AviationSafety WORLD

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BAD WEIGHT COMPUTATION DOOMS TAKEOFF

THE JOURNAL OF FLIGHT SAFETY FOUNDATION

OCTOBER 2006

STEPPING Down

One of the advantages of our new journal format is that the Flight Safety Foundation (FSF) President gets one page each month to express his thoughts. For me this opportunity will be short-lived. I am writing this as president; when you read it I will be past president. As previously announced, I step down on Oct. 1, and hand FSF's reins to Bill Voss, our new president and CEO.

Of course, I am not retiring without some sadness, but I also have much gratitude for the privilege of having had a career packed with experiences spanning more than 53 continuous years in aviation.

But undoubtedly the most significant period for me has been my 13 years at FSF's helm. The organization has changed significantly, today firmly established, respected and financially secure. While it has no legal or regulatory standing, the Foundation has a powerful voice; when FSF speaks, the aviation industry listens.

The Foundation is known for initiating safety improvements, many of which are taken for granted today. Lately we have championed flight operational quality assurance, or FOQA, training proven to prevent accidents. We led the industry's fight to reduce approach and landing and controlled flight into terrain accidents. More recently, we developed guidelines for the operation of new long range corporate and airline aircraft. We also initiated changes to ICAO Annex 13 regulations concerning accident investigations, a major success that prevents judicial interference from hindering investigations. A new initiative is aimed at reducing ground accidents, which cost the industry many lives and more than US$5 billion every year. And there are other programs, as well.

It's a bold thing to say, but FSF is today involved in, or actually leading, just about every important safety initiative under way in the world.

It is in human nature to be industrious, to develop new and better ways of doing business. Safety is not the prime reason for business, but safety must be an essential ingredient or there won't be much business. Consequently, there can be no higher calling than to ensure that safety is maintained and constantly improved. This has been my calling, and every day I remember that our efforts help reduce costs, prevent injuries and save lives.

Aviation is an incredibly safe industry. But we must not take safety for granted. Maintaining safety is a never-ending task that allows no relaxation of the many defenses that have been developed to ensure the very high standards we now enjoy.

Young though it is, aviation is by far the safest means of mass transportation. It has changed the face of the world and its economy, and I am proud to have been a part of it. However, the part I have played would not have been possible without the support of the colleagues with whom I have worked and to whom I owe much gratitude.

Now I pass the FSF baton to Bill Voss. He is ideally suited to take on the leadership of this great organization, and I will watch in awe as FSF and the industry soar to even greater heights in the years to come.

Stuart Matthews
President and CEO
Flight Safety Foundation

AviationSafetyWORLD

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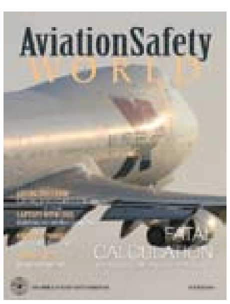

About the Cover
An MK Airlines 747-200 crashed on takeoff due to flawed weight calculations.
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Share Your Knowledge

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>.

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Flight Safety Foundation

Serving Aviation Safety Interests for More Than 50 Years

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.

MemberGuide

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Lost

The sad irony of the Comair CRJ crash in Lexington, Kentucky, U.S., is that the Federal Aviation Administration's efforts to improve on-airport navigation information to reduce the incidence of runway incursions should have helped prevent the Comair crew from tragically attempting to take off on the wrong runway, a runway far too short for a successful takeoff.

The first hull-loss accident of a jet airliner in revenue service in the U.S. since November 2001 is a sobering event. It brings up for re-examination a number of potential contributory factors familiar from past accidents. In addition to the danger of pilots losing awareness of their position on the surface of the airport, there also are questions about the roles played by recent taxiway construction at Lexington, control tower staffing levels, and flight crew and air traffic controller performance and fatigue. Right now, however, let's look at airport surface navigation.

A story in this issue of *Aviation Safety World* reviews a warning from a terrain awareness and warning system that prevented a regional jet from landing on a runway far too short to accommodate it (See "Wrong Airport," page 42). There now are systems that provide the same sort of protection to aircraft on the ground, one from Honeywell and another from ACSS.

Honeywell's Runway Awareness and Advisory System (RAAS), on the market for several years now, uses global positioning system data to issue aural advisories based on aircraft position when compared to airport locations stored in the Enhanced Ground Proximity Warning System (EGPWS) database. RAAS, a simple software upgrade for aircraft using Honeywell's Mk V and Mk VII EGPWS systems, was developed after a Honeywell executive was in an airplane when the flight crew got lost on the surface of a major airport during a snowstorm. A number of airlines have ordered the upgrade.

ACSS expects its SafeRoute system will be certificated by mid-2007. The surface area movement management component of SafeRoute is a graphic representation showing pilots exactly where the aircraft is on an airport surface map display, plus the location of other aircraft and vehicles equipped with automatic dependent surveillance-broadcast or mode S transponders. SafeRoute also provides visual and aural warnings. UPS was the first to order SafeRoute.

Just as the pilots of the aircraft in this issue's story had a "mental map shift" that allowed them to pick up the wrong runway during a turn towards the final approach course, perhaps the crew at Louisville had a similar shift that would have been unmasked by some location assistance.

These new systems offer an important extra layer of protection against aircraft straying on the airport surface to create conflicts with other aircraft, or pilots attempting to take off from a taxiway or, as in the case of the Lexington accident, the wrong runway. While airport and regulatory bodies should continue to enhance on-airport information to pilots, operators should seriously consider the safety insurance one of these systems provides.

CFIT Checklist Worksheet Origin

The August *Aviation Safety World* included an article about the work that Gerald Pilj and I did on the digital FSF *CFIT Checklist*. I thought I would add a little background as to how that happened.

I have been involved with the CFIT issue since 1986, when I was assigned the project as lead test pilot for Gulfstream Aerospace for the certification of the digital GPWS into the Gulfstream III. I am currently the chairman of the Government Air Safety Investigators Working Group for the International Society of Air Safety Investigators, and I am assigned to the Memphis Flight Standards District Office (FedEx Express certificate) as the assistant aircrew program manager for the Airbus A300/310 and as the aircrew program manager for the Airbus A380.

I have used the laminated FSF *CFIT Checklist* for years, and it was only lately that I thought how much easier it would be to use it on computers.

FedEx actually uses a version of your CFIT checklist to determine the CFIT threat for every flight. Gerald and I were attending a training course in Oklahoma City when I began to develop the computerized version that now has been completed. Gerald noticed that I was having difficulty in the programming and volunteered his assistance. In very short order, Gerald had solved the problems, and I passed contact numbers on to him so he could directly work with Flight Safety Foundation to finalize the digital version now on the FSF Web site. Gerald's hard work made it possible.

Thanks for accepting my idea and a new way of presenting it to the world of aviation safety.

William L. (Bill) McNease
Memphis Flight Standards District Office
U.S. Federal Aviation Administration

Touching Thoughts About Ice

Back from holiday, I picked up the new *Aviation Safety World,* glanced through it and concluded: This is great, a vast improvement over the multitude of different publications in the past.

While I like the photograph caption on page 10 [July 2006] calling for pilots to use touch to detect small ice particles, I have great difficulty accepting the procedure of performing "tactile inspection" only after a certain aircraft type has suffered a ground ice accident. A simple instruction to do "a tactile check" on the wings of those aircraft is not enough.

There is a definite need for better defenses against what seems like "cosmic cycles" of certain types of accidents. Please remember that after the Dryden (F28, 1989), La Guardia (F28, 1992) and Skopje (F100, 1993) ground ice accidents, there were no more for eight or nine years. Recently, there has been a new string of ground ice accidents — a Bombardier CRJ-200 in China, two Bombardier Challengers (one in Birmingham, England, and one in Montrose, Colorado, U.S., as mentioned in the article), and two or three Cessna Caravans in the United States. This means that the lessons learned from those days have gone away.

A deeper study is required about why certain lessons learned apparently fade away. Finally, the authorities need to investigate if current regulations are indeed adequate.

Once again, your new magazine is great!

Rudi den Hertog
Chief Engineer
Fokker Services BV

Editor's note: The U.S. National Transportation Safety Board recommended that the U.S. Federal Aviation Administration "develop visual and tactile training aids to accurately depict small amounts of upper wing surface contamination" and "require all commercial airplane operators" to use incorporate them in initial and recurrent training.

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>.

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>, +1 541.895.3012.

OCT. 29–NOV. 1 ➤ Annual ATCA Conference & Expo. Air Traffic Control Association. Washington. Gail Hanline, <gail.hanline@atca.org>, <www.atca.org/activities>, +1 703.299.2430, ext. 308.

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 ➤ Annual General World Assembly, Conference & Exhibition & ACI Africa Regional Conference & Assembly. Airports Council International. Cape Town, South Africa. Nathalie Zulauf, <nzulauf@aci.aero>, <www.aciworld.aero>, +41 22 717 8758.

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, Germany. 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.

NOV. 30–DEC. 1 ➤ International Aviation Industry Issues Seminar. Airports Council International–North America. Washington. Diane Peterson, <meetings@aci-na.aero>, <www.aci-na.org>, +1 202.293.8500.

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.

DEC. 7 ➤ Value Added by Independent Safety Assessment. London. Centre for Software Reliability. Bristol, England. Joan Atkinson, <joan.atkinson@ncl.ac.uk>, +44 (0)1912 227996.

FEB. 6–7 ➤ (Hong Kong), Feb. 9 (Nagoya, Japan) Asian Business Aviation Conference & Exhibition (ABACE). National Business Aviation Organization. <convention@nbaa.org>, <www.abace.aero>, +1 202.783.9000.

FEB. 13–15 ➤ Safety-Critical Systems Symposium 2007. Centre for Software Reliability. Bristol, England. Joan Atkinson, <joan.atkinson@ncl.ac.uk>, +44 (0)1912 227996.

MARCH 1–3 ➤ Heli-Expo 2007 Conference & Exhibition. Helicopter Association International. Orlando, Florida, U.S. Marilyn McKinnis, <www.heliexpo.com>, <marilynmckinnis@rotor.com>, +1 703.683.4646.

MARCH 20–25 ➤ Australian International Airshow. Aerospace Australia. Victoria, Australia. <expo@airshow.net.au>, +61 3.5282.0500.

APRIL 2–5 ➤ 58th Annual Aviation Maintenance Conference. ARINC. Phoenix, Arizona, U.S. Roger S. Goldberg, +1 410.266.2915.

APRIL 16–17 ➤ ACI–NA Public Safety & Security Spring Conference. Airports Council International–North America. Spokane, Washington, U.S. Amy Peters, <apeters@aci-na.aero>, <www.aci-na.org>, +1 202.293.8500.

APRIL 24–26 ➤ 9th Annual Canadian Airport Management Conference. Airports Council International–North America and Canadian Airports Council. Ottawa, Canada. <meetings@aci-na.aero>, <www.aci-na.org>, +1 202.293.8500.

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

Aviation Safety World, the journal 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.

Safety News

FAA Offers Safety Management Systems Guidance

The U.S. Federal Aviation Administration (FAA) has published guidance for the development of safety management systems (SMSs) by airlines, air taxi operators, corporate flight departments, pilot training schools and other aviation service providers (*Flight Safety Digest*, November–December 2005).

Neither implementation of an SMS nor compliance with the guidelines contained in Advisory Circular (AC) 120-92, *Introduction to Safety Management Systems for Air Operators,* is mandatory, although the AC said that FAA encourages every aviation service provider to develop an SMS as "a quality management approach to controlling risk."

"An SMS … provides the organizational framework to support a sound safety culture," the AC said. "For general aviation operators, an SMS can form the core of the company's safety efforts. For certificated operators, such as airlines, air taxi operators and aviation training organizations, the SMS can also serve as an efficient means of interfacing with FAA certificate oversight offices. The SMS provides the company's management with a detailed roadmap for monitoring safety-related processes."

The AC said that an SMS also should address a company's safety culture because the principles of an SMS will function properly only if "the people that make up the organization function together in a manner that promotes safe operations."

Dornier 328 Training Recommendation

The U.K. Air Accidents Investigation Branch (AAIB) is recommending that Avcraft Aerospace, which holds the type certificate for the Dornier 328, advise operators of the airplane to provide training for pilots in dealing with situations in which power levers cannot be positioned appropriately after landing.

