AviationSafety WORLD

CAUTION — TURBULENCE
Auto-reporting advances

SALVAGING PILOTS
Battling alcoholism

NIGHT DEPARTURE
Learjet 35A CFIT

LEADERS LOG
Aaronson

GOING WITH THREE

PRESSING ON AFTER ENGINE SHUTDOWN

THE JOURNAL OF FLIGHT SAFETY FOUNDATION

SEPTEMBER 2006

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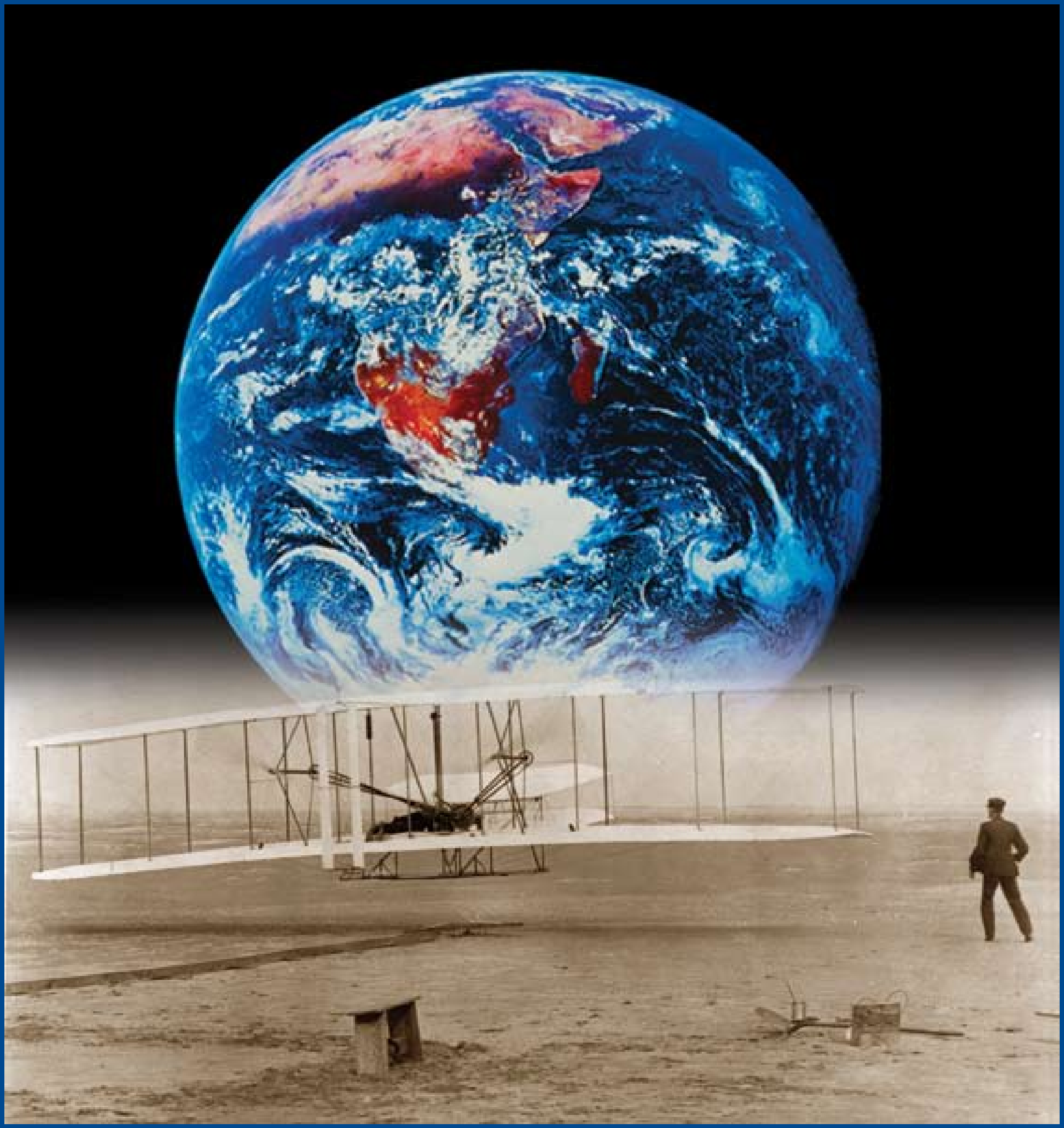

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KEEPING Pace

Flight Safety Foundation keeps pace with the safety challenges of the fast-changing aviation industry. I'd like to tell you, briefly, about some of the more recent developments.

The Foundation has absorbed Aviation Safety Alliance, which was set up by the directors of the Air Transport Association to educate the media on aviation safety.

A communications department, led by Emily McGee, formerly with the Aviation Safety Alliance, has been established to continue the Alliance's work and to improve the Foundation's external communications.

The FSF Web site, <www.flightsafety.org>, is being upgraded. Currently, nearly all FSF publications for the past 17 years are available on line and can be freely downloaded.

The recommendations and best practices contained in the FSF *Approach-and-Landing Accident Reduction (ALAR) Tool Kit* have been accepted by the U.S. Federal Aviation Administration (FAA) and the European Aviation Safety Agency (EASA). We're engaged in regional implementation, and have held some 25 training workshops around the world. To date, some 3,000 people have attended the workshops, which are provided by the Foundation free of charge.

The Foundation brought together under its neutral umbrella all stakeholders concerned in ultra-long-range (ULR) aircraft operations and developed consensus guidelines and best practices that were successfully implemented by Singapore Airlines on its New York–Singapore non-stop route. Other airlines are now starting ULR operations using the FSF guidelines, and the International Federation of Air Line Pilots' Associations supports the FSF recommendations (see Air Mail, *Aviation Safety World*, August 2006, page 6).

The Foundation has developed flight operational quality assurance (FOQA) pilot programs that are being tested in the corporate aviation industry.

Ground Accident Prevention (GAP) is a major FSF initiative addressing apron accidents, which cost the aviation industry some US$5 billion per year.

The Foundation successfully introduced amendments to International Civil Aviation Organization (ICAO) Annex 13, which deals with accident investigation. As a result, states have guidelines for laws and regulations to protect sources of safety information so that accident investigations will not be hindered by litigation concerns and judicial interference.

The Foundation facilitated industry meetings to develop consensus on new guidelines and procedures to be followed if smoke, fire or fumes are detected in flight. These procedures have been accepted, and the flight manuals of aircraft are now being changed to reflect them.

The Foundation has long pointed out the need to address the significantly higher accident rates in developing regions, particularly Africa and South America. As a result, the Foundation has played a major role in developing for ICAO the recently published Global Aviation Safety Roadmap, a plan for coordinated effort among all major stakeholders to effect safety improvements in regions where they are most urgent.

Nigeria had a particularly poor record in 2005, with four major accidents and 225 fatalities. Its government announced a major shake-up in the civil aviation organization and appointed Dr. Harold O. Demuren as the new director general of the Nigerian Civil Aviation Authority. Dr. Demuren, a longtime member of the FSF Board of Governors, turned to the Foundation for assistance. That is now being provided, and the Foundation has a team of experienced aviation personnel in Nigeria.

Flight Safety Foundation is involved in, or leading, virtually every major aviation safety improvement effort in the world today. We rely on the industry we serve to help us. The cost is not great, and we welcome new and continuing membership.

Stuart Matthews.

Stuart Matthews
President and CEO
Flight Safety Foundation

AviationSafetyWORLD

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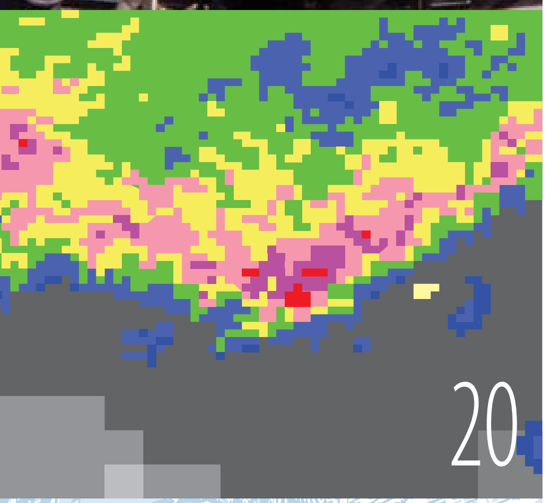

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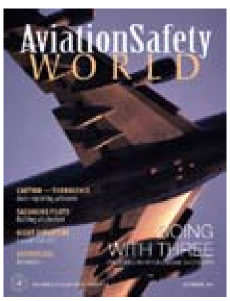

About the Cover
British Airways' three-engine transatlantic flight is reviewed.
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Share Your Knowledge

If you have an article proposal, manuscript or technical paper that you believe would make a useful contribution to the ongoing dialogue about aviation safety, we will be glad to consider it. Send it to Director of Publications J.A. Donoghue, 601 Madison St., Suite 300, Alexandria, VA 22314-1756 USA or <donoghue@flightsafety.org>.

The publications staff reserves the right to edit all submissions for publication. Copyright must be transferred to the Foundation for a contribution to be published, and payment is made to the author upon publication.

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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 900 member organizations in 142 countries.

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SWEATING THE Small Stuff

Trudging through the heat of this year's Farnborough Air Show outside of London, I blinked the sweat out of my eyes and worked to refocus my vision on events at the show that mattered to me from an *Aviation Safety World* point of view. Several decades of watching the business end of air transport had deeply embedded a different set of air-show reflexes. But this year, all that mattered to me were the things related to safety — improving safety, mostly, but also trying to be attuned to developments that had the potential to degrade safety margins. Frankly, I expected that there would be a number of developments discussed at the show that enhanced safety, but having never concentrated on that aspect it was just my best guess.

There were, it turned out, numerous announcements that met these new specifications. Further, the wide selection of topics reminded me that a safe operation is a construct of thousands of little details — small stuff, really.

The aviation safety community is a decade into an era in which important classes of accidents, the killers — things like controlled flight into terrain, approach-and-landing accidents, and loss of control — have been identified and targeted for action. The great achievements of the campaigns against those big issues may have drawn some attention from the smaller parts of the safety mosaic, but they remain. Thankfully, the drive to maximize safety remains so strong, and therefore the market for such improvements remains so healthy, that manufacturers remain motivated to invest time and money in development and innovation, continuing to push the cause forward on a wide front.

Avionics remains a leading provider of new safety tools. At Farnborough, one could see a new generation of radars; evolving electronic flight bags; improved enhanced vision systems and now synthetic vision systems; ground navigation assists; and a wide range of new applications based on the developing automatic dependent surveillance-broadcast technology which promises a step-change advancement of information distribution and air traffic control innovation and amounts to another really Big Thing.

But there are other things, as well. For example, Michelin's Near Zero Growth tire technology that resists cuts and wear — developed for Concorde after the fatal accident — is becoming available for other aircraft. And tests are under way on a wake vortex warning system that aims to increase airport capacity by minimizing the risk of vortex encounters.

Unfortunately there still are issues that await serious progress. One that comes immediately to mind is the question of fuel tank inerting. European Aviation Safety Agency (EASA) officials speaking at the show said there still is no answer. "We are discussing this for two years now with [the U.S. Federal Aviation Administration (FAA)], but it is not finalized," said EASA Technical Director Norbert Law. "We are still forming a decision with FAA on both sides."

While there remains a lack of agreement about the best way forward on this matter, or even agreement on the degree of risk posed by continued operation without inerting in existing or newly designed aircraft, Law said EASA felt confident enough about the issue to tell Airbus that the A380, which does not have a center tank, can be built without inerting. This despite the fact that recently a 727 blew up on the ramp, and it wasn't a center tank but a wing tank that triggered that event.

Nonetheless, advances continue, both on the big topics and in a thousand smaller things across the board. And while the system is still a bit short of perfect, it was gratifying to see at Farnborough evidence of progress in small stuff moving toward that perfection goal.

Congratulations From Toulouse

I just received the first issue of the Foundation's new publication. Congratulations to all for this very attractive and content-rich new presentation!

The challenge of encapsulating in one publication all the previous bulletins and *Flight Safety Digest* has undoubtedly been achieved.

I will go through the various articles, but I wished to share with you, without delay, my enthusiasm and appreciation for this achievement.

Michel Trémaud
Senior Director,
Safety Programs/Initiatives Product Safety
Airbus
Toulouse, France

Tribute to Former Editors

Congratulations to Flight Safety Foundation for its new publication, *Aviation Safety World*! As a flight safety information user (U.S. National Aeronautics and Space Administration and Enders Associates International) and provider (FSF), I have watched and participated in the steady progression of the Foundation's publications for over 48 years as they were successively adapted to the evolutionary needs of the broader aviation community they have served. This could not have happened without the dedication of a group of individuals over the years who enabled the timely dissemination of vital safety information to the user community.

Former editors Gloria Heath, Doris Ahnstrom, Ira Rimson, Cecil Brownlow and Roger Rozelle with their devoted staffs played crucial roles in making Flight Safety Foundation the respected source of objective and credible aviation safety information.

I look forward to seeing the continued growth and development of this information link to the user community in the months and years to come.

John H. Enders
Former President, CEO and Vice Chairman
Flight Safety Foundation

Aviation Safety World encourages comments from readers, and will assume that letters and e-mails are meant for publication unless otherwise stated. Correspondence is subject to editing for length and clarity.

Write to J.A. Donoghue, director of publications, Flight Safety Foundation, 601 Madison St., Suite 300, Alexandria, VA 22314-1756 USA, or e-mail <donoghue@flightsafety.org>.

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SEPT. 19–21 ➤ 2006 Conference on Risk Analysis and Safety Performance in Aviation. U.S. Federal Aviation Administration. Atlantic City, New Jersey, U.S. Rosanne Weiss, <rosanne.weiss@faa.gov>, <http://aar400.tc.faa.gov/FlightSafety/Conference2006.htm>, +1 609.485.4370.

SEPT. 25–27 ➤ 2006 Air Medical Transport Conference. Association of Air Medical Services. Phoenix. Natasha Ross, <nross@aams.org>, <www.aams.org>, +1 703.836.8732.

SEPT. 25–27 ➤ Crisis Management Conference 2006. International Air Transport Association. Warsaw. Alison Zahynacz, <zahynacza@iata.org>, <http://iata.org/events/crisis2006>, +1 514.874.0202, ext. 3353.

SEPT. 27–29 ➤ Worldwide Symposium on Air Navigation: Flying Through Congested Skies. International Civil Aviation Organization and McGill University. Montreal. <icaohq@icao.int>, <www.icao.int>, +1 514.954.8219.

OCT. 2 ➤ Safety Seminar. International Federation of Air Line Pilots' Associations. Rio de Janeiro. Arnaud du Bedat, <arnauddubedat@ifalpa.org>, +44 (0)1932 571711.

OCT. 3–5 ➤ Bombardier Learjet Safety Standdown 2006. Wichita, Kansas, U.S. Dawn Pepperd, <dawn.pepperd@aero.bombardier.com>, +1 316.946.7240.

OCT. 3–5 ➤ IAFPA Conference. International Aviation Fire Protection Association. Dublin. Colin Simpson or John Trew, <admin@iafpa.org.uk>, +44 (0)7879 872994.

OCT. 5–6 ➤ Risk Management for the SMS Accountable Executive. Dalhousie University RBC Centre for Risk Management and AlgoPlus Consulting. Halifax, Nova Scotia, Canada. Dr. Ronald Pelot, Dalhousie, <ronald.pelot@dal.ca>, +1 902.494.1769; Dr. Alex Richman, AlgoPlus Consulting, <arichman@algoplusaviation.com>, +1 902.423.5155.

OCT. 17–19 ➤ National Business Aviation Association Annual Meeting and Convention. Orlando, Florida, U.S. Jan Kelliebrew, <jkelliebrew@nbaa.org>, <www.nbaa.org>, +1 202.783.9283.

OCT. 23–26 ➤ International Air Safety Seminar (IASS). Flight Safety Foundation. Paris. Namratha Apparao, <www.flightsafety.org>, +1 703.739.6700, ext. 101.

OCT. 23–25 ➤ SAFE Association 44th Annual Symposium. Reno, Nevada, U.S. Jeani Benton, <safe@peak.org>, <www.safeassociation.com>, +1 541.895.3014.

NOV. 1–3 ➤ Third Annual International Aviation Safety Forum. U.S. Federal Aviation Administration and Air Transport Association of America. Chantilly, Virginia, U.S. (near Dulles International Airport). <www.faa.gov/news/conferences>.

NOV. 7–10 ➤Blue Angels Seminar 2006. National Transportation Safety Board Bar Association. Pensacola, Florida, U.S. Tony B. Jobe, <jobelaw@msn.com>, <www.ntsbbar.org>, +1 985.845.8088.

NOV. 12–14 ➤ AAAE Runway Safety Summit. American Association of Airport Executives. Boston. <aaaemeetings@aaae.org>, <www.aaae.org>, +1 703.824.0500.

NOV. 13–15 ➤ European Aviation Conference. Hamburg. Everest Events. Caroll Everest, <caroll@everestevents.co.uk>, <www.everestevents.co.uk>, +44 (0)1342 324353.

NOV. 14–17 ➤ Aircraft Maintenance & Reliability Seminar. Transportation Systems Consulting Corp. Tampa, Florida, U.S. <www.tsc-corp.com>, +1 727.785.0583.

NOV. 17 ➤ IS-BAO (International Standard for Business Aircraft Operations) Implementation Workshop. Long Beach, California, U.S. International Business Aviation Council (IBAC). Bill Stine, <bstine@nbaa.org>. IBAC: +1 514.954.8054.

NOV. 27–29 ➤ Asia-Pacific Regional Conference. International Federation of Air Line Pilots' Associations. Auckland, New Zealand. Carole Couchman, <carolecouchman@ifalpa.org>, <www.ifalpa.org>, +44 (0)1932 571711.

DEC. 5–6 ➤ Airport, Port & Transport Security Europe. London. Sarah Kershaw, <skershaw@ibeltd.com>, <www.apts-expo.com>, +44 (0)1303 850259.

DEC. 6–7 ➤ Approach-and-Landing Accident Reduction (ALAR) Workshop. Flight Safety Foundation. Tokyo. James M. Burin, <burin@flightsafety.org>, +1 703.739.6700, ext. 106.

Aviation safety event coming up? Tell industry leaders about it.

Aviation Safety World, the new publication of Flight Safety Foundation, includes an events calendar in every issue. If you have a safety-related conference, seminar or meeting, we'll list it. Get the information to us early — we'll keep it on the calendar until the issue dated the month before the event! Send listings to Rick Darby at Flight Safety Foundation, 601 Madison St., Suite 300, Alexandria, VA 22314-1756 USA, or <darby@flightsafety.org>.

Be sure to include a phone number and/or an e-mail address for readers to contact you about the event.

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Safety News

Changes Recommended in MSAW System Design

The U.S. National Transportation Safety Board (NTSB) has recommended changes in the minimum safe altitude warning (MSAW) system and the conflict alert system, which direct the attention of air traffic controllers to impending collisions or ground contact.

NTSB on July 12, 2006, issued four safety recommendations to the U.S. Federal Aviation Administration (FAA):

- "Redesign the [MSAW] and conflict alert systems and alerting methods such that they reliably capture and direct controller attention to potentially hazardous situations detected by the systems. Implement software changes at all air traffic control facilities providing MSAW and conflict alert services;
- "Implement any software and adaptation modifications needed to minimize or eliminate unwarranted [MSAW] alerts;
- "Perform a technical and procedural review at all air traffic facilities with [MSAW] or conflict alert capability to verify that software configuration and parameters are consistent with local air traffic procedures. Ensure that MSAW and conflict alert warnings are provided to the relevant controllers; [and,]
- "Amend FAA Order 3120.4L, *Air Traffic Technical Training*, to require that all controllers study and demonstrate an understanding of the relationship between charted minimum instrument flight rules altitudes and the underlying topography for their areas. Emphasize that controllers should maintain awareness of aircraft altitudes to detect and effectively react to situations in which a safety alert may prevent an accident (especially aircraft operating in remote areas at night)."

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The recommendations followed the investigation of 11 aircraft accidents that caused "serious concern about the effectiveness of [FAA's] methods of ensuring that air traffic controllers detect and properly respond to imminently hazardous situations," NTSB said. Of the 11 accidents, 10 involved apparent controlled flight into terrain (CFIT) and one involved a midair collision.

EMAS Halts Falcon 900 in Runway Overrun

A Dassault Falcon 900 business jet that overran the runway after a brake system malfunction during landing at Greenville, South Carolina, U.S., was brought to a controlled stop after entering an engineered materials arresting system (EMAS) arrestor bed at the end of the runway (see *Aviation Safety World,* August 2006, p. 13).

Five people in the airplane were not injured, and the airplane received no significant damage, according to Engineered Arresting Systems Corp. (ESCO), the developer of EMAS.

ESCO said that this was the fourth time an EMAS arrestor bed has safely stopped a commercial aircraft following a runway overrun. EMAS was installed in 2003 at Greenville Downtown Airport — the first installation of an arrestor bed designed specifically for small business jets and other general aviation aircraft.

Port Authority of New York and New Jersey

Bulletin Identifies Atlantic Navigation Errors

International aviation specialists monitoring flights over the Atlantic Ocean have observed significant errors in navigation, altitude deviations and loss of longitudinal separation, the International Federation of Air Line Pilots' Associations (IFALPA) says.

In its June 15, 2006, *Safety Bulletin*, IFALPA said that International Civil Aviation Organization (ICAO) North Atlantic Working Groups had identified "repetitive" navigation errors of as much as 25 nm (46 km) and altitude deviations of 300 ft or more. Most navigation errors have occurred after issuance of a re-clearance, the working groups said.

The working groups issued an oceanic errors safety bulletin (OESB) containing recommendations to reduce errors.

The recommendations, intended to be discussed during initial and recurrent ground training, said that flight crews "must ensure they correctly copy the re-clearance, reprogram (and execute) the FMS [flight management system], … update the master computer flight plan (CFP) and update the plotting chart. … Crews must follow a re-clearance (and not the previous flight plan)."

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CASA Warns of Turbulence Risks

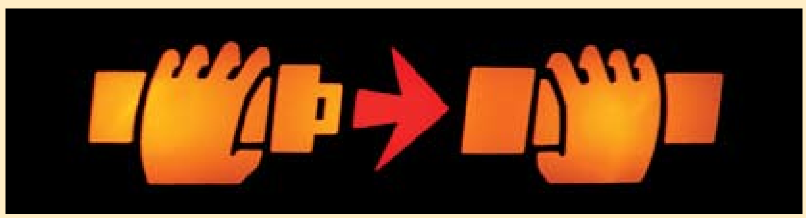
The Civil Aviation Safety Authority of Australia (CASA) has issued a reminder to airline flight crews to "be vigilant about the dangers to passengers and cabin crew of in-flight turbulence."

CASA's warning was issued after occurrences in which two cabin crewmembers were injured when they were thrown to the floor when a Boeing 767 encountered moderate to severe clear air turbulence during a flight from Adelaide to Perth, a crewmember on another 767 was injured when she fell backward onto a bench during light turbulence and two Bombardier Dash 8 crewmembers were thrown to the floor by moderate turbulence during landing.

"While turbulence is normal and happens often, it can be dangerous," CASA said. "Its roller coaster ride can cause passengers and cabin crew who are not wearing their seat belts to be thrown about without warning."

About one dozen serious turbulence incidents are reported annually in Australia, CASA said.

