be well-developed. SOPs must be well documented, understood thoroughly and supported by the flight crews, who should be line-checked periodically to ensure that SOPs are being used. The incorporation of an active line/route check program — on at least an annual basis — is one indicator of a quality program.

Piloting Techniques

From observation flights, FSF safety auditors have found that some corporate pilots develop individual techniques and procedures that deviate from a company's established SOPs. Sometimes, this seems to have occurred without the pilot's awareness; other pilots apparently made unilateral decisions to develop their own techniques and procedures. The Foundation has recommended to many non-airline operators that jump seat line checks be conducted at least annually (as required by U.S. regulations for airlines) to ensure that SOPs are being used. Pilots selected to conduct line checks also should receive specific training to properly perform this function. A standardized line-check guide should be used by all check pilots. These line checks should not be conducted by a member of the flight crew.

In an operation that had converted recently from single-pilot twin-engine airplanes to two-pilot jets, FSF safety auditors

During several days or weeks on-site, many aspects of flight operations and ground operations are observed. (FSF photo)

observed that the two pilots were sitting side by side, but mentally and physically, they were operating independently. For example, each pilot would do such tasks as changing radio frequencies without coordinating with the other pilot; the pilot not flying (PNF) would acknowledge an air traffic control (ATC) instruction; and the PNF would reset the altitude alert without calling it to the attention of the pilot flying. Until the FSF audit team identified the lack of coordinated crew action, the pilots did not realize that their single-pilot habits and techniques were inappropriate and unsafe for a two-member flight crew.

Furthermore, since this operator sent only one pilot at a time to the manufacturer's facility for initial training and refresher training, the simulator instructor had no opportunity to identify or to correct the unsafe practices resulting from poor crew coordination. A proper check flight by the chief pilot or check pilot also could have identified this problem.

All pilots of major airlines, as well as those of nearly all corporate aviation departments operating turbine-powered aircraft, receive periodic training in simulators. Nevertheless, some commuter airlines do not have simulators, either because their fleet is too small to justify owning/leasing them or because a simulator has not been produced for the aircraft being used. Consequently, training is conducted in the line aircraft. Some of these training programs have been substandard. In one instance, the training period was interrupted on two consecutive days because the airplane was needed for a scheduled flight. Although the training check-sheet items finally were checked, the effectiveness of the observed training periods was questionable. At other times, shortcuts were taken in procedures or maneuvers, and crewmembers attempted to justify the shortcuts as necessary to reduce cost of operation or to complete the training period.

The most effective pilot training takes place when pilots participate as a full crew while using their organization's own checklists and aircraft-specific SOPs. Proper crew coordination is enhanced when all crews receive semi-annual line checks (at least annual line checks in corporate operations) from a standardization pilot. Observation flights with pilots trained under this concept showed that the well-managed, coordinated flight decks where each crewmember was in the communication loop contributed to the safe and efficient conduct of the flight.

Pilot Perception of Management's Intent

Published airline schedules expose the pilot-in-command to outside influences to complete the mission. Such influences may produce pressure that may be real or perceived. Management's attitude toward compliance with documented limits and procedures has been found to be a vital factor in supporting safety policy. Of vital importance, flight crews must be comfortable with exercising their professional judgment, even in situations where such actions do not support meeting a schedule.

Some operators have conservative operating standards and limitations published in company manuals, yet senior pilots and even supervisory pilots deviated from these procedures. When less-experienced pilots observe senior pilots operating outside the published limits, there is an inference that this is acceptable, or even expected. That management allows such deviations connotes their acceptance, results in a serious compromise of safety and undermines established professional standards. Management must not tolerate any deliberate deviations or exceptions to established policies, regardless of the seniority or experience of the pilot. Top management should meet with the flight operations department staff to insist on full compliance with published operating standards and limitations. Moreover, information in company manuals should be reviewed periodically to ensure that the information is current and appropriate.

Of vital importance, flight crews must be comfortable with exercising their professional judgment, even in situations where such actions do not support meeting a schedule.

During confidential interviews, FSF safety auditors have been told by corporate pilots that they have felt subtle pressure from some executives to complete flights under operating conditions in which the pilots were not comfortable. Situations were described where the executive would emphasize during each segment of the flight his need to be at a certain destination at a specific time. Some pilots said that they felt such pressures from some executives more than others, regardless of where the executives ranked in the organization. Most pilots had difficulty identifying why they responded to these subtle pressures.

No pilots said that they had been ordered to continue a flight after advising the passengers that such action was unsafe. Nevertheless, several pilots said that when they advised passengers that the flight would have to be interrupted because of malfunctioning equipment, they had been challenged as to why they could not continue with the remaining equipment. Some pilots conceded that they had continued operating with malfunctioning components when they were carrying certain personnel because they had learned from previous experiences that they would be challenged.

The very nature of corporate aviation exposes the pilot directly to the highest level of corporate management. Under these circumstances, a question may be perceived as an order. An expression of dissatisfaction from a CEO may be perceived as a threat to a pilot's job security. Because of the possibility of such real pressure or perceived pressure, the aviation department manual should contain a preface committing the support of the corporate organization to compliance with published operating standards and appropriate safety decisions made by the captain on the flight. This preface should have the written endorsement of the CEO.

Contract Pilots

Some airlines and corporate operators use contract pilots. These temporary employees tend to be highly experienced, but they may be more interested in getting the job done than in complying with company policy.

In one instance, a pilot, hired on a six-month contract, was using the SOPs of his previous employer, which differed considerably from those of the company for whom he was under contract. This was particularly detrimental to his employer, a small airline, because he was flying as pilot-in-command with newly qualified first officers. Because they usually did not fly with the same captain for more than one trip sequence, the first officers were not developing standardized flight procedures.

Contract pilots can provide the same levels of operational safety, efficiency and reliability as full-time pilot employees, if they are trained to their current client's procedures and standards. They should receive periodic line checks to ensure that they understand and comply with established policies and procedures, and that they are meeting the company's operational standards.

Cabin Services

Problems involving the stowage of carry-on baggage have become the most common complaint heard from airline flight attendants and many airline safety staffs throughout the world. Briefcases, handbags and computer bags carried by passengers also are a problem on corporate aircraft. Airlines and corporate operators should emphasize the importance of the passenger's responsibility for stowing properly all personal baggage before takeoff and before landing.

Maintenance and Engineering Record Keeping

The most consistent deficiency that FSF safety auditors have found in maintenance and engineering departments is record-keeping procedures and practices. Many operators have not provided their maintenance personnel with adequate training in completing the various maintenance and airworthiness records — especially in MEL-discrepancy management.

Most operators use computerized programs for their maintenance records. Some rely totally on the computerized programs for planning and alerting functions. Frequently, maintenance administrators do not perform any cross-checking or monitoring to assure that the computerized record is not flawed. The alerting system is thus subject to failure.

Despite improvements, instances still occur in which component limits (hour or calendar) are exceeded, usually because of operator carelessness in monitoring the "maintenance due list." Such mistakes emphasize the necessity for having someone monitor or cross-check to preclude overlooking an individual's failure.

The most consistent deficiency that FSF safety auditors have found in maintenance and engineering departments is record-keeping procedures and practices.

There is a tendency among corporate operators to rely on computerized records. Computer records are not acceptable to FAA as the total record-of-compliance with required maintenance; they must be supported by adequate data on paper or microfilmed data to substantiate the automated system entry.

Records showing compliance with U.S. airworthiness directives (ADs) have been the subject of much controversy as a result of FAA inspections during the past decade. In reviewing various operators' records of AD compliance, many entries have been found that would be judged inadequate under the current interpretation of the FARs. With aircraft being bought and sold worldwide, adequate records have become a serious international problem.

Conversely, some operators have a tendency to retain old methods of record keeping that usually require considerable paperwork, although newer, more efficient methods that use computers have been developed. Mergers, consolidations and acquisitions have created additional problems. Maintenance departments had considerable duplication and transcription of data from one record form to another, which multiplied the exposure to errors of commission or errors of omission.

FSF safety auditors identified — in maintenance-log entries and maintenance responses to pilot write-ups in aircraft logbooks — a tendency to link responsibility to a third party, such as "item referred to manufacturer, will be corrected when data and parts are available." Operators must recognize that the responsibility for airworthiness rests with the operator and that such entries are not a valid corrective action.

Maintenance Analysis

Another problem is swapping components for the purpose of troubleshooting. Although this is a common practice, operators have been cautioned that such swapping of components can lead to serious problems. If the component is faulty, it could cause associated components to fail. Legal liabilities and airworthiness issues could arise if a failure occurs after such a swap.

FSF audit teams also have found reviews of past records that revealed serious, chronic discrepancies of which managements were unaware. For example, FSF safety auditors found that on one airplane, an oxygen cylinder had been replaced 88 times in a 90-day period because of low pressure. A system leak was obvious; nevertheless, no one addressed the cause, only the symptom was treated. This indicated a lack of effective surveillance and analysis, a regulatory requirement for airline operations that can be useful for any operator. Computers and database software make trend analysis and tracking of related actions relatively simple.

Information Distribution

There is a lack of feedback to maintenance technicians about the effectiveness of their corrective actions. In corporate aviation departments and smaller airlines, a corrective action is usually to remove and replace a component. Although maintenance technicians may know immediately that a replacement was effective in correcting the symptoms observed, very seldom do they receive any feedback relative to the problem found with the faulty component.

In small organizations, the repair or overhaul of the component may be handled by a non-technical purchasing office in corporate headquarters. In a larger operation, there may be follow-up action by an engineering function or reliability function; nevertheless, as in the smaller organizations, information about the actual cause of a malfunction or a failure usually is not communicated to the technician. As a result, maintenance technicians never may know if their troubleshooting was valid.

Smaller organizations should establish a procedure to review the results of a component tear-down with the entire maintenance crew. In larger operations, the technical training staff should be included in the distribution of the findings of the reliability function, so that future training sessions or bulletins can inform the entire maintenance crew.

Evaluation of service bulletins and of modifications issued by manufacturers has been weak, particularly within small airlines and corporate operators. In several instances, information affecting flight operations was not coordinated with the manager of that function. In one company, an alert bulletin received by the maintenance manager had an operational limitation, but the limitation was not brought to the attention of the chief pilot.

With the exception of most large airlines, operators had no procedure to assure a coordinated analysis of service bulletins and to document the final action decision. A "paper trail" is becoming increasingly important, not only in the interest of good safety practice, but also in view of litigation and more stringent record-keeping requirements by regulatory authorities. Maintaining a computerized list that tracks the service-bulletin adoption/completion/rejection rationale is simple.