The safety recommendation follows a June 22, 2006, runway overrun in Aberdeen, Scotland, which occurred after the crew was unable to release the latches on the power levers to move them rearward from flight idle to the beta control range to help slow the airplane, which came to a stop in a grassy area about 350 m (1,148 ft) beyond the runway. An AAIB special bulletin said that the captain "steered the aircraft to avoid lights and antenna installations and attempted to move the condition levers to shut the engines down. Although aircraft movement over the uneven ground and the design of the condition levers made this difficult, he was eventually successful."

The report did not include an assessment of damage to the airplane but said that it was intact and that there was no fire. None of the 19 people in the airplane was injured.

AAIB said that the incident was similar to an overrun involving another Dornier 328 in Genoa, Italy, in 1999, in which the airplane overran the runway at speed and plunged into the Ligurian Sea. Four people drowned.

The AAIB safety recommendation said that Avcraft Aerospace should "advise all operators of Dornier 328 turboprop aircraft to detail procedures and provide adequate training to ensure that their pilots are able to act appropriately if the beta control range on the power levers cannot be selected after landing."

Iconic Auditory Warning Signals Studied

Some unconventional auditory signals have potential to be used as warning signals in civil aviation, according to a study conducted for the Australian Transport Safety Bureau. An August 2006 report on the study, *Design and Evaluation of Auditory Icons as Informative Warning Signals*, described two experiments that examined the effect of different types of warnings, including visual warnings and auditory icons — or caricatures of everyday sounds.

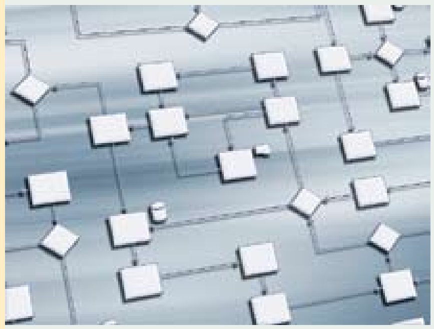
"Warning signals that are iconic and that stand in a direct relation to the event being signaled, such as the sound of coughing to signal the presence of carbon monoxide, should convey information about the nature of the critical event, as well as alerting the operator that there is a problem," the report said. "By contrast, signals that are arbitrarily associated with an event, such as a beep to signal the presence of carbon monoxide, provide little information about the nature of the event."

Results of the study suggested that auditory iconic warnings have the potential not only to alert pilots but also to inform them of the nature of a critical incident.

Changes Urged in Certification of Safety-Critical Systems

The U.S. National Transportation Safety Board (NTSB) has recommended changes in the process used by the U.S. Federal Aviation Administration to evaluate the compliance of critical flight safety systems with airworthiness standards.

NTSB said in its report *Safety Report on the Treatment of Safety-Critical Systems in Transport Airplanes* that recent accident investigations had generated questions about the FAA certification process. A safety-assessment process would be effective in identifying safety-critical systems during type certification, and the absence of any requirement for preparation of a list of safety-critical systems during type certification "compromises the ongoing assessment of these systems," the report said.



The report included recommendations calling on FAA to "compile a list of safety-critical systems derived from the safety-assessment process for each type certification project, and place in the official type certification project file the documentation for the rationale, analysis methods, failure scenarios, supporting evidence and associated issue papers used to identify and assess safety-critical systems."

Other recommendations called on FAA to amend advisory materials to "include consideration of structural failures and human/airplane system interaction failures" in assessing safety-critical systems, and to adopt SAE (formerly the Society of Automotive Engineers) recommendations to require ongoing assessments of safety-critical systems throughout an airplane's life cycle.

Australian Drug Testing in Aviation

Workers in Australia's civil aviation industry — including flight and cabin crewmembers, ground refuellers, baggage handlers, security screeners and air traffic controllers — will undergo mandatory drug and alcohol tests beginning in October 2006.

Testing will take several forms, said Warren Truss, the Australian government minister for transport and regional services.

"Testing could involve screening applicants prior to [their] taking on safety-sensitive roles, random on-the-job testing and monitoring the effectiveness of rehabilitation as an employee prepares to return to work," Truss said.

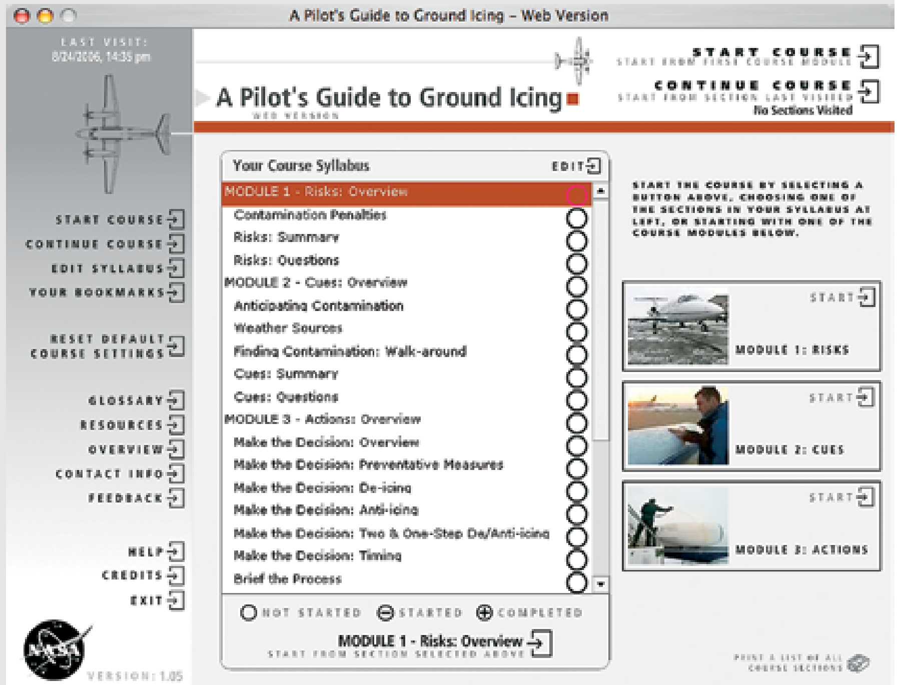
Testing is being implemented because in other countries, tests have reduced safety risks associated with the use of drugs and alcohol, Truss said. The testing program will be accompanied by educational initiatives designed to "warn of the dangers posed by drug and alcohol use, including prescription and over-the-counter medicines and the additional risks they can pose in a safety-sensitive aviation environment," he said.

Icing-Hazards Course Takes to the Web

The U.S. National Aeronautics and Space Administration's (NASA's) Aircraft Icing Project, which has designed in-flight education and training aids to increase pilot awareness of icing hazards, now has developed Web-based courses on the same subject matter.

A report prepared for NASA on the Web-based course delivery system said that Web-based coursework reduced distribution costs and increased pilot access to the program. The program's researchers said that studies indicate that the effectiveness of icing training materials increases when visually based multimedia are used.

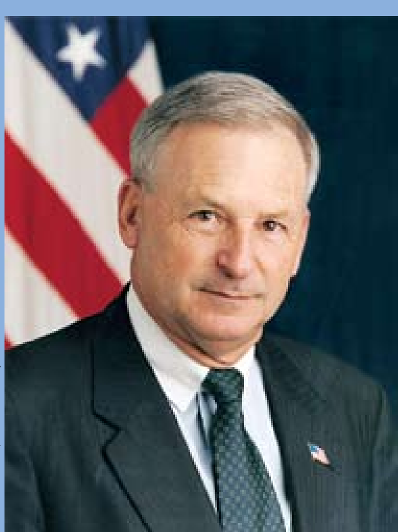
The courses can be downloaded from the icing project Web site at <http://aircrafticing.grc.nasa.gov/courses.html>.



U.S. National Aeronautics and Space Administration

In Other News …

Mark V. Rosenker, acting chairman of the U.S. National Transportation Safety Board (NTSB) since March 2005, has been sworn in as chairman, and **Capt. Robert L. Sumwalt,** a member of the Flight Safety Foundation Icarus Committee and a US Airways pilot for 24 years, has been sworn in as an NTSB member through 2011 and designated to serve a two-year term as vice chairman. … The **U.S. National Transportation Safety Board** has issued an urgent recommendation after three dual-engine flameouts in two years involving Beechjet 400s with Pratt & Whitney Canada JT15D-5 engines. No one was injured in the incidents, all of which involved airplanes between 38,000 feet and 40,000 feet near convective activity; a power reduction preceded each incident. The recommendation asks the U.S. Federal Aviation Administration to require Beechjet 400 pilots to activate ignition and anti-ice systems at high altitudes if they are in or near visible moisture or near convective activity, or before a power reduction in those conditions. … **Alteon Training**, a Boeing subsidiary, has opened a pilot and maintenance training facility at the Flight Training Center of All Nippon Airways (ANA) near Haneda Airport in Tokyo.


U.S. National Transportation Safety Board

Rosenker


Sumwalt

Compiled and edited by Linda Werfelman.

Safety Independence

BY MIKE AMBROSE

If today's airlines lost aircraft at the same rate that their predecessors did in the mid-1960s, politicians would be calling for urgent and radical reform, safety regulators worldwide would be open to major public criticism and many of today's air travelers would migrate to other forms of transport perceived to be safer. Examining the accident statistics of those days shows that it was not uncommon for the world's largest airlines to each lose at least one airframe a year — a rate that would be totally unacceptable today.

Mike Ambrose, director general, European Regions Airline Association

The past half century has seen an evolution of progressively improving safety standards and achievements. Better design and testing; better training, simulation and procedures; improved maintenance and maintainability; improved instrumentation and more. The list of all factors that have contributed to today's safer system is long and includes the efforts of many dedicated individuals in very specific areas.

Yet, it is human beings who remain at the heart of the system — aircrew, engineers/maintenance workers, ground personnel, air traffic controllers. All too often seasoned air safety professionals faced with some new event bitterly observe, "same accident, different people, location and tail logo."

Very few accident investigations do not discover weaknesses and shortcomings in practices and procedures of the airline concerned. No airline is immune. Even the best-run operators can discover, to their surprise and horror, "dirty linen" in their day-to-day management. Airline boards and managements should constantly strive to abide by the old adage "always behave in a way that you will be proud to explain at the subsequent court of inquiry."

If safety is to be taken to the next level of achievement, more attention must be given to "breaking the accident chain." Identification and correction of events that adversely affect air safety is essential to ensure that unusual events do not become incidents and incidents do not become accidents. The air safety committee (ASC) within each operator is a vital part of this process. Any airline that does not have such a committee should create one. It is a vital forum, the compulsory creation of which could easily justify separate regulation.

The ASC should function as the clearinghouse for both the exchange of safety information and concerns, and the instigation of corrective actions. It should provide a key service to the board and president of an aircraft operator. However, it can only do so if the conditions under which its members participate facilitate open discussion.

Open and uninhibited involvement is unachievable if the air safety committee is chaired by the operator's CEO.

It is arguable that open and uninhibited involvement is unachievable if the ASC is chaired by the operator's CEO. The company's CEO, president, chairman or COO chairing the ASC has objectives and concerns that are wider than safety. He or she will almost certainly be influential in commercial, budgetary and personnel matters. They can thus unwittingly be a strong inhibitor to both managers and lower grade staff who might be unwilling to raise legitimate safety concerns counter to the CEO's corporate objectives.

Regardless of the size of the company, the CEO, staff and shareholders of any aircraft operator should feel certain that relevant safety issues are being managed proactively but, when the CEO is leading the ASC, that is very far from certain.

Many of today's CEOs lack the operational and technical experience of their predecessors; their skills are concentrated in other areas essential for the company's success, e.g., finance and marketing. It is likely that their instincts — and perhaps even their enthusiasm — for detecting safety problems that might be lurking just below the surface are unlikely to be as finely honed as those of experts in safety and technical matters.

Conversely, CEOs who have achieved their positions following a successful career in, say, flight operations, might be reluctant to accept publicly ideas that challenge the way in which they have previously operated. In each case, there is a strong argument to bar the CEO from the ASC's chairmanship.

So, how can such surety be achieved? One step is for the CEO to strongly and personally promote a "penalty free" reporting culture throughout all departments of the company. The second step is to appoint an independent, external and suitably experienced senior executive — or a non-executive director — to lead the ASC: This should be a person with a demonstrable record of experience in safety matters. Their personal circumstances should be such that they are not beholden to the company for income, and their ultimate principal concern is protection of their personal reputation and integrity. The CEO can remain on the ASC but only as a participant, albeit a senior one.