"The best defense airlines can deploy against the dangers of turbulence is quick action to ensure passengers and crew are seated and fasten their seat belts," CASA said. "To do this, airlines need to have effective training for pilots and cabin crew on turbulence-related issues, to promote good communication between all crew on board aircraft and strategies to ensure compliance with directions to fasten seat belts."



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DNA Testing Aids in Bird-Strike Identification

Forensic DNA testing can be used to identify species killed in bird strikes, according to research conducted for the Australian Transport Safety Bureau (ATSB).

The research involved animal tissues collected using 250 DNA-sampling kits sent to airports across Australia. The tissues that were tested were exposed to damaging conditions, and researchers found that the conditions most damaging to DNA occur when bird samples are left at room temperature for seven days or longer. If DNA is to be used routinely to identify strike samples, procedures must be developed to limit the time of non-refrigerated storage, according to a report on the research.

The researchers also found that, although they had expected ATSB's top eight highest risk species to be the animals most frequently involved in strikes, only 27 percent of the samples used in their tests were found to be species from that list.

The DNA tests identified three bat species and 17 bird species — a greater diversity than was expected. The report recommended that airport personnel be given additional assistance in species identification to "ensure that the correct species are being managed in habitats surrounding civilian aerodromes."

Council Urges Increase in Aeronautical Research

The U.S. National Aeronautics and Space Administration (NASA) is being encouraged to intensify its aeronautical research efforts to make the air transportation system more efficient, safer and environmentally friendly.

The National Research Council, a nonprofit institution that advises the U.S. government on research and technology, says the United States can maintain global leadership in aviation only by continuing to invest in research and technology projects conducted by NASA, industry, universities and other government agencies.

"The air transportation system will need to double its capacity over the next 10 to 35 years, develop new technologies to reduce noise and emissions, and decrease the number of accidents even though the number of flights will increase substantially," said Paul Kaminski, chairman of a council committee that made the recommendations.

The recommendations — included in a report, *Decadal Survey of Civil Aeronautics — Foundation for the Future* — call for the development of aircraft that are quieter, more efficient and less polluting than today's aircraft; and for new technologies than can "quickly detect and respond to anomalies outside or inside a plane" and reduce delays during periods of peak travel.

Research projects that ultimately are selected should receive stable funding for at least a decade, the report said. Funding for the NASA aeronautics program has been cut from more than US$1 billion in fiscal 2004 to $724 million in fiscal 2007, which will begin Oct. 1, 2006. Additional funding cuts would prevent completion of vital research, the report said.

The report will be available in fall 2006 from the National Academies Press.

U.S. National Aeronautics and Space Administration

In Other News …

The International Civil Aviation Organization has identified 29 high-risk areas at the new Bangkok Suvarnabhumi Airport, scheduled to open in September. Airport officials say all of the problems — some of which involve signs on the taxiways, apron (ramp) and airside roads; lights; and markings — will be corrected before the airport opens. … A study by the U.S. Federal Aviation Administration has found that the use of flameless ration heaters — used to heat prepackaged ready-to-eat meals used by the military, disaster-response teams and others — in an aircraft cabin presents a potential hazard in the form of high temperatures and "violent ignition events." … The U.S. Federal Aviation Administration has begun implementing a program designed to reduce flight delays resulting from severe thunderstorms and other severe weather. The Airspace Flow Program will allow air traffic control to delay aircraft that are likely to encounter extremely bad weather and issue expected departure times to their crews; aircraft unaffected by the bad weather will proceed without delay.

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Compiled and edited by Linda Werfelman.

To a Higher Level

BY ROBERT J. AARONSON

Safety is, and will always be, the top priority in the air transport industry. This commonly held commitment to safety has been an essential driver to aviation's constantly improving safety record. Airports Council International (ACI) and the airports community are fully committed to pursuing the highest safety standards in airport operations worldwide.

Working in accordance with the International Civil Aviation Organization (ICAO) requirements, ACI has always promoted adequate State oversight of safety, and this should be functionally separate from the operational management of airports. From the inception of the ICAO Universal Safety Oversight Audit Program (USOAP), ACI supported its extension to airports. It is important that this extension of the safety oversight program fosters a harmonized approach by all States to airport safety regulation.

ACI is pursuing three key areas for increasing airport safety achievements — information sharing, training and documentation.

ACI has a long history of fostering safety initiatives: 20 years of monitoring apron safety; establishing and promoting new ACI policies on safety; holding ACI Airport Operational Safety Conferences and Safety Summits; providing training courses on airport safety; producing ACI handbooks on safety; contributing to ICAO safety-related panels and working groups; assisting ICAO on the development of ICAO technical standards for airport design, construction and operation; and reviewing airport safety deficiencies. ACI encourages dialogue between all concerned at the local, national and international levels to improve the overall level of safety when any deficiencies are reported.

But in 2005, a series of fatal aviation accidents delivered a wake-up call to the air transport industry, encouraging all of us to reassess the situation and create new initiatives that would help to raise the safety bar even higher.

Our ability to learn lessons from each incident and to transform that knowledge into corrective action is a powerful means of building a worldwide safety framework that is well adapted for both present and future needs.

With that principle in mind, ACI has redoubled its safety efforts and is pursuing three key areas for increasing airport safety achievements — information sharing, training and documentation.

Information Sharing

Airports have provided great support for increasing information transparency, most recently at the ICAO meeting of the Directors General of Civil Aviation Conference on a global strategy for aviation safety. ACI believes that incident reporting should be non-punitive — immune from sanctions — provided that there is no evidence of wilful negligence or wilful unsafe acts.

To capitalize on the concept of mutual benefit from sharing incident data, ACI has launched a Web site that allows the free flow of information from airport to airport to encourage the development of a global aviation safety culture. Web site content is designed to facilitate airports learning from peer experience.

Initial site features include information on safety management systems; a Web-based "forum" for questions and answers, including discussion of incidents; clear statements of ACI policies; handbooks and specific safety information; and a section where users can upload safety-related documents, images and videos. Data from the ACI Apron Safety Survey is also available, providing an overview of the number and types of incidents and accidents based on ACI member airports' experience. Also posted are updates of evolving risk mitigation safety technologies and systems.

The site will grow with increased usage. In the next release we plan to include best practice information submitted by airports with a strong safety culture. The best practices section also will allow the downloading of video clips, images and training content to be used as visual aids in developing programs. Safety experts' contact information will be provided as well.

Safety Management and Audits

ACI encourages airport management to request that all stakeholders operating on the aerodrome develop and implement a safety management system, regularly updated by the stakeholder, and reviewed and audited by the airport operator. ACI members are well aware that they cannot reduce accident rates on their own. An industrywide collaborative approach is needed, for example, on runway incursion prevention.

Safety audits should be carried out regularly to ensure that international, national and local standards and procedures are observed. Audits, in cooperation with local management and personnel, are an effective method of checking the actual level of safety, and detecting flaws or hazards. A regular and systematic audit process is a vital element of a safety management system.

ACI is considering the introduction of an airport safety audit program to assist its members in building this process. Recognizing airport complexities, an audit would be based on the characteristics and configuration of each airport while seeking to apply universal standards of best practice.

ACI Safety Training

Training is essential in ACI's safety enhancement efforts. First step: building a program of safety courses designed by airports, for airports. ACI recently convened a focus group to define airport safety training needs. Safety managers from a diverse range of airports discussed issues such as the structure, content, methodology and frequency of airport safety courses. The clear message from the group is the importance of practical, relevant and ongoing safety training in making safety the top priority. Consequently, a comprehensive curriculum of airport safety courses, shaped by the focus group's input, is scheduled to begin in October 2006.

Safety Resources

ACI's two new airport safety publications — the *Airside Safety Handbook* and the *Aerodrome Bird Hazard Prevention and Wildlife Management Handbook* — cover aspects of key worldwide airport safety issues, and are succinct guides to current best practices, including checklists for action, risk assessment and mitigation.

The documents, developed by the ACI Operational Safety Subcommittee, follow the guidance and leverage best practices of various airport members, national civil aviation authorities, ICAO and existing ACI policies to produce valuable "hands-on" guides for use both by managers developing safety procedures and by staff conducting daily operations.

ACI encourages all industry partners involved in promoting quality safety practices to visit the Global Safety Network site at <www.aci-safetynetwork.aero>, and to examine our safety publications, available on the ACI website at <www.aci.aero> in the Publications section. These are valuable tools that will help us work together in a well-informed and transparent manner as we continue to better our safety results.

With this series of new and interlinked activities, ACI is addressing its members' needs and contributing to a safer aviation industry for the future. We will continue to work closely with ICAO, governments and our industry partners, the airlines, air navigation service providers, airline pilots and industry suppliers, to ensure the highest standards of professional service. ●

Robert J. Aaronson is director general, Airports Council International.

SAFE WITH THREE?

A 747 flight of nearly 11 hours with an engine shut down has touched off an international debate and a call for clear guidance for airlines.

BY MARK LACAGNINA

Picture yourself in command of a four-engine aircraft embarking on a transcontinental, transoceanic flight. Persistent surging necessitates the shutdown of one engine soon after departure. Consultation with crewmembers, company and charts gives a green light for continuing the flight. Nevertheless, the decision — and the responsibility for the decision — rest squarely on your shoulders. Do you forge ahead, or turn back, dump fuel and land?

This decision was faced last year by the commander of a Boeing 747-400 bound from Los Angeles to London. He decided to continue the flight toward the destination, but stronger-than-expected headwinds over the North Atlantic and a projected fuel reserve below the flight crew's comfort level prompted a diversion to an alternate airport. The crew's declaration of an emergency when a fuel-management problem developed during the final stage of the flight only muddied the not-so-pretty picture.

Soon after the aircraft landed safely in Manchester, England, the airline was slapped with a proposed civil penalty by the U.S. Federal Aviation Administration (FAA), which claims that the aircraft was in an unairworthy condition when the flight was continued in U.S. airspace. A recent report on the incident by the U.K. Air Accidents Investigation Branch (AAIB), on the other hand, said that the aircraft was in "safe condition for extended onward flight" and that the commander's decision to continue the flight was based on airline policy that had been approved by the U.K. Civil Aviation Authority (CAA).[1]

However, AAIB found during the investigation that policies for continued flight of a four-engine aircraft after an in-flight engine shutdown vary among airlines and has called on FAA and the CAA to work with other agencies to develop clear guidance for airlines.

As the debate inspired by this flight continues to swirl around the world, a clear understanding of what happened during that flight is essential.

'Bump, Bump, Bump'

The AAIB report said that the incident began at 0524 coordinated universal time (UTC; 2224 local time) on Feb. 20, 2005, when the aircraft took off from Los Angeles International Airport with 18 crewmembers and 352 passengers for a scheduled British Airways flight to London Heathrow Airport.

The augmented flight crew had been off duty for 48 hours after conducting the inbound flight to Los Angeles. The commander, 48, had 12,680 flight hours, including 1,855 flight hours in type.

The flight crew had decided to have an additional four tonnes (4,000 kg [8,818 lb]) of fuel loaded aboard the aircraft because of forecast weather conditions and possible traffic flow restrictions in London. Total fuel load was 119 tonnes (262,350 lb).

The first officer was the pilot flying. The standby first officer occupied the jump seat for the departure from Runway 24L. The airplane was about 100 ft above ground level and the landing gear was being retracted when the crew heard "an audible and continuous 'bump, bump, bump' sound from the left side of the aircraft," the report said. The first officer corrected a slight left yaw, and the crew observed that the no. 2 — left inboard — engine's exhaust gas temperature was increasing and its engine pressure ratio was decreasing.

A tower controller told the crew that flames were visible on the left side of the airplane.

The crew agreed that surges (compressor stalls) were occurring in the no. 2 engine. The commander, the only crewmember who had previously experienced an engine surge in flight, conducted the memory items from the quick reference handbook (QRH) "Engine Limit/Surge/Stall" checklist. The surges abated when he moved the throttle to the idle position.

Copyright © Chris Sorensen Photography

Surge Symptoms

Surge is defined by the report as "an abnormal condition where the airflow through a gas turbine engine becomes unstable and momentarily reverses." The cause typically is stalling of compressor rotor blades.

"Blade stall occurs if the angle of incidence of the local airflow within the compressor relative to a rotor blade becomes excessive and the normal smooth flow over the blade breaks down," the report said. "The angle of incidence is the resultant of the rotational speed of the blades and the flow velocity through the engine. Thus, anomalies that significantly affect the flow rate at a given compressor pressure ratio can result in a stall."

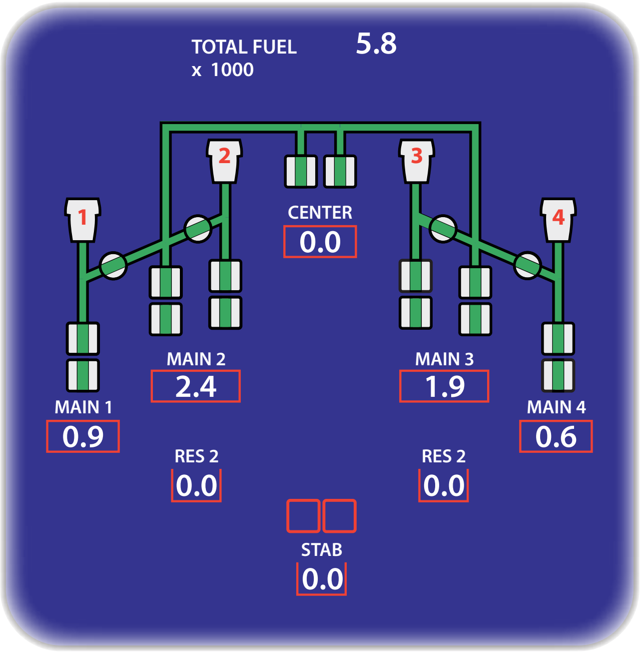
The stall condition can spread and affect other compressor blades and other compressor sections, resulting in airflow disruption and surge.

"The flow reversal associated with a surge can commonly occur on a low-frequency cyclical basis up to seven times per second," the report said. "The symptoms can include a loud bang or series of bangs audible to the passengers and crew, flames at the engine inlet and exhaust, and sudden loss of engine thrust."

The report said that jet engines often "self-recover" from a surge, but a "locked-in" compressor stall results in persistent surging.

Decision Time

The airplane was climbing through 1,500 ft when the



U.K. Air Accidents Investigation Branch

Fuel quantities shown on this EICAS display are approximately what the crew would have seen after landing.

flight crew declared an urgent condition — pan-pan — with air traffic control (ATC) and requested radar vectors to remain in the area while they analyzed the situation. They completed the checklist, and engine indications appeared normal. However, when the commander slowly advanced the throttle for the no. 2 engine, the crew heard a surge.

The commander advanced the throttle again at a higher altitude, and the crew again heard a surge. "The crew discussed the situation and agreed that the best course of action was to shut down the no. 2 engine," the report said.

The crew shut down the engine at 0529 UTC. The cabin services director was briefed on the situation and told to stand by for further instructions. The standby first officer went to the cabin and looked out a window to check for damage. "No damage could be seen by looking out of the aircraft, but it was dark and there was no effective illumination of the relevant area," the report said.

The commander and first officer reviewed company manuals and aircraft manuals, and radioed the airline's base at Heathrow. "The commander was advised that it would be preferable to continue the flight but that the course of action was the commander's decision," the report said.

The report said that the flight crew also considered the following factors:

- "The [flight management computer (FMC)] indicated a landing at final destination with approximately seven tonnes [15,432 lb of fuel], compared to the required minimum reserve of 4.5 tonnes [9,921 lb], which represents the fuel required for 30 minutes holding at 1,500 ft in the clean configuration;
- "An additional engine failure was considered, and, with regard to aircraft performance, it was deemed safe to continue;
- "The initial routing was across the continental USA, where there were numerous suitable diversion airfields;
- "The present situation would not justify an overweight landing, and the time to jettison fuel (approximately 70 tonnes [154,324 lb]) down to below maximum landing weight would be about 40 minutes;
- "The no. 2 engine was shut down, and the windmilling parameters were normal; the aircraft appeared to be in a safe condition for continued flight; [and,]
- "The manufacturer's QRH for 'Engine Limit/Surge/Stall' did not require the crew to consider landing at the nearest suitable airfield."

The commander decided to continue the flight and monitor the situation.

What If?

Because of adequate redundancy, the aircraft's systems would not be affected by long-range flight with one engine out, according to the report. "The principal effects on the aircraft would be in terms of performance penalties, with altitude capability reduced by around 5,000–8,000 ft and fuel consumption increased by around 8 percent at normal cruise speed," the report said.

The possibility of damage to the no. 2 engine from prolonged windmilling was studied during the investigation. The engine — a Rolls-Royce RB211-524, which also is used on the 767-300 — had undergone 180 minutes of windmilling, with no bearing damage, during tests for ETOPS (extended-range twin-engine operations) approval. Moreover, Rolls-Royce issued a notice in 1991 advising operators that "windmilling the engine for lengthy periods without engine oil does no harm to the bearings within that engine … therefore, a flight may continue after in-flight shutdown for oil loss." The company told investigators that no further major damage would be expected from windmilling for 12 hours or more an engine with damage similar to that in the incident engine.

What if another engine failed or had to be shut down by the crew?

"As a four-engine aircraft, the B747 is designed and certificated to tolerate the loss of a second engine following an initial IFSD [in-flight shutdown], without losing essential systems or necessary performance capabilities," the report said. "The likely effects on systems would include the need to shed nonessential electrical loads, such as galleys, and to limit bleed air supplies in order to maintain adequate performance from the operating engines. … Aircraft performance implications would include a substantial further loss of altitude capability."

Rolls-Royce told investigators that the IFSD rate for RB211-524 engines in the 12 months preceding the incident was 0.0073 per 1,000 engine flight hours — or about one IFSD per 137,000 engine flight hours.

"Previous experiences of the effects of engine surge suggest that it was likely that damage would be confined to the affected engine," the report said. "The crew's evaluation of the planned route showed that the further aircraft performance degradation resulting from a second engine loss would not be critical."

Across the Pond

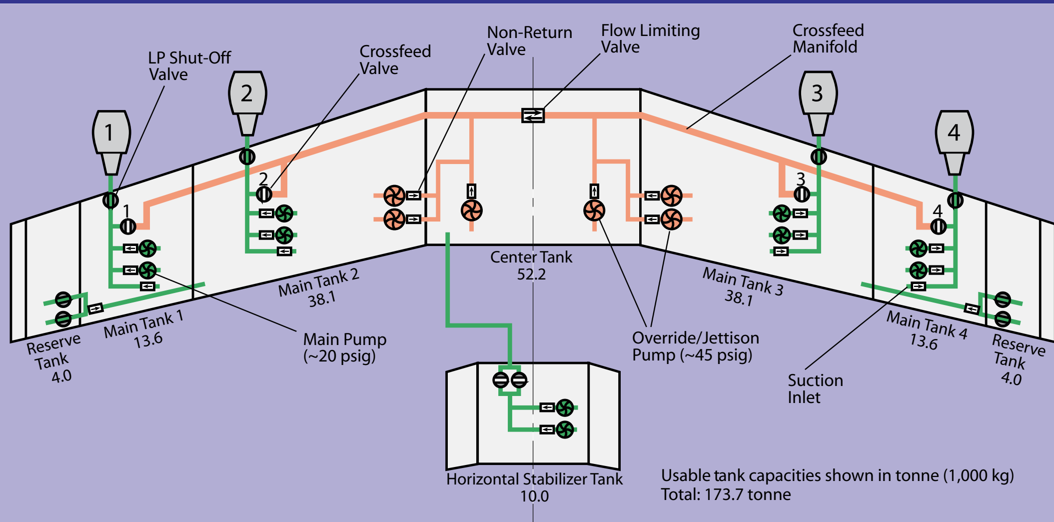
After deciding to continue the flight, the flight crew canceled the urgent condition and obtained clearance from ATC to climb to Flight Level (FL) 270, approximately 27,000 ft, where cruise was established at 0.75 Mach.

The commander rested in the crew bunk before returning to the flight deck as the aircraft neared the North Atlantic. The crew had agreed to plan for a landing at Heathrow with no less than 6.5 tonnes (14,330 lb) of fuel remaining and had requested FL 320 for the overwater segment of the flight. ATC told the crew, however, that because of opposite-direction traffic, FL 320 was not available but that either FL 350 or FL 290 was available. The crew chose FL 290 because the FMC indicated that 7.0 to 7.5 tonnes (15,432 to 16,535 lb) of fuel would remain on landing at Heathrow.

Based on the indication of adequate fuel reserve on arrival, plus the absence of any further abnormalities during the trip across the United States, the crew decided to continue the flight to London while closely monitoring the fuel supply.

The fuel system in a 747-400 comprises two main tanks and a reserve tank in each wing, a wing center-section tank and a horizontal stabilizer tank (Figure 1). In each main tank are two "main" pumps that operate in parallel and supply fuel to the respective engine and/or the crossfeed manifold. The inboard main tanks, which hold almost three times more fuel than the outboard main tanks, also have two override/jettison pumps that provide

B747-400 Fuel System



psig= Pounds per square inch gauge

Source: U.K. Air Accidents Investigation Branch

Figure 1

more than double the flow rate of the main pumps and supply fuel only to the crossfeed manifold.

In normal operation, all the pumps are activated and all crossfeed valves are opened before takeoff. During flight, the horizontal stabilizer tank is emptied first, followed by the wing center-section tank and the reserve tanks. Fuel in the inboard main tanks then is cross-fed to the engines until fuel quantity in the inboards matches the quantity in the outboard main tanks; total fuel quantity at this point typically is 55 tonnes (121,254 lb). An engine indicating and crew alerting system (EICAS) message then prompts the crew to discontinue crossfeeding by deactivating the override/jettison pumps and closing the crossfeed valves in the outboard main tanks. Each main tank now feeds fuel only to its respective engine, and no further crew action is required for fuel management unless a fuel imbalance or a low-fuel condition occurs.

Because the no. 2 engine was inoperative, a fuel imbalance did occur after the crew discontinued crossfeeding. The fuel quantity in the left inboard main tank, which normally would have been supplying fuel to the no. 2 engine, did not decrease as rapidly as the fuel quantities in the other main tanks. The crew, following the procedure in the airline's operations manual, periodically activated the override/jettison pumps in the left inboard main tank to balance the fuel in the main tanks.

Strong Winds

At an unspecified point during the overwater flight, the crew had conducted a climb to FL 350. They found, however, that the headwind was stronger than forecast at that flight level. As the aircraft neared Ireland, the EICAS indicated 12 tonnes (26,455 lb) of fuel aboard, and the FMC indicated that the aircraft would have 6.5 tonnes of fuel remaining on landing at Heathrow.

Checking alternate airports, the crew noted an FMC indication that the aircraft would have seven tonnes of fuel remaining if it were landed at Manchester Airport, which is about 140 nm (260 km) northwest of London. The crew decided to divert to Manchester.

While conducting the descent, the crew noticed that the fuel quantity in the left inboard tank no longer was decreasing, even when the override/jettison pumps were activated. Concerned that the fuel in that tank might not be usable, the crew declared an urgency and were cleared by ATC to fly directly to a position 10 nm on the extended centerline of Manchester's Runway 06R.

Inbound to Manchester, the EICAS generated a low fuel warning. The crew conducted the QRH procedure, activating all main fuel pumps and opening all crossfeed valves, and declared an emergency. The commander took control and landed the aircraft at 1604 UTC without further incident. The EICAS showed 5.8 tonnes (12,787 lb) of fuel remaining in the tanks.