Inadequate Spare Parts

FSF audit teams discovered an increasing tendency for operators to introduce new aircraft with inadequate provisions for spare parts. This is true even for the simplest parts, such as wheel-and-tire assemblies. Although reliability of the current-generation aircraft and systems is generally good, the statistical projections of component reliability may be overly optimistic when compared with actual experience.

Inspection Quality Assurance

The use of quality assurance (QA) procedures — in which production workers, rather than designated inspectors, have primary responsibility for quality of the work performed — is increasing. While the Foundation has found the concept of QA to be valid, such procedures tend to reduce the authority of designated inspectors, who sometimes are restricted or are restrained from performing random checks or sampling checks of work in progress. To provide the proper checks and balances, the inspectors need more autonomy and authority to require specific checks or to require that specific operations be performed under their surveillance. The designation of required inspection items (RIIs), which always require an inspection by a second individual, is an important factor in this concept.

During confidential interviews, FSF safety auditors have found that inspectors are aware of some problems but have chosen to take the path of least resistance rather than confront a supervisor, unless the hazard is of serious consequence. Operators should ensure that inspectors observe and report any deficiencies or hazards in the workplace, and should require that the production supervisor take prompt corrective action when deficiencies are identified.

Under Part 91, the regulation applicable to many U.S. corporate operators, there is no requirement for an inspection function. Most operators have an effective system of checks and balances that uses senior maintenance technicians to double-check the work of others. Nevertheless, many of these operators do not have a documented system that mandates items that will be double-checked. The Foundation recommends that all maintenance departments develop RII lists.

During confidential interviews, FSF safety auditors have found that inspectors are aware of some problems but have chosen to take the path of least resistance rather than confront a supervisor, unless the hazard is of serious consequence.

Selection and Training

Many operators select inspectors primarily on the basis of seniority. Under some labor contracts, seniority is the sole basis of inspector selection. While experience is a factor, and should be a factor, in selecting the inspection staff, that one maintenance technician is the most senior does not necessarily make that individual the best qualified person to be an inspector. Another weakness is the lack of training for inspectors; only the larger airlines had effective training programs for newly assigned inspectors.

Experience has shown that some individuals make better inspectors than others. Innate curiosity, a tendency to be a perfectionist and the self-confidence to question another maintenance technician's work are a few of the factors in the makeup of an effective inspector. Industry studies of inspection techniques and individual capabilities have identified the importance of, and the difficulties associated with, the proper selection and training of inspectors. Specific physical capabilities required by the job, such as visual acuity, also must be considered. The Foundation recommends that operators establish a system of evaluation and selection by which maintenance technicians are promoted to inspectors. This system should include specific training, qualification and recurrent training for inspectors.

Quality Control of Outside Agencies

Many operators contract with outside agencies for various types of services for which they lack facilities or personnel. A common practice is for operators to use the services of certificated repair stations for component repair and to use approved training agencies for pilot training and maintenance technician training. Many operators have the mistaken impression, however, that this regulatory approval assures them of a given quality and standard of performance.

Many operators audited by the Foundation were not performing adequate surveillance of their contract vendors and suppliers. The development and operation of surveillance programs should be under the direction and control of the inspection/quality control function of the organization. FARs hold U.S. operators responsible for the airworthiness of their aircraft, including maintenance work contracted to an outside agency, even when that agency is an FAA-certificated repair station.

The reliability of certain components received by one FSF audit client was inadequate, and faulty workmanship had been discovered on components returned from a particular vendor. With the agreement of the operator, the FSF audit team visited the vendor's shop and conducted a brief review. The visit confirmed that this primary vendor had neither adequate equipment nor personnel to perform the contract work. The operator had been relying on the fact that the vendor was an FAA-certificated repair station, so the operator had not performed any direct surveillance or spot checks with its own inspection staff but was relying on the FAA surveillance. The FSF safety audit report included a recommendation that the operator establish a close surveillance system and a random sampling program to monitor vendor performance and quality control.

Providers of services such as ground handling, loading and fueling typically are not required to be certified or licensed although training of personnel is required, for example, to drive vehicles and fuel aircraft. Although the responsibility for these services rests with the operator, FSF audit teams have found that many operators provided no surveillance of such contractors. The competition among fuel-service providers is such that some fuelers were among the lower-paid, lesser-trained and, consequently, higher-turnover aviation personnel. As a result, the most frequently reported safety hazards were improper use of the safety devices provided for aircraft fueling and failure to use SOPs.

Many operators audited by the Foundation were not performing adequate surveillance of their contract vendors and suppliers.

Ramp Activities and Ground Operations

Ramp Safety and Security

Some operators apparently place low priorities on ramp safety and security, and on safety in ground-support operations. While this may not be intentional, FSF auditors have seen many examples of inadequate enforcement of current rules. There are many types of accidents that have occurred on ramps because of inadequate control or supervision.

For example, FSF safety auditors observed a fuel truck being driven between the aircraft and the terminal while passengers were crossing the ramp to board. The passengers had to open a space in their line to enable the truck driver to pass. During a recent audit, a fuel truck was parked — but was not chocked — directly facing a corporate aircraft.

FSF audit teams also observed that walkways were not painted on ramps and that stanchions with lead-lines for directing the passengers to the loading steps were not used.

Fueling Practices

Risks of accidents and injuries are increased by negligence of the operator's personnel or by contract vendors, such as fuelers. For example, fuelers have been observed defeating the deadman control (a safety device that requires continuous action by the fueler to deliver fuel) on the fuel truck and leaving the area while fuel is flowing for a period of time. Over-pressurization of airplane wing tanks has caused structural damage when automatic shutoff systems have malfunctioned and the fueling was not being monitored. Although most operator manuals require that a pilot or a maintenance technician observe and direct refueling activities, FSF audit teams have found that this responsibility often is neglected.

Quality control procedures that assure that fuel going into the aircraft is free of any contamination are also the responsibility of the operator, but most operators do not have quality control standards for the fuel pumped into their aircraft.

Hazardous Materials

Several operators did not provide adequate safeguards for transporting hazardous materials. All operators are required to provide adequate training and control programs for shipping hazardous materials. Although most operators had some manuals with information about this subject, the understanding and compliance of line employees was found to be inadequate because of the absence of proper training and supervision.

Whether or not an operator allows hazardous materials on board its aircraft, a comprehensive hazardous materials program must include thorough training of loading personnel and flight crews in areas such as:

- Material identification and labeling;
- Loading and combination limitations;
- Freight-forwarder responsibilities; and,
- Emergency reaction to spills or mishandling.

Most corporate operators have adopted the policy that no hazardous materials will be carried aboard aircraft. Nevertheless, FSF safety auditors have found that some operators carried hazardous materials, but did not recognize them as such. This was most common among operators involved in oil-field activities, where passengers may carry items such as core samples, chemicals or test equipment that are hazardous materials. Infrequent maintenance aircraft-recovery flights — using a company aircraft to transport parts and/or materials required to repair another company aircraft — also involve unplanned situations that inadvertently could result in a violation of the hazardous-materials restrictions in the operations manual.

Flight Safety Foundation safety auditors encourage employees to explain their working methods and to express concerns. (FSF photo)

Aircraft, Equipment and Facilities

Workplace Safety

FSF audit teams have observed significant improvements in the standards of safety in the workplace. Provision of the more commonly needed equipment, such as ladders and work stands, has shown a steady improvement, in part because of the requirements of government, such as the U.S. Occupational Safety and Health Administration (OSHA) and its counterparts in other countries. Deficiencies most often found include:

- Lack of clear access to portable fire extinguishers;
- Improper portable fire extinguisher type for most-likely fire risk;
- Inadequate number and/or location of eye-wash stations;
- Lack of emergency body-shower equipment in the work area;
- First aid kits maintained improperly;
- Lack of training in AEDs, cardiopulmonary resuscitation and first aid; and,
- Lack of fire drills or emergency evacuation exercises.

Personal Safety

The maintenance technician working alone is one problem observed among many small operations — usually late at night after the remainder of the facility was closed. One corporate operator found a unique solution: monitoring the well-being of lone workers by using the motion-detection capability of the security system. The central security station was alerted if the technician did not move within any 10-minute period.

Another effective solution for reducing this risk is an emergency-lifesaver transmitter (beeper) that the maintenance technician can attach to his or her belt, collar or other clothing. These devices have become more sophisticated and smaller. Typically, such devices can summon (with the push of a single button) whatever emergency response is most appropriate — such as a fire department, corporate security office or emergency medical service.

Other operators, however, have no safeguards for maintenance technicians working alone, and this continues to be a risk to personnel safety and to equipment and facilities. To reduce the risks, the Foundation recommends including written policies in the maintenance manual to restrict the activities of a maintenance technician working alone.

Maintenance Stores and Shops

The stores areas of most facilities audited by the Foundation have been well organized and had excellent inventory control. The most common deficiency has been inadequate storage rooms or cabinets for flammable solvents, paints and lubricants. The FSF audit teams inspected facilities from a "what if" viewpoint. Many items have been identified that previously were not considered potential hazards by the operator. The lack of OSHA-mandated material safety data sheets (MSDSs) in the information-management system is another frequent weakness. Various agencies have developed MSDS data files, which are available on CD-ROM, through on-line access to computers or through automated telephone systems. These resources greatly simplify MSDS maintenance.

Few operators have experienced a fire or serious incident in their maintenance facilities. Unsecured high-pressure gas storage cylinders, ungrounded electrical equipment, untested hoisting equipment, trip-and-slip hazards, etc., often are overlooked as causes of personal injury or property damage.

The single-most common finding in maintenance shops is the lack of adequate eye protection for workers using cutting tools and grinding tools. In many instances, the tool was placarded "use eye protection while operating," yet there were neither face shields nor goggles available, and management had allowed the equipment to be used without enforcing the policy. Another area of concern has been the lack of inspection and testing of eye-wash stations and emergency body-shower equipment. Although FSF safety auditors found that most fire extinguishers had been inspected recently, during most safety audits, the lack of fire-prevention training for hangar personnel was a significant problem.

Corporate Aircraft Standards

When initiating the safety audit of a corporate operator, the FSF audit team reviews the mission of the aviation department. In most instances, FSF safety auditors have found that the corporation desires transportation for executives with standards of safety and convenience equal to or better than airlines. With that goal in mind, the FSF audit team reviews the equipment and procedures, and makes whatever recommendations may be appropriate to maximize the opportunities to attain that goal.