Under this type of ASC chairmanship, the most career-vulnerable employee within the ASC has more protection. It is far, far more difficult for safety issues that are legitimate — but perhaps "uncomfortable" from a corporate viewpoint — to be dismissed by the company.

When this type of ASC chairmanship is first introduced, all ASC participants, including the CEO, might be wary of the newcomer. Yet, if the right person has been chosen it should soon be possible to encourage a level of openness and trust that would have been unachievable under the chairmanship of the CEO. They should rapidly become an essential partner for the CEO and board as well as for the person responsible for day-to-day operations and safety issues, but remain impervious to other non-safety pressures.

Only when that independent ASC chairman ensures that serious safety issues will always be openly raised for discussion and correction can a conscientious CEO sleep comfortably at night. ●

Wireless broadband connectivity is helping maintenance technicians improve efficiency and safety, but only when they have the right device for the job.

BY LINDA WERFELMAN

Laptops WITH LEGS

Advances in technology have given aviation maintenance personnel a choice of portable computers — including laptops and handheld and wearable devices — to take to their work. Each device is different, and each has distinct advantages and disadvantages, as well as unique human-factors guidelines for its use, but overall, this new wave of technology is bringing a more comprehensive package of information, automatically updated, directly to the worksite.

Computers have become widespread in aviation maintenance. For example, a 2003 study found that, of 18 maintenance facilities surveyed, computer technology was in use at all 18.[1] When questioned, technicians at these facilities sometimes complained that the wireless networks that supported their portable computers were slow or intermittent, that portable-computer screens were too small or did not offer high-enough resolution and that some computers were difficult to use or were not rugged enough.

One year later, another study — this one involving the maintenance facilities of two major air carriers — found that computer and broadband network technology had permeated "most every phase of the line maintenance process, with one important exception: Maintenance technicians at neither carrier used technology on the ramp when performing maintenance on aircraft." Even though one of the facilities had laptop computers, maintenance technicians were never observed using them.[2]

In the few years since those studies were undertaken, portable computers of all types — typically operated on wireless local area networks (WLAN, more commonly known as Wi-Fi) or cellular links — have become more prevalent.

"Everybody has desktops now, and most have portable computers of some sort," said

Itronix

Ed Bach, vice president of worldwide sales at Xybernaut, the first company to patent mobile computing systems. "Until two or three years ago, people just felt more comfortable with desktop computers. But portable computers have become more common in general, and wireless connections have become more reliable."

Corey Harper, national sales manager–Air Force, for Itronix, a developer of wireless, rugged computing systems for aviation maintenance personnel and other mobile workers, said that the recent increase in use of portable computers in civil aviation maintenance began after civilian operators learned about their successful use in the military.

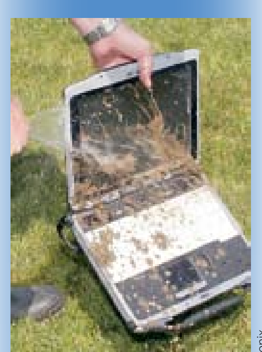
The military's record with portable computers resulted not only in increased interest from civilian operators but also in the development of civilian versions of the computers and of a maintenance work force more comfortable with the devices, Harper said.

As technicians have left the military for jobs with civilian operators, they have taken their computer expertise with them, he said.

"The airlines aren't having to show them where the 'on' button is," he said.

Some of the complaints heard by the researchers who conducted the 2003 study probably arose because the technicians did not have rugged equipment — that is, equipment with built-in protection against vibration, moisture, harsh chemicals, extreme temperatures, and being dropped from several feet above ground — for their specific tasks; because of early flaws in the emerging technology; or because they were not yet comfortable with their portable computers, mobile-computer specialists said.

"Most laptops are not designed to work in the extreme conditions facing technicians and are at a significantly greater risk of being damaged," said Bill Presler, senior manager of market development for Panasonic Computer Solutions, which manufactures laptops and other rugged portable computers for the aviation maintenance environment. Failure rates for non-rugged laptops can be as high as 25 percent; in contrast, the failure rate for Panasonic's rugged



Itronix

mobile personal computers is about 4 percent, Presler said.

Harper said that when the study was conducted, wireless computers were still relying on "leading-edge technology with accompanying problems that have since been worked out."

In addition, he said that some technicians, who did not adapt to these uses of computers, have left the field, while others have embraced the new technology.

Emphasis on Safety, Efficiency

Mobile-computer specialists said that among the primary reasons for the expanding use of computers — both desktop computers and hand-held, portable and wearable computers — are safety and efficiency.

Harper said that, for example, when technical manuals are updated properly on a network server, the update is complete, current, more accurate and more uniformly available to technicians than pages in paper manuals.

Xybernaut's Bach agreed: "The fact that all that information in the computer is available immediately … that's got to increase safety."

Maintenance productivity and turn-around time are significantly improved, he said. For example, a technician trying to replace a faulty component could benefit from the immediacy of having related technical and anecdotal information, including photographs, parts diagrams, assembly instructions, schematics and technical tips, displayed on a portable computer where he or she is working, he said.

"Our goal is to make things more efficient, and overall efficiency helps you do more things, minimizes human error," Bach said.

Presler said that wireless computers could help maintenance technicians save up to four hours a day during routine maintenance and repair tasks and could "increase aircraft safety by providing technicians with the most up-to-date information everywhere they go. … Aviation personnel can use access to wireless networks or locally based information to remotely access schematics, manuals, flight information or [government regulations]. They can perform scheduled and nonscheduled tasks more efficiently, receive flight management system updates instantly, and easily connect to on-plane computer systems to upload current information or to download and isolate faults via ARINC data loading."

The Best Match

The handheld, portable and wearable computers in use today are available in several configurations and forms:[3]

- Laptop computers, also called notebooks, are smaller and lighter in weight than standard desktop computers. They typically have a built-in keyboard and a touchpad in place of a mouse, and can be used for a variety of applications, including accessing and viewing lengthy documents, detailed images and full-size Web pages;
- Personal digital assistants (PDAs), smart phones and combination PDA-smart phones such as the BlackBerry handheld are small and easily portable. Their small screens, scroll controls and proprietary keyboard interfaces make them most useful for accessing short checklists or other short items, for limited data entry and for e-mail access;
- Tablet computers, which resemble laptops in size and weight but eliminate a physical keyboard and mouse, allow users to access lengthy documents and detailed images. Typical designs are touch-activated with a stylus and/or fingertips. They can be used to run more applications than smaller portable computers. Some devices combine laptop and tablet functions; and,
- Wearable computers, typically voice-activated devices attached to belts or headgear, free technicians' hands for other tasks. They often are recommended for jobs in close quarters — jobs in which it would be difficult and time-consuming to leave the workspace and walk to a desktop/laptop computer to access information. Nevertheless, in some situations, workspaces may be too small to safely accommodate wearable computers.

Mobile-computer specialists say that, for use in aviation maintenance, portable computers of all varieties must be rugged enough to operate after being dropped, after coming in contact with harsh chemicals such as hydraulic fluid or volatile fumes and in temperatures that are very hot or very cold. In many instances, they also must be intrinsically safe for use in hazardous environments. Some specialists recommend

Some portable computers can be attached to the user's clothing.

Xybernaut


Xybernaut

The military's successful use of portable computers led to increased interest among civilian operators.

that computers meet specific standards, such as military specifications established by the U.S. Defense Department, to withstand environmental stresses, vibrations and the jolts of being dropped onto hard surfaces.

They also say that portable computers require an easy method of connecting to other systems and transferring data between those systems. If a wireless network is involved, connectivity should be highly reliable. The computers also should have sufficient battery life for task completion, and attachment to an electrical outlet should not be required.

In addition, portable computers should be small, lightweight and conveniently shaped, with covers that are hinged and permanently attached, and rounded corners and edges. The devices should not generate so much heat that the user becomes uncomfortable, and the smallest types should be equipped with a strap or clip so they can be attached to the technician's body or clothing when they are not being used. Computer displays should be legible, with good color contrast, adequate screen size and brightness that function well in operational lighting conditions.

Researchers said that human factors are not always considered when operators select portable computer equipment for maintenance personnel.

"These systems require different usage guidelines than standard desktop computing systems because of their size, portability, human-computer interface designs and intended work environment," said a 2005 report on a study conducted for the U.S. Federal Aviation Administration (FAA).[4]

"When choosing a device, the user, task and work environment must be well understood for the most appropriate selection to be made. … Choosing a device that is not well matched to the user and his needs can result in fatigue, strain, frustration and confusion, and lead to lower efficiency and increased error."

For example:

- The user's needs may be influenced by age. After 40 or 50, many people have difficulty reading smaller fonts and may require computers that display information in larger, easily readable type. Aging also can be accompanied by a decrease in fine motor control and perceptual abilities;

- Specific tasks may require specific performance from a computer, such as a large screen and a high-resolution display for tasks that involve accessing documents and manuals or viewing images; and,

- Specific conditions in the work environment also may affect either the technician's ability to use the device — for example, too much ambient light can cause difficulty viewing a computer display, and too little light can make seeing the keyboard difficult — or the functioning of the device — for example, extreme temperatures can interfere with the normal performance of some computers, liquid crystal displays (LCDs) and batteries.

Handheld, portable and wearable computers are designed to be used — intermittently — in work environments where desktops are unavailable. If they are used for tasks that typically are performed using desktop computers, such as continuous data entry, ergonomic problems are likely, the report said.

"While considerable work has been done to develop appropriate standards and guidelines for desktop workstations (e.g., seating, lighting), little has been put forward for portable devices, whose means of interaction can vary quite substantially from more traditional systems," the report said. "For example, some portable devices rely on the thumb for primary data input. This method allows the user to hold the device in one hand, freeing the other hand for other tasks, but may result in tendonitis, which doctors have attributed to overuse."

Wi-Fi vs. WiMAX

Mobile-computer specialists said that exactly how maintenance facilities' computer applications might change upon introduction of World Interoperability for Microwave Access — more commonly known as WiMAX — is uncertain, in part because there are no guidelines for how WiMAX will be used and no indication of how much it will cost. Nevertheless, the emergence of WiMAX probably will expand the options for wireless networks, said Marie Hartis, Itronix director of marketing communications.

WiMAX differs from Wi-Fi, in part, because it has greater range — about 31 mi (50 km), compared with Wi-Fi's 150 ft (46 m) — and is expected eventually to provide for wireless areas as large as airports or even entire communities.

"The more options, the better," Hartis said. "It hopefully will get us close to ubiquitous wireless."

Presler said that, as wireless technology "continues to take hold … we fully expect computer use to increase. Because of the way computers need to be used in aviation, we also expect they [maintenance facilities] will turn to rugged computing solutions because of their reliability." ●

Notes

1. Casner, Steve; Puentes, Antonio. *Computer and Broadband Technology in the Aviation Maintenance Workplace*. Paper presented at U.S. Federal Aviation Administration (FAA) General Aviation, Aviation Maintenance and Vertical Flight Program Review. Reno, Nevada, U.S. Sept. 10–11, 2003.

2. Casner, Stephen M.; Encinas, Charles M.; Puentes, Antonio. *Computer and Broadband Technology in Aircraft Line Maintenance: A Task Analysis and Questionnaire*. Paper presented at FAA General Aviation, Aviation Maintenance and Vertical Flight Program Review. Washington, D.C., U.S. November 2004.

3. Zingale, Carolina; Ahlstrom, Vicki; Kudrick, Bonnie. *Human Factors Guidance for the Use of Handheld, Portable and Wearable Computing Devices*. FAA. Report no. DOT/FAA/CT-05/15. November 2005.

4. Ibid.

Xybernaut

Some portable computer devices are touch-activated with a stylus or fingertips.

Xybernaut

FATAL Calculation

Failure of the flight crew to detect a computer programming error led to inadequate takeoff performance by their 747.

BY LINDA WERFELMAN

The accident airplane had been converted to a full freighter in 1995.

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An MK Airlines Boeing 747-200SF failed to gain altitude on takeoff from Halifax, Nova Scotia, Canada, and struck rising ground beyond the runway end because the flight crew unknowingly used an incorrect aircraft weight to calculate takeoff speeds and thrust settings. Contributing to the Oct. 14, 2004, accident were crew fatigue and a dark takeoff environment that restricted the crew's ability to gauge the aircraft's progress in the takeoff, the Transportation Safety Board of Canada (TSB) said in the final report on the accident.[1]

The airplane was destroyed by the impact and subsequent fire, and all seven crewmembers were killed.