The report said that the crew's concern that fuel would not be available from the left inboard main tank indicated that their knowledge of the fuel system and their training on fuel management were deficient. The fuel quantity in that tank had stopped decreasing when the standpipe inlets for the override/jettison pumps were unported. This is a fuel-system feature designed to prevent fuel quantity in either inboard main tank from being reduced below about 3.2 tonnes (7,055 lb) when the override/jettison pumps are used to jettison fuel.

According to the airline's fuel-balancing procedure, the main pumps in the tanks with the lowest fuel quantity should be deactivated if use of the override/jettison pumps fails to balance the fuel. The report said that the crew apparently had been reluctant to deactivate the main pumps. It noted that the airline's fuel-balancing procedure differed from the aircraft manufacturer's recommended procedure, which calls only for deactivation of the main pumps in the tanks with the lowest fuel levels.

"If the crew had been in the habit of utilizing the manufacturer's procedures for balancing fuel by only using the main pumps, it is possible that they would have become more confident with the procedure," the report said. "After the incident, the operator reverted to the manufacturer's fuel-handling procedures."

Based on these findings, AAIB recommended that the airline include "relevant instruction on three-engined fuel handling during initial and recurrent training." Among actions taken in response to the recommendation, British Airways revised fuel-management procedures in relevant manuals and training courses, provided additional engine-out fuel-management training to all 747-400 flight crews and added three-engine fuel-management and low-fuel procedures to its recurrent training programs.

Case Displacement

The report said that the surges in the no. 2 engine likely had resulted from a series of events that began when excessive wear of a compressor section casing joint, called a birdmouth, caused a slight downward displacement of the forward end of the high-pressure compressor case. The displacement increased the clearance between the rotor blades and case liner in the lower half of the compressor. The clearance further was increased by erosion of the rotor blades from contact with the case liner in the upper half of the compressor.

The surges caused further damage resulting from contact between blades and guide vanes in both the high-pressure and intermediate-pressure compressors. This damage, in turn, exacerbated the surging.

Two previous incidents of engine surges and shutdowns resulting from birdmouth wear had led to the issuance of a Rolls-Royce service bulletin, SB 72-D574, that called for modifying the geometry of the casing and applying a wear-resistant coating to the birdmouth during routine disassembly of RB211 engines. The incident engine, which had accumulated 24,539 operating hours and 3,703 cycles, had not been disassembled and, thus, had not been modified according to the bulletin.

The surges in the incident engine also had led, indirectly, to overtemperature damage to the turbine sections. The software controlling operation of the full-authority fuel controller (FAFC) included logic that increased fuel flow to prevent flameout if a burner pressure sensing line fractured. "However, service experience showed that this logic could be erroneously activated during a surge and locked-in stall event, leading to [over-fueling] and overtemperature damage to the turbine blades and vanes."

Rolls-Royce SB RB.211-73-D435 in July 2001 introduced revised FAFC software designed to prevent this problem. At the time of the incident, British Airways had installed the revised software in 80 percent of the affected engines in its fleet. The software had not yet been installed in the incident aircraft.

Guidance Varies

During the investigation, AAIB surveyed the policies of several public transport aircraft operators regarding continued flight of a four-engine aircraft following an IFSD. The report said that British Airways provided the following guidance to its flight crews:

- "The circumstances leading to the engine failure should be carefully considered to ensure that the aircraft is in a safe condition for extended onward flight; [and,]
- "The possibility of a second engine failure should be considered. This would require evaluation of performance considerations, diversion requirements and range and endurance on two engines."

Three operators provided similar guidance, but the guidance provided by others varied. "One operator required that the aircraft land at the nearest suitable airport. Another had no policy and left it as a commander's decision," the report said. "One operator required the aircraft to return to the airfield of departure if the engine failure occurred prior to reaching cruise altitude and the conditions at that airfield were suitable; otherwise, the commander could continue to an airfield of his selection."

Based on these findings, AAIB recommended that CAA and FAA, "in conjunction with other relevant agencies, should review the policy on flight continuation for public transport aircraft operations following an in-flight shutdown of an engine in order to provide clear guidance to the operators."

Current FAA guidance is contained in U.S. Federal Aviation Regulations Part 121.565, which says that after one engine on a three- or four-engine airplane in airline service fails or is shut down, the pilot-in-command (PIC) may continue the flight to "an airport that he selects" if he decides that this is as safe as landing at the nearest suitable airport. The regulation says that the PIC must base his decision on the following:

- "The nature of the malfunction and the possible mechanical difficulties that may occur if flight is continued;
- "The altitude, weight and usable fuel at the time of engine stoppage;
- "The weather conditions en route and at possible landing points;
- "The air traffic congestion;
- "The kind of terrain; [and,]
- "His familiarity with the airport to be used."

Opinions Vary

The incident investigation supported the commander's decision to continue the flight. "No evidence was found to show that the flight continuation posed a significant increase in risk," the report said. "And the investigation established that the aircraft landed with more than the required minimum fuel reserves."

In its complaint proposing a civil penalty of US$25,000, however, FAA said that British Airways "operated an aircraft in the United States in an unairworthy condition" and "failed to comply with its operations specifications." In response, the airline requested a hearing. The case had not been resolved at press time.●

Note

1. U.K. Air Accidents Investigation Branch (AAIB) report no. EW/C2005/02/04. *AAIB Bulletin* 6/2006.

Smooth Ride

Automated turbulence reports and enhanced turbulence radar aim to further reduce the risk of in-flight injury.

BY WAYNE ROSENKRANS

Several new technologies coming to fruition offer help in meeting the challenge of reducing and ultimately eliminating the unexpected encounters with in-flight turbulence that take a steady toll of injuries and occasional deaths. One is a new generation of turbulence detecting radars coming on the market; another is a new system now in limited use that automatically reports turbulence encounters to ground stations, with the promise that eventually the reports routinely will be data-linked into flight decks.

The best part for the airlines is the minimal initial and recurring cost of this reporting system that can save them so much not only in injuries to passengers and crew but in fuel, as well. But even as airlines step up to try these evolving tools, unresolved issues remain about how to integrate them into flight operations.

In 2005, the average number of occupant injuries caused by turbulence — if minor injuries are counted — was about three per day on U.S. Federal Aviation Regulations Part 121 air carriers, according to proprietary data, U.S. Federal Aviation Administration (FAA) data and U.S. Bureau of Transportation Statistics data, said Paul Robinson, Ph.D., president of AeroTech Research (USA), a contractor for the U.S. National Aeronautics and Space Administration (NASA). Figure 1 shows turbulence as a significant condition in weather-related accidents among U.S. air carriers.

In January 2006, FAA published Advisory Circular (AC) 120–88A, *Preventing Injuries Caused by Turbulence,* updating its 1997 guidance to air carriers based on analyses and recommendations of the U.S. Commercial Aviation Safety Team (CAST) and the ongoing research and development in government, academia and industry. Table 1 shows some of the current and anticipated resources for tactical turbulence awareness.[1]

A prominent theme of the AC is the importance of constantly communicating turbulence information. The AC said, "In the past, the practice of rerouting has met with limited air carrier acceptance, primarily because of the inaccuracy of first generation turbulence forecast products, the subjectivity inherent in pilot weather reports (PIREPs), if available, and the operational costs of rerouting. … The most promising way to capture and convey [real-time] information is through a comprehensive program of reports from aircraft in flight. That program would be founded on automated turbulence reporting supplemented by human reports (PIREPs)."

Among its recommendations, the AC suggests that Part 121 operators "commit to the installation of the Turbulence Auto-PIREP System (TAPS)," developed by Robinson and his staff under NASA's Turbulence Prediction and Warning System (TPAWS) project, which concluded at the end of 2005. TAPS is software that uses the same vertical accelerometer that feeds the flight data recorder and ties into the aircraft's existing aircraft communications addressing and reporting system (ACARS).

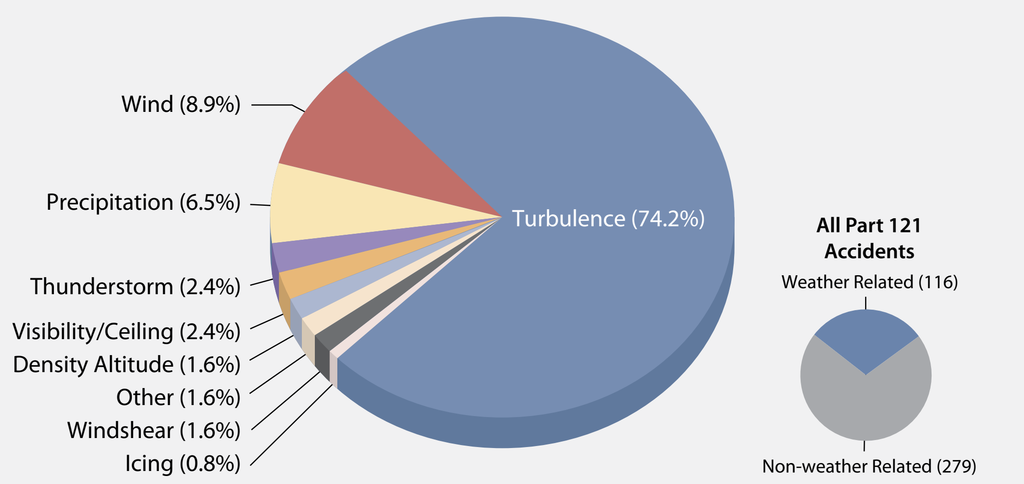
The current International Civil Aviation Organization (ICAO) metric for automated turbulence reporting is eddy dissipation rate (EDR) data. The U.S. National Center for Atmospheric Research (NCAR) developed the EDR method for automated turbulence measurement in flight. Since 2001, in a separate program from TAPS, more than 100 airliners have been downlinking peak and average EDR turbulence readings.

Low Cost

These efforts fill specialized niches at present, but to deliver their full benefit they will have to be integrated into commercial air transport operations. "To operate safely, everyone in the cockpit and on the ground has to be able to assimilate one big picture of turbulence and wrap that into the big picture of airspace and airspace usage," Robinson said. "All of the strategic and tactical products have to fit together — and I don't know if that answer is out there yet."

Enhanced turbulence mode weather radar (E-Turb) and TAPS were the main technologies

U.S. FARs Part 121 Weather-Related Accidents by Weather Condition, 1994–2003



FARs = U.S. Federal Aviation Regulations

Source: National Aviation Safety Data Analysis Center, U.S. Federal Aviation Administration

Figure 1

Tactical Turbulence Awareness

Distance From Turbulence	Resources	
	Currently in Use	**Under Development**
100+ nm (185+ km)	Weather radar	Flight deck graphical weather and turbulence forecast products
100–5 nm (185–9 km)	PIREPs	Automated turbulence reports
40–0 nm (74–0 km)	Weather radar with turbulence mode	Enhanced turbulence mode weather radar

PIREPs = Pilot weather reports

For strategic purposes, typically up to six hours before departure, various turbulence forecast products also are in use and others are under development.

Source: AeroTech Research (USA)

Table 1

that came out of TPAWS, said Jim Watson, senior research engineer, Crew Systems and Aviation Operations Branch, and former TPAWS project manager for NASA's Aviation Safety and Security Program. NASA-authored technical reports about them are scheduled for presentation at the congress of the International Council of the Aeronautical Sciences in Hamburg, Germany, in September 2006. Robinson is a scheduled presenter at the Flight Safety Foundation International Air Safety Seminar in Paris in October 2006.

"NASA also is providing technical support directly to FAA during certification activities, particularly for E-Turb radar, and we fund ongoing technology development for cockpit display of TAPS information using a Class 2 electronic flight bag [EFB] with AeroTech Research and ARINC," Watson said.

E-Turb on Board

Turbulence detection algorithms historically were uncorrected for aircraft type and flight configuration. In comparison, E-Turb adds a hazard prediction algorithm that calculates g load — i.e., aircraft loading relative to the acceleration of gravity — for the airplane using factors such as altitude, true airspeed and weight and balance, and graphically displays results to pilots. Experiments in fall 2000 and spring 2002 using NASA's instrumented Boeing 757 demonstrated a detection range of 25 to 40 nm (46 to 74 km). When flight crews intentionally traversed an area of moderate or severe turbulence — which a commercial flight crew typically would not do — researchers found 80 to 85 percent accuracy in predicting the actual turbulence encountered, he said.

In 2004, one Delta Air Lines Boeing 737-800 was equipped with a prototype E-Turb mode in its WRT 2100 receiver/transmitter, part of a Rockwell Collins WXR-2100 Multiscan Radar system, and with TAPS software code. In this installation, the E-Turb mode adds a display of relative turbulence hazard overlaid on the thunderstorm reflectivity display. In addition to the solid magenta representations of moderate or greater turbulence, speckled magenta areas represent light turbulence. "The direction to pilots has been that seat belt signs should be illuminated before going through a speckled magenta area, and that seat belt signs should be on for any solid magenta area, which should be avoided if possible," Robinson said.

Data from the Delta 737-800 equipped with E-Turb show pilots approaching a solid magenta area and then deviating around it. There is a "strong correlation between radar-predicted loads and actual loads when avoidance is not possible," Robinson said. "There is not a whole lot of correlation between thunderstorm reflectivity and turbulence."

In their 2005 analysis of 554 E-Turb radar events, researchers found that in 55 events, 9.9 percent, there was no predicted turbulence on the radar display, little or no reflectivity in the vicinity, and yet the airplane's vertical accelerometer data confirmed turbulence; 204 events, 36.8 percent, there was a radar display of an area of predicted turbulence the aircraft did not enter and turbulence was not detected by the vertical accelerometer; and 295 events (53.2 percent) involved radar displays of predicted turbulence, the aircraft traversing the affected area and the turbulence recorded by the vertical accelerometer.

Wayne Rosenkrans (FSF)

Robinson

Genesis of TAPS

"In fiscal year 2002, the NASA 757 also transmitted the first turbulence encounter reports to Glenn Research Center in Cleveland to validate the technology that became TAPS," Watson said. "The accelerometer we use … is loads-based," Robinson said, "so it focuses on how badly the aircraft is getting shaken up by continually calculating a turbulence hazard metric — the same as we use in E-Turb radar. When the hazard metric exceeds a threshold, a report is made." Figure 2 shows elements of the TAPS architecture.

On Delta airplanes, TAPS software resides in the aircraft condition monitoring system (ACMS), a partition of the digital flight data acquisition unit (DFDAU) that continuously monitors airplane data buses. Air-ground communication automatically is handled by the existing ACARS VHF/satellite link. "When the hazard metric exceeds a threshold, the automatic turbulence report is a very small data packet that comes down to the ground through the communications infrastructure," Robinson said. "Because it's event-driven, there can be entire flights where you don't hear from the system."

Delta offered to install TAPS software for NASA's in-service evaluations.

In addition to the E-Turb–equipped airplane, TAPS software was replicated on 70 other 737-800s. The same software code also currently sends reports from 52 airplanes in Delta's 767-300/400 fleet.

TAPS reports are displayed using ARINC's Web Aircraft Situation Display (WebASD), a commercial system that uses "push" technology to update data via the Internet on any computer's Web browser, including NEXRAD radar overlays and infrared satellite imagery. Delta's dispatchers have password-protected access to the TAPS reports from their fleet.

Each TAPS report appears on WebASD displays as one of three symbols distinguishable by shape and color: a green icon for light turbulence, an amber icon for moderate turbulence and a red icon for severe turbulence. When the user clicks a mouse pointer on any icon, a pop-up window appears, showing the aircraft identification (flight number); coordinated universal time of event; flight level; wind speed and direction; temperature; plus/minus peak load around 1 g (such as "1.2G/0.7G") and the hazard metric (such as "0.101"), called "RMS g" because it uses root mean square to express deviation from 1 g; maintenance flag (MFO, maintenance required); and weight/speed values (such as "263/22 kt," representing 263,000 pounds [119,296 kg] and 220 kt).

TAPS displays are available to Delta's entire dispatch team for evaluation but have not been built into daily procedures, according to Neil Stronach, vice president of the Delta Operations Control Center. "While wide adoption by authorities and industry is still being figured out, we continue to evaluate it, provide feedback and participate in industry activities driving toward a conclusion and utilization of either TAPS or EDR, or both," Stronach said. "We are going to be given a nudge toward adopting a standard so that we can get industrywide coverage."[2]

Delta pilots do not know when their airplane transmits a TAPS report. "We've seen in discussions between pilots and dispatchers — either voice or with ACARS — that pilots ask dispatchers if their aircraft has made any TAPS reports," Robinson said.

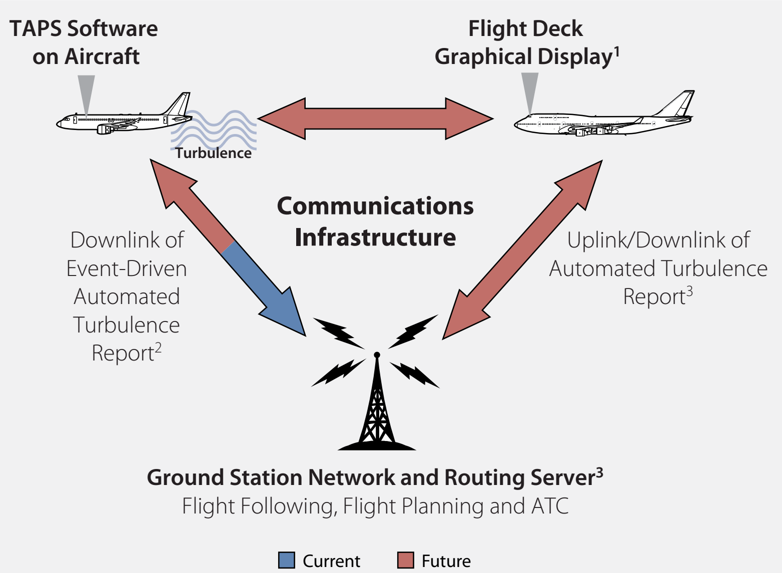
A fundamental capability of E-Turb and TAPS is data scaling, translating turbulence hazard metrics so that they have practical value to flight crews and others. Any very turbulent environment increases the workload for pilots and dispatchers. "Delta's dispatchers can run WebASD in the background of their separate flight-following application, and if one of the aircraft they're following has its flight path threatened by a TAPS report of moderate or severe turbulence, a little pop-up window will appear to alert them to maximize the window to assess the situation and communicate with flight crews." Ideally, TAPS information would be integrated with Delta's primary flight-following software, Robinson said, but that could not be done for cost and time reasons.

In one 96-hour observation period, 345 TAPS reports were sent from 737-800s while their crews made 47 turbulence PIREPs. From June 10, 2004,

Wayne Rosenkrans (FSF)

Watson

TAPS Architecture



TAPS = Turbulence Auto-PIREP System   ATC = Air traffic control

Notes:

1. Future uplink/downlink and air-to-air communication of automated turbulence reports would include onboard report interpretation and generation of a receipt to the sender.
2. The report includes data such as turbulence hazard metric, weight/airspeed, time, location and altitude.
3. TAPS currently uses ARINC's aircraft communications addressing and reporting system (ACARS) and Web Aircraft Situation Display (WebASD).

Source: AeroTech Research (USA)

Figure 2

through Aug. 31, 2005, Delta dispatchers received 35,656 TAPS reports from 15,510 flights, including 1,047 TAPS reports of moderate turbulence and 89 TAPS reports of severe turbulence.

Pilots today make the decision whether their airplane has experienced turbulence severe enough that it needs to be inspected. "What we'd be able to do with TAPS in the future is make measurements, and if the loads have exceeded the severe-loads thresholds in the maintenance manual, a TAPS maintenance flag would advise the air carrier to inspect that airplane," Robinson said.

Minimal Bandwidth

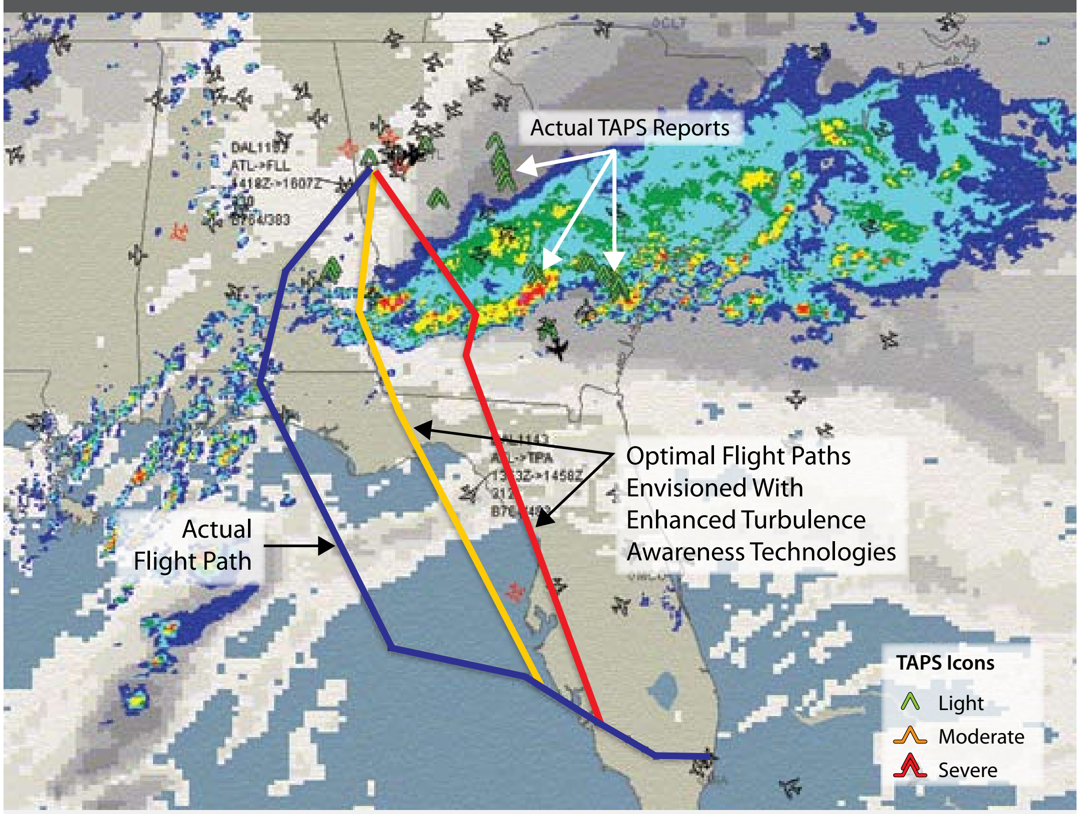
To date, AeroTech Research has uplinked a few TAPS reports to selected aircraft and verified that reports were received (though not displayed on the flight deck), and has developed software to automatically select which aircraft in the airspace should receive specific TAPS reports. "We are just starting to look at communication and routing that would be required to get this data up to the airplanes," Robinson said. "Flight deck display is being done this fiscal year. TAPS plus E-Turb on the flight deck is a long-term solution."

Robinson also has studied examples of actual Delta flights in which long deviations around weather were taken based on the NEXRAD displays, yet TAPS reports showed that shorter routes through gaps in the weather were clear of turbulence threats. Figure 3 shows an actual flight path that theoretically could be shortened with enhanced turbulence awareness technologies.

One TAPS limitation is the fact that if a TAPS-equipped airplane doesn't fly into turbulence there are no reports available. Another limitation is the possibility of interrupted data communication, although there would be strong drive to quickly restore full communication.