Although an FSF audit team usually finds that the avionics equipment and cabin amenities are outstanding, team members often discover that some basic safety items have been overlooked. Among items cited have been:

- Safety equipment such as AEDs, first aid kits and passenger smoke hoods not installed;
- Interior-material flammability standards and toxic smoke standards not met;
- Supplemental safety equipment not properly placarded;
- Passenger information cards incomplete or lacking equipment information;
- Protective breathing equipment not available for flight attendants;
- Lack of portable oxygen bottles with supplemental medical capability;
- Pilots providing cabin service to passengers in violation of Part 91.105;
- Passenger briefcases and bags stowed improperly on takeoff; and,
- No enforcement of restrictions on the use of portable electronic devices (such as computers) during takeoff and landing.

Summary

Of all the lessons learned in conducting FSF safety audits, a single factor appears in nearly every audit: communication. The lack of communication or the misinterpretation of verbal or written communication frequently is the underlying cause of an accident/incident: Nearly every hazard was known and identified by someone but, for whatever reason, was not communicated to the individual capable of correcting it (or was communicated but not acted upon).♦

[This is the third edition and fourth printing of *The Practice of Aviation Safety*; Flight Safety Foundation published the first edition in 1990. Darol V. Holsman, Robert A. Feeler and the FSF editorial staff updated the information in this edition. The late Capt. E.R. Arbon was a senior captain for Trans World Airlines, manager of the ARCO aviation department and vice president of operations for the Foundation. Capt. L. Homer Mouden (retired) was a line captain for Mid-Continent Airlines and Braniff International Airways, a director of flight safety for Eastern Air Lines and vice president of technical affairs for the Foundation. Holsman, manager of aviation safety audits for the Foundation and a pilot with 8,000 flight hours, was chief of U.S. Air Force Strategic Airlift Operations, a pilot-proficiency examiner for FlightSafety International and manager of the aviation safety program for Saudi Arabian Oil Co. Feeler, an FSF auditor, administrator of the FSF Q-Star Charter Provider Verification Program, and a certified aircraft maintenance technician since 1952, was a senior manager for two U.S. airlines.]

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U.S. Air Carrier Accidents, 1997–1999, Involve Turbulence, Ground Operations and Approach-and-landing Problems

Categorization of data shows opportunities to reduce nonmajor accidents.

Capt. Thomas A. Duke
with
FSF Editorial Staff

Data from the U.S. National Transportation Safety Board (NTSB) were used to prepare the following overview of accidents that occurred from 1997 through 1999 among air carriers operating under U.S. Federal Aviation Regulations (FARs) Part 121.

NTSB Aviation Accident/Incident Database (AID) data were used for the following:[1]

- A review of major accidents and nonmajor accidents by various database fields in the AID and by adding non-NTSB database fields (such as a brief description of the accident, NTSB classification, aircraft generation and category of air carrier);[2]
- A review of nonmajor accidents; and,
- A review of accidents that occurred during the 36 months after implementation of the "commuter rule" March 20, 1997.[3] The rule changed the composition of subsequent data for Part 121 accidents and their comparability to earlier time periods. (Data from 1997, the transition year, comprise accidents among aircraft previously operated under Part 121 and some aircraft that operated under Part 135 for about three months before the commuter rule implementation date.)

The AID data and accompanying narratives were used to classify, count and compare 152 Part 121 accidents that occurred in 1997 through 1999 and 159 accidents that occurred during the first 36 months of operations under the commuter rule. In 1997, 44 accidents occurred in scheduled service and five accidents occurred in unscheduled service. In 1998, 43 accidents occurred in scheduled service and seven accidents occurred in unscheduled service. In 1999, 48 accidents occurred in scheduled service and five accidents occurred in unscheduled service. Table 1 (page 36) shows NTSB's accident-severity classifications and the accident rates per million hours flown.

NTSB's determinations of probable cause and contributing factors are not included in this overview because they were available for relatively few of these accidents; the information will be part of NTSB's annual reviews of aircraft accident data for U.S. air carrier operations, which include tables of data, analyses of accident statistics, probable causes and contributing factors. The current annual review, for 1996, contains separate data for Part 121 operations and Part 135 operations.[4]

Two major Part 121 accidents occurred in 1997, none occurred in 1998, and two occurred in 1999. Forty-seven nonmajor Part 121 accidents occurred in 1997, 50 occurred in 1998, and 51 occurred in 1999.

Among the four major accidents, three occurred during cargo operations and one occurred in passenger service.

The AID data for 1997 through 1999 showed that:

- Eighty-seven of the accidents (57 percent) occurred among major air carriers;

Table 1
Classification of Accidents, U.S. Federal Aviation Regulations Part 121 Air Carriers,[1] 1997–1999

	Accidents by NTSB Classification				Aircraft Hours Flown	Accident Rates per Million Hours Flown			
Year	Major[2]	Serious[3]	Injury[4]	Damage[5]	(millions)	Major	Serious	Injury	Damage
1997	2	4	24	19	15.838	0.126	0.253	1.515	1.2
1998	0	3	21	26	16.846	0.0	0.178	1.247	1.543
1999	2	1	20	29	17.428	0.115	0.057	1.148	1.664
Total	**4**	**8**	**65**	**74**					

[1] Effective March 20, 1997, scheduled passenger operations in airplanes with 10 or more passenger seats and scheduled passenger operations in turbojet airplanes must be conducted under U.S. Federal Aviation Regulations (FARs) Part 121.

[2] The U.S. National Transportation Safety Board (NTSB) classifies an accident as a *major accident* if any of three conditions is met: a Part 121 aircraft was destroyed, multiple fatalities occurred, or there was one fatality and a Part 121 aircraft was damaged substantially.

[3] NTSB classifies an accident as a *serious accident* if at least one of two conditions is met: one fatality occurred without substantial damage to a Part 121 aircraft, or there was at least one serious injury and a Part 121 aircraft was damaged substantially.

[4] NTSB classifies an accident as a *serious injury accident* if a nonfatal accident occurred with at least one serious injury and without substantial damage to a Part 121 aircraft.

[5] NTSB classifies an accident as a *substantial damage accident* if no person was killed or seriously injured but any aircraft was damaged substantially.

Source: U.S. National Transportation Safety Board

- Thirty-six accidents (24 percent) occurred among regional air carriers;
- Twenty-one accidents (14 percent) occurred among aircraft operated by cargo air carriers;
- Eight accidents (5 percent) occurred among small-fleet air carriers;[5]
- Fifty-five different air carriers were involved — approximately half of all U.S. airlines operating during this period. The number of accidents per air carrier ranged from one to 20;
- Fourteen major air carriers were involved in one or more accidents;
- The accidents involved 922 crewmembers and 13,446 passengers;
- Five fatalities and 53 serious injuries occurred among crewmembers, and 12 fatalities and 65 serious injuries occurred among passengers; and,
- Among ground workers, four fatalities and eight serious injuries occurred.

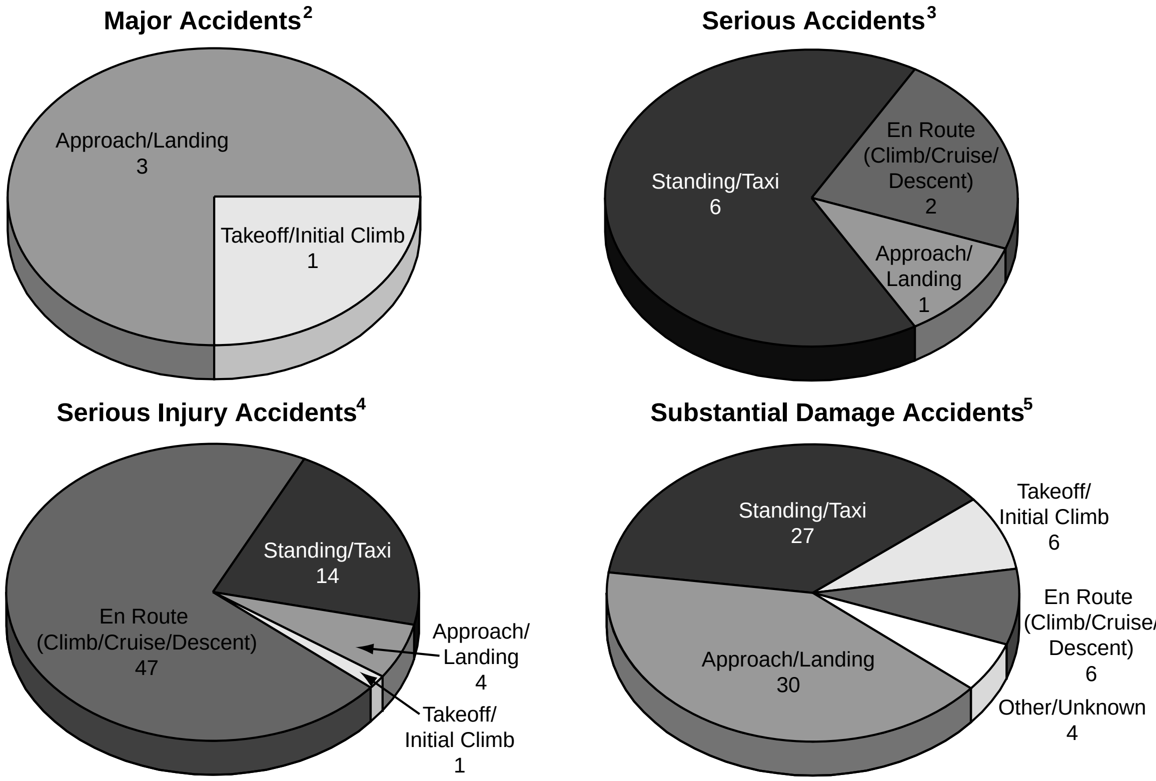
Figure 1 (page 37) shows the phase of flight during which the accidents occurred. Accident-reduction initiatives for major aircraft accidents typically have focused on approach and landing, and on takeoff and departure.

Among nonmajor accidents, the data show decreases in serious accidents[6] and serious injury accidents.[7] The data show increases in substantial damage accidents,[8] which typically occurred on the airport surface. The 73 substantial damage accidents included 30 ground collisions with vehicles, aircraft or objects/terrain (e.g., snow banks).