Investigators said that the crew probably used the takeoff weight from the previous flight to calculate performance data for the Halifax takeoff using the Boeing Laptop Tool (BLT)[2]; the resulting V speeds[3] and thrust settings were "too low to enable the aircraft to take off safely for the actual weight of the aircraft," the report said.

The flight crewmember who used the BLT likely did not recognize that the data were incorrect for the takeoff in Halifax, and the crew likely did not perform checks in accordance with the operator's standard operating procedures (SOPs) that would have detected the errors, the report said.

"The company did not have a formal training and testing program on the BLT, and it is likely that the user of the BLT in this occurrence was not fully conversant with the software," the report said.

The report identified two additional contributing factors:

- "Crew fatigue likely increased the probability of error during calculation of the

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takeoff performance data and degraded the flight crew's ability to detect this error"; and,

- "Crew fatigue, combined with the dark takeoff environment [at 0354 local time], likely contributed to a loss of situational awareness during the takeoff roll. Consequently, the crew did not recognize the inadequate takeoff performance until the aircraft was beyond the point where the takeoff could be safely conducted or safely abandoned."

The accident occurred at the beginning of a flight to Zaragoza, Spain — the third in a series of four flights being conducted by a "heavy," or augmented, flight crew of two captains, one first officer and two flight engineers. A loadmaster and a maintenance technician also were aboard.

The series of flights originated Oct. 13 in Luxembourg, when Flight 1601 departed at 1556 coordinated universal time (UTC) — after a six-hour delay — for Bradley International Airport in Windsor Locks, Connecticut, U.S.

At Bradley, after 4.5 hours on the ground for cargo unloading and loading, and a captain and flight engineer crew change, Flight 1602 departed for Halifax at 0403 UTC Oct. 14.

After landing in Halifax at 0512 UTC, more cargo was loaded into the airplane. Two crewmembers — not identified in the report — were observed sleeping in passenger seats during the loading.

At 0653 UTC, the crew began the takeoff roll on Runway 24. The airplane's lower aft fuselage struck the runway during rotation and again several seconds later; the airplane remained in contact with the ground until it was 825 ft (252 m) beyond the end of the runway. It then flew 325 ft (99 m) before the lower aft fuselage struck an earthen berm supporting an instrument landing system localizer antenna. The airplane's tail separated on impact, and the rest of the airplane continued in the air for 1,200 ft (366 m), then struck the ground and burned (Figure 1, page 20).

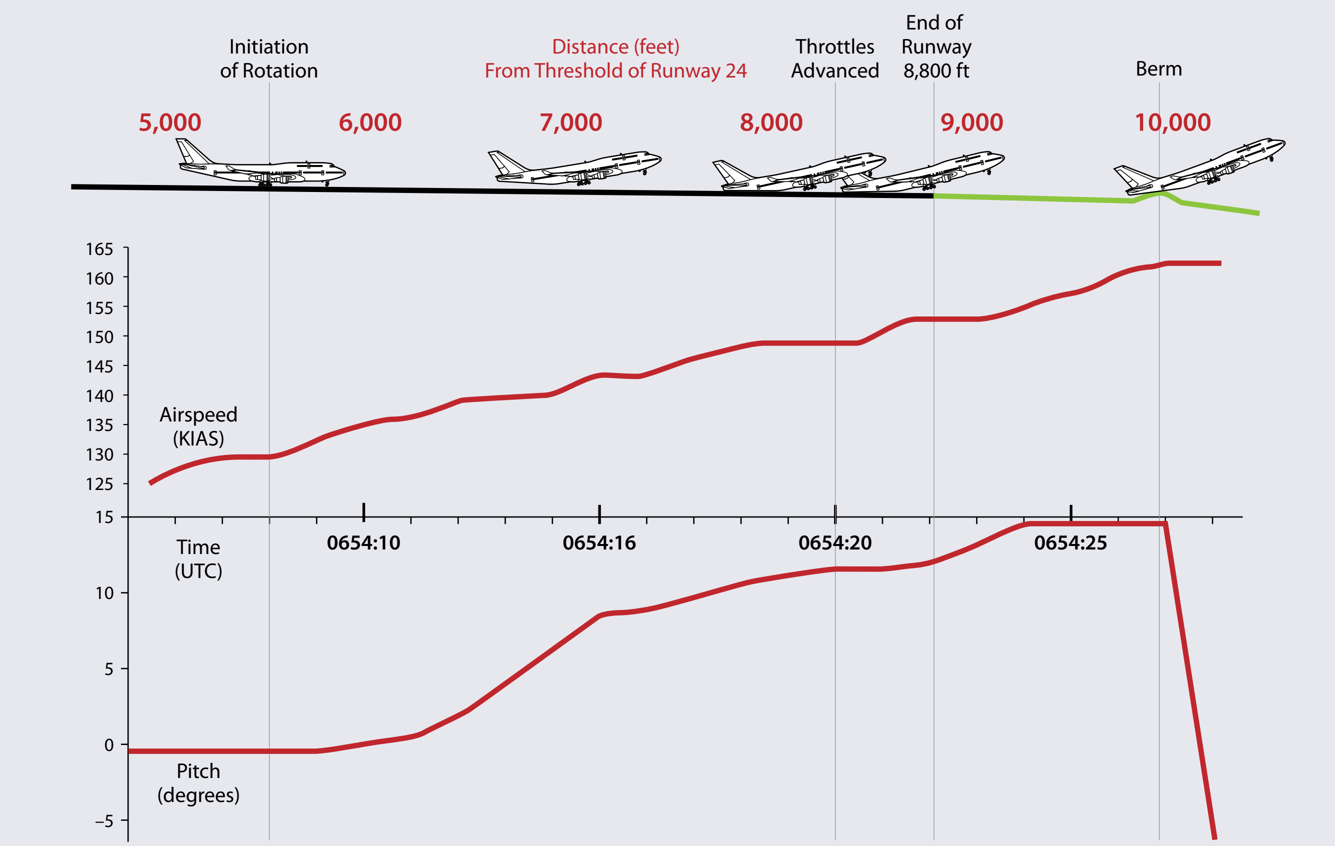
Airport weather conditions at 0700 UTC included wind from 260 degrees at six knots, visibility of 15 mi (24 km), overcast ceiling at 1,800 ft above ground level and a temperature of 10 degrees C (50 degrees F).

The airplane's cockpit voice recorder (CVR) tape was damaged beyond use by the post-impact fire. Its flight data recorder (FDR) yielded data that enabled comparisons of flight

The Boeing Co.

The Boeing Laptop Tool is used in calculating takeoff and landing performance data.

Takeoff Sequence



UTC= Coordinated universal time KIAS = Knots indicated airspeed

Source: Transportation Safety Board of Canada

Figure 1

performance during the takeoffs at Bradley and Halifax.

SOP 'Difficulties'

The captain of Flight 1602 had a Ghanaian airline transport pilot license (ATPL) and a current medical certificate. He had 23,200 flight hours, including 254 flight hours in type in the 90 days preceding the accident and 4,000 flight hours in 747s, and had been off duty for 29 hours before reporting to work for the series of flights that began Oct. 13. He had worked for MK Airlines since its inception in 1990.

In 2000, when the company changed its 747 SOPs and required all 747 pilots and flight engineers to undergo additional training, the captain "had some difficulties adjusting to the new SOPs," the report said; after a two-week review period, he completed the training "without further difficulty."

The report said that records showed "there were instances where supervisory pilots had to counsel the captain regarding non-adherence to SOPs; however, in the period before the accident, he had demonstrated a marked improvement."

The captain was "not comfortable using personal computers and software" such as the BLT and preferred to refer to paper charts and manuals in calculating performance data, the report said. Colleagues generally considered him "competent flying the aircraft," the report said. "He was respected and exercised adequate command authority in the aircraft, although he preferred to work in a casual manner."

The first officer, who had a Ghanaian ATPL and a current medical certificate, had 8,537 flight hours, including 245 flight hours in the 90 days before the accident, and had been off duty for 17 hours before reporting to work Oct. 13. He was "a competent pilot, and comfortable using personal computers," the report said. "As the only first officer for the series of flights, he would have had to be an active crewmember on duty on the flight deck for all takeoffs, departures, arrivals and landings for the series of flights."

The flight engineer was qualified and certified in accordance with Ghanaian Civil Aviation Regulations (GCARs) and had a current medical certificate, the report said.

Roots in Ghana

MK Airlines, which had a Ghanaian air operator certificate (AOC), began operations as Cargo d'Or, using one Douglas DC-8. An office was established near London Gatwick Airport to facilitate sales. After investing in another Ghanaian airline in 1993, the company's name was changed to MK Airlines. Expansion continued throughout the 1990s, and at the time of the accident, the company operated six DC-8s and six 747s. The company employed about 450 people; several flight crewmembers told accident investigators that there were crew shortages, especially in 747s.

The report said that MK Airlines had a "familial approach" to business, which resulted in both a "strong sense of loyalty and commitment to the success of the company" and a working environment in which managers and supervisors "could have had difficulty ensuring that their 'friends' adhered to company procedures and policies."

Company managers said that they had an "open approach" to flight safety and that they wanted a flight operations quality and flight safety program that was developed in-house to reflect the company culture. The program was developed slowly and, at the time of the accident, was so new that some components described in the company operations manual (OM) had not been fully implemented.

Many MK Airlines flight crewmembers lived in southern Africa and were separated from their families for weeks at a time while on duty, the report said.

"With the political and social unrest in some of these areas, there was the potential for harm to come to their families when the employees were away," the report said. "There were several examples cited where employees' families had experienced incidents of home invasion and/or personal attack. This was identified as a source of stress within the company."

Not long before the accident, the captain of Flight 1602 — at the request of the company's managing director — had submitted a letter to the company in which he expressed concern about the increasing number of pilots leaving the company, indicated that there were not enough crews for the aircraft and suggested a new compensation package to provide more financial stability for flight crewmembers.

Records showed that the Ghanaian Civil Aviation Authority (GCAA) had decreased the frequency of its inspections of MK Airlines and that the actual inspections performed in the two years before the accident were "below the minimum frequency of about 20 inspections indicated in the inspector's handbook," the report said.

Company managers said that they had an "open approach" to flight safety.

Excluded Weight

The accident airplane, which was manufactured in 1980 as a passenger-cargo combination freighter and converted in 1995 to a full freighter, had 80,619 operating hours and 16,368 cycles. The airplane's maximum allowable takeoff weight was 377,842 kg (832,990 lb).

The takeoff weight when the airplane departed from Bradley was 239,783 kg (528,626 lb). The weight-and-balance information left at Halifax by the Flight 1602 crew indicated that the takeoff weight was 350,698 kg (773,149 lb), with the center of gravity within limits. The actual weight was about 353,800 kg (779,987 lb) — higher than recorded because the weight of several items was inadvertently excluded — but still within limits.

'Self-Study' of BLT

Training on new technology equipment and software, such as the BLT, was conducted through "self-study and hands-on experience, using training material developed from the manufacturer's manual," the report said. "The information was distributed through notices to flight crews but had not been incorporated into the OM. There was no formal documentation to record an assessment of the individual's knowledge and competency using the equipment."

The BLT included a weight-and-balance summary page on which the computer's user could enter passenger weights, cargo zone weights and fuel; using this data, the BLT updated the takeoff weight at the bottom of the summary page. The updated weight was then "passed back to the planned weight field on the main input dialogue screen, and would automatically overwrite any entry in the planned weight field, without any notification to the user."

The report said that this feature was "believed to be a key element in how the incorrect takeoff performance data were generated."

In February 2004, 747 flight crewmembers received a 46-page manual on how to use the BLT to calculate performance data, along with a notice from the company's 747 chief training pilot asking crewmembers to study the information "for when the BLT program is put onto onboard computers." Some crewmembers received instructions for using the BLT during regular recurrent training, but most received no formal training on the BLT, the report said.

In March 2004, 747 flight crews received a two-page notice — one page for pilots and one page for loadmasters — that said the BLT software had been installed on all aircraft computers and approved for calculating performance data. The notice asked crewmembers to use the accompanying procedure to complete takeoff data cards.

On the loadmasters' page, the notice said, "When closing the weight-and-balance page,

Transportation Safety Board of Canada

the takeoff weight as listed in the weight-and-balance page will now appear in the planned takeoff weight block." This comment was not included in the instructions for pilots.

The notice also asked flight crewmembers to read the instructions in the BLT manual.