By the end of 2005, 48,600 TAPS reports had been received and evaluated. Because TAPS is event-driven, however, its data communication requirements are extremely low compared with other aeronautical data communications. "Delta's TAPS-equipped airplanes make an average of 35 TAPS reports per month, and each report is less than a kilobit of data," Robinson said. "Communication requirements are minimal. In 2006, TAPS software continues to run on Delta airplanes with

Retrospective Visualization of Delta Air Lines Flight, Atlanta to Miami



TAPS = Turbulence Auto-PIREP System PIREP = Pilot weather report

Flight paths, figure labels and the legend are overlaid on an ARINC Web Aircraft Situation Display (WebASD) depicting air traffic, infrared satellite imagery, NEXRAD color weather radar imagery and a base map of the southeastern United States.

Source: AeroTech Research (USA)

Figure 3

no cost to anyone, except that ARINC has a little overhead cost for operating the ground station network and routing server." In development of the Class 2 EFB so far, developers have found no insurmountable issues of bandwidth required for uplinking TAPS report data to airplane flight decks from ground networks.

Pathfinder Predicament

Accurate information about actual effects of turbulence on airplanes would help air traffic control to keep their blocked areas of airspace — shown as polygons on radar displays — at the minimum size required for safety. "Now, these polygons sometimes cover entire states," Watson said. "We need to bring TAPS into the air traffic management system, and we are continuing to discuss this with FAA's Air Traffic Organization."

Another suggested application for E-Turb and TAPS is the situation in which one flight crew could serve as the pathfinder for others. "After a certain time, ATC will want to reopen a route it has closed," Robinson said. "The forecast and satellite imagery have to define when the blocked area reopens, but in a performance-based operational concept, the preferred pathfinder would be a crew that is E-Turb-equipped and TAPS-equipped."

In addition to avoiding needless deviations, the technology also could save fuel by avoiding operations at nonoptimal altitudes while avoiding turbulence that is not hazardous. "To avoid excessive fuel burn, if the airplane only will be in light turbulence for 20 minutes, the crew does not have to descend 4,000 or 8,000 feet," Robinson said. "When one Delta flight crossed the United States west to east and experienced turbulence, its crew descended from FL 350 to FL 270 for half an hour. The TAPS report from another Delta aircraft passing through the same turbulence at the same time showed that there was only light turbulence. In the future, the crew that descended might not have to make that descent and take the fuel-burn hit."

Pending final reports on NASA's in-service evaluation, only a few U.S. airlines have inquired about details of installing TAPS software despite its minimal cost. Meanwhile, air traffic management involvement will be a critical enabler, Robinson said. "The federal government's multi-agency Joint Planning and Development Office [JPDO] is looking at this as part of network-enabled operations."

Delta's Experience

"TAPS technology is great in that it eliminates the lag time from traditional pilot reporting through ATC and then broadcast of PIREPs," Stronach said. "The EDR solution also seems well developed and provides input into forecast models that meteorologists use, so there is a very strong push in this industry toward an EDR solution."

Delta procedures specify that flight crews will make PIREPs if they encounter turbulence. Availability of TAPS reports has enabled some comparisons. "They demonstrate that there is a bias by the individual pilots — typically, they will have a tendency to report the turbulence as more severe than the TAPS RMS g loading would support," Stronach said. "We see the value in being more accurate and timely, but until we get a standard, we can't put TAPS into practical use." If a captain rates turbulence as severe, aircraft maintenance will treat the encounter as severe and conduct a severe-loads inspection.

"Future TAPS scenarios are very reasonable once TAPS is adopted and widely used; it's absolutely a viable technology," Stronach said. "We can foresee a time frame where turbulence PIREPs would not be necessary — the equipment would tell us everything. But a few hundred TAPS-equipped airplanes flying around within the airspace do not give the coverage necessary to get the footprint — the turbulence visibility — required to provide the widest safety net." Based on Delta's experience with E-Turb radar, he also expects that technology to be viable.

Robinson believes that the industry will be hard-pressed to meet the turbulence information needs of all user constituencies with one "silver bullet" among all the meteorological/engineered solutions in play.

"JPDO seems to be where all these [options] are coming together," Watson said. "E-Turb and TAPS are evolutionary technologies that will work their way into the Next Generation Air Transportation System [NGATS] being developed by the JPDO." ●

Notes

1. In May 2006, the U.S. Federal Aviation Administration (FAA) said the System-Wide Information Management (SWIM) system is being designed to connect networks that use or provide aviation-related information to create network-centric operations.
2. A 2003 federal law laid the groundwork for an integrated plan to transform the U.S. air transportation system to meet requirements of the year 2025. Called the Next Generation Air Transportation System (NGATS), the initiative is administered by the multi-agency Joint Planning and Development Office (JPDO). "Data link communications will replace voice communications between aircraft and air traffic management systems, improving the accuracy and timeliness of information exchange," JPDO said. "Aircraft will become mobile 'nodes' integral to this information network, not only using and providing information, but also capable of routing messages or information sent from another aircraft or a ground source." <www.jpdo.aero>

Investigative authorities on two continents seek regulatory action on 10 anti-icing safety recommendations.

Chilling EFFECTS

BY LINDA WERFELMAN

Accident investigation boards in the United Kingdom and the United States, citing dozens of winter accidents, are pressing regulatory authorities to act on a series of safety recommendations involving aircraft operated in icing conditions.

The U.K. Air Accidents Investigation Branch (AAIB) said it had found numerous occurrences — during the past two northern hemisphere winters — of flight control restrictions on airplanes with nonpowered flight controls. The restrictions were "believed to have been caused by the freezing of the rehydrated residues of thickened de/anti-icing fluids that had accumulated in the aerodynamically quiet areas of the elevator and aileron controls."

The July 2006 AAIB *Bulletin* outlined 13 occurrences from the winter of 2005–2006 — 11 involving Avro 146/RJs and two involving Embraer EMB 145s — and restated four safety recommendations, previously included in the April 2006 AAIB *Bulletin*. The April *Bulletin* described 37 occurrences during the winter of 2004–2005 involving 25 Avro 146/RJs, two EMB 145s and three Bombardier DHC-8s — all registered in the United Kingdom — and seven other European-registered aircraft.

"The AAIB has repeatedly expressed its concerns to the U.K. CAA [Civil Aviation Authority], the JAA [Joint Aviation Authorities] and EASA [the European Aviation Safety Agency] that effective measures to address the airworthiness concerns posed by the residues of thickened de/anti-icing fluid have yet to be implemented," AAIB said. "Experience has shown that the currently available thickened deicing fluids, with their rehydratable residues, are not practically suited for use on aircraft with nonpowered flight controls and continue to pose a hazard to flight safety through their ability to cause flight control restrictions."

The AAIB recommended:

- "That the [JAA], in consultation with [EASA], issue safety documentation to strongly encourage operators of aircraft with nonpowered flight controls to use Type I de/anti-icing fluids,[1] in preference to 'thickened' fluids, for deicing";
- "That where the use of thickened de/anti-icing fluids is unavoidable, the [JAA], in consultation with [EASA], ensure that operators of aircraft with nonpowered flight controls who use such fluids invoke controlled maintenance procedures for the frequent inspection for accumulations of fluid residues and their removal";
- "That [EASA] introduce certification requirements relating to de/anti-icing fluids for use on aircraft with both powered and nonpowered flight controls"; and,
- "That, prior to [EASA] assuming responsibility for operational matters within Europe, they consider the future need for the training and licensing of companies who provide a de/anti-icing service so that anti-icing fluids are applied in an appropriate manner on all aircraft types but specifically to ensure that the entry of such fluids into flight control mechanisms and control surfaces is minimized."

'Deficiencies' in Cold-Weather Operations

In a related development, the U.S. National Transportation Safety Board

(NTSB) expressed concern about "deficiencies in the cold-weather operational procedures" used by Saab SF340 flight crews and about the airplane's performance in icing conditions. The NTSB statement followed a preliminary investigation of an incident involving loss of control of a Saab SF340 over California and a review of three similar SF340 incident reports by the Australian Transport Safety Bureau (ATSB) in the previous eight years.

NTSB proposed four new safety recommendations — including one urgent recommendation — and reiterated two earlier safety recommendations, also related to operations during icing conditions.

The urgent recommendation said that the U.S. Federal Aviation Administration (FAA) should "require all operators of Saab SF340 series airplanes to instruct pilots to maintain a minimum operating airspeed of 1.45 x V_S [stall speed] during icing encounters and before entering known or forecast icing conditions and to exit icing conditions as soon as performance degradations prevent the airplane from maintaining 1.45 x V_S."

The other new recommendations said that FAA should:

- "Require the installation of modified stall-protection logic in Saab SF340 series airplanes certified for flight into known icing conditions;
- "Require the installation of an icing detection system on Saab SF340 series airplanes"; and,
- "Require all operators of turbopropeller-driven airplanes to instruct pilots, except during intermittent periods of high workload, to disengage the autopilot and fly the airplane manually when operating in icing conditions."

In issuing the safety recommendations, NTSB cited the preliminary findings of its investigation of a Jan. 2, 2006, incident in which an American Eagle SF340B+ en route from San Luis Obispo, California, U.S., to Los Angeles, encountered icing conditions during climb at 11,500 ft in instrument meteorological conditions. The airplane entered a rapid descent, and the crew did not regain control until after the airplane had descended to about 6,500 ft. The crew continued to the scheduled destination and conducted a normal landing. No one was injured in the incident.

The airplane was not equipped with an icing detection system, and at the time of the incident, the flight crew was using the autopilot, which reacted to the buildup of ice on the wings by slowly increasing the airplane's pitch, causing a decrease in airspeed. The increase in pitch probably was so gradual that it was not detected by the crew, NTSB said.

"If the flight crew had been flying the airplane manually, the airplane's performance degradation would have been more readily apparent," NTSB said. "The flying pilot would have maintained a continuous scan of the primary flight instruments and would have been required to increase back pressure on the yoke or continuously manually trim the airplane to maintain the desired climb rate. The pilot also likely would have been aware of the resulting changes in pitch and any tendency for the airplane to roll. It is also more likely that he would have noticed the associated decrease in airspeed and reduced the airplane's pitch angle and climb rate to avoid further airspeed reductions."

NTSB said that, in addition, the incident airplane — like other SF340s outside Canada — was not equipped with stall protection logic and an ice speed switch, which were required by Transport Canada before the SF340 was introduced in Canada in 1994. The system provides a lower "trigger" angle-of-attack in the stall warning system for SF340s operated in Canada.

The reiterated recommendations — first issued in 2003, as a result of the investigation of an Oct. 25, 2002, accident in which a Raytheon Beech King Air A100 struck terrain in Eveleth, Minnesota, U.S., during an attempted nonprecision instrument approach in instrument meteorological conditions[2] — said that FAA should convene a panel of specialists in airplane design, aviation operations and aviation human factors to review the feasibility of requiring installation of low-airspeed alert systems in airplanes engaged in commercial operations under U.S. Federal Aviation Regulations Parts 121 and 135, and, if the panel found the installations feasible, establish requirements for installation of the alert systems.

If flight crews on the accident and incident airplanes had been alerted quickly to the rapid decrease in airspeed, they might have been able to take successful corrective action, NTSB said. ●

Notes

1. Type 1 deicing fluids are half ethylene glycol and half heated water, and are considered "unthickened." Other types contain thickening agents to increase their viscosity and therefore to enable them to remain on the aircraft throughout ground operations and then to be shed during the takeoff roll.

2. Eight people, including U.S. Sen. Paul Wellstone, were killed in the accident, and the airplane was destroyed. The U.S. National Transportation Safety Board said that the probable cause was "the flight crew's failure to maintain adequate airspeed, which led to an aerodynamic stall from which they did not recover."

Guarding the Airways

Protective breathing equipment reduces risk of smoke inhalation injury.

BY WAYNE ROSENKRANS

Immediate, aggressive action is required at the first sign of an in-flight fire, according to updated guidance for cabin crews. With that advice, some recommendations also remind crewmembers to pay attention to their defenses against smoke inhalation injury.

The importance of correctly donning and activating protective breathing equipment (PBE) at the appropriate time — considering the limited number of PBEs and hand fire extinguishers aboard aircraft — to prevent incapacitation by smoke is detailed in U.S. Federal Aviation Administration (FAA) Advisory Circular (AC) 120-80, *In-Flight Fires,* that in January 2004 updated guidance about fires that may not be visible or easily accessed by the crew.

"Remember, it is critically important that you protect yourself from the effects of smoke and fumes while attempting to fight a fire," the AC said. "Do not enter an enclosed area or begin to battle a fire that is generating heavy smoke without first donning your [PBE]. A small fire can quickly grow to be large and uncontrollable. … Any delay might result in a crewmember's inability to breathe and/or see."

Smoke comprises airborne solid and liquid particulates and gases. The exact composition of smoke is determined by the materials burned, temperature, rate at which temperature increases, humidity, duration of the exposure to heat and amount of oxygen present. One report by FAA's Civil Aerospace Medical Institute (CAMI) said, "Since the aircraft structure is composed of a variety of carbon- and nitrogen-containing polymeric materials, there is a strong potential for the generated smoke to be rich in carbon monoxide and hydrogen cyanide."[1]

U.S. Federal Aviation Regulations, like those of some other civil aviation authorities, require operators to provide "a breathable atmosphere to protect crewmembers from the effects of smoke, carbon dioxide or other harmful gases and oxygen deficiency caused by other than an airplane depressurization, while attempting to locate and/or extinguish an in-flight fire onboard an airplane. Crewmember PBE is required whether the airplane is pressurized or not, and is not intended as an evacuation aid."

Current PBEs protect one wearer for at least 15 minutes; research is underway to develop a new generation of PBEs that could extend protection to at least 20 minutes and possibly up to five hours.[2] Some PBEs use a continuous flow, open circuit design; others use a closed circuit, rebreather design.

Familiarity with the specific PBE model(s) aboard the aircraft, which may differ from a training model, saves time in an emergency, reduces chances of damage while handling or donning the PBE, helps ensure a tight neck seal that will maximize breathing time and keep out toxins, and may remind crewmembers that the breathing gas will escape if the PBE is passed to another person after activation.[3] Because 24 months elapse between recurrent operating drills with PBE in the United States, for example, it can be useful to mentally rehearse when to use PBE, what to do if PBE fails preflight inspection and how to open the sealed pouch, don and activate the PBE, monitor any low-oxygen (breathing gas) indicator and immediately remove the PBE when breathing gas has been depleted or the unit fails.

In Airbus procedures, examples of when to wear PBE include situations in which smoke or fire is still present after initial steps to extinguish an oven fire and upon feeling the door panel of a lavatory with the back of the hand and finding it hot.

Smoke Experiences

In November 2000, the first officer of a McDonnell Douglas MD-80 Super 80 operated by a U.S. airline said that he regretted his failure to use a PBE while investigating the source of smoke in the cabin.

"Five to eight minutes after takeoff, I smelled an electrical burning smell with a slight chemical odor," he said. "I jumped up to check the cabin and found smoke in the cabin. … The smoke would appear and dissipate in waves. … We landed without incident. Later (two hours or so), my eyes burned, [my] throat hurt and [I] became hoarse, and I had bronchial irritation. I realized if there is smoke in the cabin, not knowing the source, crewmembers and passengers should be warned to cover their mouths [and noses with cloth]. … I know if it were to happen again, I [would] consider [wearing the PBE] or covering my mouth with a wet cloth to reduce irritation."[4]

Circumstances in the following accident have been cited in discussions of crew responses to in-flight fires and smoke. Soon after takeoff, the first officer, two flight attendants and five passengers received minor injuries from smoke inhalation in August 2000 when AirTran Airways Flight 913, a McDonnell Douglas DC-9-32, returned to the Piedmont-Triad International Airport in Greensboro, North Carolina, U.S. The emergency landing was prompted by an in-flight fire in an enclosed forward area accessible from the cabin and smoke in the cockpit. Five other passengers and one ground crewmember received minor injuries during the evacuation.

B/E Aerospace

Clear polycarbonate visor panels in this PBE design provide a wide field of vision.

In its final report, the U.S. National Transportation Safety Board (NTSB) said, "Examination of the airplane revealed severe smoke and heat damage around the electric power center (EPC) and within the cockpit. Removal of the forward and aft EPC panels revealed heavy sooting, melted wire insulation, visibly broken wires and localized heat damage. … [NTSB] also learned during its investigation of this accident that neither flight attendant on board … attempted to locate the source of the smoke in the cabin or to use any of the fire fighting equipment available to them."[5]

Some medical journals note that the human body's upper airway naturally provides significant protection to the lower airway and lungs against extreme heat from hot, dry air, unlike steam, which quickly can cause severe lung injury. The primary causes of smoke-inhalation injury include direct heat energy; insufficient oxygen to breathe; toxic effects of chemicals such as asphyxiants, irritants and systemic toxins; and the choking effect of airborne particulates such as soot and dust. The most deadly and common asphyxiants in fires are carbon monoxide and hydrogen cyanide. Lethally hot smoke and extremely low oxygen levels are most likely to occur at an advanced fire stage. Irritants in smoke tend to dissolve on water-covered surfaces of the body, causing inflammation of the mucous membranes that line the eyelids, nose and the passageway from the nasal cavity into the throat.

Several medical researchers during the past 10 years have urged greater awareness of the threat of hydrogen cyanide poisoning in smoke inhalation. "If hydrogen cyanide is present and has been inhaled in a sufficient amount to paralyze respiration, there is no immediate treatment (antidote) available at the fire scene," one article said. "The only antidotal procedure approved in the United States for cyanide poisoning [from smoke inhalation] … is impossible to use when [carbon monoxide in the blood, as carboxyhemoglobin] is present unless special precautions are taken [in a hospital setting]."[6]

Uncommon Events

Like airline accidents generally, occurrences of serious injury or death from smoke inhalation while fighting an in-flight fire have been rare. According to the *Statistical Summary of Commercial Jet Airplane Accidents* published by Boeing Commercial Airplanes, 10 of 237 fatal accidents (4.2 percent) in the worldwide commercial jet fleet during 1987–2005 fell into the "fire/smoke (non-impact)" category. These smoke/fire accidents involved 618 onboard fatalities. Smoke-caused fatalities typically have occurred while the airplanes were on the ground, where the cabin crew's priority shifts from fire fighting to passenger evacuation.

The apparent infrequency of in-flight medical events involving smoke inhalation is reflected in international airline crews' requests for medical advice. David Streitwieser, M.D., medical director of MedAire's MedLink service and a specialist in emergency medicine, said, "I can recall only a few patches [radio/telephone communications involving emergency physicians on the ground] involving fumes of some kind — and none involving smoke — in the 50,000 patches I have reviewed over 10 years. The presence of the fumes was never actually verified in some of the cases."

Medical Care

Pilots or flight attendants concerned about health effects from their exposure to smoke in the cockpit or cabin may consider MedLink's medical advice protocols or seek medical attention if injury is suspected anytime after the exposure. "Medical oxygen would be the primary onboard treatment," Streitwieser said. "The albuterol inhaler [a bronchodilator medication] might be useful for passengers [or crew] with audible wheezing or a history of asthma and a smoke exposure. Persons exposed to smoke would need to be seen by first responders or later [by a physician] if they had shortness of breath, persistent cough, chest pain, pain with swallowing, [sensation of] throat burning or noisy breathing — technically, wheezing or stridor," a high-pitched sound while breathing.

In serious smoke/fire injuries, thermal injury to the upper respiratory tract may lead to significant upper airway swelling, resulting in noisy breathing, airway occlusion and respiratory arrest, said one medical journal.[7] "Patients initially may [visit a physician without any symptoms], as symptoms may take up to 24 hours to develop," the journal said. "Signs that indicate potential significant inhalation injury include singed nasal hairs, carbonaceous [carbon particles in] sputum, and burns to the face or any major burn. Patients may [see the physician] with cough, [labored breathing] or hoarseness. Rales [crackling/rattling sound] and wheezing may be heard on physical examination. … Fiberoptic bronchscopy has long been … the gold standard for early diagnosis and also may help clear carbonaceous debris from the respiratory tract, predict development of acute respiratory distress syndrome and allow for [insertion of a tube to assist breathing] if significant inhalation injury is found."●

Notes

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Member News

Flight Safety Foundation Icarus Committee member Capt. Robert Sumwalt has been confirmed by the U.S. Congress to a five-year term as member of the National Transportation Safety Board, and has been named vice chairman.

Congratulations to Eastman Kodak Aviation Services for achieving 60 years of safe operations in corporate aviation.

Jurg Schmid, former head of flight safety at Swiss International Air Lines, was recently named head of safety management at Skyguide.

Doug Schwartz, formerly with AT&T Aviation and currently an FSF Board of Governors member, has been named vice president of flight operations and standards for TAG Aviation.

FlightSafety International, the aviation and marine training company headquartered in New York, is celebrating its 55th year in business.

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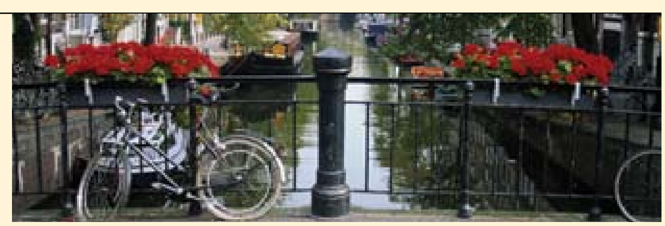

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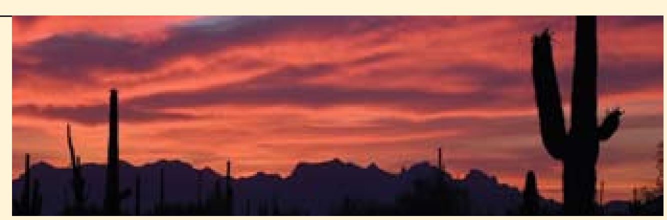

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When Bottle

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Alcoholism among flight crewmembers is rare but does exist. Afflicted pilots can turn to programs designed to help them stop drinking and keep their jobs.

BY LINDA WERFELMAN

Alcoholism is a chronic, often progressive disease that — untreated — can lead to death. The United Nations World Health Organization (WHO) estimates that, of about 2 billion people worldwide who consume alcoholic beverages, about 76 million have diagnosable problems related to alcohol.[1]

WHO data show that alcohol causes 1.8 million deaths a year. Alcohol consumption is associated with more than 60 types of disease and injury, including esophageal cancer, liver cancer, cirrhosis of the liver, epileptic seizures and motor vehicle accidents.

For pilots, excessive alcohol consumption presents risks not only to health but also to their flying careers. The International Civil Aviation Organization (ICAO) says that alcoholism among crewmembers is relatively infrequent and that less than one pilot in every 5,000 worldwide loses his or her professional license each year because of problems associated with alcohol.[2,3] Programs exist to help pilots stop drinking (and engaging in other forms of substance abuse) and return to the flight deck.

Medical specialists differentiate between alcoholism — also known as alcohol dependence — and alcohol abuse. *Alcoholism* is characterized by a craving for alcohol; a loss of control, or inability to stop drinking; physical dependence on alcohol, with withdrawal symptoms such as nausea, shakiness or anxiety after stopping drinking; and an increased tolerance for alcohol, which results in increased consumption to produce the "high" associated with drinking. *Alcohol abuse* is a related condition in which excessive drinking results in health or social problems in someone who may not display all characteristics of alcoholism and is not dependent on alcohol (see "Signs of a Problem," page 34).