Table 2 (page 38) and Figure 2 (page 42) show accidents grouped by similar description. This information showed the following:

- Thirty-eight accidents (25 percent) occurred during approach and landing. These accidents included three major accidents, one serious accident, four serious injury accidents and 30 substantial damage accidents. Three of the four major accidents occurred during approach and landing. Two aircraft were destroyed, and 31 aircraft were damaged substantially. One crewmember and 10 passengers were killed. Seven crewmembers and 32 passengers received serious injuries;
- Fifty-seven accidents (34 percent) occurred en route (climb, cruise and descent). In en route accidents, 67 serious injuries occurred to passengers or cabin crewmembers during turbulence or during abrupt maneuvers by flight crews responding to ground-proximity warning systems (GPWSs), terrain awareness and warning systems (TAWSs), traffic-alert and collision avoidance systems (TCASs) and/or visual detection of aircraft that presented a collision hazard; and,
- Forty-eight accidents (32 percent) occurred during ground operations (i.e., standing, pushback, taxi and takeoff). Twenty accidents on the airport surface involved

Accident Severity and Flight Phases, U.S. Federal Aviation Regulations Part 121 Air Carriers,[1] 1997–1999



[1] Effective March 20, 1997, scheduled passenger operations in airplanes with 10 or more passenger seats and scheduled passenger operations in turbojet airplanes must be conducted under U.S. Federal Aviation Regulations (FARs) Part 121.

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[4] NTSB classifies an accident as a *serious injury accident* if a nonfatal accident occurred with at least one serious injury and without substantial damage to a Part 121 aircraft.

[5] NTSB classifies an accident as a *substantial damage accident* if no person was killed or seriously injured but any aircraft was damaged substantially.

Source: Thomas A. Duke

Figure 1

collisions with vehicles, five accidents involved collisions with aircraft, and six accidents involved collisions with objects/terrain (e.g., snow banks). Among ramp workers, three fatalities occurred. Three aircraft evacuations involved injuries to a total of five passengers; no crewmembers were injured. One passenger was killed and one passenger, two flight attendants and one ground worker received serious injuries from falls.

Another method of accident review is to group accidents by related circumstances so that similar interventions may be developed. For example, in-flight injuries from turbulence have similar safety interventions — for example, proper use of seat belts — and could be considered together. This can help to reveal repetitive circumstances and the severity of consequences.

Accidents comprised the following related circumstances:

- In-flight turbulence and/or loss of control/uncontrolled descent were involved in 44 accidents (29 percent). One passenger was fatally injured; 26 passengers and 35 crewmembers received serious injuries;
- Eight accidents (5 percent) involved abrupt maneuvers in flight; nine flight attendants and one passenger

Continued on page 41

Table 2
Selected Accidents by Related Descriptions, U.S. Federal Aviation Regulations Part 121 Air Carriers,[1] 1997–1999

Date	Aircraft Type	Aircraft Damage	Degree of Injury	Description
April 1, 1997	Boeing 737	None	Serious	Abrupt maneuver (evasive)
June 8, 1997	Boeing 737	None	Serious	Abrupt maneuver (evasive)
June 30, 1999	McDonnell Douglas MD-11	Substantial	None	Abrupt maneuver (ground-proximity warning systems [GPWS])
Sept. 20, 1999	Boeing 757	None	Serious	Abrupt maneuver (GPWS)
Dec. 1, 1998	ATR-72	None	Serious	Abrupt maneuver (traffic-alert and collision avoidance systems [TCAS])
Sept. 27, 1999	Boeing 767	None	Serious	Abrupt maneuver (TCAS)
Nov. 7, 1999	McDonnell Douglas DC-10	Substantial	None	Abrupt maneuver (TCAS)
May 21, 1998	McDonnell Douglas DC-10	None	Serious	Abrupt maneuver; uncontrolled altitude deviation
Aug. 7, 1999	McDonnell Douglas DC-10	Substantial	None	Airframe/component/system failure (flap separation)
Feb. 8, 1999	Beech 1900	Substantial	None	Bird strike
Feb. 22, 1999	Boeing 757	Substantial	None	Bird strike
May 25, 1999	De Havilland DHC-6	Substantial	None	Bird strike
Oct. 6, 1999	De Havilland DHC-8	Substantial	None	Bird strike
March 4, 1999	McDonnell Douglas DC-9	Substantial	None	Bird strike
May 14, 1997	Boeing 777	Substantial	None	Collision between aircraft (other than midair)
July 27, 1998	De Havilland DHC-8	Substantial	None	Collision between aircraft (other than midair)
Aug. 7, 1999	De Havilland DHC-6-float	Substantial	None	Collision between aircraft (other than midair)
Aug 7, 1999	De Havilland DHC-6-float	Minor	None	Collision between aircraft (other than midair)
Dec. 17, 1999	McDonnell Douglas DC-8	Substantial	None	Collision between aircraft (other than midair)
Nov. 5, 1999	Boeing 777	Substantial	None	N/A
Aug. 14, 1998	Boeing 737	Substantial	None	Dragged tail skid
Sept. 20, 1998	Boeing 757	Substantial	None	Dragged tail skid
Nov. 11, 1998	McDonnell Douglas MD-11	Substantial	None	Dragged tail skid
Oct. 7, 1998	Boeing 727	Substantial	None	Engine failure (uncontained)
Jan. 21, 1998	ATR-42	Substantial	Minor	Engine fire
May 21, 1997	Embraer EMB-120	Substantial	None	Engine fire; hydraulic failure; landing overrun
May 9, 1997	British Aerospace BAe 31	Substantial	None	Engines started while engine air inlet plugs were installed
Jan. 18, 1997	Boeing 737	Minor	Serious	Evacuation injury (passenger)
Aug. 7, 1997	Lockheed L-1011	Minor	Serious	Evacuation injury (passenger)
Jan. 9, 1998	Boeing 767	Minor	Serious	Evacuation injury (passenger)
Dec. 26, 1998	McDonnell Douglas MD-88	None	Serious	Evacuation injury (passenger)
April 19, 1998	Boeing 727	Minor	Serious	Evacuation injury (passenger initiated)
May 12, 1998	Boeing 747	None	Serious	Evacuation injury (passenger initiated)
Jan. 15, 1999	Boeing 767	Substantial	N/A	Hard landing
June 2, 1999	Boeing 757	Substantial	None	Hard landing
Feb. 6, 1997	Airbus A300	Substantial	None	Hard landing; dragged tail skid
July 15, 1999	Airbus A300	Substantial	None	Hard landing; dragged tail skid
July 31, 1997	McDonnell Douglas MD-11	Destroyed	Minor	Hard landing; landing gear collapsed
Nov. 25, 1997	Shorts SD-3	Substantial	None	Hard landing; landing gear collapsed
Feb. 26, 1998	Fokker F-28	Substantial	None	Hydraulic failure; loss of directional control on landing; ran off side of runway; nose gear separation
Oct. 15, 1997	Beech 99	Substantial	None	In-flight collision with object (electric transmission wire)
Jan. 7, 1997	Airbus A300	Minor	Serious	In-flight clear air turbulence
Jan. 28, 1997	McDonnell Douglas DC-9	None	Serious	In-flight clear air turbulence
Feb. 25, 1997	Boeing 767	None	Serious	In-flight clear air turbulence
June 11, 1997	Boeing 737	None	Serious	In-flight clear air turbulence
Sept. 26, 1997	Airbus A300	None	Serious	In-flight clear air turbulence

Table 2
Selected Accidents by Related Descriptions, U.S. Federal Aviation Regulations Part 121 Air Carriers,[1] 1997–1999 *(continued)*

Date	Aircraft Type	Aircraft Damage	Degree of Injury	Description
Jan. 6, 1998	Boeing 757	None	Serious	In-flight clear air turbulence
March 4, 1998	Boeing 737	None	Serious	In-flight clear air turbulence
April 18, 1998	Boeing 747	Minor	Serious	In-flight clear air turbulence
Sept. 27, 1998	De Havilland DHC-8	Minor	Serious	In-flight clear air turbulence
Oct. 4, 1998	Boeing 767	None	Serious	In-flight clear air turbulence
July 8, 1999	Boeing 737	Minor	Serious	In-flight clear air turbulence
Oct. 27, 1999	Airbus A300	None	Serious	In-flight clear air turbulence
Sept. 6, 1997	British Aerospace BAe ATP	None	Serious	In-flight clear air turbulence; uncontrolled descent
April 7, 1997	Airbus A320	None	Serious	In-flight turbulence (weather/unspecified)
April 28, 1997	Boeing 737	None	Serious	In-flight turbulence (weather/unspecified)
June 3, 1997	Boeing 767	None	Serious	In-flight turbulence (weather/unspecified)
July 25, 1997	McDonnell Douglas DC-10	None	Serious	In-flight turbulence (weather/unspecified)
Sept. 14, 1997	Boeing 747	None	Serious	In-flight turbulence (weather/unspecified)
Oct. 1, 1997	McDonnell Douglas DC-9	None	Serious	In-flight turbulence (weather/unspecified)
Oct. 31, 1997	De Havilland DHC-8	None	Serious	In-flight turbulence (weather/unspecified)
Dec. 11, 1997	Saab 340	None	Serious	In-flight turbulence (weather/unspecified)
Dec. 28, 1997	Boeing 747	Minor	Fatal	In-flight turbulence (weather/unspecified)
May 24, 1998	Boeing 757	None	Serious	In-flight turbulence (weather/unspecified)
Nov. 11, 1998	Boeing 777	None	Serious	In-flight turbulence (weather/unspecified)
Dec. 13, 1998	Boeing 737	None	Serious	In-flight turbulence (weather/unspecified)
Feb. 1, 1999	Airbus A320	None	Serious	In-flight turbulence (weather/unspecified)
Feb. 7, 1999	Boeing 757	None	Serious	In-flight turbulence (weather/unspecified)
Feb. 8, 1999	McDonnell Douglas MD-80	None	Serious	In-flight turbulence (weather/unspecified)
March 3, 1999	Saab 340	None	Serious	In-flight turbulence (weather/unspecified)
May 5, 1999	Boeing 737	None	Serious	In-flight turbulence (weather/unspecified)
May 25, 1999	Boeing 737	None	Serious	In-flight turbulence (weather/unspecified)
June 25, 1999	Boeing 737	None	Serious	In-flight turbulence (weather/unspecified)
Sept. 2, 1999	Boeing 737	Minor	Serious	In-flight turbulence (weather/unspecified)
Sept. 16, 1999	Airbus A320	None	Serious	In-flight turbulence (weather/unspecified)
Sept. 30, 1999	Airbus A319	None	Serious	In-flight turbulence (weather/unspecified)
Dec. 13, 1999	Boeing 777	None	Serious	In-flight turbulence (weather/unspecified)
May 7, 1998	McDonnell Douglas DC-9	Substantial	Serious	In-flight turbulence and hail
July 22, 1998	Boeing 767	None	Serious	In-flight turbulence; uncontrolled altitude deviation
June 11, 1999	Boeing 777	None	Serious	In-flight turbulence; uncontrolled altitude deviation
May 13, 1998	Fokker F-28	None	Serious	In-flight turbulence; uncontrolled descent
Sept. 17, 1998	ATR 42	None	Serious	In-flight wake turbulence
Jan. 15, 1999	McDonnell Douglas DC-9	None	Serious	In-flight wake turbulence
May 12, 1997	Airbus A300	Minor	Serious	In-flight loss of control
Aug. 7, 1997	McDonnell Douglas DC-8	Destroyed	Fatal	In-flight loss of control and collision with terrain
Feb. 9, 1998	Boeing 727	Substantial	Minor	Landed short of runway threshold
July 6, 1997	Boeing 727	Substantial	Minor	Landing gear collapsed
Nov. 7, 1997	Fokker F100	Substantial	None	Landing gear collapsed
Aug. 31, 1998	Boeing 727	Substantial	None	Landing gear collapsed
Oct. 5, 1999	McDonnell Douglas MD-11	Substantial	None	Landing gear collapsed
Sept. 1, 1997	McDonnell Douglas DC-9	Substantial	Minor	Landing gear collapsed (nose gear)
May 8, 1999	Saab 340	Substantial	Serious	Landing overrun