"It could not be determined if the occurrence crew read the BLT manual issued in February or the simplified instructions issued in March," the report said. "Reports from other MK Airlines Limited flight crews indicated that the operating captain was not comfortable using the BLT, while the first officer had been observed using it."

The report said that, without the CVR tape, it was difficult to determine exactly why the flight crew used low engine pressure ratio (EPR) settings and a low rotation speed; nevertheless, it described this as the most likely scenario:

> The takeoff data card was most likely completed using performance data from the BLT. The FDR data for the Halifax takeoff was nearly identical to that of the Bradley takeoff, indicating that the Bradley takeoff weight was used to generate the performance data in Halifax. The Bradley weight in the weight-and-balance page was likely unknowingly transferred to the performance page due to a reversion feature of the software. The user subsequently selected "calculate," which resulted in the generation of takeoff performance data containing incorrect V speeds and thrust setting for Halifax. The flight crew used the incorrect V speeds and thrust setting during the takeoff attempt; however, the settings were too low, especially the thrust setting, to enable the aircraft to take off safely.

24-Hour Duty Day

A 2002 revision of the OM established a maximum duty time of 24 hours — and 18 flight hours — for an augmented crew flying one to four sectors. The Flight 1602 crew was scheduled for a 24.5-hour duty day. At the time of the accident, they had been on duty nearly 19 hours; had they completed their flight schedule, delays experienced in Luxembourg and at Bradley would have resulted in a 30-hour duty day. Voyage reports indicated that the flight's loadmaster and ground engineer had been on duty 45.5 hours.

The report quoted the OM as saying that all flights were "planned in accordance with the limitations of the company's approved rest, duty and flight time schemes." Nevertheless, a review of planned duty periods for MK Airlines Flights 1601/1602 showed that about 71 percent of the flights were planned for longer than 24 hours; the average was 24.37 hours. Airline management and GCAA officials said that they were unaware of this.

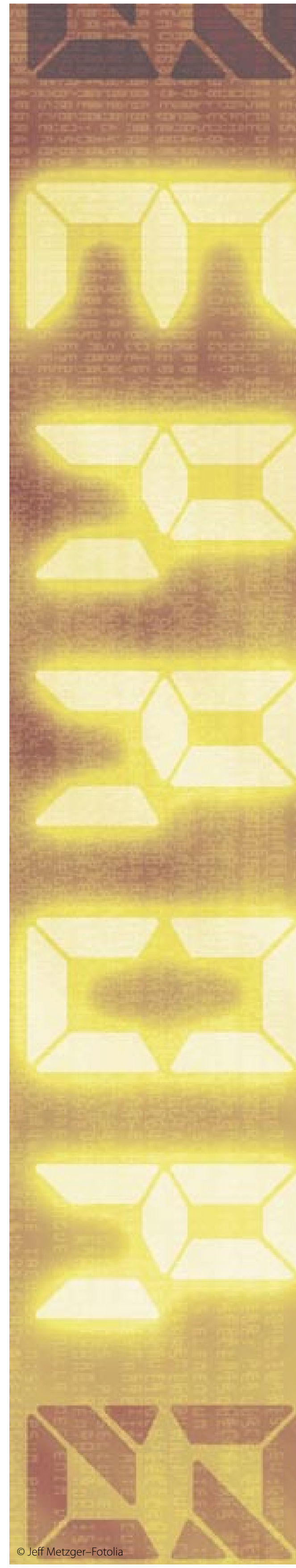
Actual duty periods for Flights 1601/1602 exceeded 24 hours 95 percent of the time; the average was 26.85 hours. Company management was aware of this; GCAA was not.

The report cited sleep research that has found that most people begin to require sleep after they have been awake about 15 or 16 hours; the amount of sleep required typically is between 7.5 and 8.5 hours per day.

"A person who does not obtain required sleep will develop a sleep debt and will be subject to performance degradation," the report said. "Fatigue can lead to forgetting or ignoring normal checks and procedures, reversion to old habits and inaccurate recall of operational events. Fatigue can also reduce attention, the effects of which are that people overlook or misplace sequential task elements, become preoccupied with a single task and are less vigilant."

The flight and duty time scheme used by MK Airlines typically resulted in a requirement that a critical crewmember — in this instance, the augmented crew's sole first officer — "be in his or her respective seat for all landings and takeoffs." This disrupts rest/sleep patterns.

Members of other MK Airlines flight crews said that they typically began to feel fatigued



during the stopover in Halifax and tried to nap there. The report described sleeping in the airplane as a routine fatigue-management practice at the company and said this indicated that crews were attempting to mitigate risks associated with fatigue.

Safety Actions

After the accident, numerous safety actions were taken, including the following:

- Transport Canada published a Commercial and Business Aviation Advisory Circular in June 2005 "to reinforce the absolute necessity for accurate load control";
- GCAA told MK Airlines on Nov. 1, 2004, to stop using the BLT "until such time as approval is given by the GCAA" and to comply with rest requirements described in the GCARs for all crewmembers, including loadmasters and ground engineers, until submission of a new company schedule for approval;
- MK Airlines issued a notice on Oct. 20, 2004, discussing required checks on cargo weights. Within two weeks of the accident, the airline issued a notice directing flight crewmembers to immediately stop using the BLT and to use alternate procedures; the airline made a related submission to the U.K. Civil Aviation Authority (CAA) in accordance with CAA guidance on approval of electronic flight bags;
- MK Airlines implemented — with the approval of GCAA and monitoring by U.K. CAA inspectors — a flight time scheme outlined in a U.K. CAA publication, *Avoidance of Fatigue in Air Crews* (CAP 371);
- MK Airlines issued a crew notice about counseling "to reduce fatigue and stress in light of the accident and the continued political and security situation in southern Africa." In addition, a new pay schedule was introduced that "improved the financial security of crewmembers";
- MK Airlines established a safety management system and drafted a new company safety policy. A flight data monitoring program was being implemented;
- At the request of MK Airlines, the U.K. CAA, in cooperation with GCAA, conducted a full audit of the airline for International Civil Aviation Organization compliance. As a result, MK Airlines decided to obtain Joint Aviation Requirements compliance; subsequent revisions were made in the airline's organizational structure, operations, training, maintenance and other areas, and new personnel were hired for new positions;
- The Boeing Co. on Nov. 11, 2004, issued a BLT Operator Message to all BLT users, reviewing the software feature that automatically overwrites entries in the planned weight field on the main screen when a user views the weight-and-balance summary page, reminding users that performance data are calculated using the weight in the planned weight field, and urging operators to ensure proper training for their crews on that feature; and,
- The U.K. CAA in November 2005 audited MK Airlines and found "nothing of an immediate threat to safety." Officials of U.K. CAA and managers of MK Airlines discussed whether the airline should continue to hold an AOC from Ghana; the airline continued operating out of the United Kingdom.

As a result of the accident investigation, TSB recommended that the Canadian Department of Transport, in conjunction with other regulatory authorities, "establish a requirement for transport category aircraft to be equipped with a takeoff performance monitoring system that would provide flight crews with an accurate and timely indication of inadequate takeoff performance." ●

Notes

1. Transportation Safety Board of Canada. *Reduced Power at Take-off and Collision With Terrain, MK Airlines Limited, Boeing 747-244SF 9G-MKJ, Halifax International Airport, Nova Scotia, 14 October 2004*, Aviation Investigation Report A04H0004. June 29, 2006.
2. The Boeing Laptop Tool (BLT) is a software application for calculating takeoff performance data, landing data and weight-and-balance information. The 747 performance data in the software are those contained in the approved 747 flight manual.
3. V speeds are defined in the report as follows:
   - V_1 — Takeoff decision speed;
   - V_r — Rotation speed; and,
   - V_2 — Takeoff safety speed.

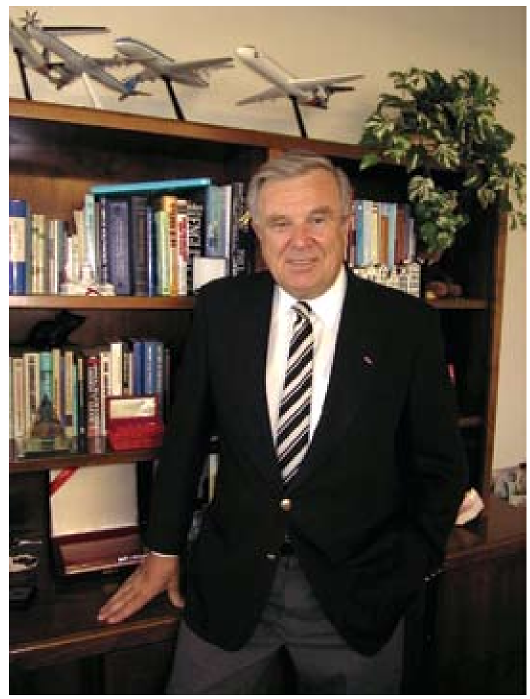
A Change at the Top

This month, as Bill Voss takes Flight Safety Foundation's reins from Stuart Matthews, we pause to recognize the man who has led FSF since 1994 and introduce the new leader.

When Stuart Matthews became Flight Safety Foundation's president and CEO in 1994, he had been a member of the FSF Board of Governors since 1989, and then its chairman from 1991; he was well-informed about the challenges that faced him. In the aftermath of the first Gulf War the finances of the aviation industry that funds FSF were tenuous, and the Foundation faced an uncertain future. Stuart knew that the Foundation was well-respected by the global aviation community and realized the importance of keeping it alive to help drive aviation toward higher levels of safety.

Upon taking over the Foundation's leadership Stuart announced his top two priorities: He would restore FSF finances and, using a statistics-driven approach, focus its resources on "the major causes of accidents today," specifically controlled flight into terrain (CFIT) and approach and landing accidents. Recent trends tend to confirm that programs developed by the Foundation in cooperation with industry, programs such as the CFIT training aid and *Approach and Landing Accident Reduction Toolkit*, have helped cut the risk of these most deadly of all accidents. And along the way, slowly but steadily, Stuart's management strengthened the Foundation's finances to today's healthy status.

Few people have been as qualified for their jobs as Stuart, who started his aviation life while still in school. At age 17, before he could drive a car, he earned his pilot license. Two years later he and his friends built an airplane, which Stuart flew. He continued flying for a number of years, both as a Royal Air Force reservist and on his own, logging more than 5,000 flights as a glider instructor.



Matthews

A chartered engineer, Stuart in 1953 started his first real job at de Havilland Aircraft, rubbing shoulders with one of aviation's great pioneers, Sir Geoffrey de Havilland, working on the Comet, the world's first jet airliner. Later, with British Aircraft Corp., he was involved in the Concorde program from 1964 to 1967.

Moving to the air transport world, he joined British Caledonian Airways, first as a fleet planner but ultimately becoming responsible for all corporate planning as that innovative carrier blazed a trail for new airlines.

Making a big jump in both focus and geography, he agreed in 1974 to lead Fokker Aircraft back to North America; since the 1930s, Fokker aircraft in North America had been manufactured under license by industry partners. He established Fokker Aircraft U.S.A. and ran it for 20 years, to the day, before retiring as chairman. Stuart's success was a bright spot in Fokker history. "We sold a lot of aircraft," he said,


Voss

including the largest single commercial order for Netherlands-based company at the time. Upon his retirement from Fokker he was knighted by the Queen of the Netherlands for his services to aviation.

Stuart held the FSF posts of chairman, president and CEO until the start of 2001, when Carl W. Vogt became non-executive chairman.

When Stuart assumed the Foundation leadership role, he promised that, following in the footsteps of FSF founder Jerry Lederer, he said he would bolster FSF's role as "the conscience of the industry … Our role is to vigorously point the way and to show how to prevent accidents. Safety cannot be compromised in an industry that is changing so rapidly."

As he steps down after nearly 13 years, the Foundation today is financially strong and leading or participating in nearly every safety initiative in the world. Jerry Lederer would be pleased.

An Introduction

William R. Voss — Bill to his friends — comes to Flight Safety Foundation as its new president and CEO directly from another aviation organization with a worldwide scope, the International Civil Aviation Organization. Beginning in January 2004, Bill was director of the ICAO Air Navigation Bureau (ANB). He was instrumental in developing ICAO's standards and recommended practices, which have reinforced safety-critical aspects of international aviation system infrastructure.

As director of the ANB, Bill recognized the importance of regional safety oversight organizations, a philosophy which meshes with FSF priorities. He encouraged ICAO support for regional organizations' efforts to resolve resource problems in developing nations. He worked with donor nations and industry to coordinate maximum regional assistance, and pushed for development of the Global Communication, Navigation, Surveillance/Air Traffic Management (CNS/ATM) Plan as a blueprint for integrating plans across regions.