Physical dependence on alcohol develops gradually, as alcohol consumption changes the balance of some chemicals in the brain — including those associated with pleasure, inhibition and excitement — and causes a craving for alcohol. Other factors associated with excessive drinking and eventual dependence on alcohol include genetic factors that may increase vulnerability to alcoholism; emotional factors such as stress, anxiety or emotional pain; and low self-esteem or depression.[4]

For pilots and others in the aviation industry, occupational factors may appear to encourage alcohol consumption.

Meets Throttle

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"Stress, prolonged and frequent absences from home and family, and boredom play a role in … alcohol consumption," the International Center for Alcohol Policies (ICAP) said in a report that discussed alcohol in civil aviation. "With respect to the impact of alcohol on the performance of job-related duties, the relationship seems to be similar to that between drinking and driving. Alcohol reduces reaction time and impairs performance in a dose-dependent manner. While there is some evidence that at lower [blood alcohol concentration] levels, impairment may — at least in part — be compensated for by a pilot's experience, any such compensation — to the extent that it exists — only applies to familiar or routine situations. The ability to perform in an emergency or an unfamiliar circumstance remains impaired."[5]

Another occupational factor that can increase the temptation to drink is difficulty sleeping, which often results from working odd hours, such as those worked by pilots on overnight and long-range flights.

The ICAO *Manual of Civil Aviation Medicine* says that a pilot should be diagnosed with "drug dependence of the alcohol type" if his or her alcohol consumption "exceeds the amount culturally permitted, or if he habitually drinks at times which are outside the accepted licensing hours, or if he injures his health or his social relationship by repeated excessive alcoholic consumption."

The "culturally permitted" amount of alcohol consumption varies considerably. Data compiled by ICAP on "sensible drinking guidelines" include suggestions by authorities in Indonesia and the Philippines to "avoid drinking alcoholic beverages," by authorities in the United States to consume no more than one or two drinks a day, and by the French National Academy of Medicine not to exceed five drinks a day.

ICAO considers alcohol dependence difficult to cure and a potential hazard to flight safety because of its interference with reaction time and judgment.

"For these reasons, alcoholism is a bar to holding a flying license … unless the applicant abstains completely and then only if accredited medical conclusion considers the prognosis good," ICAO says.

When a pilot is diagnosed with alcoholism and his or her medical certificate is revoked, ICAO prescribes 12 months of total abstention, during which the pilot visits a company

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Signs of a Problem

Indications of a drinking problem — either alcoholism or alcohol abuse — may include:[1,2]

- Drinking alone;
- Feeling a need to drink, and being unable to limit alcohol consumption;
- Establishing a drinking "ritual" that typically involves drinking before, during or after dinner, and feeling annoyed if the ritual is interrupted or irritable as drinking time nears, especially if alcohol is not available;
- Developing increased tolerance, so that more drinks are required to feel the effects of alcohol; and,
- Experiencing withdrawal symptoms — including nausea, sweating or shaking — without alcohol.

Indications that may be seen in pilots and other aviation personnel include:[3]

- Frequent absences from work, and repeatedly calling in sick at the last minute;
- Errors in flight planning or maintenance procedures because of a lack of attention to detail and intellectual deterioration caused by drinking; and,
- Frequent trips to hotel bars during layovers.

Medical specialists say the answers to the following questions may help determine whether someone has a problem with alcohol:[4]

- Have you ever thought that you should limit your drinking?
- Have you been annoyed by other people criticizing your drinking?
- Have you felt guilty about your drinking?
- Have you had a drink first thing in the morning to "steady your nerves" or get rid of a hangover?

Specialists say that one "yes" answer may indicate an alcohol problem; two or more "yes" answers indicate that a problem is very likely.

— LW

Notes

1. U.S. National Institute on Alcohol Abuse and Alcoholism (NIAAA). *FAQs: How Can You Tell If Someone Has a Problem?* <www.niaaa.nih.gov/FAQs>.
2. Mayo Clinic. *Alcoholism Overview*. <www.mayoclinic.com/health/alcoholism/DS00340>.
3. Snyder, Quay C. "FAA-Sanctioned Pilot Alcohol Abuse Programs in Business Aviation." In *Issues, Decisions and Attitudes: A Spring Break for Safety: Proceedings of the 48th Annual Corporate Aviation Safety Seminar*. Alexandria, Virginia, U.S.: Flight Safety Foundation, 2003.
4. NIAAA.

physician or family physician every two weeks and a psychiatrist every three months; at each meeting with the psychiatrist, the pilot should provide a note from the family physician and another note from a close relative "to confirm that the patient has remained completely abstemious," ICAO says.

After this, the pilot may be permitted to resume flight duties if he continues to avoid alcohol and visits a psychiatrist every six months for two years "with the same evidence of complete abstention." Any relapse should result in permanent loss not only of medical certification but also of pilot licenses, ICAO says.

Old Attitudes

At one time — in part because of the threat that they would lose their jobs — airline pilots with drinking problems typically ignored their abuse of alcohol until they had reached the late stages of alcoholism.[6,7]

"A diagnosis of chemical dependency once created a seemingly insurmountable obstacle in getting the help needed," Donato J. Borrillo, M.D., a senior aviation medical examiner, wrote in the Spring 2003 issue of *The [U.S.] Federal Air Surgeon's Medical Bulletin*. "In addition, fellow pilots and flight attendants were reluctant to intervene for fear of threatening a colleague or friend's livelihood."

Then, in the mid-1970s, the U.S. National Institute on Alcohol Abuse and Alcoholism (NIAAA) and the Air Line Pilots Association, International (ALPA) formed an alliance to develop and test a program that treated alcoholism as a disease. The program — the Human Intervention Motivation Study (HIMS) — was designed to enable afflicted pilots to stop drinking and to seek medical recertification and a return to their flight duties.

"The HIMS program charter is to save lives and careers while maintaining flight safety," the HIMS mission statement says. "Trained managers and peer pilots interact to identify and, in many cases, conduct an intervention to direct the troubled individual to a substance abuse professional for a diagnostic evaluation. If deemed medically necessary, treatment is then initiated. Following successful treatment and comprehensive continuing care, the pilot is eligible to seek FAA [U.S. Federal Aviation Administration] medical recertification."[8]

During the three decades of its existence, the HIMS program — administered by ALPA under contract with FAA — has helped more than 3,500 airline pilots in the United States, providing treatment for alcohol or drug abuse and enabling them to return to the flight deck, said Donald Hudson, M.D., ALPA's aeromedical adviser. The program's success rate is about 85 percent, which means that about 15 percent of the pilots who receive alcoholism "special issuance"[9] medical certificates from FAA relapse before mandatory retirement at age 60.[10] About two-thirds of all relapses occur within the first two years after receipt of the special issuance; because FAA policies differ from ICAO's in this regard, most of these pilots return to the treatment program — and then go back to work and stay sober for the remainder of their flying careers, Hudson said.

If a pilot experiences a second relapse, FAA's response typically does not allow a return to flight duties.

Several years after creation of the HIMS program in the United States, a similar program was established in Canada. Today, about 30 airlines are active in HIMS programs. In addition, some airlines have established similar, in-house treatment programs.

Paul Collins-Howgill, M.D., head of the U.K. Civil Aviation Authority (CAA) Aeromedical Certification Unit, said that, although airlines in the U.K. have not adopted peer-intervention programs similar to HIMS, most are "sympathetic and cooperative when a pilot with an alcohol problem is identified."

Anthony Evans, M.D., chief of ICAO's Aviation Medicine Section, said that most major airlines and regulatory authorities have rehabilitation programs.

Through the HIMS program, an afflicted pilot is evaluated — in accordance with FAA requirements — by a specially trained aviation medical examiner (AME), who coordinates the pilot's medical recertification. After the initial treatment, which often involves 28 days in an inpatient program, the AME oversees regular — typically, monthly — interviews of the pilot by a trained flight manager and pilot peer committee member and follow-up observations that continue for months after the pilot returns to the flight deck.

Treatment continues with a period of "aftercare" — sometimes called "continuing care" — during which the monitoring of the pilot proceeds, typically through weekly group meetings with other airline pilots who also are fighting alcohol or drug problems. Aftercare may continue for

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months or years as part of a system designed to ensure the pilot's continuing abstention. Participation in Alcoholics Anonymous, or a similar alcoholism-recovery support group, is encouraged but not required.

A pilot can receive a new special issuance medical certificate from FAA as early as 120 days after initial treatment, if he or she has completed program requirements, been evaluated by an aviation medical examiner and provided FAA with all required paperwork.

'Benevolent Persuasion'

Most pilots do not enter the program voluntarily, the HIMS treatment statement says.

"Most arrive because of some type of benevolent persuasion," the statement says. "Many believe their job is threatened. This endangers their entire sense of being and identity. To lose their license and be denied flying would shake the very foundation of their universe. They enter with great suspicion."

Once in the program, however, they "immediately set forth to complete the 'checklist,' memorize the 'manual,' follow all 'procedures,' … pass the counselor's 'check ride,' and maintain the proper 'glide path' to recovery."

In recent years, a treatment program resembling HIMS has been developed for corporate pilots and flight departments. Quay Snyder, M.D., president of the aeromedical consulting group Virtual Flight Surgeons (VFS), said that VFS has designed the corporate Aviation Alcohol and Substance Abuse Abatement Program (AASAAP) "to mirror HIMS, [while] recognizing the varying philosophies and requirements of different operators." As of July 2006, about 20 pilots from 12 companies had received treatment, had their medical certificates reinstated and returned to flying, with continued monitoring of their progress. One fractional ownership operator also has implemented a version of AASAAP.

"We are trying to bring the same health, safety and career protection benefits to the corporate aviation community, but the business aviation world has yet to decide if they recognize the problem and want to take steps to make their profession a safer and healthier one," Snyder said. "Currently, most companies — with a few notable exceptions — choose not to recognize the problem, to ignore it or drive it underground by firing pilots who may have a medical problem. That hurts their bottom line and compromises safety." ●

Notes

1. United Nations World Health Organization. *Global Status Report on Alcohol — 2004*. Geneva, Switzerland, 2004.

2. International Civil Aviation Organization (ICAO). *Manual of Civil Aviation Medicine*. Part III, "Medical Assessment," Chapter 9, "Mental Fitness and Neurological Examination." 1985.

3. For example, Paul Collins-Howgill, M.D., head of the U.K. Civil Aviation Authority (CAA) Aeromedical Certification Unit, said that his 2004 audit of the CAA Drug and Alcohol Clinic found that initial assessments were conducted of 29 pilots (27 men and two women). Of the 29 assessments, 26 involved alleged misuse of alcohol and three involved alleged drug misuse. Eleven pilots were identified as requiring further treatment. Two patients relapsed, and two of the initial patients "decided to stop flying and continue drinking," he said. "The professional pilot population in the U.K. is 20,000, so [ICAO's] one in 5,000 figure seems correct."

4. Mayo Clinic. *Alcoholism Overview*. <www.mayoclinic.com/health/alcoholism/DS00340>.

5. International Center for Alcohol Policies (ICAP). *Alcohol and the Workplace*. August 2003. < www.icap.org>.

6. Russell, Julia C.; Davis, Audie W. *Alcohol Rehabilitation of Airline Pilots*, DOT/FAA-AM-85-12. U.S. Federal Aviation Administration Civil Aeromedical Institute. 1985.

7. Borrillo, Donato J. "The HIMS Program." *The Federal Air Surgeon's Medical Bulletin* Volume 41 (Spring 2003): 10.

8. Human Intervention Motivation Study (HIMS). *About HIMS*. <himsprogram.com/index.php>.

9. U.S. Federal Aviation Regulations Part 67, *Medical Standards and Certification*, says that a special issuance of a medical certificate is granted at the discretion of the federal air surgeon to applicants who do not meet specific medical requirements "if the person shows to the satisfaction of the federal air surgeon that the duties authorized by the class of medical certificate applied for can be performed without endangering public safety during the period in which the authorization would be in force."

10. Donald Hudson, M.D., aeromedical adviser for the Air Line Pilots Association, International, said that some relapse is to be expected because of the nature of alcoholism as a chronic brain disease. By comparison, the success rate of substance abuse treatment programs for the general public is between 50 and 60 percent, Hudson said.

Further Reading From FSF Publications

Mohler, Stanley R. "Medical Advances Enable FAA to Grant More Discretionary Medical Certificates to Pilots." *Human Factors & Aviation Medicine* Volume 46 (July–August 1999).

Mohler, Stanley R. "Continued Caution Urged for Pilot Use of Alcohol." *Human Factors & Aviation Medicine* Volume 45 (March–April 1998).

CFIT on a dark night departure

The pilots of the Learjet air ambulance likely were affected by fatigue during the VFR departure; a controller failed to relay radar altitude warnings.

BY MARK LACAGNINA

Photo Illustration: Copyright © Chris Sorensen Photography

About 0025 local time, two minutes after departing from San Diego to return home on the fourth leg of an air-ambulance operation that had begun the previous afternoon, a Learjet 35A struck a mountain, killing all five occupants. The flight crew's attempts to obtain an instrument flight rules (IFR) clearance before takeoff had been unsuccessful, so they had departed under visual flight rules (VFR). They were flying the Learjet about 100 ft below the clouds and communicating with air traffic control (ATC) when the accident occurred on Oct. 24, 2004.

In its final report, the U.S. National Transportation Safety Board (NTSB) said that the probable causes of the accident were "the failure of the flight crew to maintain terrain clearance during a VFR departure, which resulted in controlled flight into terrain, and the air traffic controller's issuance of a clearance that transferred the responsibility for terrain clearance from the flight crew to the controller, failure to provide terrain clearance instructions to the flight crew and failure to advise the flight crew of MSAW [minimum safe altitude warning] alerts."

A contributing factor was "the pilots' fatigue, which likely contributed to their degraded decision making," the report said.

The first leg of the trip was a repositioning flight, with two medical crewmembers aboard, from the operator's home base in Albuquerque, New Mexico, to pick up another medical crewmember in El Paso, Texas.[1] The airplane departed from Albuquerque about 1520 San Diego time (1620 Albuquerque time). From El Paso, the airplane was flown to Manzanillo, Mexico, to pick up a medical patient and an accompanying passenger. The airplane then was flown to Brown Field Municipal Airport, 13 nm (24 km) southeast of San Diego. The flight crew conducted a visual approach and landed at Brown Field about 2324.

The captain, 56, had 13,000 flight hours, including 525 flight hours in type and 639 flight hours in Learjet 25s. His wife told investigators that he had conducted at least one previous flight to San Diego, in January 2003. The copilot, 30, had 3,000 flight hours, including about 60 flight hours in type and 100 flight hours in Learjet 25s. There was no record that he had ever flown to San Diego.

Fatigue Factor

Reconstruction of the 72 hours preceding the accident showed that the captain and copilot were on duty 10 hours and flew more than seven hours on Oct. 21. Because of a generator problem, they spent that night in Battle Creek, Michigan, while the problem was fixed.

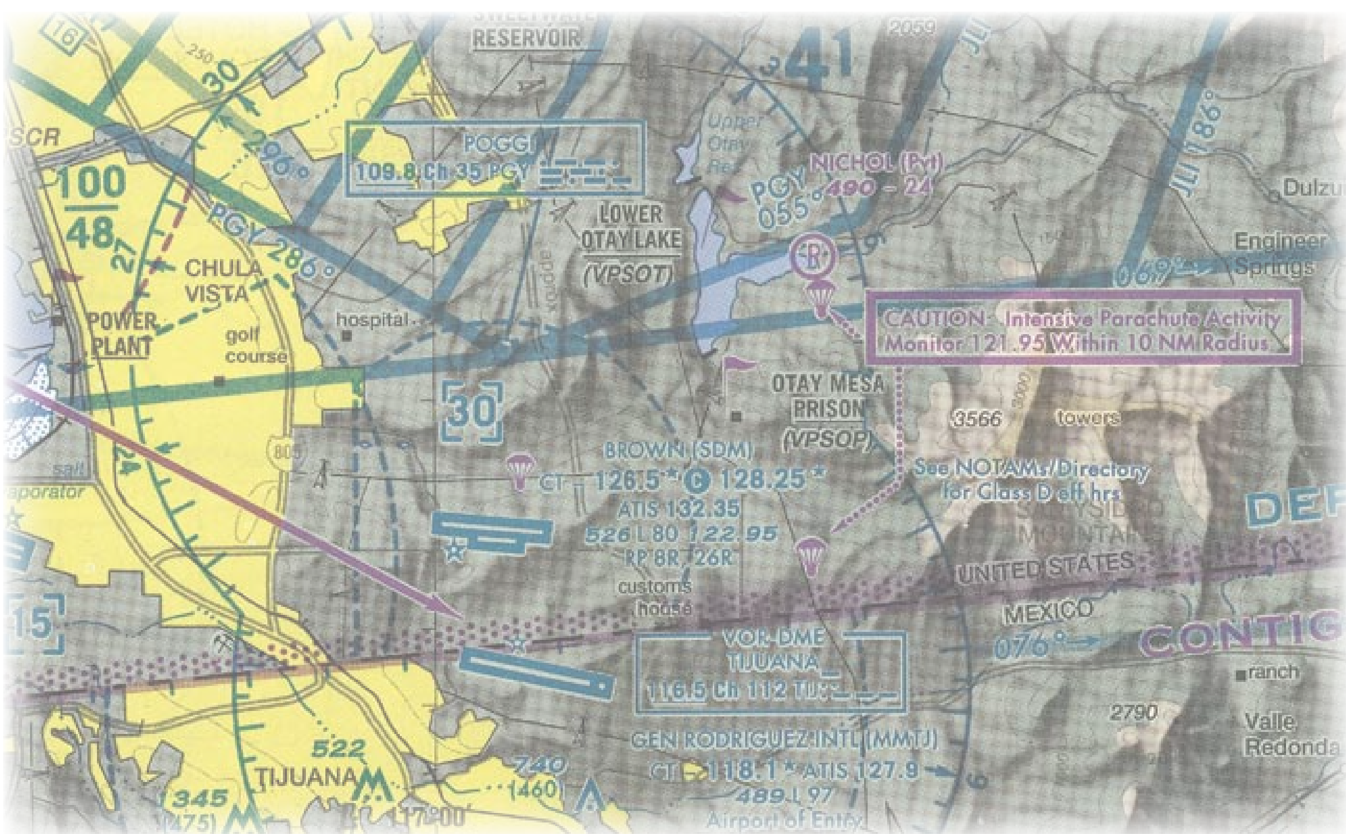
On Oct. 22, they flew the airplane back to Albuquerque, logging 3.3 flight hours during 4.3 hours of duty. The captain went to bed about 2130 and arose about 0700 on Oct. 23. The copilot went to bed about 2130 and arose about 0830. They received calls assigning them to the air-ambulance trip early that afternoon.

"Fatigue adversely affected the ability of both pilots to properly plan the departure."

"At the time of the accident, the captain had been awake about 17.5 hours, the copilot had been awake about 16 hours, and both pilots had accumulated about 11 hours of duty time," the report said. "Although the duty and rest times of both flight crewmembers were in compliance with [regulations], the accident flight departed about three hours past both crewmembers' normal bedtimes at the end of a long duty day. … It is likely that physiological and psychological fatigue adversely affected the ability of both pilots to properly plan the departure and assess the risks associated with it."

No Reply

Soon after midnight on Oct. 24, one of the pilots telephoned the San Diego Flight Service Station (FSS) and filed an IFR flight plan, estimating a 0020 departure. The route of flight was direct to



U.S. Federal Aviation Administration

Palm Springs, California, about 75 nm (139 km) northeast of Brown Field, and direct to Albuquerque, with Flight Level 370 (approximately 37,000 ft) requested for cruise. The pilot did not ask the FSS specialist for weather information or an IFR clearance with a clearance void time.

Before starting the Learjet's engines, the flight crew listened to a portion of the automatic terminal information service (ATIS) broadcast. The report said that cockpit voice recorder (CVR) data indicated that the pilots "listened only to the remarks portion of the [ATIS] recording and did not listen to the weather information," which is obtained from the airport's automated surface observing system (ASOS).

The ASOS report included an overcast ceiling at 2,100 ft, 8.0 mi (12.9 km) visibility, temperature 14 degrees C (57 degrees F), dew point 12 degrees C (54 degrees F), calm surface winds and an altimeter setting of 29.92 in Hg.

The control tower at Brown Field was closed. In an attempt to obtain an IFR clearance before departure, the copilot tried to establish radio communication with the airport's clearance delivery facility, the San Diego FSS on two different frequencies and the nearby Tijuana, Mexico, airport control tower.

"After the copilot's fourth failed attempt to obtain the IFR clearance using the radio, the captain said, 'All right, let's just do VFR,'" the report said. "According to the operator, the flight crew had a cellular telephone and a satellite telephone aboard the airplane. The CVR recording revealed no attempt by either crewmember to telephone the FSS for an IFR clearance and clearance void time."

Learjet 35A

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The Learjet 35, introduced in 1974, is similar to the Learjet 25 but has turbofan engines rather than turbojet engines, a longer fuselage and longer wings. The Learjet 35A, introduced in 1976, has wing modifications designed to reduce stall speeds and approach speeds, and improve takeoff performance. Maximum takeoff weight was increased to 18,300 lb (8,301 kg) from 17,000 lb (7,711 kg).

The airplane has accommodations for two pilots and eight passengers. The pressurization system can maintain a cabin altitude of 6,500 ft at maximum operating altitude, 45,000 ft.

The Honeywell (formerly Garrett and AlliedSignal) TFE731-2-2B engines are rated at 3,500 lb (1,588 kg) thrust. Usable fuel capacity is 6,198 lb (2,811 kg). Maximum rate of climb at sea level is 4,760 fpm. Maximum single-engine rate of climb at sea level is 1,470 fpm. Maximum operating Mach number is 0.81. Maximum range with four passengers and a 45-minute fuel reserve is 2,196 nm (4,067 km). Maximum landing weight is 15,300 lb (6,940 kg).

Production of the Learjet 35A ended in 1994.

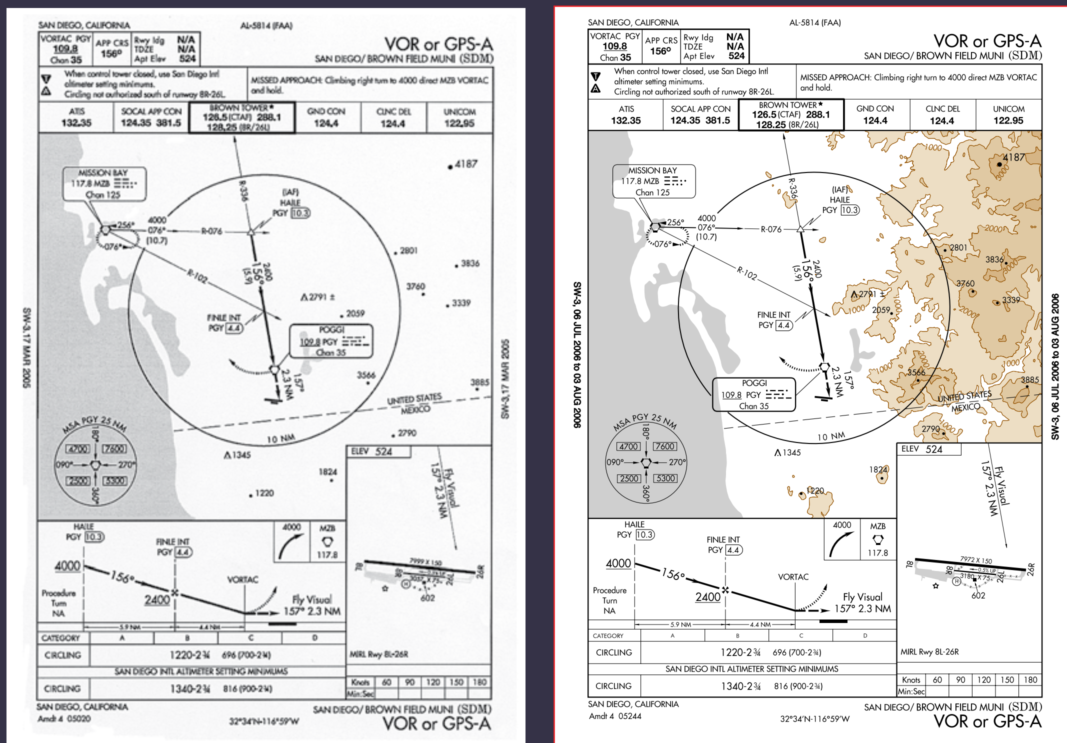
Source: *Jane's All the World's Aircraft*

'Go Straight Out'

The flight crew decided that a departure from Runway 08L would take them away from the city of San Diego and place them on a heading almost direct to Albuquerque. The captain said, "Depart on runway eight. Just go straight out." The copilot, the pilot flying, said, "That sounds real good to me."