Table 2
Selected Accidents by Related Descriptions, U.S. Federal Aviation Regulations Part 121 Air Carriers,[1] 1997–1999 *(continued)*

Date	Aircraft Type	Aircraft Damage	Degree of Injury	Description
June 1, 1999	McDonnell Douglas MD-82	Destroyed	Fatal	Landing overrun
June 28, 1999	Airbus A310	Substantial	None	Landing overrun
Oct. 17, 1999	McDonnell Douglas MD-11	Destroyed	Minor	Landing overrun
March 5, 1997	McDonnell Douglas DC-9	Substantial	Minor	Loss of directional control on ground
Sept. 24, 1998	Convair CV-240	Substantial	None	Loss of engine power; forced landing; ditching
March 14, 1997	McDonnell Douglas DC-9	Substantial	None	Loss of engine power (partial) — ice ingestion
June 26, 1997	Lockheed L-1011	None	Serious	Miscellaneous equipment (galley elevator malfunction)
May 4, 1997	Boeing 737	None	Serious	Miscellaneous/other (flight attendant fall)
March 17, 1999	Boeing 737	None	Serious	Miscellaneous/other (flight attendant fall)
Dec. 7, 1997	McDonnell Douglas DC-9	None	Serious	Miscellaneous/other (flight attendant galley injury)
June 9, 1999	Boeing 747	None	Serious	Miscellaneous/other (flight attendant galley-lift injury)
May 26, 1997	Lockheed L-1011	None	Serious	Miscellaneous/other (flight attendant trip and fall)
May 13, 1997	McDonnell Douglas MD-88	Minor	Serious	Miscellaneous/other (ground collision; passenger fall)
March 6, 1998	McDonnell Douglas DC-10	None	Serious	Miscellaneous/other (ground worker fall)
March 27, 1997	Lockheed L-1011	None	Fatal	Miscellaneous/other (ground worker injury)
Jan. 13, 1999	Boeing 727	None	Serious	Miscellaneous/other (ground worker injury)
April 9, 1997	McDonnell Douglas DC-10	Substantial	None	Miscellaneous/other (improper airspeed/ unknown)
Aug. 5, 1997	Boeing 757	None	Fatal	Miscellaneous/other (passenger fall)
April 4, 1998	McDonnell Douglas DC-10	Substantial	None	On-ground collision with object
March 26, 1997	De Havilland DHC-8	Substantial	None	On-ground collision with object (de-ice cart)
July 24, 1999	Boeing 757	Substantial	None	On-ground collision with object (jetway)
Oct. 15, 1999	Airbus A320	Substantial	None	On-ground collision with object (pedestrian walkway)
Aug. 8, 1998	Airbus A320	None	Serious	On-ground collision with object (ramp worker)
Jan. 20, 1998	Beech 1900	Substantial	None	On-ground collision with object (snow bank)
Nov. 27, 1999	Boeing 727	Substantial	None	On-ground collision with object (tractor)
June 26, 1998	Lockheed L-382	Substantial	None	On-ground collision with object (trees)
April 1, 1997	Fokker F-28	Substantial	Minor	On-ground collision with vehicle
Aug. 22, 1997	Swearingen 227	Substantial	None	On-ground collision with vehicle
Oct. 1, 1997	Boeing 727	Substantial	Serious	On-ground collision with vehicle
Oct. 15, 1997	Beech 1900	Substantial	Minor	On-ground collision with vehicle
Jan. 6, 1998	Boeing 727	Minor	Serious	On-ground collision with vehicle
March 9, 1998	Canadair CL-65	Substantial	Minor	On-ground collision with vehicle
March 11, 1998	Fokker F-28	Substantial	Serious	On-ground collision with vehicle
March 11, 1998	Fairchild-227	Substantial	None	On-ground collision with vehicle
June 17, 1998	Boeing 737	Substantial	Minor	On-ground collision with vehicle
Sept. 2, 1998	McDonnell Douglas DC-9	Substantial	None	On-ground collision with vehicle
Oct. 11, 1998	McDonnell Douglas MD-88	Substantial	None	On-ground collision with vehicle
Oct. 25, 1998	ATR 42	Substantial	Minor	On-ground collision with vehicle
Nov. 3, 1998	McDonnell Douglas MD-88	Minor	Serious	On-ground collision with vehicle
Dec. 1, 1998	Boeing 747	Substantial	None	On-ground collision with vehicle
April 12, 1999	Saab 340	Substantial	None	On-ground collision with vehicle
May 28, 1999	Boeing 727	Substantial	None	On-ground collision with vehicle
July 2, 1999	McDonnell Douglas DC-9	Substantial	None	On-ground collision with vehicle
Sept. 12, 1999	Boeing 737	Substantial	None	On-ground collision with vehicle
Dec. 23, 1997	Beech 1900	Substantial	None	On-ground collision with terrain (snow bank)

Table 2
Selected Accidents by Related Descriptions, U.S. Federal Aviation Regulations Part 121 Air Carriers,[1] 1997–1999 *(continued)*

Date	Aircraft Type	Aircraft Damage	Degree of Injury	Description
Dec. 21, 1998	Boeing 727	Substantial	None	On-ground collision with terrain (snow bank); collision with vehicle
Jan. 7, 1997	ATR 42	Substantial	Minor	On-ground collision with terrain (soft ground)
Nov. 3, 1998	Saab 340	Minor	Fatal	Propeller contact to person
July 28, 1999	ATR 42	Minor	Fatal	Propeller contact to person
Aug. 13, 1999	ATR 42	None	Serious	Propeller contact to person
Aug. 19, 1998	Beech 1900	Substantial	Minor	Propeller leading edge cap separation
Nov. 1, 1998	Boeing 737	Substantial	Minor	Ran off side of runway during landing
April 23, 1999	De Havilland DHC-6	Substantial	None	Ran off side of runway during landing
Sept. 11, 1998	Boeing 767	Substantial	None	Ran off side of runway during landing; gear collapsed
Sept. 16, 1998	Boeing 737	Substantial	None	Ran off side of runway during landing; gear collapsed (nose gear)
Dec. 17, 1998	ATR 42	Substantial	None	Ran off side of runway during landing; ground collision with object (runway lights)
July 29, 1999	Boeing 747	Substantial	None	Uncontained engine failure
Sept. 12, 1999	Boeing 737	Substantial	None	Uncontained engine failure; loss of engine power (partial) — mechanical failure/malfunction
April 6, 1997	Beech 1900	Substantial	None	Unsecured cargo/baggage door
March 1, 1999	Lockheed L-188	Substantial	None	Wheels-up landing (propeller damage)

Total Accidents = 152

[1] Effective March 20, 1997, scheduled passenger operations in airplanes with 10 or more passenger seats and scheduled passenger operations in turbojet airplanes must be conducted under U.S. Federal Aviation Regulations Part 121.

N/A = Not available   ATR = Avions de Transport Regional

Source: Thomas A. Duke

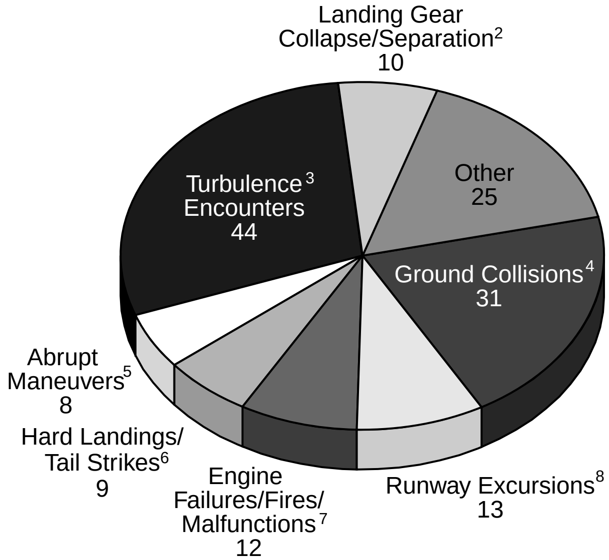
received serious injuries in these accidents. Five of the aircraft were current-generation aircraft types, and two of the aircraft were early wide-body types.[9] Two accidents involved GPWS warnings, and three accidents involved TCAS warnings;

- Operations on runways were involved in 26 accidents (17 percent). These accidents primarily involved runway excursions (e.g., landing overrun or running off side). Thirteen runway excursions occurred during landing; none occurred during takeoff. The results of runway excursions included the destruction of two aircraft, substantial damage to 11 aircraft and injuries to four crewmembers and 31 passengers. Eight accidents, including one major accident, occurred during takeoff and initial climb. One accident involved a rejected takeoff. One accident during runway operation involved a bird strike, and one involved an unsecured cargo/baggage door. One substantial damage accident involved penetration of the cabin after the debonding of a propeller erosion shield. Four accidents involved hard landings, and five accidents involved tail strikes. The hard landings and tail strikes involved 10 current-generation aircraft, two early wide-body aircraft and seven second-generation aircraft. In five accidents, the aircraft landing gear fractured or collapsed. Substantial damage was reported in all of the tail strikes; no injuries occurred in these accidents. Five accidents involved gear collapses, and one accident involved a wheels-up landing. No injuries occurred in these accidents;

- Eight accidents (5 percent) involved airport ground personnel in hazardous contact with aircraft. Three ground workers were struck by rotating propellers; two ground workers were killed, and one received serious injuries. Three ground workers were struck by moving aircraft; one ground worker was killed, and two ground workers received serious injuries. One ground worker was seriously injured by a cargo door, and one ground worker was seriously injured by an aircraft entry door; and,

- Twelve accidents (8 percent) involved engine failures, engine fires or failures/malfunctions of airframes, components or systems (other than landing gear). Two accidents involved no damage; 10 accidents involved substantial damage. Two crewmembers received serious injuries; no passengers were injured. The three accidents with uncontained engine failures involved turbojet/turbofan aircraft. Two accidents involved engine fires.