Before heading the ICAO bureau, Bill served for 23 years in the U.S. Federal Aviation Administration (FAA), where he specialized in air traffic management, air traffic control and, as director of the FAA Terminal Business Service, applying business management principles to providing integrated air traffic control capabilities. In that capacity, he managed and directed 1,200 employees in 11 locations. FSF's slightly lower head count, about 20 employees in one location, should present fewer logistical problems.

Earlier positions at FAA included director, Office of Air Traffic System Development; deputy Integrated Product Team leader; senior analyst; and, early in his career, four years as an air traffic controller at a major U.S. airport and a stint as a charter pilot.

Bill's certificates and ratings include a wide range of aviation specialties. They include airline transport pilot, single- and multi-engine; FAA control tower operator; airframe and powerplant mechanic; flight instructor, airplane and instrument; and ground instructor, advanced and instrument. He has about 2,000 flight hours in general aviation aircraft.

Bill Voss will lead Flight Safety Foundation as a professional who knows aviation not only from the top down, but from the inside out. ●

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The Way

BY DAROL HOLSMAN

This article extends the discussion of the most consistent aviation department problems found by the Flight Safety Foundation Audit Team, based on the final reports submitted to clients that contracted for operational safety audits during 2004. The recommended solutions for the findings are the opinions of the FSF Audit Team. Some are based on regulatory requirements; some on FSF recommended safety practices; and others on the industry best practices.

When the FSF Audit Team completes a safety audit a final report is submitted to the client that details the *observations*, *findings* and *recommendations* identified during the review. All observations in our reports are documented policies, procedures and practices that exceed the industry best practices; the findings identify areas in which the team would advise the client to adopt better policies, procedures or practices to parallel industry best practices; and recommendations describe one or more actions that could be taken by the client to meet industry best practices.

This article will focus on the FSF Audit Team recommendations to correct several of the most frequent findings identified in the Administration and Organization topic area (*Aviation Safety World*, September 2006, p. 46).

In 13 audits of flight operations, or 65 percent of 20 audits completed, it was found that internal communications systems were lacking or underdeveloped. These recommendations were offered:

- Establish a consistent pattern of leadership team meetings. Include line-assigned personnel regularly to develop an environment of inclusiveness and teamwork.
- The director/manager/chief pilot should make every effort to keep his or her personnel informed on corporate matters that will, or could, affect flight operations personnel.
- Develop a flight crew information file, in electronic or hard-copy format, that provides a continuous flow of operations information to the crewmembers. Establish a file management system that ensures continuous updates and an archival record.
- Conduct all-hands meetings no less frequently than once each quarter. Take advantage of corporate board meeting opportunities when personnel are in one place.

- Hold pilot meetings following the all-hands meetings. Always schedule a safety presentation during pilot meetings.

In another 13 flight operations it was found that there were no desktop procedures developed to enhance personnel job assignment continuity. To those departments these recommendations were offered:

- Identify the key personnel in the flight operation who could subject the organization to a single-point failure if that individual suddenly were not available for an extended time for any reason.
- Establish an internal administrative requirement that key personnel will develop desktop resources — such as digital documents — that describe the procedures and practices in their area of responsibility in case they are unable to perform their jobs. This should not be simply a listing of duties and responsibilities, but should detail actual actions, paperwork flow and shortcuts to getting the work done.
- Management should review the desktop resources when first completed and annually thereafter.
- Identify a backup for each key person and provide opportunities for job training and acting assignments — that is, substitutes — when key personnel are absent for vacation or training, or on assignment.

In eight flight operations — 40 percent of the total audits — it was found that the corporate administrative manager lacked adequate knowledge of corporate aviation. These recommendations were offered:

- Executive management should authorize the aviation corporate administrative manager to attend the Darden Graduate School of Business Administration cours, "Managing the Corporate Aviation Function," at the University of Virginia, or a similar course of study at another university.
- Coordinate with the corporate administrative manager to provide access to the National Business Aviation Association certified aviation manager courses on-line.
- The director/manager/chief pilot should develop an in-depth aviation department orientation program for the corporate executive to whom he or she reports.
- Regularly conduct face-to-face meetings with the corporate manager and aviation department personnel.

Another eight flight departments were found to lack a long-term and short-term succession plan for leadership team members. These recommendations were offered:

- Identify the primary "acting" replacement for each leadership position in the organization, such as director, chief pilot and maintenance manager; for example, the chief pilot is designated to be the acting replacement for the director. Include this information in the flight operations manual so there is no question about who is in charge when the incumbent is absent.
- Establish a program that will ensure the development of candidates for management positions in the aviation department.
- Assign alternate candidates positions in management, providing them opportunities to develop self-confidence and allowing management to evaluate their capabilities.●

The data used in this article have been de-identified. Questions about this article should be sent to Darol Holsman, manager, Aviation Safety Audits, Flight Safety Foundation at dvhjkh@sbcglobal.net or +1 618.345.7449 (office phone) or +1 202.258.2523 (cell phone).

Nigeria's Way Forward

BY DR. HAROLD DEMUREN

After the unfortunate fatal airline accidents in late 2005, the federal government of Nigeria embarked on a major reform of its aviation industry. The objectives of this reform are to achieve the highest level of safety; enshrine probity, transparency and professionalism in the conduct of aviation business; and restore public confidence. The Presidential Task Force on Aviation and the Ministerial Task Force on Airworthiness and Operational Competency sprang into action — assessing the level of infrastructural decay and commencing a safety audit of the industry, respectively. The government showed commitment by making resources available to effect the reform and provided executive support toward the passage of a civil aviation bill. The accident figures showed that Nigeria needed to change course — to ensure that we join the "league of nations" so that as aviation becomes safer in the world, we also make it safer in Nigeria and the West African subregion.

When I met with the International Civil Aviation Organization (ICAO) staff earlier this year, it was very clear why every nation's civil aviation authority and every accident investigation body has to be autonomous. I am happy to report that Nigeria today is making the Nigerian Civil Aviation Authority (NCAA) fully autonomous. Following the passage of the civil aviation bill, there will no longer be political interference in safety regulation. Achieving this through the primary legislation is an ongoing effort; however, the bill before our National Assembly has passed its first and second readings — and has been subjected to the required process of stakeholder review and a public hearing at the National Assembly — on a fast track to passage. This was a very important step.

Harold O. Demuren, Sc.D., is director general and CEO of the Nigerian Civil Aviation Authority.

As we looked at the depth of our problems and the level of decay in the Nigerian system and the subregion, we believed that Flight Safety Foundation (FSF) could play a role in analyzing issues while offering expertise on available solutions. In the past, FSF safety seminars and programs have been a major influence for change in the subregion. It has been a desire of the NCAA to bring government and industry to the leading edge, joining the same bandwagon to promote safety, and that is just what is happening.

Recently, I talked with the World Bank and the International Finance Corporation (IFC), its private sector arm. Both have been very concerned about the safety of air transportation in Nigeria. But they are very pleased that our government is directly confronting aviation safety problems with all seriousness. After looking at our programs in 2006, they said they are happy that we have been dealing with FSF and its air transport safety services, led by Louis Sorrentino of SH&E. They saw the relationship as a plus for us, the right way to go.

First, we had to cope with the acute shortage of skilled manpower within the NCAA. Like many other CAAs, the Nigerian aviation authority has been plagued by shortages, especially flight operations/airworthiness safety inspectors and air traffic controllers. So, in March 2006, we asked for assistance from FSF, essentially to provide skilled manpower immediately — a secondment of experts to Nigeria. Soon afterward, Lou Sorrentino came with a team of eight experts in the areas of airworthiness, personnel licensing, flight operations, airports, air navigation and aviation security. This involvement already has been of tremendous assistance as they have been working with the NCAA across the spectrum of flight safety. The corporate objective of our organization has been revised, making safety our topmost priority.

The FSF team identified the areas where we needed to make improvements, which we embarked on immediately. The team assisted us by completing a diagnostic on our safety oversight system and organization. The resultant gap analysis of identified deficiencies is now being addressed quickly in preparation for the November 2006 audit by the ICAO Universal Safety Oversight Audit Program.

So far, we have focused on putting in place proper systems, processes and procedures for effective safety oversight so that we can meet international standards. Instead of taking years, this is a fast-track approach because we must implement all this before the audit deadline. At the same time, our tasks include steps to pass the U.S. Federal Aviation Administration's International Aviation Safety Assessments (IASA) Category 1 [i.e., "State does comply with ICAO standards"] before the end of 2006. Passing the ICAO audit and

Wayne Rosenkrans (FSF)

Dr. Harold Demuren discusses NCAA's preparations for international assessments with Stuart Matthews, FSF president and CEO; Louis Sorrentino, SH&E senior vice president; and José Muñoz, SH&E director of safety and civil aviation programs.

Port Harcourt International Airport, photographed in April 2005, is part of the Nigerian air transport infrastructure being rehabilitated in 2006.

IASA is a test of our ability at the NCAA to provide effective, ongoing regulatory oversight to civil aviation.

Training within government and industry also is critical to ensuring that we achieve our safety objectives. Enhancing human capacity and capability is a major area of our current work. All the efforts discussed above require human beings and won't succeed unless people are well prepared through initial training, continuing training and retraining.

Simultaneously, we have been working with the airport authority to improve aviation security at all our airports. FSF and SH&E also provided the NCAA an expert in aviation security, who assisted us in preparing for the July 2006 follow-up audit under the ICAO Universal Security Audit Program. The expert was of tremendous value in turning things around. We are very pleased that Nigeria now has in place aviation security regulations, aviation security requirements and corresponding training manuals for airlines, service providers and airports — meeting international requirements.

In addition, Nigeria has embraced the International Air Transport Association (IATA) Operational Safety Audit (IOSA) program, encouraging air carriers that want to operate on international routes to voluntarily embrace IOSA as if the audit were compulsory. Many Nigerian air carriers are already moving in this direction.

While FSF and SH&E have been providing a significant part of the safety oversight and structural support, we have also been receiving assistance from many other organizations: Boeing is providing significant technical assistance with training; Airbus is providing similar programs. IATA is supporting the NCAA with training and IOSA gap analysis for airlines. IATA is also supporting the Nigerian Airspace Management Agency on procurement and maintenance of navigational aids (navaids).

Safety developments also are spreading across the subregion — not just Nigeria — because of the work of the ICAO Cooperative Development of Operational Safety and Continuing Airworthiness Program (COSCAP)–Banjul Accord Group, comprising the anglophone states[1] of Cape Verde, Gambia, Ghana, Guinea, Liberia, Nigeria and Sierra Leone. Subregional airline liberalization developments are also spreading under the umbrella of the 1999 decision to implement the Yamoussoukro Decision concerning the liberalization of access to intra-African air transport markets.

Typical problem reports to the NCAA from international pilots have involved navaids not working and the absence of briefings for weather and navaid status. We already have taken a major step in these areas by reactivating crew briefing rooms that provide crews with real-time weather information for the departure airport, destination and en route.

Nigerian airport infrastructure rehabilitation includes runway resurfacing, airport security fences, airfield lighting, and rehabilitation of control towers and radar. These are part of the massive development program funded by the government of Nigeria.

It also must be placed on record that half of the air carrier accidents in Africa involve aircraft registered outside Africa and operating illegally in many cases (e.g., aircraft with questionable safety certificates and fake insurance). The NCAA is fighting to ensure that all these illegal operations stop forthwith and to regulate them with requirements similar to those of the United States of America. New regulations have been introduced to require foreign airlines to be issued operations specifications. There will be no room for flag-of-convenience operators. The next hajj operations by airlines [for Muslim pilgrims traveling to Saudi Arabia] will be a true test of our commitment.

At the end of the day, the NCAA expects to say, "We have built a sustainable, world-class safety oversight structure and system for Nigeria — we have promoted global aviation safety." ●

Note

1. In anglophone states or regions, English is one of the languages used for official purposes.

Losing the Cabin

Insights on civil aircraft depressurization.