The report said that the flight crew did not discuss the mountainous terrain east and northeast of the airport, and they did not follow the published obstacle departure procedure for Runway 08L. The procedure requires almost a complete course reversal, with an initial climbing left turn to 3,900 ft on a heading of 280 degrees.

While conducting a pre-departure checklist, the pilots set their altimeters to 29.93 in Hg. The captain's departure briefing was: "Will be standard callouts tonight, and if you can't punch up through a nice hole then just, you know, stay at a reasonably safe altitude and underneath two



Colored terrain contours were added to charts after the accident.

U.S. Federal Aviation Administration

hundred and fifty knots, and I'll do the best I can to get somebody's attention."

The airplane was climbing through 1,800 ft after takeoff when the captain established radio communication with SOCAL (Southern California) Approach Control. "Off Brown Field at this time, squawking VFR, the IFR please to Albuquerque," he said.

The controller assigned a transponder code and asked the captain to "ident" — that is, to select the transponder's identification mode. The controller then told the captain that the airplane was in radar contact. "Fly heading of zero two zero [and] maintain VFR," the controller said. "As soon as you get above five thousand, I'll have an IFR clearance for you."

The controller was employed by the U.S. Federal Aviation Administration (FAA) in 1987. He worked at SOCAL Approach in 1994 and 1995, and at the Brown Field and San Diego International Airport control towers before returning to SOCAL in 1998.

The controller had worked a shift from 0630 to 1430 on Oct. 23 and returned at 2300 to work the midnight shift from 0000 to 0830. "The controller stated that he rested but did not sleep before reporting for the midnight shift and that he was not tired when he handled the accident flight," the report said.

The captain's acknowledgement of the controller's instructions was the last recorded radio transmission from the Learjet. Recorded ATC radar data indicated that the airplane was in level flight at 2,300 ft and 3.5 nm (6.5 km) west of mountainous terrain that rises to 3,566 ft. "The heading issued by the controller resulted in a flight track that continued toward the mountains," the report said.

"At night, clouds and terrain are difficult for pilots to see, and a gradual loss of visual cues can occur as flight is continued toward darker terrain," the report said. "Given that the accident flight occurred at night, over rural terrain and with few visual cues, and that the overcast cloud layer would have prevented moonlight from illuminating the terrain, it is likely that the flight crew did not see the rising terrain as the airplane continued toward it."

The company that owned the accident airplane told investigators that a terrain awareness and warning system (TAWS) was scheduled to be installed in the airplane in January 2005.

'Knowledge and Opportunity'

The controller told investigators that he issued the 020-degree heading to keep the airplane out of Mexican airspace and to turn it toward the first waypoint listed on the flight plan. "The controller stated that he was aware of the mountainous terrain east [of the airport]," the report said. "When asked why he took no action to warn the flight crew of the airplane's proximity to terrain, the controller stated that it was the pilot's responsibility to avoid terrain when operating under VFR. … The controller also stated that he was aware of the cloud ceiling at 2,100 feet AGL [above ground level] and that he expected the pilots to maintain VFR and to advise him if they were unable to do so."

Soon after the controller issued the heading assignment to the Learjet flight crew, a Mode C altitude return from the airplane's transponder generated an MSAW alert, consisting of an aural warning and a visual warning on the controller's radar display. The last Mode C return received from the airplane four seconds later also generated an MSAW alert.

The controller told investigators that he did not hear or see the MSAW alerts because he was communicating on a landline with a Tijuana Approach controller. The SOCAL controller provided a "radar point-out" of the Learjet, which was in Tijuana airspace, and told the Tijuana controller that it was "northbound out of your airspace."[2] He said that when he returned his attention to the radar display, the Learjet's data block had gone into "coast status," indicating that radar contact with the airplane had been lost.

The report said that recorded radar data and communication data do not support the controller's statement. "The MSAW alerts began 34 seconds before the controller initiated the call to the Tijuana controller. Radar contact with the airplane had been lost for 15 seconds when the controller began coordinating the flight's position with the Tijuana controller."

According to FAA's ATC manual, "the issuance of a safety alert is a controller's first priority regardless of whether the flight is operating under VFR or IFR," the report said.[3] The manual also states that a controller assumes responsibility for terrain clearance if he or she issues an instruction, such as a turn to a specific heading.

"Regardless of his failure to appropriately apply the procedures for handling a VFR–IFR flight, the controller [involved in the accident flight] was aware of the topography near [Brown Field] and that the airplane was quickly approaching a mountainous area," the report said. "The controller had the knowledge and opportunity to alert the flight crew to an unsafe condition, but he failed to do so."

The accident occurred 30 seconds after the last MSAW alert. The crew of a San Diego Police Department helicopter, using night vision goggles and infrared imaging, found the wreckage about 20 minutes after the accident. The airplane had struck a mountain at 2,256 ft, about eight nm (15 km) east of Brown Field. The helicopter crew said that the main impact crater was 75 ft to 100 ft below a layer of broken-to-overcast clouds.[4]

Among actions taken after the accident were the addition of colored terrain contours to Brown Field approach charts published by the U.S. government and the addition of information in FAA's *Airport/Facility Directory* about mountainous terrain near the airport. NTSB made no recommendations based on the accident investigation. ●

This article is based on NTSB Aircraft Accident Brief AAB-06/05, which comprises 22 pages, and NTSB public docket 38850, which comprises 332 pages and 37 photographs.

Notes

1. The report said that the Learjet was owned by Med Flight Air Ambulance, which also employed the crewmembers. The accident flight was conducted as a charter operation by ATI Jet, which wet-leased the airplane from Med Flight. The service agreement between the two companies had been approved by the U.S. Federal Aviation Administration (FAA) principal operations inspector assigned to ATI Jet. The report indicated, however, that the agreement did not comply with FAA regulations because Med Flight did not hold a certificate to conduct common carriage. "On June 10, 2005, the FAA issued Notice 8400.83 to its inspectors, clarifying the regulation that such wet-lease agreements are prohibited," the report said.

2. *Radar point-out* is defined by FAA as "an action taken by a controller to transfer the radar identification of an aircraft to another controller if the aircraft will or may enter the airspace or protected airspace of another controller and radio communications will not be transferred."

3. FAA Order 7110.65P, *Air Traffic Control*.

4. The report noted that the accident site was less than 1.5 mi (2.4 km) from the site where a Hawker Siddeley DH-125 struck the mountain on a dark night March 16, 1991, killing all 10 occupants. The Hawker crew had departed under visual flight rules from Runway 08L at Brown Field and was trying to pick up an instrument flight rules clearance when the accident occurred. In report no. LAX91FA132, the U.S. National Transportation Safety Board said that the probable causes of the accident were "the pilot's failure to maintain proper altitude clearance over mountainous terrain and the copilot's failure to adequately monitor the progress of the flight."

Learning From Experience

Incident No. 3

Delayed

Pull-Up

Third in a series focusing on approach-and-landing incidents that might have resulted in controlled flight into terrain but for timely warnings by TAWS.

BY DAN GURNEY

Anomalies in the depiction of the nonprecision approach procedure are among several factors that might have played a role in the premature descent conducted by the flight crew of a widebody glass-cockpit aircraft in this incident. The hazard was exacerbated by the failure of the crew to respond appropriately to a terrain awareness and warning system (TAWS) warning.[1] A second warning was required to motivate the crew to extract the aircraft and themselves from a close call with terrain.

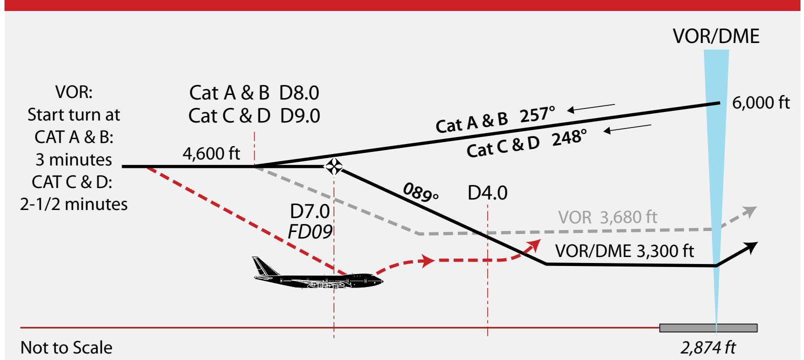
The chart for the VOR/DME (VHF omnidirectional radio/distance measuring equipment) approach, which the crew apparently was conducting in nighttime visual meteorological conditions (VMC) with visibility restricted by haze, shows that a minimum altitude of 4,600 ft should have been maintained until reaching the final approach fix (FAF), 7.0 nm DME from the station. However, the crew began the descent for the final segment of the approach two nm before reaching the FAF, from there flying a three-degree descent path (Figure 1).

The aircraft was about 1,300 ft too low when it crossed the FAF. The descent was continued below the minimum descent altitude (MDA) for the VOR/DME approach, 3,300 ft, likely because the flight crew had the ground environment in sight and was continuing the flight by reference to external visual cues. The crew received a "TERRAIN, PULL UP" warning from the TAWS when the aircraft was 250 ft above ground level — a city in this case — and 6.7 nm from the station (about 6.0 nm from the runway threshold). The crew stopped the descent and began a climb, but leveled the aircraft at the MDA. Not having reached the charted step-down fix for descent to the MDA, 4.0 nm, the aircraft was 380 ft below the appropriate minimum altitude and about 100 ft below the top of a nearby obstacle.

The aircraft was in level flight at the MDA for about 1.5 nm before the TAWS generated a "TOO LOW, TERRAIN" warning, which apparently prompted the crew to conduct a missed approach.

Several factors that might have contributed to the premature descent at 9.0 nm were considered

Approach Profile View and Aircraft Flight Path



D = Distance From VOR/DME (nm)

Source: Dan Gurney

Figure 1

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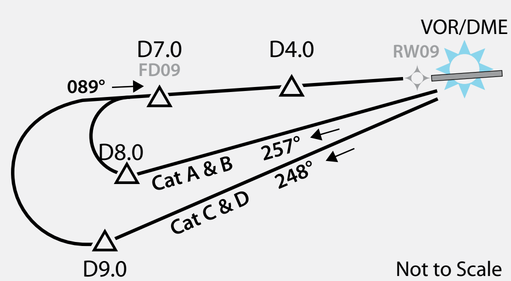
in the author's analysis of the incident, which was reviewed by a select group of aviation safety professionals and airline pilots. Chief among the likely factors was confusion caused by anomalies in the charted approach procedure. Among the anomalies are the following:

- The chart includes information for a VOR approach as well as the VOR/DME approach to Runway 09. In the charted profile view, a dashed line depicting the glide path for the final segment of the VOR approach indicates that the descent from 4,600 ft is initiated *before* reaching the FAF. Furthermore, this pre-FAF descent point is identified on the chart by a listing of the turn-in points for the procedure turn — 8.0 nm for Category A and B aircraft and 9.0 nm for Category C and D aircraft (Figure 1 and Figure 2). Thus, the crew might have mistakenly identified the descent point for the VOR/DME approach as the 9.0 nm turn-in point rather than the required 7.0 nm.

Approach Plan View



D = Distance From VOR/DME (nm)

Source: Dan Gurney

Figure 2

- The chart includes area navigation (RNAV) waypoints for flight management system (FMS) programming and other uses. The FAF is identified by the RNAV waypoint "FD09," as well as by "D7.0" (7.0 nm DME), which provides an additional opportunity for misidentification of the FAF as 9.0 nm.

- Another anomaly, which likely was not a factor in the incident but nevertheless presents a source of confusion, is the inclusion in the chart's profile view — but not in the plan view — of information on turn-in points defined by timing for crews conducting the VOR procedure in aircraft not equipped with DME — three minutes for Category A and B aircraft, and 2.5 minutes for Category C and D aircraft.

Besides misidentification of the FAF from the information on the approach chart, the following are possible explanations for the premature descent and low approach:

- The crew deliberately descended early, in a "duck-under, dive-and-drive" procedure.

- Having abandoned the published approach procedure to conduct a visual approach, the crew experienced the "black-hole effect." The existing conditions were conducive to this effect: a dark night and featureless terrain beyond the city with lights on or near the airport as the only visual stimuli. The crew's depth perception was affected, resulting in the illusion that the airport was closer than it actually was or that the aircraft was too high, causing them to conduct the visual approach below the correct flight path.

- While programming the FMS, the crew entered waypoints at 9.0 nm DME on both the outbound and inbound courses of the procedure turn to facilitate a continuous turn to the inbound course. Subsequently, they mistook the electronic flight information system (EFIS) display of the 9.0 nm waypoint on the inbound course for the FAF.

- The runway position either was not displayed by the EFIS or was not referred to by the crew. Thus, the crew likely had little or no awareness of the aircraft's position relative to the runway.

The crew apparently did not effectively use two terrain-avoidance tools at their disposal: the altitude/range table provided on the approach chart (Table 1) and the aircraft's radio altimeter. A cross-check of the altitude/range table would have shown clearly that the aircraft was too low. The radio altimeter, properly set and monitored, likely would have provided an early warning that the aircraft was too low.[2]

The crew did not climb to a safe altitude after the first TAWS warning. This might have resulted from mental reversion to outdated advice applying to early generation ground-proximity warning systems (GPWS). Crews were advised to pull up and climb to a safe altitude *or*, if in daytime VMC, to continue flight if the aircraft was verified to be clear of terrain and obstacles.

In the author's opinion, the crew should have continued the climb to 6,000 ft, the sector safe altitude — also called minimum safe altitude — shown on the approach chart.

Lessons to Be Learned

A thorough approach briefing at a time of relatively low workload in the cockpit is important to ensure that the flight crew understands a charted procedure and agrees on how it will be conducted. The crew also should cross-check an FMS-generated routing and its display on the EFIS to ensure that it corresponds with the charted procedure.

The standard operating procedure (SOP) for crew action in the event of a TAWS warning must require, unconditionally, an immediate climb to a safe altitude. The determination of what constitutes a safe altitude should not be left to the crew's judgment; SOPs must define safe altitudes for the various phases of flight. Only after reaching the safe altitude should the crew re-evaluate the situation.

Flight crews should use all terrain-avoidance tools at their disposal, including altitude/range tables and radio altimeters. Requirements and guidance for effective use of these tools should be included in company SOPs.

Flight crews also should recall that MDA is not always a safe altitude, particularly at relatively long distances from the runway.●

Altitude/Range

DME	7.0 nm	6.0 nm	5.0 nm	4.0 nm	3.0 nm
Altitude	4,600 ft	4,300 ft	3,990 ft	3,680 ft	3,370 ft

Source: Dan Gurney

Table 1

[This series, which began in the July issue of *Aviation Safety World*, is adapted from the author's presentation, "Celebrating TAWS Saves, But Lessons Still to Be Learned," at the 2006 European Aviation Safety Seminar and the 2006 Corporate Aviation Safety Seminar.]

Dan Gurney served in the British Royal Air Force as a fighter pilot, instructor and experimental test pilot. He is a co-author of several research papers on all-weather landings. Gurney joined BAE Systems in 1980 and was involved in the development and production of the HS125 and BAe 146, and was the project test pilot for the Avro RJ. In 1998, he was appointed head of flight safety for BAE Systems. Gurney is a member of the FSF CFIT/ALAR Action Group, the FSF European Advisory Committee and the FSF steering team developing the "Operators Guide to Human Factors in Aviation."

Notes

1. *Terrain awareness and warning system* (*TAWS*) is the term used by the International Civil Aviation Organization to describe ground-proximity warning system (GPWS) equipment that provides predictive terrain-hazard warnings; *enhanced GPWS* (*EGPWS*) and *ground collision avoidance system* (*GCAS*) are other terms used to describe TAWS equipment.

2. The Flight Safety Foundation Approach-and-landing Accident Reduction (ALAR) Task Force recommends that during a straight-in nonprecision approach, the radio altimeter be set at 1,000 ft for the initial segment, 500 ft for the intermediate segment and 250 ft for the final segment. The settings correspond to obstacle-clearance requirements for the design of approach procedures. FSF ALAR Task Force; FSF Editorial Staff. "ALAR Briefing Notes." *Flight Safety Digest* Volume 19 (August–November 2000).

Indispensable CRM

Inadequate crew resource management found in every fatal accident involving a commercial aircraft in Greek airspace.

BY RICK DARBY

Problems of crew resource management (CRM) were associated with all fatal accidents involving commercial aircraft in Greek airspace during 1983–2003, according to a human factors analysis of accidents. "Crew skill errors" occurred in more than 71 percent of the fatal accidents and "crew violations" were found in 57 percent, although there was a "strong statistical decrease" in the most recent decade, the report said. "Adverse mental states" were associated with more than 71 percent of the fatal accidents, and effects of the "physical environment" on flight crews played a causal role in 43 percent.

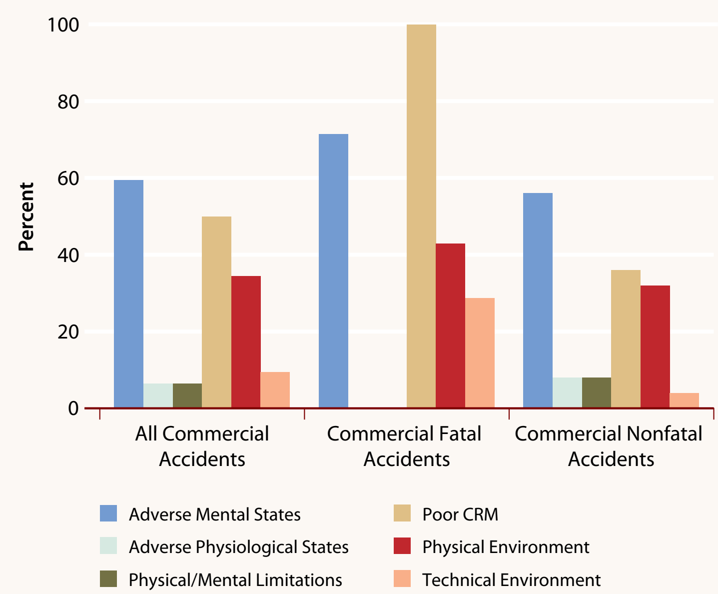
The findings were presented this year by a four-member team of Greek aviation safety researchers.[1] Their study was based on reports of 185 aviation accidents and incidents involving flight crew error, of which 41, or 22.2 percent, occurred in commercial operations.[2] All events were recategorized for the study as fatal or nonfatal accidents. In commercial aviation, 19.5 percent were fatal and 80.5 percent were nonfatal. The source reports, from the Hellenic Accident Investigation and Aviation Safety Board, were evaluated by the researchers using the Human Factors Analysis and Classification System (HFACS),[3] introduced in 2000 by the U.S. Federal Aviation Administration, and derivative classification and analysis tools for maintenance human errors and air traffic control (ATC) human errors.

"Poor CRM" was a factor in 100 percent of fatal accidents, and 50 percent of all accidents, involving commercial aircraft (Figure 1). "Adverse mental states"[4] — primarily a loss of situational awareness —was a factor in 71.4 percent of the fatal accidents. The effect of the "physical environment" as a precondition for unsafe acts by pilots played a role in 42.9 percent of the fatal accidents, and the "technical environment" was an important factor in 28.6 percent.

The "poor CRM" found in all fatal accidents contrasted with its presence in 36 percent

'Poor CRM' Found in Every Fatal Accident

Commercial Aircraft Accidents in Greek Airspace, 1983–2003



Source: Ioannis Markou, Ioannis Papadopoulos, Nikolaos Pouliezos, Sarantis Poulimenakos

Figure 1

of nonfatal accidents involving commercial aircraft. Among the fatal accidents, "crew skill errors" were found in 71.4 percent and "crew violations" in 57.1 percent (Figure 2).[5] "Crew decision error" was a factor in 28.6 percent and "crew perceptual error" was found in 42.9 percent.

At the organizational level, various types of poor supervision were found in some fatal accidents involving commercial aircraft (Figure 3). "Failure to correct problem" and "supervisory violations"[6] were each a factor in 42.9 percent, "inadequate supervision" in 14.3 percent and "planned inappropriate operations" in 28.6 percent.

The study considered the phases of flight in which accidents occurred. Half of the fatal accidents involving commercial operations happened during descent/landing, and 37.5 percent during initial climb.

Nonfatal accidents involving commercial aircraft are shown in Table 1 (page 52). "Crew skill error" and "poor CRM" were the most common factors in the approach phase. "Adverse mental states," "crew skill error," "crew decision error" and "physical environment" factors were the most common in the en route phase. "Crew violations" was the most frequent factor in the loading, taxi and unloading phases.

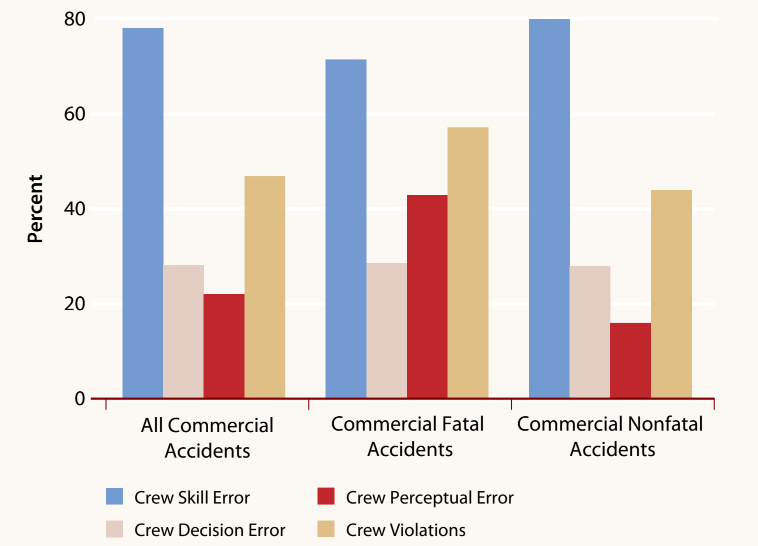
Fatal accidents involving commercial aircraft are shown in Table 2 (page 52). In the en route phase, "poor CRM" was found in all the accidents, and "crew perceptual errors," "crew violations" and "physical environment" played a role in two-thirds of the accidents. In the descent phase, "crew skill error," "adverse mental states" and "poor CRM" were found in all the accidents.