Accidents by Related Descriptions, U.S. Federal Aviation Regulations Part 121 Air Carriers,[1] 1997–1999



Total Accidents = 152

[1] Effective March 20, 1997, scheduled passenger operations in airplanes with 10 or more passenger seats and scheduled passenger operations in turbojet airplanes must be conducted under U.S. Federal Aviation Regulations (FARs) Part 121.

[2] Landing gear collapse, separation, failure/malfunction.

[3] Clear air turbulence, weather turbulence and wake turbulence.

[4] Collisions with vehicles, aircraft and objects/terrain (e.g., snow banks).

[5] Pilot responses to visually detected in-flight collision hazards and warnings from ground-proximity warning systems (GPWS), terrain awareness and warning systems (TAWS) and traffic-alert and collision avoidance systems (TCAS).

[6] Hard landings and/or dragged tail skid (all during landings).

[7] Including failures/malfunctions of airframes, components or systems (other than landing gear).

[8] Landing overrun or running off side.

Source: Thomas A. Duke

Figure 2

Table 3 (page 43) shows the distribution of accident severity among major air carriers, regional air carriers, small-fleet air carriers and cargo air carriers.

The 87 accidents among major air carriers predominantly occurred during ground operations (standing/taxi) and during en route turbulence. These accidents occurred under the following circumstances:

- Thirty-five involved turbulence (10 clear air turbulence, 22 weather-related turbulence or unspecified turbulence and one wake turbulence);
- Thirteen involved ground collisions with vehicles, aircraft or objects/terrain, including accidents in which aircraft were struck;
- Five involved abrupt maneuvers in flight;
- Five involved evacuation injuries; and,
- Four involved hard landings.

The 36 accidents among regional air carriers occurred predominantly during ground operations (standing/taxi). These accidents occurred under the following circumstances:

- Twelve involved ground collisions with vehicles, aircraft or objects/terrain (e.g., snow banks); and,
- Six involved turbulence in flight.

Reviews of the 21 accidents among cargo air carriers showed that they included 11 approach-and-landing accidents and four ground collisions; the eight accidents among small-fleet air carriers did not involve repetitive circumstances.

Turboprop airplanes with 10 passenger seats to 30 passenger seats and all operators conducting scheduled passenger service in turbojet airplanes were required to operate under Part 121, effective March 20, 1997. Accidents involving such aircraft formerly operated by commuter air carriers under Part 135 are of interest in safety research. Data were reviewed for the 19 nonmajor accidents among these aircraft in the first 36 months of the period when operation under Part 121 was required. Seventeen were substantial damage accidents, and two were serious injury accidents. One passenger received a serious injury, and one ground worker received a serious injury. No fatalities occurred. In seven accidents, ground collisions occurred with vehicles, aircraft or objects/terrain (e.g., snow banks).

During the 1990s, the U.S. Federal Aviation Administration (FAA) and U.S. air carriers determined goals and methods for reducing major accidents[10] and worked on interventions for turbulence-related accidents (including enhanced ability for pilots to predict and/or avoid turbulence and to warn cabin occupants) and the prevention of ground accidents at increasingly congested airports.[11] The following interventions have been developed to improve air carrier safety:

- Comprehensive educational resources for approach-and-landing accident reduction (ALAR) are available in the Flight Safety Foundation *ALAR Tool Kit;*[12]
- Flight operational quality assurance programs,[13] which analyze data from routine flight operations, have provided valuable guidance for the prevention of unstabilized approaches, hard landings and tail strikes;
- Aviation Safety Action Programs at some air carriers facilitate the collection, protection and analysis of data submitted voluntarily to FAA by airlines or pilots;[14]

Table 3
Classification of Accidents by Air Carrier Category, U.S. Federal Aviation Regulations Part 121 Air Carriers,[1] 1997–1999

		Accidents by NTSB Classification				
Year	**Air Carrier Category**	**Major[2]**	**Serious[3]**	**Injury[4]**	**Damage[5]**	**Total**
1997	Major	0	3	18	7	28
	Regional	0	0	4	11	15
	Cargo	2	1	0	1	4
	Small-fleet	0	0	2	0	2
1998	Major	0	2	15	12	29
	Regional	0	1	3	7	11
	Cargo	0	0	1	6	7
	Small-fleet	0	0	2	1	3
1999	Major	1	0	18	11	30
	Regional	0	2	2	6	10
	Cargo	1	0	0	9	10
	Small-fleet	0	0	1	2	3
Total		**4**	**9**	**66**	**73**	**152**

[1] Effective March 20, 1997, scheduled passenger operations in airplanes with 10 or more passenger seats and scheduled passenger operations in turbojet airplanes must be conducted under U.S. Federal Aviation Regulations (FARs) Part 121.

[2] The U.S. National Transportation Safety Board (NTSB) classifies an accident as a *major accident* if any of three conditions is met: a Part 121 aircraft was destroyed, multiple fatalities occurred, or there was one fatality and a Part 121 aircraft was damaged substantially.

[3] NTSB classifies an accident as a *serious accident* if at least one of two conditions is met: one fatality occurred without substantial damage to a Part 121 aircraft, or there was at least one serious injury and a Part 121 aircraft was damaged substantially.

[4] NTSB classifies an accident as a *serious injury accident* if a nonfatal accident occurred with at least one serious injury and without substantial damage to a Part 121 aircraft.

[5] NTSB classifies an accident as a *substantial damage accident* if no person was killed or seriously injured but any aircraft was damaged substantially.

Source: Thomas A. Duke

- Significant maintenance interventions and engine-monitoring interventions were implemented during the late 1990s to prevent uncontained engine failures in turbojet aircraft and turboprop aircraft. The Commercial Aviation Safety Team, a joint effort by FAA and industry, has developed performance measures that include tracking incident rates and tracking the number of cracks detected in engine disks when engines are overhauled. Appropriate procedures, training and technology also can reduce further the risk of inappropriate crew response to engine malfunctions and engine fires;[15] and,

- Passenger/crewmember injuries and substantial aircraft damage following abrupt flight maneuvers have occurred, in part, because of the implementation of alerting technologies that help to prevent controlled flight into terrain and midair collisions. Pilot training must emphasize pilot responses to TCAS warnings and GPWS/TAWS warnings. Pilot training also must include airplane upset recovery and evasive maneuvering.♦

Notes and References

1. U.S. National Transportation Safety Board (NTSB) Aviation Accident/Incident Database reports were available — in preliminary status, factual status or final status — for accidents that occurred from Jan. 1, 1997, through Dec. 31, 1999, and for the first three months of 2000.

2. NTSB. "1999 Aviation Accident Statistics Show an Increase in Accident Rates for Airlines and Commuters, Decrease for General Aviation." News release. February 25, 2000. In 1996, NTSB adopted a severity-classification system for U.S. Federal Aviation Regulations (FARs) Part 121 accidents. A *major accident* is an accident in which any of three conditions is met: a Part 121 aircraft was destroyed, there were multiple

fatalities, or there was one fatality and a Part 121 aircraft was damaged substantially.

3. On Dec. 20, 1995, the U.S. Federal Aviation Administration (FAA) published several regulatory amendments known collectively as the "commuter rule" to bring scheduled passenger operations in airplanes with 10 or more passenger seats and scheduled passenger operations in all turbojet airplanes under the requirements of Part 121.

4. NTSB. *Annual Review of Aircraft Accident Data, U.S. Air Carrier Operations, Calendar Year 1996*. NTSB/ARC-99/01. July 26, 1999.

5. The author used industry sources from 2000 to assign Part 121 operators in the NTSB Aviation Accident/Incident Database during 1997–1999 to the categories of major air carrier, regional air carrier and cargo air carrier. All other operators were categorized by the author as small-fleet air carriers.

6. NTSB defines a *serious accident* as an accident in which at least one of two conditions is met: there was one fatality without substantial damage to a Part 121 aircraft, or there was at least one serious injury and a Part 121 aircraft was damaged substantially.

7. NTSB defines a *serious injury accident* as a nonfatal accident with at least one serious injury and without substantial aircraft damage to a Part 121 aircraft.

8. NTSB defines a *substantial damage accident* as an accident in which no person was killed or seriously injured, but in which any aircraft was damaged substantially.

9. Boeing Commercial Airplanes Group. "Statistical Summary of Commercial Jet Airplane Accidents, Worldwide Operations, 1958–1999." This summary defines *first-generation aircraft* as Boeing 707/720, McDonnell Douglas DC-8, De Havilland Comet 4, British Aerospace Convair CV-880/990, British Aerospace Caravelle and British Aerospace Mercure; *second-generation aircraft* as Boeing 727, British Aerospace BAC 1-11, McDonnell Douglas DC-9, Boeing 737-100/-200, Fokker F-28, British Aerospace Trident and British Aerospace VC-10; *early wide-body aircraft* as Boeing 747-100/-200/-300/SP, McDonnell Douglas DC-10, Lockheed L-1011 and Airbus A300; and *current-generation aircraft* as McDonnell Douglas MD-80/-90, Boeing 767, Boeing 757, British Aerospace BAe 146, Airbus A310, Airbus A300-600, Boeing 737-300/-400/-500, Airbus A320/A319/A321, Fokker F-100, Boeing 747-400, McDonnell Douglas MD-11, Airbus A340, Airbus A330, Boeing 777, Boeing 737-600/-700/-800, Boeing 717, Bombardier RJ-70/-85/-100 and Bombardier CRJ.