BY MARK LACAGNINA

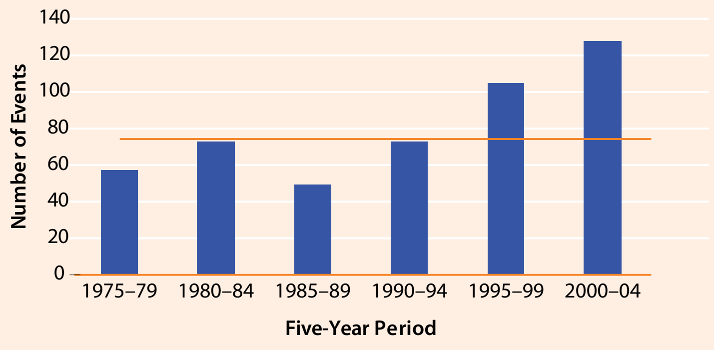
A cabin depressurization likely will be survived if it is recognized early and the appropriate emergency procedures are conducted expeditiously, according to a recent report by the Australian Transport Safety Bureau (ATSB).

Citing a paucity of studies of accidents and incidents involving cabin depressurization in civil aircraft, ATSB delved into more than 30 years of data to throw more light on how often such events occur, why they occur and what happens when they occur.[1]

Sifting through 8,302 accidents, 95 serious incidents (near accidents) and 151,941 incidents that occurred in Australia from Jan. 1, 1975, through March 31, 2006, researchers identified 517 as "pressurization failure events." Figure 1 shows the events grouped in five-year periods. "The apparent increase in depressurization [events] from 1985–1989 to a peak in 2000–2004 may be due to several factors, such as changes in reporting and recording of events, differences in aircraft fleet composition with each epoch, differences in hours flown per five-year period, etc.," the report said. "In the absence of more information, it is not possible to attribute any specific significance to this apparent trend."

Table 1 shows that two-thirds of the events occurred in airline operations. "The vast

Pressurization Failure Events by Five-Year Periods



Source: Australian Transport Safety Bureau

Figure 1

majority of depressurization events occurred in large passenger-carrying commercial transport aircraft category," the report said. "This is not surprising, given that these aircraft fly the most frequently and have the highest pressure differential."

Almost three-quarters of the pressurization failure events were precipitated by mechanical problems.

A pressurization system typically flows compressed air from turbine engine compressor sections, piston engine turbochargers or engine-driven superchargers through air-conditioning packs or heat exchangers into a sealed "pressure vessel" that can include the flight deck, passenger cabin and baggage and cargo compartments. A perfect seal is not possible — control cables, electrical wiring and other components must be routed through the pressure vessel; cutouts must be made for doors, emergency exits, windows and appendages such as radio antennas — so, the system must accommodate some leakage.

The flight crew has controls to regulate the flow of compressed air through inflow valves and outflow valves. Modern pressurization system controllers can operate automatically with information provided by air data computers and cabin sensors. Instruments enable the flight crew to monitor cabin altitude, the rate of change of cabin altitude and *differential*, the difference between cabin air pressure and outside air pressure. When air pressure inside and outside the cabin is equal, the differential is zero. When the cabin is being maintained at sea level pressure, 14.7 psi, at a pressure altitude of 24,000 ft, 5.7 psi, the differential is 9.0 psi (14.7 minus 5.7). Each system has a maximum differential — 4.7 psi for the Beech King Air 90 and 10.7 psi for the Concorde, for example. European and U.S. certification regulations say that cabin altitude cannot exceed 8,000 ft when a transport category airplane is being flown at its maximum operating altitude.[2] Transport category airplanes have warning lights that illuminate when cabin altitude nears or exceeds 10,000 ft, and some also have aural warnings.

Pressurization Failure Events by Operation

Operation	Number	Percentage
Airlines	344	66.5%
Charter	78	15.1%
Other aerial work	34	6.6%
Military	19	3.7%
Commuter	16	3.1%
Private	10	1.9%
Business	8	1.5%
Flight training	3	0.6%
Unknown	5	1.0%
Total	**517**	**100.0%**

Source: Australian Transport Safety Bureau

Table 1

Altitude data were available for 55 of the 517 events. The average altitude at which the 55 events occurred was 25,800 ft; the average cabin altitude reached after the depressurizations was 10,978 ft. The report said that cabin altitude exceeded 14,000 ft in six events. The highest cabin altitude reached was 22,000 ft, when cabin pressure in a Fairchild SA227C was "dumped" for unspecified reasons at 22,000 ft during a charter flight.

Data on the rate of cabin altitude change were available for 39 events. The average rate was 1,712 fpm. In eight events, the rate was 2,000 fpm. Sixteen events exceeded a rate of 2,000 fpm. The highest rate was 6,500 fpm.

Mechanical Problems

Table 2 (page 36) shows the causes of the pressurization failure events. The report said that studies of military aviation in Australia, Canada and the United States also have found that nearly 75 percent of depressurizations were caused by mechanical problems.

More than half — 228 — of the mechanical problems found in the ATSB study originated with pressurization system controllers. "System failure" was cited in 42 events, and outflow valve problems played a role in 28 events. "Maintaining a constant cabin altitude is a balance between the entry of pressurized air and the outflow of

Almost three-quarters of the pressurization failure events were precipitated by mechanical problems.

© Werner Gillmer–Shutterstock

this air," the report said. "If the outflow valves are not operating properly, cabin altitude will not be maintained at the desired level."

Mechanical problems also included air leaking through doors and windows. "The leaks were due to several reasons, including faulty door and window seals, cracked windows or improperly closed doors," the report said. "In general, these events resulted in inability to maintain the desired cabin altitude, even though the cabin pressurization system was otherwise working normally. The rate of cabin pressure change in those cases was generally slow, readily identified by the crew, and an uneventful descent was generally carried out."

Structural failure caused two events, neither of which involved injury to occupants. "In one event, the structural failure was a loss of a fuselage panel, leading to an explosive decompression," the report said. "The other event occurred in a Beech 200 aircraft involved in low-capacity air transport operations, with two crew and nine passengers on board. At an airspeed of 200 knots and descending through 17,000 feet en route to Sydney, New South Wales, the main cabin door separated from the aircraft. After a rapid descent was carried out to 11,000 feet, the aircraft [was] successfully landed at Sydney."

Human error played a role in 5 percent of the events. Flight crew errors caused 16 events, and errors by maintenance technicians caused 11 events (see "ASRS Insights").

Fatal Flight

There was one fatal accident among the 517 pressurization failure events studied by ATSB involving a Beech Super King Air 200 that was on a charter flight with a pilot and seven passengers from Perth to Leonora, both in Western Australia, on Sept. 4, 2000.[3]

Soon after departure, the pilot was cleared to climb to Flight Level (FL) 250 (approximately 25,000 ft). About 20 minutes later, the air traffic controller observed on his radar display that the aircraft was climbing above

Causes of Pressurization Failure Events

Cause	Number	Percentage
Control problem	228	44.1%
Door problem	62	12.0%
System failure	42	8.1%
Outflow valve problem	28	5.4%
Operator error	16	3.1%
Window failure	14	2.7%
Maintenance error	11	2.1%
Air leak	2	0.4%
Seal problem	2	0.4%
Structural problem	2	0.4%
Engine failure	1	0.2%
Not specified	109	21.1%
Total	**517**	**100.0%**

Source: Australian Transport Safety Bureau

Table 2

FL 250. When asked to verify his altitude, the pilot told the controller to stand by. Open-microphone transmissions from the aircraft during the next eight minutes included one unintelligible syllable, sounds of a person breathing and background propeller and engine noise. In its final report on the accident, ATSB said that these transmissions were symptomatic of hypobaric hypoxia, which can affect mental functions before it affects physical abilities. "For example, a hypoxic pilot may be quite capable of pressing the [microphone] transmit button but may be unable to form the words to speak," the accident report said.

About one hour and 25 minutes after departing from Perth, the aircraft overflew Leonora at 34,000 ft. The aircraft maintained a steady heading of about 050 degrees, indicating that the autopilot heading-hold and pitch-hold modes were engaged. The flight crew of a business jet that intercepted the King Air saw no lights or movement inside the aircraft. "The aircraft was probably unpressurized for a significant part of its climb and cruise for undetermined reasons," the accident report said. "The pilot and passengers were incapacitated, probably due to hypobaric hypoxia, because of the high cabin altitude and their not receiving supplemental oxygen."

ASRS Insights

A search by *Aviation Safety World* of the U.S. National Aeronautics and Space Administration's Aviation Safety Reporting System database found 75 voluntary reports of "depressurization" or "decompression" events in 2001 through 2005.

Twenty-six reports included the possible cause of the depressurization/decompression. Cabin door seal failures were cited in six reports — one involving an air carrier aircraft, three involving business jets and two involving twin-turboprops. Malfunction of the cabin door seal pressure regulator caused another business jet to depressurize.

Cargo door seal failures were cited in four reports by airline flight crewmembers. Another airliner depressurization was attributed to failure of the seal around an electronics equipment compartment door.

Other causes included failures of a cabin door-position sensor, a baggage door seal, a pressurization system controller and an air-conditioning pack; a faulty weight-on-wheels sensor; a loose heater shroud hose clamp; a ground-air connection valve that failed to close after engine start; and an outflow valve that was jammed open by a "silver cloth." A cracked cabin window outer pane was cited in the depressurization of a Mitsubishi MU-2.

Some reports cited operator error, including a flight crew's failure to reselect the air-conditioning packs after takeoff, pack switches that might have been inadvertently repositioned when bumped by a logbook that was being returned to its holder, and bleed air switches left in the "OFF" position. Another report said that after returning to the departure airport, the crew of a Boeing 737-700 found that they had departed with the pressurization mode selector set to manual rather than automatic. A 737-300 crew departed with one air-conditioning pack inoperative according to the provisions of the aircraft's minimum equipment list, only to have the other pack fail during cruise at Flight Level (FL) 240.

A flight attendant reported perceived deficiencies in communication and training. She was aboard an Airbus A300 that had been climbing to cruise altitude but then began to descend. After a "muffled" public-address system announcement by a pilot, another flight attendant called the flight deck and learned that a depressurization had occurred. The oxygen masks had not deployed, and the flight attendant attempted to retrieve an oxygen bottle but could not find the bracket releases in the dark storage compartment. In her report, she recommended that flight attendants receive training on the operation of emergency equipment in total darkness.

A common element among the reports by flight crewmembers is that the pilots apparently followed their training by donning their oxygen masks, initiating a descent and conducting the emergency checklist. The report by the captain of an Israel Aircraft Industries Astra SPX was typical: The aircraft was at FL 430 when a door seal deflated, causing a rapid depressurization, with cabin altitude very quickly reaching 20,000 ft. The pilots donned their oxygen masks and initiated a high-speed descent to 12,000 ft. The captain said, "I attribute [the positive outcome to] extensive simulator training with rapid-decompression awareness and procedures."

Of note, however, is that a few pilots reported that they initially mistook the cabin altitude warning horn for an aircraft configuration warning, and some pilots faulted themselves for neglecting to declare an emergency or to clearly convey to air traffic control the reason they were leaving their assigned altitudes.

— ML

About three hours and 37 minutes after passing over Leonora, the aircraft struck terrain near Burketown, on the northern coast of Queensland. Because of extensive aircraft damage and the absence of flight data and voice recorders, ATSB was not able to determine why the cabin either did not become pressurized or lost pressurization. The aircraft had been flown the morning of the accident, and no problems with the pressurization system were noted. The report also said that the accident pilot was known for his professionalism and methodical use of checklists.

The pressurization system in the accident aircraft included visual warnings but not an aural warning of excessive cabin altitude. The report said that the accident might have been prevented if an aural warning, as well as the visual warnings, had been generated when cabin altitude exceeded 10,000 ft. An ATSB recommendation to require such warnings in pressurized aircraft was rejected by the U.S. Federal

Aviation Administration as "not necessary to meet minimum airworthiness standards" but accepted by the Australian Civil Aviation Safety Authority (CASA). However, CASA later withdrew rulemaking action after public comment opposed the cost of mandatory installation of aural warnings.

The report on the study of pressurization failure events said that several other fatal accidents recently have occurred worldwide, including the Oct. 25, 1999, Learjet 35 accident in the United States, in which professional golfer Payne Stewart and five others were killed, and the Aug. 14, 2005, Boeing 737 accident in Greece, in which all 121 occupants were killed (see "Accidents and Incidents Involving Cabin Depressurization, 1995–2005," page 40).

Hypoxia Strikes

The report said that symptoms of hypoxia, one of the greatest hazards of depressurization, include light-headedness, confusion, tremors, impaired judgment and decision making, dizziness, and ultimately loss of consciousness. Other studies have linked hypoxia to symptoms including rapid breathing, headache, fatigue, sweating, reduced coordination, impairment of vision, cyanosis — a blood oxygen deficiency that causes a blue coloring of the lips and skin beneath the fingernails, and sensations of tingling, cold and warmth.