The researchers analyzed the demographics of pilots involved in accidents. The age of the pilot flying and pilot not flying are shown in Table 3 (page 52). The pilot flying was over 50 years old in 65 percent of the fatal accidents involving commercial aircraft.

No maintenance errors were associated with fatal accidents during commercial aircraft operations; ATC errors were one of the causal factors cited in 12.5 percent of these accidents. ●

Skill Errors Predominated

Commercial Aircraft Accidents in Greek Airspace, 1983–2003

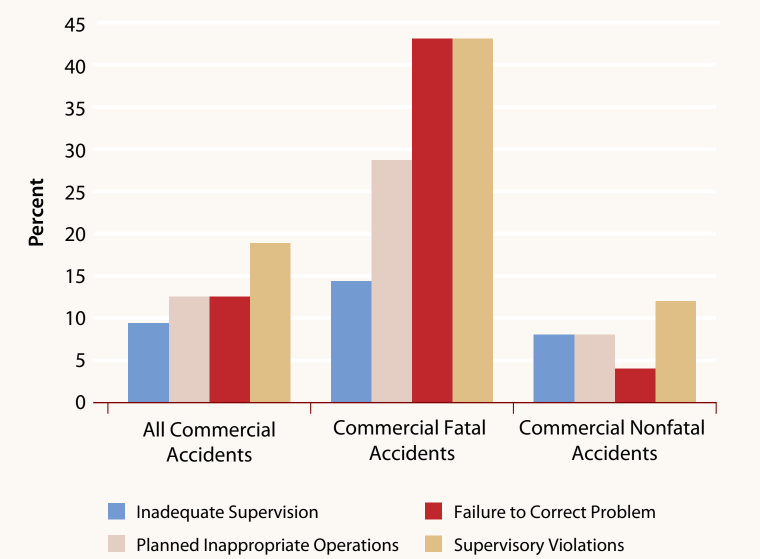


Source: Ioannis Markou, Ioannis Papadopoulos, Nikolaos Pouliezos, Sarantis Poulimenakos

Figure 2

Organizational Supervision Problems More Common in Fatal Accidents

Commercial Aircraft Accidents in Greek Airspace, 1983–2003



Source: Ioannis Markou, Ioannis Papadopoulos, Nikolaos Pouliezos, Sarantis Poulimenakos

Figure 3

Notes

1. Markou, Ioannis; Papadopoulos, Ioannis; Pouliezos, Nikolaos; Poulimenakos, Sarantis. "Air Accidents-Incidents Human Factors Analysis: The

Crew Errors During Approach in Nonfatal Accidents

Commercial Aircraft Accidents in Greek Airspace, 1983–2003

	Error Type: Percentage of Accidents								
Phase of Flight	Crew Skill Error	Crew Decision Error	Crew Perceptual Error	Crew Violations	Adverse Mental States	Adverse Physiological States	Poor Crew Resource Management	Physical Environment	Technical Environment
Load, taxi, unload	60.0	20.0	0.0	80.0	60.0	0.0	20.0	20.0	0.0
En route	75.0	50.0	0.0	25.0	100.0	25.0	0.0	50.0	0.0
Approach	84.6	23.1	30.8	38.5	38.5	0.0	53.8	30.8	7.7

Source: Ioannis Markou, Ioannis Papadopoulos, Nikolaos Pouliezos, Sarantis Poulimenakos

Table 1

Fatal Accident Human Factors

Commercial Aircraft Accidents in Greek Airspace, 1983–2003

	Error Type: Percentage of Accidents								
Phase of Flight	Crew Skill Error	Crew Decision Error	Crew Perceptual Error	Crew Violations	Adverse Mental States	Adverse Physiological States	Poor Crew Resource Management	Physical Environment	Technical Environment
En route	33.3	33.3	66.7	66.7	33.3	0.0	100.0	66.7	33.3
Descent	100.0	66.7	33.3	66.7	100.0	0.0	100.0	0.0	0.0

Source: Ioannis Markou, Ioannis Papadopoulos, Nikolaos Pouliezos, Sarantis Poulimenakos

Table 2

Most Pilots Flying in Accidents Were Over 50

Commercial Aircraft Accidents in Greek Airspace, 1983–2003

	Pilot Flying Age (%)		Pilot Not Flying Age (%)	
	<50	>50	<50	>50
All Commercial Accidents	37	63	78	22
Commercial Fatal Accidents	35	65	75	25
Commercial Nonfatal Accidents	40	60	80	20

Source: Ioannis Markou, Ioannis Papadopoulos, Nikolaos Pouliezos, Sarantis Poulimenakos

Table 3

Greek Experience 1983–2003." *Proceedings of the 18th annual European Aviation Safety Seminar*, Athens, Greece. Alexandria, Virginia, U.S.: Flight Safety Foundation, 2006.

2. The designations of accidents and incidents followed the definitions in International Civil Aviation Organization Annex 13, *Aircraft Accident and Incident Investigation*. The fatal and nonfatal accidents analyzed included commercial operations with airplanes and helicopters; turbojet, turboprop and piston-engine aircraft; aircraft in all weight categories; and both scheduled and nonscheduled operations, including cargo, passenger and positioning flights.

3. Shappell, Scott A.; Wiegmann, Douglas A. *The Human Factors Analysis and Classification System — HFACS*. U.S. Federal Aviation Administration Office of Aviation Medicine. Report no. DOT/FAA/AM-00/7. February 2000.

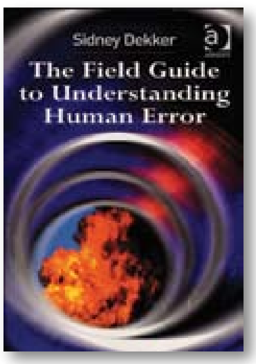
4. "Adverse mental states," in the HFACS classification system, include, for example, "loss of situational awareness," "channelized attention" and "mental fatigue."

5. "Crew violations," in the HFACS classification system, are not necessarily violations of civil aviation regulations. Examples include "failed to use the radar altimeter," "flew an unauthorized approach" and "failed to properly prepare for the flight."

6. "Supervisory violations," in the HFACS classification system, are not necessarily violations of civil aviation regulations. They include "authorized unnecessary hazard," "failed to enforce rules and regulations" and "authorized unqualified crew for flight."

When Errors 'Make Sense'

A new book argues that human errors seemed correct at the time they were made and provide insight into deeper, systemic problems.



BOOKS

The Field Guide to Understanding Human Error

Dekker, Sidney. Aldershot, England: Ashgate, 2006. 252 pp. Figures, tables, references, index.

Sidney Dekker makes the case for a paradigm that is increasingly accepted by human factors specialists and accident investigators, although perhaps less by aviation management, the news media and the public. Rather than perceiving human error as a cause of accidents, which Dekker calls "the Old View," the "New View" sees it as a symptom of underlying trouble in the system — the organization, the rules and the procedures.

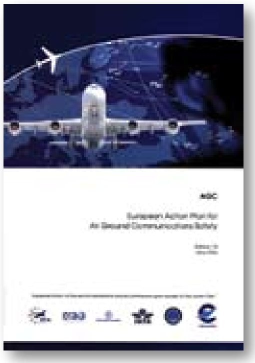
Traditionally, when a human error led to an incident or accident, the tendency was to look for carelessness, procedural violation or lack of motivation. But, says Dekker, people in safety-critical positions, such as pilots, know only too well the possible consequences of complacency or failure to follow procedures. They typically do not make errors because they are daydreaming or have a bad attitude. What is found in retrospect to have been an error seemed reasonable at the time it was made.

"It *has* to make sense, otherwise they would not be doing it," the author says. "So if you want to understand human error, your job is to understand *why* it made sense to them. Because if it made sense to them, it may well make sense to other practitioners too, which means that the problem may show up again and again."

How can an error seem to be the right move to a skilled, rational pilot? Dekker says that the pilot works within a system, and no system exists purely to be safe. Its goal is to make a profit or achieve other ends. Dekker says, "Besides safety there are multiple other objectives: pressures to produce; to not cost an organization extra money; to be on time; to get results; to keep customers happy. People's sensitivity to these objectives, and their ability to juggle them in parallel with demands for safety, is one reason why they were chosen for their jobs, and why they are allowed to keep them."

So pilots are expected to put safety first, but also to make trade-offs in practice. Moreover, says Dekker, the trade-offs are among unevenly calculable factors: "Goals other than safety are easy to measure (How much fuel or time will we save? Will we get to our destination?). However, how much people borrow from safety to achieve these goals is very difficult to measure. … The trade-offs need to be made under much uncertainty and often under time pressure."

Accidents do not result from human shortcomings in otherwise well-functioning processes, Dekker says; on the contrary, they result from people doing their best to create safety amid a patchwork of technologies, regulations,



procedures and goals that does not automatically ensure it.

According to the New View, "If you want to learn anything of value about the systems we operate, you must look on human errors as a window on a problem that every practitioner in the system might have; a marker in the system's everyday behavior, and an opportunity to learn more about organizational, operational and technological features that create error potential."

The position Dekker argues for implies that some standard fixes for human error are unproductive, or even counterproductive. For example, he says:

- "Adding or enforcing existing procedures does not guarantee compliance. A typical reaction to failure is procedural overspecification — patching observed holes in an operation with increasingly detailed or tightly targeted rules that respond specifically to just the latest incident. But procedural overspecification is likely to widen the gap between procedures and practice, rather than narrow it."
- "We often think that adding just a little bit more technology will help remove human error. After all, if there is technology to do the work, or to monitor the human being doing the work, then we have nicely controlled the potential for error. But more technology does not remove the potential for human error. It merely relocates or changes it."
- "If you hunt down individual people for system problems, you will quickly drive real practice underground. You will find it even more difficult to know how work really takes place. Do you want to wait for an accident to reveal the true picture?"

The Field Guide to Understanding Human Error leads the reader through many other corollaries of his view that errors tend to point to flaws in the system rather than flaws in individuals.

REPORTS

European Action Plan for Air Ground Communications Safety

European Organisation for the Safety of Air Navigation (Eurocontrol). Edition 1.0, May 2006. 67 pp. Tables, references, appendixes. Available via the Internet at <www.eurocontrol.int/safety/gallery/content/public/library/AGC_action_plan.pdf> or from Eurocontrol.*

This action plan, developed by the combined efforts of several organizations including Flight Safety Foundation, is designed to help reduce the number of incidents in which miscommunication between air traffic control and aircraft pilots is a factor. It is particularly aimed at lowering the number of level busts — deviations from the assigned altitude — and runway incursions.

The plan results from studies and surveys to identify common problems, and is presented in the form of recommendations, best practices and resources for civil aviation authorities, controllers, pilots, aircraft operators and others. Briefing notes are categorized under general, call sign confusion, loss of communications, blocked transmission and radio discipline. Other resources, such as Eurocontrol, U.K. Civil Aviation Authority and International Civil Aviation Organization publications, are listed.

CASCADE Stream 1 Real-Time Simulation

Trzmiel, Aymeric; Rognin, Laurence. Eurocontrol. EEC 404. February 2006. 131 pp. Figures, tables, annexes, references. Available via the Internet at <www.eurocontrol.int/eec/public/standard_page/2006_report_404.html > or from Eurocontrol.*

The CASCADE (Cooperative ATS [Air Traffic Services] Through Surveillance and Communication Applications Deployed in ECAC [European Civil Aviation Conference]) program aims to reduce air traffic management delays, increase safety and increase efficiency. An experiment conducted in May and June 2005 involved three CASCADE Stream 1 services to controllers: auto-transfer — that is, automatic transfer of aircraft control to the next sector, pilot preferences downlink (PPD) and aircraft-derived data for ground tools (ADD).

The experiment assessed the controllers' familiarization with the services, the acceptance of the services and the effect of the services on controller workload, situational awareness, safety and capacity.

Researchers found that fewer than 10 percent of controllers in the experiment used the auto-transfer function, while "the PPD and ADD services were well appreciated and considered as useable by most of the controllers," the report said.

In general, the CASCADE Stream 1 services neither increased nor decreased the controllers' workload. The services' effect on situational awareness was positive but limited. Controllers perceived PPD and ADD services as a potential safety benefit, but the auto-transfer service was considered a source of risk if the transfer occurred at an inappropriate moment. The benefits of data link for reducing communication frequency usage were still observed during the operation of CASCADE 1 services.

Controllers suggested improvements both to the simulation environment and to the CASCADE Stream 1 services interface. They recommended, for instance, clarifying the distinction between the visual representation of aircraft with and without data link capability.

WEB SITES

International Cabin Safety Research Technical Group Aircraft Accident Database, <www.rgwcherry.co.uk/html/accidentdatabase.html>

The database is sponsored by Transport Canada, the U.K. Civil Aviation Authority and U.S. Federal Aviation Administration (FAA) and maintained by R.W. Cherry & Associates, United Kingdom.

The Web page says, "The database currently contains information on 3,376 accidents, and of these, textual information is available on 1,036. The database was initially intended to carry out analytical work aimed at improving occupant survivability. More recently the scope has been expanded, and it now includes information on non-survivable accidents."

Data are obtained primarily from accident investigation authorities on transport category

passenger aircraft (with 19 or more passenger seats) and cargo aircraft certificated under U.S. Federal Aviation Regulations Part 25 requirements or equivalent non-U.S standards. Individual accident records contain typical accident data information (e.g., aircraft type, operator and occupant statistics).

Records may contain more specific information (e.g., fire-, water- or impact-related, fuselage ruptured, fuel tank ruptured, evacuation). Records can be made to appear in different screen views and can be exported into other formats, such as spreadsheets.

The database must be downloaded to the user's computer. Downloaded files contain textual and numeric data, a glossary, diagrams and photographs. Periodic updates are available.

Instructions for downloading the software, stored files and optional picture files are on the Web site. No technical support for the database is available.

The sponsors say, "The database is freely available for use as a resource for improving aviation safety." They suggest that "any conclusions derived from the database [be] independently verified. In particular, analyses based on the database selection criteria can lead to misleading conclusions and should be independently confirmed."

The database is an outgrowth of the Cabin Safety Research Technical Group, whose activities are described at the FAA's Web site,

<www.fire.tc.faa.gov/cabwg.stm>. This Web site provides an alternate link to the accident database.

Transport Canada Aviation Safety Publications and Videos, <www.tc.gc.ca/civilaviation/systemsafety/pubs/menu.htm>

Transport Canada (TC) develops and administers policies, regulations and services for the Canadian transportation system. Transport Canada, Civil Aviation (the civil aviation authority) conveys a significant amount of aviation knowledge through numerous publications, regulations and technical information appearing on the TC Web site.

Available to pilots, flight crew, maintenance technicians, instructors, passengers and others in the aviation community are posters, brochures, educational packages, videos and reports. The specific Web site discussed here presents a categorized list of these materials.

By selecting entries within categories, users are linked to product descriptions, availability and accessibility. Some materials are free and may be viewed on line or downloaded to the user's computer. Some materials require purchase. Several examples are as follows:

- The category *Aviation Safety Videos* opens to a collection of videos for purchase with titles such as "Plane Talk on Ice" and "The Human Factors in Aviation Maintenance."

- The *Posters* category lists titles (e.g., "Everything Moves at an Airport. Be Aware! Runway Incursions Are Real!") that are available for instant downloading.
- A multi-media kit, "Crew Resource Management," appears under the category *Educational Packages* and comprises a video, CD with slides, participant's workbook and facilitator's notes.

Product descriptions may not include dates of production or publication, but some items are flagged as being new or updated. The information is intended to provide continuing value.

REGULATORY MATERIALS

Specification for Airport Light Bases, Transformer Housings, Junction Boxes, and Accessories

U.S. Federal Aviation Administration (FAA) Advisory Circular (AC) 150/5345-42E. May 8, 2006. 38 pp. Figures. Available from FAA via the Internet at <www.airweb.faa.gov>.

Programs for Training of Aircraft Rescue and Firefighting Personnel

U.S. Federal Aviation Administration (FAA) Advisory Circular (AC) 150/5210-17A. April 28, 2006. 14 pp. Appendix. Available from FAA via the Internet at <www.airweb.faa.gov>.

SAE Documents to Support Aircraft Lightning Protection Certification

U.S. Federal Aviation Administration (FAA) Advisory Circular (AC) 20-155. April 28, 2006. 2 pp. Available from FAA via the Internet at <www.airweb.faa.gov>.

Airspace Flow Program

U.S. Federal Aviation Administration (FAA) Advisory Circular (AC) 90-102. May 1, 2006. 6 pp. Available from FAA via the Internet at <www.airweb.faa.gov>. ●

Source

* Eurocontrol
96, Rue de la Fusée
B–1130 Brussels
Belgium

— *Rick Darby and Patricia Setze*

Controller Faulted for Near Collision

An airliner on go-around passed 100 ft above a regional jet holding on the runway.

BY MARK LACAGNINA

The following information provides an awareness of problems that can be avoided in the future. The information is based on final reports on aircraft accidents and incidents by official investigative authorities.

JETS

Workload Incorrectly Prioritized

Boeing 737-400, Canadair Regional Jet. No damage. No injuries.

US Airways Flight 1251, a 737-400, was about 10 nm (19 km) from the runway at Fort Lauderdale–Hollywood (Florida, U.S.) International Airport when the local controller cleared the flight crew to land on Runway 09L at 2342 local time Nov. 9, 2005. The controller also advised the crew that several aircraft would be departing from the runway, said the report by the U.S. National Transportation Safety Board (NTSB).

The controller then cleared an airliner for takeoff from Runway 09L and instructed the crew of a regional aircraft to taxi into position on the runway and hold for takeoff. About one minute later, the controller cleared the regional aircraft for takeoff and instructed the crew of Comair Flight 5026, a Canadair Regional Jet, to taxi into position and hold. He advised the Comair crew that arriving traffic, the 737, was on a four-nm (seven-km) final approach.

"At 2345:15, the controller began a series of exchanges with a helicopter that was 38 miles [70 km] from [the airport] and trying to contact Miami Approach Control," the report said. "The controller stated that he spent some time working with the helicopter pilot, trying to establish his altitude and position in order to give the pilot the correct [radio] frequency. At that point, the controller said he mistakenly believed that he had already cleared [the Regional Jet] for takeoff."

At 2345:48, the 737 crew asked the controller if they had been cleared to land. "When [the crew] questioned his landing clearance, the controller stated that he scanned the runway and the radar display and didn't see anything, so he repeated the landing clearance," the report said. "Immediately, an unidentified voice on the frequency stated, 'Traffic on nine left.'"

The controller said that he did not hear the radio transmission. "He realized that he had lost track of [the Regional Jet], so he scanned the radar display, looking for a 'tag up' or for a primary return and didn't see either one," the report said. "He looked at the runway again and saw [the Regional Jet] still holding in position. He immediately radioed, "USAir, go around. USAir, go around. USAir 1251, go around."

Recorded air traffic control radar data indicated that the 737 passed about 100 ft above the Regional Jet during the go-around. The report did not say how many people were aboard the aircraft.

The controller notified the tower supervisor of the incident, and the supervisor conducted a quality assurance review (QAR). The QAR summary report concluded that no loss of required separation between the aircraft had occurred because the 737 crew had been instructed to go around when the aircraft was about one nm (two km) from the runway.

The day after the incident, the Regional Jet captain filed a near midair collision report with the control tower.

The control tower is located between Runway 09L and Runway 09R, which is used primarily for smaller general aviation aircraft. When the incident occurred, the controller was handling arrivals and departures on both runways, requiring him to divide his attention in opposite directions, the report said.

"While [the 737] was on approach, there were multiple departures and arrivals operating on Runway 09L and a [Piper] Seneca waiting to depart on Runway 09R," the report said. The controller described his workload as moderate. Weather conditions included 10 mi (16 km) visibility, scattered clouds at 3,500 ft and surface winds from 060 degrees at 12 kt.

The controller was handling arrivals and departures on both runways.

Investigators asked the controller, a 22-year veteran, how he kept track of aircraft cleared to taxi into position and hold on a runway. "The controller stated that his personal practice used to be to slide the departure [data] strip to the left when clearing an aircraft into position on the runway and then cock the strip holder to the left when clearing the aircraft for takeoff," the report said. "Starting in September, the tower adopted a standard procedure requiring that the strip [holder] be cocked to the left when an aircraft is cleared into position and hold, and that the paper strip be slid left, out of the holder, when the takeoff clearance is issued." The controller said that he was using the new procedure but that it had not yet become "second nature" to him.

The controller also told investigators that when vehicle traffic on a nearby highway is heavy at night, vehicle lights can make it difficult to see aircraft at the approach end of Runway 09L.

NTSB said that the probable cause of the incident was "the local controller's failure to monitor the operation and recognize a developing traffic conflict, which resulted in a loss of separation between [the 737 and the Regional Jet]." The board said that a contributing factor was "the controller's incorrect prioritization of his workload."

Neglected Throttle Plays Role in Overrun

Airbus A320-200. Substantial damage. No injuries.

The Airbus A320 was en route on a scheduled TransAsia Airways flight with 106 people aboard from Tainan, Taiwan, to Taipei Sungshan Airport on Oct. 18, 2004. Weather conditions at the airport included winds from 297 degrees at 11 kt, 4,500 m (three mi) visibility in light rain, scattered clouds at 800 ft, a broken ceiling at 1,800 ft and an overcast ceiling at 3,500 ft.

The report by the Aviation Safety Council of Taiwan said that the crew conducted an instrument landing system (ILS) approach to Runway 10 and was cleared to land at 1958 local time. The captain, 51, had 12,918 flight hours, including 8,729 flight hours in A320s. The first officer, the pilot flying, 45, had 10,431 flight hours, including 7,048 flight hours in type.

After encountering moderate turbulence on final approach, the first officer disengaged the autopilot at 282 ft radio altitude (RA) but did not disengage the autothrottles. The cockpit voice recorder recorded a central warning system warning, "retard," four times when the aircraft was below 20 ft RA. Groundspeed was 146 kt and airspeed was 138 kt, one kt higher than the crew's calculated landing reference speed, when the main landing gear touched down 1,750 ft (534 m) from the approach end of the wet runway, which was 8,550 ft (2,608 m) long and had a 524-ft (160-m) stopway. Landing weight was 121,454 lb (55,092 kg); maximum landing weight is 142,196 lb (64,500 kg).

Five seconds after touchdown, the autothrottles disconnected and the no. 1 engine thrust reverser deployed. The no. 2 engine thrust reverser did not deploy. The report said that the no. 2 engine thrust reverser had malfunctioned on a previous flight and the airline had deferred maintenance in accordance with provisions of the aircraft's minimum equipment list.

The crew had armed the speed brakes and selected a medium autobraking deceleration rate. However, the first officer did not retard the no. 2 throttle to the idle position, which corresponds to a throttle lever angle of 20 degrees or less. The no. 2 throttle lever angle was 22.5 degrees on touchdown; the no. 1 throttle lever angle was 19.7 degrees and was reduced to zero degrees after touchdown — and later to minus 22.5 degrees to select reverse thrust. The ground spoilers did not deploy automatically after touchdown because the no. 2 throttle lever angle remained at 22.5 degrees. Moreover, the autobrakes did not activate automatically because the ground spoilers had not deployed.

The A320 flight crew operating manual says that the pilot flying "should pull the thrust levers back at 20 feet, and the landing should occur without a long flare. … An audible 'retard' callout reminds the pilot if he has not pulled back the thrust levers when the aircraft has reached 20 feet."