10. The goals of the FAA *1998 FAA Strategic Plan* are to reduce, by 2007, U.S. aviation fatal accident rates by 80 percent from 1996 levels. The goals include reducing, by 2007, the U.S. aviation fatal accident rate per aircraft departures, as measured by a year-moving average, by 80 percent from the year average for 1994–1996; reducing the overall aircraft accident rate per aircraft departures; reducing the number and type of fatalities and losses from accidents that occur for each major type of accident; and reducing the risk of mortality to a passenger or flight crewmember on a typical flight.

11. U.S. General Accounting Office (GAO). *Aviation Safety: Safer Skies Initiative Has Taken Initial Steps to Reduce Accident Rates by 2007*. Report no. GAO/RCED-00-111, June 2000, 39, 55–56.

12. The Flight Safety Foundation *ALAR Tool Kit* is a unique set of pilot briefing notes, videos, presentations, risk-awareness checklists and other products designed to help prevent approach-and-landing accidents (ALAs). The tool kit is based on the data-driven conclusions and recommendations of the FSF ALAR Task Force, as well as data from the U.S. Commercial Aviation Safety Team (CAST) Joint Safety Analysis Team (JSAT) and the European Joint Aviation Authorities (JAA) Safety Strategy Initiative (JSSI).

13. Flight operational quality assurance (FOQA) is a program for obtaining and analyzing data recorded in flight operations to improve flight-crew performance, air carrier training programs and operating procedures, air traffic control procedures, airport maintenance and design, and aircraft operations and design.

14. Aviation Safety Action Programs include several demonstration programs — partnerships involving FAA and air carriers — that established incentives to encourage employees of the air carriers to disclose safety-related information to FAA and to identify possible violations of the FARs without fear of punitive legal enforcement sanctions.

15. GAO, 75. Flight Safety Foundation is a member of CAST.

About the Author

Capt. Thomas A. Duke (retired) accumulated 11,400 flight hours during 30 years as a military pilot and later as a U.S. Federal Aviation Regulations Part 121 supplemental airline captain flying four-engine transport airplanes. He served six years as director of safety for the U.S. Air Force Reserve and has more than 16 years of safety management experience. Duke also worked for the U.S. National Transportation Safety Board. He earned a master's degree in systems management at the University of Southern California and a bachelor's degree in Russian civilization at Dartmouth College. He is the author of more than 20 articles on airline safety.

Transport Canada Publishes Guidelines on Implementing Safety Management Systems

The report describes the concept of safety management systems as a "businesslike approach to safety" that defines a process for managing risks.

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Reports

Introduction to Safety Management Systems. Transport Canada. Document TP 13739 E. April 2001. 41 pp. Figures. Available from Transport Canada.

In 1999, Transport Canada developed a new civil aviation safety framework, Flight 2005, to guide its focus on aviation safety for five years. The cornerstone of the Flight 2005 effort was identified as the implementation of safety management systems.

This bilingual report (English and French) is an introduction to Transport Canada's safety management system principles. The report describes the desired safety culture and outlines ways to achieve the safety culture.

"A safety management system is a businesslike approach to safety," the report says. "It is a systematic, explicit and comprehensive process for managing safety risks."

Safety management systems are based on the knowledge that "there will always be hazards and risks, so proactive management is needed to identify and control these threats to safety before they lead to mishaps," the report says.

The report says that the principal challenges for Transport Canada and the aviation industry in Canada include the identification of methods of making the Canadian aviation system safer and lowering the accident rate as the industry continues to grow.

The systems approach to safety management will be the most efficient way to meet the challenges, the report said.

Documentation of Validity for the AT-SAT Computerized Test Battery, Volume I. Ramos, R.A.; Heil, Michael C.; Manning, Carol A. U.S. Federal Aviation Administration (FAA) Office of Aviation Medicine. DOT/FAA/AM-01/5. March 2001. 165 pp. Figures, tables, appendixes. Available through NTIS.*

This document (volume I) and the companion document (volume II) comprise the comprehensive report of a research project that developed and validated the computerized selection of tests used to hire air traffic control specialists (ATCSs) for FAA.

Through the 1980s and 1990s, FAA developed and applied several screening programs and qualification programs to select candidates for ATCS training. Early programs typically measured an individual's ability to perform well in test-taking environments or training environments, but the programs were not effective in identifying individuals who were likely to succeed in job performance. Later programs analyzed job tasks and developed ways to measure job performance in an attempt to screen candidates for training. In 1997, in anticipation of having to replace the large number of ATCSs who will reach retirement eligibility beginning in 2005, FAA began researching better methods for predicting ATCS job performance and for screening candidates for training. Air Traffic Service (ATS) has said that from 500 ATCS candidates to 800 ATCS candidates must be hired every year for the next several years to maintain proper staffing levels. ATS also has said that two years to four years will be required for newly trained ATCSs to reach their full performance levels.

The report says that the ATCS position requires a combination of knowledge, skills and abilities, such as the ability to perform multiple tasks simultaneously, that are not prevalent in the labor force. The report defines the main task of the ATCS as maintaining a "proper level of separation between airplanes."

This report describes the development, administration, analysis and revisions of the Air Traffic Selection and Training (AT-SAT) pilot battery of tests, job task analysis and job performance measures. The AT-SAT tests measure individual skills and abilities in the following areas: applied math, dials, angles, sound, and memory tests; analogies, word relationships, information processing and reasoning, planning and thinking ahead; and scenarios involving situational awareness, projections of future actions and recall after interruptions.

Documentation of Validity for the AT-SAT Computerized Test Battery, Volume II. Ramos, R.A.; Heil, Michael C.; Manning, Carol A. U.S. Federal Aviation Administration (FAA) Office of Aviation Medicine. DOT/FAA/AM-01/6. March 2001. 179 pp. Figures, tables, appendixes. Available through NTIS.*

This is the second part of the report on the Air Traffic Selection and Training (AT-SAT) predictor development and validation project. The report discusses development of criteria for air traffic control specialist (ATCS) performance, task analysis that reflects the complex nature of the job and computer-based performance measures. The report also discusses the relationship between AT-SAT predictor measures and criterion measures and 30 years of archival data from the FAA Civil Aeromedical Institute studies on ATCS selection and training.

International Accident Facts Second Edition. National Safety Council. Itasca, Illinois, U.S. 1999. 106 pp. Tables.

Activities and programs of the National Safety Council, a not-for-profit U.S. public service organization, and its global subsidiary, the International Safety Council, focus on educating society about safety practices and health practices that reduce human suffering and economic losses. This report is a tabulation of United Nations World Health Organization data about occupational injuries and deaths by country and industry, including air transport accidents.

Advisory Circulars

Instructions for Continued Airworthiness: In-service Inspection of Safety Critical Turbine Engine Parts at Piece-Part Opportunity. U.S. Federal Aviation Administration (FAA) Advisory Circular (AC) 33.4-2. March 8, 2001. 9 pp. Available through GPO.**

Uncontained failure of safety-critical parts is the leading cause of engine-related continued airworthiness assessment methodology (CAAM) level 3 and level 4 hazards or events for turbofan engines, 15 years of transport aircraft accident data and incident data show.

A CAAM level 3 hazard or event is a malfunction of a propulsion system or auxiliary power unit (APU) that causes substantial damage to the aircraft or its systems, such as penetration of a fuel line or fuel tank. A CAAM level 4 hazard or event is a propulsion system or APU malfunction that involves forced landing, loss of aircraft, fatalities or serious injuries.

This AC provides guidance and acceptable methods for complying with the requirements of U.S. Federal Aviation Regulations Part 33.4 and contains instructions for in-service inspections of safety-critical turbine engine parts. In-service inspections should be conducted each time a safety-critical part is completely disassembled, unless the part has been inspected within the previous 100 cycles in service.

Books

Meteorology for Pilots. Wickson, Mike. Third edition. Shrewsbury, England: Airlife Publishing, 2001. 350 pp.

This book was compiled to help student pilots prepare for U.K. Civil Aviation Authority examinations in meteorology and European Joint Aviation Requirements airline pilot licenses. The book includes diagrams and photos and discusses various aspects of meteorology, climatology and aviation weather hazards. A chapter on "practical forecasting from a pilot's point of view" is included to help pilots appreciate the intricacies of weather forecasting and to develop their own landing forecasts and en route forecasts.♦

Sources

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5285 Port Royal Road
Springfield, VA 22161 U.S.
Internet: http://www.ntis.org

** Superintendent of Documents
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Washington, DC 20402 U.S.
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Airplane Taxies Onto Grass After Landing at Airport With Construction in Progress

The airplane was taxied onto a grassy area sprayed with black asphalt that adjoined the runway. Neither the notices to airmen nor the automatic terminal information service said that work was being done adjacent to the runway.

FSF Editorial Staff

The following information provides an awareness of problems through which such occurrences may be prevented in the future. Accident/incident briefs are based on preliminary information from government agencies, aviation organizations, press information and other sources. This information may not be entirely accurate.

Air Carrier

Incident Prompts Recommendation for Review of Taxiway Lighting, Marking

Boeing 767. Minor damage. No injuries.

The flight crew had read the notices to airmen (NOTAM) before their flight to an airport in England and had listened to the airport automatic terminal information service (ATIS) information before conducting the evening approach.

They were given vectors for an instrument landing system approach to Runway 26L, and they could see the runway when the airplane was seven nautical miles (13 kilometers) away. The captain observed floodlights being used in connection with work around the threshold of Runway 08L; he said that the work might affect runway exits that were closer to the departure end of the runway and that their use of the second rapid-exit turnoff would be desirable. (The work had not been mentioned in the NOTAM or the ATIS.)

The flight crew's final check of airspeed showed that the airplane was traveling 133 knots. (Landing reference speed [V_{REF}] — the indicated airspeed that the airplane should be flying 50 feet above the landing area in landing configuration — was 128 knots.) The aircraft weighed about 30,000 kilograms (66,138 pounds) less than maximum landing weight. Before landing, the flight crew selected autobrake level 3, which operated normally, as did the speed brakes. The airplane touched down on the runway centerline in the correct position.

"The first officer selected 60 percent reverse thrust; but during the rollout, it became apparent to the [captain] that autobrake level 3 would not achieve the required deceleration to use [the second rapid-exit turnoff]," the report said. "The [captain] therefore increased the autobrake level to 4. …

"The aircraft slightly overshot the second [rapid-exit turnoff] centerline as it decelerated through 40 knots. The [captain] stated that at 35 knots, he initiated the right turn to clear the runway using the nosewheel-steering tiller."