The captain called out "no brake" several times after touchdown. The first officer said, "What's going on, sir?" The captain replied, "I have no idea."

The first officer applied the wheel brakes 13 seconds after touchdown, when the aircraft was about 3,750 ft (1,144 m) from the departure end of the runway, but he perceived that the aircraft was not decelerating adequately. The first officer applied maximum reverse thrust on the no. 1 engine. The captain also applied the wheel brakes.

Groundspeed was 66 kt when the aircraft entered the stopway. It then veered off the left side of the stopway. Both engine nacelles struck the ground when the aircraft came to a stop with its nose landing gear collapsed in a drainage ditch at 1959. The crew shut down the engines and started the auxiliary power unit. No smoke or fire was detected. The captain recommended that the purser evacuate the passengers from the rear exits via service stairs transported to the aircraft by ground service personnel. The purser told the captain that the rear exits were too high to use the service stairs and that the passengers would be evacuated using the slides. No one was injured during the evacuation.

The first officer said, "What's going on, sir?" The captain replied, "I have no idea."

Engine Ingests Deicing Boot Debris

Israel Aircraft Industries Westwind 2. Minor damage. No injuries.

The aircraft departed from Shannon, Ireland, at 1303 local time June 8, 2005, for an air-ambulance flight to St. Johns, Newfoundland, Canada, with seven people aboard. While climbing through 16,000 ft, the flight crew heard a loud bang and observed an increase in the left engine's interstage turbine temperature. The crew throttled the engine to flight idle, returned to Shannon and landed without further incident.

The report by the Irish Air Accident Investigation Unit (AAIU) said that a six-ft (two-m) section of the deicing boot on the left wing had separated and had been ingested by the left engine. "As a consequence, a number of engine fan blades were damaged by boot material," the report said.

AAIU said that the separation was caused by "insufficient/poor bonding between the boot material and the surface of the wing leading edge." The report said that the aircraft's deicing boots had been inadequately maintained.

"There is a storage/shelf life for the boots, but there is no definite service life when boots are installed on the aircraft," the report said. "The boots should be inspected every 200 flying hours and all damage repaired promptly. The deicing boot condition should be checked during each preflight inspection."

The crew said that nothing of concern had been found during their preflight inspection of the aircraft. Investigators inspected the aircraft the day after the incident. "Both port and starboard wing boots were in poor condition," the report said. "The length of boot which tore away revealed that very little of the adhesive cement had adhered to the wing surface. In addition, silver 'high-speed' adhesive tape was used to fill the skin contours. The aircraft manufacturer recommends the use of an aircraft structure filler for this purpose."

Smoking Door Lock Prompts Diversion

McDonnell Douglas MD-11. Minor damage. No injuries.

The aircraft, operated by World Airways, was en route from Osan Air Base, South Korea, to Seattle with 201 people aboard on April 28, 2005. It was about 950 nm (1,759 km) southwest of Anchorage, Alaska, U.S., when the flight crew smelled and saw smoke in the cockpit. They declared an emergency and diverted the flight to Anchorage, where the aircraft was landed without further incident.

The NTSB report said that a crew change had occurred just before the smoke was detected. During the crew change, the cockpit security door was opened and closed. "An examination of the security door by maintenance personnel and the [NTSB] investigator-in-charge revealed an excess length of wiring, which provides power to the electrically locking security door, was lying atop the door's metal-encased, unshielded locking solenoid inside the door frame," the report said. "Several of the wires were encased in a plastic anti-chafe mesh. A portion of the mesh was melted and had the smell of burnt plastic."

The report said that the door manufacturer's installation instructions do not include information about securing excess wiring above the locking solenoid.

NTSB said that the probable cause of the incident was "the inadequate installation of the cockpit security door locking device" and that a contributing factor was "the [door] manufacturer's insufficiently defined installation instructions."

Long Touchdown Results in Overrun

Cessna Citation Ultra. Destroyed. No injuries.

The captain, who had 5,600 flight hours, said that the visual approach to the 3,975-ft (1,212-m) runway at the Leakey, Texas, U.S., airport was normal until he reduced power to idle on short-final approach. He noticed that airspeed was 16 kt above the reference speed but continued the approach "because the aircraft was close to the runway" and there was "extra landing distance to work with beyond what was required."

The captain said that the aircraft floated beyond the desired touchdown point. The NTSB report said that the aircraft touched down about 2,100 ft (641 m) beyond the approach end of the runway, overran the departure end and struck trees about 200 ft (61 m) beyond the threshold. The aircraft, which was operated by NetJets, was destroyed by the impact and a post-impact fire. None of the six occupants was injured.

The report said that the aircraft flight manual showed that, under the existing conditions, required landing distance was 2,955 ft (901 m). NTSB said that the probable cause of the accident was "the pilot's failure to land the aircraft at the proper touchdown point on the runway to allow adequate stopping distance."

TURBOPROPS

Trees Block Rejected Landing

Short Brothers SD3-60. Substantial damage. Two serious injuries.

The aircraft, operated by Air Cargo Carriers, was on a cargo flight from Toledo, Ohio, U.S., to Oshawa (Ontario, Canada) Municipal Airport on the night of Dec. 16, 2004. The Oshawa tower controller told the flight crew that there was a cloud layer at about 100 ft, visibility was 0.5 mi (0.8 km) and the runway was covered by snow, said the report by the Transportation Safety Board of Canada (TSB).

The captain had more than 5,300 flight hours, including 1,000 flight hours in type. The first officer, the pilot flying, had 800 flight hours, including 400 flight hours in type. While conducting the localizer back-course approach to Runway 30, the first officer had difficulty maintaining course, and the captain took control about three nm (six km) from the runway.

The aircraft touched down about one-third of the way down the 4,000-ft (1,220-m) runway. "The captain selected full reverse [thrust]," the report said. "He noted that the rate of deceleration was slower than expected and observed the end of the runway approaching. After five to eight seconds of full-reverse application, he called for a go-around, and the power levers were advanced to maximum takeoff power. With little runway remaining and without referencing the airspeed indicator, the captain rotated to a takeoff attitude."

The aircraft struck the airport boundary fence, rising terrain and trees. "The cockpit area was wedged between two cedar trees," the report said. "However, the flight crew evacuation was not hampered."

The crew had used 15 degrees of flap for the approach and landing. The report said the flight manual showed that at the aircraft's landing weight, landing distance was more than 4,100 ft (1,251 m) on a dry runway and about 7,400 ft (2,257 m) on a slippery runway.

The report said that Short Brothers had issued an all operator message (AOM) in March 2004 that said there was a remote possibility of flap asymmetry caused by fatigue failure of a flap actuator and that an airworthiness directive prohibiting flap extension to 30 degrees was pending. Based on the AOM, the aircraft operator limited flap extension to 15 degrees. The manufacturer subsequently conducted tests that "cleared" the flap actuators and issued another AOM in October 2004, stating that the airworthiness directive would not be adopted. The report said that the accident flight crew had not been told that the prohibition against using 30 degrees of flaps had been rescinded.

Loose Attachment Binds Elevator

Beech 1900D. No damage. No injuries.

During takeoff from Rockland, Maine, U.S., on Aug. 2, 2005, the Colgan Air captain pulled the control wheel with both hands to rotate the airplane, but the control wheel did not move. "The captain then pulled significantly harder, and the yoke moved quickly aft," the NTSB report said. "The airplane jumped into the air, but the captain was able to maintain controlled flight and continue to the destination airport." None of the nine occupants was injured.

During cruise, however, the captain had to adjust trim every one or two minutes to correct the airplane's tendency to slowly pitch nose-up. After the airplane was landed in Augusta, Maine, seven rivets on the elevator hinge-point attach brackets were found loose, and one rivet was missing. Loose rivets also were found in other 1900s, and the U.S. Federal Aviation Administration (FAA) issued an airworthiness directive, AD 2005-18-21, to correct the problem.

The captain pulled the control wheel with both hands to rotate the airplane, but the control wheel did not move.

Crew Loses Control During Restart Attempts

Fairchild Metro III. No damage. No injuries.

A flight instructor with 8,230 flight hours, including 5,388 flight hours in type, was conducting an endorsement training flight on Nov. 21, 2004, with a pilot who had 1,649 flight hours, including 4.5 flight hours in type. The report by the Australian Transport Safety Bureau (ATSB) said that the aircraft was at 4,500 ft near Lake George, New South Wales, when the instructor shut down the left engine.

"During the engine restart preparation, the instructor departed from the published procedure by moving the power lever for the left engine into the beta range and directing the pilot to select the unfeather test switch," the report said. "These actions were appropriate to prepare an engine for start on the ground with a feathered propeller but not during an airstart. As a result, the propeller on the left engine became fixed in the start-locks position."

The crew lost control, and the airplane descended 1,000 ft to about 450 ft above ground level (AGL) before the crew regained control and apparently climbed back to 4,500 ft. "The crew could not diagnose the source of the loss of control and proceeded to start the left engine while the propeller was fixed on the start locks," the report said. "As a result, the crew lost control of the aircraft for a second time, and it descended 1,300 ft, to about 300 ft AGL, before they regained control."

"After the propeller was fixed in the start-locks position, there would have been significantly high drag on the left side of the aircraft, resulting in it being extremely difficult to maintain the aircraft's altitude and direction," the report said. "The instructor displayed exceptional aircraft-handling skill to be able to regain control of the aircraft and to return to Canberra for an uneventful landing."

The report said that the instructor was administering his first Metro endorsement when the incident occurred and had not practiced an airstart in eight years.

PISTON AIRPLANES

Rejected Takeoff Results in Overrun

Piper Chieftain. Substantial damage. One serious injury, three minor injuries.

During a night takeoff for a charter flight from Nhill, Victoria, Australia, on July 25, 2005, the pilot encountered resistance to rearward movement of the control column when he attempted rotation at about 90 kt. He reduced power to idle and applied maximum wheel braking. The aircraft overran the 1,000-m (3,281-ft) runway and passed through the airport boundary fence, over a public road and through another fence before coming to a stop 162 m (532 ft) from the end of the runway. The pilot received serious injuries, and three passengers received minor injuries.

The ATSB report said that the investigation did not determine why the pilot encountered control resistance when he attempted rotation. The aircraft flight manual indicated that under the existing conditions, accelerate-stop distance was about 845 m (2,772 ft). The report said that the accelerate-stop distance is predicated on setting maximum power before releasing the brakes and rejecting the takeoff at 88 kt. The pilot had conducted a rolling takeoff, gradually increasing power to maximum and had rejected the takeoff above 90 kt.

"This occurrence also highlights the critical importance of pilots checking that the flight controls are capable of full and free operation prior to commencing the takeoff roll," the report said.

Wrong Truck, Wrong Fuel

Aero Commander 500S. Destroyed. Two serious injuries.

The pilot said that before departing from Mount Pleasant, South Carolina, U.S., for a public-use flight on April 14, 2003, he had asked the fueler to top off the fuel tanks with 100-octane aviation gasoline.

The fueler later told NTSB investigators that he mistakenly used the Jet A-1 fuel truck instead of the avgas truck and pumped 58 gal (220 l) of Jet A-1 into the airplane.

"The pilot performed a preflight including taking fuel samples from under the wings," the report said. The pilot said that engine start, run-up and taxi were uneventful. After takeoff, the airplane was about 200 ft AGL when power was lost from both engines. The two occupants were seriously injured, and the airplane's left wing separated and the aft portion of the cabin was crushed during the forced landing.

NTSB said that the probable cause of the accident was "improper refueling of the airplane by airport personnel" and that a factor was "the inadequate preflight inspection by the pilot-in-command."

'Violent Shaking' Traced to Flutter

De Havilland Beaver. Substantial. No injuries.

The pilot said that the airplane began to shake violently and became uncontrollable during a charter sightseeing flight at 11,000 ft near Mount McKinley, Alaska, U.S., on March 7, 2005. He shut down the engine, believing it to be the problem, but the vibration continued. He then reduced airspeed, and the vibration ceased at about 80 mph.

The pilot restarted the engine, flew the airplane back to Talkeetna at a slow airspeed with the flaps extended and landed without further incident, the NTSB report said. The pilot and the three passengers were not injured.

An examination of the airplane by FAA aerospace engineers found that the ailerons and rudder were "severely under-balanced," the report said.

NTSB said that the probable cause of the accident was "aerodynamic flutter of the ailerons during normal cruise flight due to their improper maintenance/balancing, which resulted in structural damage to the airplane's wings."

HELICOPTERS

Freewheel Slippage Causes Structural Failure

Eurocopter AS355F1. Destroyed. Three fatalities.

The pilot was conducting a test flight near Andover, Hampshire, England, on Dec. 2, 2003, following installation of an overhauled main rotor gearbox and combining gearbox. The two engineers who had performed the installation were aboard the helicopter.

"Eyewitnesses heard unusual noises coming from the helicopter before the tail boom apparently folded forward around the cabin," said the U.K. Air Accidents Investigation Branch report. "The helicopter then fell to the ground, catching fire on impact."

Examination of the wreckage showed that the two gearboxes and the main rotor had detached before impact, and that the freewheels in the combining gearbox had slipped under load. "It is concluded that a series of freewheel slippages followed by aggressive re-engagements led to the structural failure," the report said.

The investigation did not determine conclusively why the slippage had occurred but found that the freewheel rollers had come from a batch of rollers that had been coated improperly. "The helicopter manufacturer recorded five incidents of slippage under load coinciding with the introduction of rollers from this batch," the report said. "Satisfactory performance of the freewheels resumed following the removal from service of the incorrectly coated batch of rollers."

Flight Continued Into Adverse Weather

Bell 206-L1. Destroyed. Three fatalities.

The helicopter struck the water at a high speed and in a nose-down attitude about two nm (four km) from the destination, Intracoastal City, Louisiana, U.S., during a charter flight from a platform 114 nm (211 km) offshore in the Gulf of Mexico on June 24, 2004. The pilot and the two passengers were killed.

The accident site was in an area affected by a convective SIGMET warning of embedded thunderstorms, the NTSB report said. There was no record that the pilot, who had 6,562 flight hours, including 5,309 flight hours in type, had obtained a formal preflight or in-flight weather briefing.

NTSB said that the probable cause of the accident was "the pilot's continued flight into adverse weather conditions, resulting in a loss of control." ●

Preliminary Reports

Date	Location	Aircraft Type	Aircraft Damage	Injuries
July 6, 2006	Patroklos Island, Greece	Canadair CL-215	destroyed	2 none
Engaged in a firefighting operation, the airplane was scooping up seawater in the Argosaronic Gulf when it struck a wave and sank. Both pilots escaped from the airplane and were rescued by a helicopter crew.				
July 7, 2006	Goma, Congo	Antonov An-12	destroyed	6 fatal
An engine problem occurred after the Mango Airlines airplane departed from Goma for a cargo flight to Kisangi. The flight crew was returning to Goma when the airplane struck a hill.				
July 8, 2006	Irkutsk, Russia	Airbus A310-300	destroyed	124 fatal, 59 serious, 17 none
The airplane, operated by S7 Airlines, overran Runway 30, which is 3,165 m (10,384 ft) long, and struck a concrete barrier while landing at about 0750 local time. Weather conditions included an overcast at 600 ft, 3,500 m (two mi) visibility and winds from 280 degrees at 10 kt with thunderstorms in the area.				

Continued on next page

Preliminary Reports

Date	Location	Aircraft Type	Aircraft Damage	Injuries
July 8, 2006	Tenerife, Spain	Sikorsky S-61N	NA	6 fatal
The helicopter was being operated by Helicsa on a repositioning flight from Santa Cruz de la Palma to Gran Canaria in visual meteorological conditions when it struck the sea near Tenerife.				
July 10, 2006	Multan, Pakistan	Fokker F-27	destroyed	45 fatal
The Pakistan International Airlines airplane reportedly had engine problems soon after takeoff for a flight to Lahore. The airplane struck a powerline, crashed in a field and burned.				
July 10, 2006	Hamilton, Montana, U.S	Cessna Citation Ultra	substantial	2 none
The airplane overran the 4,200-ft (1,281-m) runway and came to a stop in a creek 328 ft (100 m) beyond the runway.				
July 10, 2006	Easton, Washington, U.S.	Piper Chieftain	destroyed	1 fatal
The airplane was at 8,000 ft on a cargo flight from Spokane to Seattle when the pilot told air traffic control (ATC) that the airplane did not have enough power to maintain the assigned altitude. Soon thereafter, he told ATC that the airplane did not have enough power to cross the Cascade Mountains and that he was diverting to Easton. The airplane struck a tree on final approach to the Easton airport.				
July 12, 2006	Kigoma, Tanzania	Lockheed C-130	destroyed	5 serious
The airplane reportedly was chartered by the United Nations for a flight to Kigoma from Manono, Congo. The flight crew conducted a go-around on the first landing attempt. A tire reportedly burst on the second landing attempt, and the airplane veered off the left side of the runway..				
July 12, 2006	Taos, New Mexico, U.S.	Bell 206B	substantial	2 minor
The pilot conducted a forced landing in mountainous terrain after a tail-rotor problem occurred.				
July 15, 2006	Madrid, Spain	Embraer RJ135ER	substantial	none
The airplane, operated by Regional Compagnie Aérienne Européenne, was parked at the Madrid-Barajas Airport when it was struck by the right wing tip of a taxiing Thai Airways 747-400. The RJ's entire tail section reportedly was ripped off.				
July 18, 2006	Jeanerette, Louisiana, U.S.	Beech 58P Baron	destroyed	3 fatal
Witnesses said that a thunderstorm was near the airport and that visibility was less than one mi (two km) in heavy rain when the airplane, which was on a business flight from Corpus Christi, Texas, touched down about midway down the 3,000-ft (915-m) runway. The witnesses heard sounds consistent with a rejected landing and saw the airplane become airborne near the departure end of the runway. The airplane struck the airport fence, a building, several trees, the roof of a house, several powerlines and a mobile home. The pilot, the passenger and a resident of the mobile home were killed.				
July 19, 2006	Cresco, Iowa, U.S.	Cessna Citation Ultra	destroyed	2 fatal, 2 serious
A severe thunderstorm warning was in effect for the area when the airplane — en route from Oxford, Mississippi, to Rochester, Minnesota — crashed in a corn field. The pilots were killed, and the two passengers received serious injuries.				
July 19, 2006	Saint Thomas, Virgin Islands	Douglas DC-3	destroyed	4 none
The airplane, operated on a cargo flight by Tol Air Services, was ditched in the ocean after one engine failed on initial climb.				
July 23, 2006	Fort Lauderdale, Florida, U.S	Cessna 402	substantial	1 none
The airplane, operated by Bimini Island Air, struck a runway sign after the nose landing gear collapsed on landing.				
July 25, 2006	Spanish Fork, Utah, U.S.	Spectrum 33	destroyed	2 fatal
Witnesses said that the experimental very light jet rolled right and the right wing tip struck the ground immediately after takeoff. The airplane, which had accumulated 44 flight hours since its first flight in January 2006, was being operated on a maintenance test flight. The preliminary report said that initial examination of the wreckage indicated that the flight control linkage was connected in a manner that would have caused the ailerons to deflect in reverse of sidestick control input.				
July 28, 2006	Memphis, Tennessee, U.S.	McDonnell Douglas MD-10F	substantial	3 none
The nose landing gear collapsed during landing, and the left engine on the FedEx Express airplane was damaged by a postaccident fire.				
July 29, 2006	Sullivan, Missouri, U.S.	de Havilland Twin Otter	destroyed	6 fatal, 2 serious
Witnesses heard a popping sound soon after the airplane took off with seven parachutists aboard. The airplane descended and struck a utility pole and a tree before crashing near a house.				

NA = not available

This information, gathered from various government and media sources, is subject to change as the investigations of the accidents and incidents are completed.

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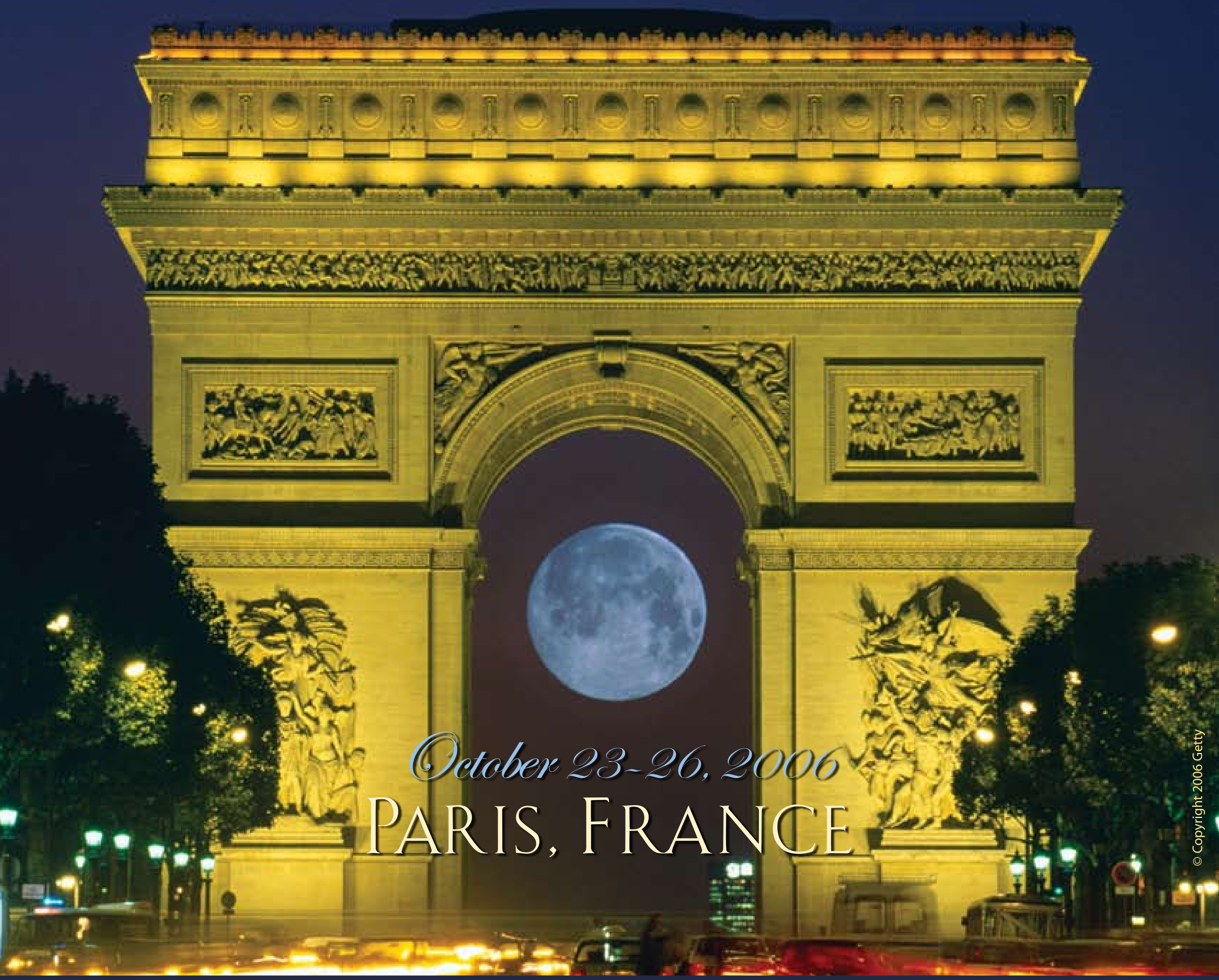

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