The captain said that, although the airplane was not on the centerline, it nevertheless was about to enter "an area of tarmac." There were no edge lights on the rapid-exit turnoff, and they were not required. Painted markings on the runway and nearby paved surfaces were not visible because of water on the surface and glare from lights at the work area. During the turn, as the airplane's forward section moved over the rapid-exit turnoff centerline, the airplane "bucked" and stopped, the report said. The captain applied the brakes and realized that some of the landing-gear wheels were not on paved surface and that the airplane could not move. The engines were shut down, and passengers disembarked using mobile steps.

An investigation showed that the area that the captain believed was tarmac was actually grass between the runway and the rapid-exit turnoff that had been sprayed with black asphalt.

After the incident, the airport placed lighting across the entrance of the rapid-exit taxiways where they joined the outer edge of the runway shoulder.

The airplane operator issued guidelines for using rapid-exit taxiways that said that centerline markings "*must* be followed, and the speed of the aircraft must allow it to safely maintain the centerline *and* decelerate to an appropriate level by the end of the [rapid-exit taxiway]."

The operator also recommended a review of the practice of spraying black asphalt on non-load-bearing surfaces near the runway edge, of the installation of taxiway edge markings, the positioning and lighting of work areas near runways and other operational areas, and of the distribution of information about new runways or taxiways.

Flight Deck Smoke, Fumes Traced to Faulty DME

Boeing 767. Minor damage. No injuries.

After departing from Singapore, the flight crew observed smoke and smelled electrical fumes on the flight deck. After failing to determine the source of the smoke and fumes, they donned oxygen masks and diverted the flight to an airport in Indonesia.

An inspection by maintenance personnel revealed that the right distance-measuring-equipment (DME) circuit breaker was open because of a malfunction in the right DME interrogator unit. The DME unit was disabled in accordance with minimum equipment list guidelines to allow the flight to continue to an airport in Australia, where the unit was replaced.

The manufacturer's inspection revealed that the DME unit's A5 modulator had overheated. Similar malfunctions had occurred in two other units on another airplane nine months earlier. Service bulletins that had recommended modifications of the unit were not mandatory, and the modifications had not been incorporated into the three malfunctioning units.

Air Taxi Commuter

Cabin Smoke Blamed on Leaking Oil

Fokker F27 Mark 50. No damage. No injuries.

The airplane was being flown through 1,000 feet after departure from an airport in England when a cabin crewmember told the captain that there was smoke in the cabin. The flight deck then began to fill with smoke, and the captain declared an emergency and received clearance to return for landing at the departure airport.

The first officer turned the airplane onto a downwind leg, and the pilots donned oxygen masks and smoke hoods. The smoke was so dense, however, that they had difficulty seeing the tear seals on the protective bags that contained the smoke hoods.

The flight crew performed the emergency checklist, and after they turned off the air-conditioning system, smoke stopped entering the cabin. The pilots conducted a normal landing, stopped the airplane on the runway and shut down the engines.

The incident occurred two days after the airplane had been flown to the departure airport. After arrival, oil was observed on the lower engine cowl of the right engine, aft of the spinner and around the engine intake.

"Upon inspection, the reduction-gearbox-propeller-shaft seal was thought to have failed," the incident report said. "The right propeller was therefore removed, a new reduction-gearbox-shaft seal fitted and the propeller refitted. Engine ground runs were then performed satisfactorily, and the aircraft was returned to service."

The next day, during takeoff for a scheduled passenger flight, the first officer observed smoke in the cabin and the flight deck, and the crew rejected the takeoff.

"The aircraft was brought to a halt on the runway, the air-conditioning bleed air was switched 'OFF,' and the smoke disappeared," the report said.

In both instances, the captains said that the cabin crew was unable to inform the flight deck of the smoke in the cabin. Normally, use of the interphone system sounds a buzzer on the flight deck, but — to limit interruptions to the flight crew — the buzzer is inhibited for 40 seconds during takeoff after the airplane reaches a speed of more than 80 knots.

After the first incident, maintenance personnel attempted to reproduce the problem but failed. A small amount of oil was observed under the right engine nacelle, but it was believed to have been a result of the earlier work to replace the reduction-gearbox-shaft seal.

Nevertheless, the report said, "since oil in this area was likely to be injected through the air intake, it could have contaminated the compressor air bleed for the air-conditioning system and thus have caused the smoke to appear within the cabin. The oil was … cleaned away, and an entry [was] made in the technical log for the engine nacelle to be checked for oil traces and cleaned after every flight. The aircraft was then returned to service."

After the second incident, maintenance personnel observed new traces of oil beneath the right engine, and they again replaced the reduction-gearbox-propeller-shaft seal. Another oil leak was observed near the air intake, behind the propeller-feathering pump, which was replaced. New traces of oil were observed after high-speed taxi runs; the area was cleaned, and another engine ground run was performed. No new oil leaks were observed, and the airplane was returned to service.

An investigation found that the source of the oil leaks was the propeller-feathering pump.

"The feathering pump is exercised prior to the first flight of the day as part of flight crew checks," the report said. "This defective pump would have leaked oil into the right engine intake prior to each of the incident takeoffs, causing the oil to be mixed with the hot compressed air bled into the air-conditioning system, producing the oil 'smoke/mist' in the cabin. The feathering pump would not normally have been exercised as part of the engineering ground runs. This might have accounted for the failure of these engine ground runs to reproduce the reported oil smoke/mist effects. The airline's [maintenance] contractor has since issued [a maintenance bulletin] … to highlight this aspect."

As a result of the incident, the operator told cabin crewmembers that, if they receive no response when attempting to use the interphone during takeoff, they should "wait at least 40 seconds and try again," the report said. Cabin crewmembers were told that, in the event of an emergency, they must enter the flight deck to communicate with the pilots.

Electrical Short Blamed For Cockpit Fire

Beech C-99. Minor damage. No injuries.

Instrument meteorological conditions prevailed for the evening flight from an airport in the United States. The pilot said that he was flying the airplane in cruise at 9,000 feet when he smelled an odor in the cockpit and observed flames coming from the main-circuit-breaker panel below the right cockpit window.

The pilot reported the problem to air traffic control. While he was reporting the fire, the flame extinguished, but smoke remained in the cockpit. The pilot landed at an en route airport.

An inspection by maintenance personnel showed that the fire had burned a 0.25-inch (6.35-millimeter) hole in the covering of the circuit-breaker panel. Maintenance personnel said that the apparent cause of the fire was an internal short in the back-lighting panel beneath the panel. The malfunction did not involve enough electrical current to activate a circuit breaker.

Corporate
Business

Takeoff Rejected After Attempt at Rotation Fails

Learjet 35. Substantial damage. No injuries.

Visual meteorological conditions prevailed for the afternoon departure of the emergency medical services flight from an airport in the United States. The flight crew conducted all pre-takeoff checklists and observed that flight-control movements appeared normal. When the airplane accelerated to rotation speed (125 knots) during the takeoff roll, the captain applied back pressure to the control yoke, but the airplane's nose did not rise. When the airplane was halfway down the runway traveling about 140 knots, the flight crew decided to reject the takeoff.

The report said that the rejected takeoff checklist was completed and that maximum braking was applied. The airplane rolled off the end of the runway and slid into a chain-link fence.

The pilot said that the control yoke had moved to its full-aft position but did not have "normal resistance." A preliminary investigation revealed that the ailerons and the horizontal stabilizer moved freely through their full range of travel, that the pitch trim had been set to the takeoff position, that flaps had been selected to eight degrees and that spoilers had been extended. No snow or ice was observed on the wings or the horizontal stabilizer, and the weight and balance were within acceptable limits. (The accident report did not mention an examination of the elevators.)

Smoke in Cockpit Prompts Landing

De Havilland DHC-6. Minor damage. No injuries.

After departure from an airport in Canada, the flight crew observed smoke in the cockpit. They received clearance from air traffic control to return to the departure airport for landing.

The flight followed maintenance to replace the oxygen-regulator panel. The incident report said that wiring for the panel illumination had been connected incorrectly, causing an electrical short circuit, which resulted in overheating of the wiring and the lighting rheostat. The panel illumination had not been tested after installation.

The circuit breaker did not activate during the incident.

Other General Aviation

Pilot Blames Tail Wind For Landing Accident

Stinson 108-3. Substantial damage. No injuries.

Visual meteorological conditions prevailed during the midday landing at an airport in the United States. The pilot said that he had departed from the airport earlier in the day, when the wind favored Runway 25. Several hours later, during the return flight, he monitored the automatic terminal information service at an airport on a nearby island, where the wind was from 340 degrees.

The pilot said that, during his first attempt to land on Runway 25, he believed that there was a tail wind. He conducted a go-around and observed a limp windsock in an area surrounded by trees at the approach end of the runway.

He then landed the airplane on Runway 25, but the wind pushed the empennage to the left, and the airplane departed the right side of the runway, struck a tree and stopped.

"After the accident, the pilot observed that [another] windsock on the hangar was favoring Runway 07, at five [knots] to seven knots," the report said.

Airplane Strikes Electrical Conductors

Bellanca 8KCAB. Substantial damage. No injuries.

Day visual meteorological conditions prevailed as the airplane was flown toward an area in South Africa where the pilot intended to perform aerobatic maneuvers. The pilot flew the airplane along a river and did not see three 11-kilovolt electrical conductors that spanned the river about 30 meters (98 feet) above the water.

The airplane collided with the electrical conductors, then struck the river about 250 meters (820 feet) downstream.

The accident report said that the probable cause of the accident was that the pilot conducted a flight below 500 feet "without familiarizing himself with the terrain and location of possible hazards."

Rotorcraft

Pilot Loses Control of Helicopter In Turbulence

Messerschmitt-Bolkow-Blohm BK117 B-2. Substantial damage. No injuries.

The helicopter suddenly pitched to a nose-up attitude during a shallow climb at 4,600 feet during a post-maintenance flight. The indicated airspeed decreased to zero, and the helicopter pitched nose-down to a slightly inverted attitude. After a 2,000-foot descent, the pilot regained control and conducted a normal landing.

An inspection by maintenance personnel found no reason for the sudden loss of control.

At the time of the incident, weather reports said that winds were from the west, increasing from 35 knots at 2,000 feet to 50 knots at 7,000 feet. Those conditions are favorable for mountain waves and rotor winds, the report said.

The report said that the helicopter was being flown on the lee side of a mountain when the incident occurred and that an encounter with winds was probable.

Passenger Struck by Rotor Blade

Sikorsky SK-76A. No damage. One fatality.

Visual meteorological conditions prevailed when the helicopter was landed on an oil platform in the Gulf of Mexico. The helicopter's rotors were engaged when a passenger attempting to board was struck by the main rotor.♦

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