Symptoms of hypoxia were encountered by aircraft occupants in four events. A 737-700 pilot became light-headed and nauseous when the aircraft was in cruise flight at FL 400. After observing that cabin altitude was increasing at 4,000 fpm, the flight crew conducted a descent to 10,000 ft and continued the flight to the destination. Cabin crewmembers aboard a Fokker F27 reported that they encountered mild symptoms of hypoxia at 25,000 ft. The pilot of a Rockwell Commander 685 encountered symptoms of hypoxia after the pressurization system failed during climb. The symptoms encountered by the occupants in the other event were not specified.

A loss of consciousness occurred during a Royal Australian Air Force training flight in a civilian aircraft on June 21, 1999.[4] The pilot and two passengers were en route from Edinburgh, South Australia, to Oakey, Queensland. Passing through 10,400 ft, the pilot was conducting the "Climb" checklist when he received a change in routing from air traffic control (ATC). The pilot reprogrammed the global positioning system (GPS) receiver and then completed the checklist.

The aircraft was nearing the assigned altitude, FL 250, when ATC told the pilot that the aircraft was not maintaining the assigned track. The passenger in the copilot seat, who was a certificated pilot but not rated in type, noticed that the pilot was repeatedly performing a task required to reprogram the GPS receiver. "The pilot was not familiar with the GPS receiver and had received no formal training in its operation," the incident report said. "The controller advised the pilot again that the aircraft was still off track; however, the pilot did not reply to this transmission."

Soon thereafter, the pilot became unconscious. The passenger in the copilot seat took control of the aircraft and began an emergency descent. "The other passenger unstowed the pilot's oxygen mask and took several breaths of oxygen from it before fitting it to the unconscious pilot," the incident report said.

The pilot regained consciousness during the descent. While returning to Edinburgh, he noticed that both "BLEED AIR OFF" annunciator lights were illuminated and that the bleed air switches were set to "ENVIR OFF," a position at which the cabin bleed air inflow valves would be closed. The "Climb" checklist calls for repositioning the vent blower switches. "These switches were located very near to the bleed air valve switches, and it is probable that the pilot inadvertently moved both bleed air switches to 'ENVIR OFF' during the climb checks instead of moving the two blower switches," the incident report said.

Barotrauma

In four events, passengers sustained minor ear problems, "most likely otic barotrauma," the report said. All four events occurred during emergency descents in airline aircraft. One event involved an emergency descent at 1,500 fpm following a depressurization at 37,000 ft.

"Most barotrauma of the ears and sinuses is generally a consequence of descent [into higher ambient pressure] rather than the initial depressurization event," the report said. "This is true in the present study, with most of the injuries being ear-related pressure pain due to the emergency descent."

None of the events involved decompression illness, in which a sudden reduction in pressure causes gases in body cavities — such as the sinuses, ears, abdomen and teeth — to expand. Decompression illness also can be caused by gases that escape from solution in the blood and body tissues, causing various problems, including blurring of vision, inability to speak or understand what is spoken, and pain in joints, a condition commonly called the bends. The report said that the absence of decompression illness in the events studied probably was due to the "generally slow average rate of aircraft decompression, the relatively low maximum cabin altitude reached (14,000 feet) and the subsequent emergency descent."

The report said that although the study showed that the risk of loss of cabin pressurization is low and the risk of injury to occupants is low if it should happen, complacency must be avoided. "The inherent risks of operating in the hostile environment at high altitude must not be taken for granted," the report said. "While the rate of decompression events is low, the potential risks involved with such an event are considerable, especially if the event is rapid, not recognized by the crew and emergency procedures are not carried out promptly. … Often, the failure of the cabin pressurization system is unexpected. Given the significant potential risk of hypoxia, pilots need to always be prepared for this contingency." ●

Ground damage by a tug might have led to a rupture of an MD-83's fuselage and rapid depressurization at FL 240 (see page 41).

Notes

1. Newman, David G. *Depressurisation Accidents and Incidents Involving Australian Civil Aircraft, 1 January 1975 to 31 March 2006.* Australian Transport Safety Bureau (ATSB) Research and Analysis Report B2006/0142. June 2006.

2. European Aviation Safety Agency Certification Specifications CS 25.841. U.S. Federal Aviation Regulations Part 25.841.

3. ATSB Aviation Safety Report BO/2000371, *Pilot and Passenger Incapacitation; Beech Super King Air 200, VH-SKC; Wernandinga Station, Qld, 4 September 2000.*

4. ATSB Air Safety Occurrence Report 199902928, *Inflight Pilot Incapacitation 72 km East of Edinburgh Aerodrome.*

Appendix
Accidents and Incidents Involving Cabin Depressurization, 1995–2005

Date	Location	Aircraft Type	Aircraft Damage	Injuries
Jan. 5, 1995	Isfahan, Iran	Lockheed Jetstar	destroyed	12 fatal
The aircraft, operated by the Iranian air force, was climbing through 2,000 ft when a pilot reported a problem with the pressurization system and requested clearance to return to base. Soon thereafter, the aircraft struck terrain.				
July 9, 1995	Chicago	ATR 72-200	minor	1 minor, 64 none
A recently installed main cabin door, with a handle that moved in the opposite direction, opened soon after takeoff and separated from the aircraft as the flight crew returned for landing. A flight attendant seated near the door when it opened received injuries to her arm when she fell while moving away from the door.				
Aug. 9, 1995	Cordoba, Argentina	CASA CN-235-200	minor	1 fatal, 29 none
The aircraft was climbing through 6,000 ft when the main cabin door opened. A flight attendant standing near the door was lost overboard.				
Aug. 23, 1995	Pacific Ocean	Lockheed L-1011	substantial	236 none
A rapid decompression occurred at Flight Level (FL) 330. The flight crew conducted an emergency descent, turned back to Los Angeles and landed without further incident about two hours later. The aft pressure bulkhead had separated from the fuselage crown due to the failure of improperly fastened stringers.				
Aug. 25, 1995	Budapest, Hungary	Boeing 737-300	substantial	85 none
The flight crew was not aware that the tail had struck the runway during takeoff. During climb, the crew encountered cabin pressurization problems and decided to return to Budapest.				
Feb. 14, 1996	Caracas, Venezuela	Douglas DC-9-50	substantial	91 none
The aircraft was climbing through 20,000 ft when a rapid depressurization occurred. The flight crew returned to Caracas. Part of the rear pressure bulkhead had failed due to fatigue cracks that initiated near the cutout for the cabin door.				
May 12, 1996	Indianapolis	Boeing 727-200	none	11 minor, 101 none
The aircraft was en route from Chicago to St. Petersburg, Florida, at FL 330 when the cabin altitude warning horn sounded. The captain, the pilot monitoring, noticed that the right air-conditioning pack was off, and he and the flight engineer attempted to re-engage the pack without using a checklist. The flight engineer inadvertently opened the outflow valve, causing the cabin to depressurize fully. The captain, flight engineer and lead flight attendant became unconscious. The oxygen masks deployed in the cabin and were donned by the other flight attendants and the passengers. The first officer, who had donned his oxygen mask when the first warning occurred, conducted an emergency descent. The other crewmembers regained consciousness during the descent, and the aircraft was landed in Indianapolis without further incident.				
Feb. 13, 1997	Atlanta	Boeing 727-200	minor	92 none
The flight crew continued the takeoff after the aft cargo door warning light illuminated. The crew heard a "pop," and the cabin depressurized as the aircraft was climbing through 900 ft. Ground service personnel had failed to properly close the door.				
July 30, 1997	Berlin	Lockheed Electra	substantial	5 none
The aircraft was climbing through 11,500 ft when the main cargo door opened. The flight crew returned to Berlin and landed without further incident. The cargo door had not been secured properly before takeoff, and the cockpit warning light had been dimmed so low that it could not be seen.				
Aug. 8, 1998	Baker, Nevada, U.S.	Piper Cheyenne	destroyed	3 fatal
Soon after the pilot reported a loss of pressurization at FL 270, the aircraft descended rapidly and struck terrain. The aircraft had been restricted to a maximum operating altitude of 12,500 ft after an inspection 10 months earlier found that the oxygen system required maintenance.				

Continued on next page

Appendix
Accidents and Incidents Involving Cabin Depressurization, 1995–2005

Date	Location	Aircraft Type	Aircraft Damage	Injuries
Oct. 25, 1999	Aberdeen, South Dakota, U.S.	Gates Learjet 35	destroyed	6 fatal
The aircraft was on a charter flight from Orlando, Florida, to Dallas. Radio communication was lost soon after the flight crew reported climbing through FL 230 and was cleared to FL 390. The aircraft continued flying on a northwesterly heading for 3.7 hours and reached an altitude of 40,600 ft. The aircraft began descending after the left engine flamed out.				
June 13, 2000	Rio de Janeiro, Brazil	Boeing 737-200	NA	85 none
A rapid decompression occurred at FL 290. A 28-in (71-cm) crack was found in the fuselage above the forward service door.				
Sept. 15, 2001	Belo Horizonte, Brazil	Fokker 100	substantial	1 fatal, 88 none
The aircraft was en route from Recife to São Paulo when an uncontained engine failure occurred. Debris penetrated the cabin, killing one passenger. The flight crew conducted an emergency landing at Belo Horizonte.				
Feb. 17, 2002	San Juan, Argentina	Boeing 737-200	NA	NA
The flight crew conducted an emergency landing following a cabin depressurization. A small crack was found in the fuselage aft of the forward left door.				
Aug. 23, 2003	Denver	Beech 1900D	minor	16 none
The aircraft was climbing through 8,000 ft when the cabin door opened. The flight crew returned to Denver. The report said that the first officer had failed to ensure that the cabin door was secure before takeoff.				
Dec. 5, 2004	Anchorage, Alaska, U.S.	Boeing 747-100SR	minor	3 none
After a rapid depressurization occurred during cruise at FL 300, the flight crew returned to Anchorage. A 12-in (30-cm) tear was found along a line of rivets between the nosewheel well and the electronics service bay.				
May 13, 2005	Denver	McDonnell Douglas MD-88	substantial	98 none
A broken nose landing gear actuator rod penetrated the forward pressure bulkhead during initial climb. After confirming with tower controllers that the landing gear appeared to be down and locked, the flight crew landed without further incident.				
Aug. 14, 2005	Grammatikos, Greece	Boeing 737-300	destroyed	121 fatal
The cabin altitude warning horn sounded as the aircraft was climbing through 12,000 ft during a flight from Larnaka, Cyprus, to Athens. A preliminary report said that the captain was in radio communication with airline maintenance personnel until the aircraft passed through 28,900 ft. The aircraft, apparently being flown on autopilot, entered a holding pattern near Athens at FL 340. Both engines flamed out more than an hour later, and the aircraft descended to the ground.				
Aug. 24, 2005	Shanghai, China	Airbus A340-310	minor	256 none
The flight crew was not aware that a tail strike had occurred, causing substantial damage on takeoff from Shanghai. Indications of a cabin pressurization problem appeared as the aircraft climbed through 9,900 ft. The crew returned to Shanghai.				
Nov. 9, 2005	Tanta, New South Wales, Australia	Boeing 737-700	none	none
About 11 minutes after the aircraft reached FL 400, the captain felt a stomach upset and ear discomfort, and noticed that cabin pressure altitude was climbing at 4,000 fpm. The cabin altitude warning horn sounded about 44 seconds after the crew began an emergency descent to 10,000 ft. The aircraft was landed at the destination, Melbourne. Both positive pressure relief valves had failed.				
Dec. 26, 2005	Seattle	McDonnell Douglas MD-83	substantial	142 none
The aircraft was climbing through 24,000 ft when the flight crew heard a loud bang and the cabin rapidly depressurized. The crew returned to Seattle and landed without further incident. A six- by 12-in (15- by 30-cm) hole was found in the right fuselage, between the middle and forward cargo doors. A ground service worker said that he had grazed the aircraft with a tug; he had not reported the incident before the aircraft departed.				

NA = not available

Sources: Airclaims, Australian Transport Safety Bureau, Hellenic Air Accident Investigation and Aviation Safety Board, U.K. Air Accidents Investigation Branch, U.S. National Transportation Safety Board

Fourth 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

Wrong Airport

Learning From Experience
Incident No. 4

An insidious loss of positional awareness called "mental map shift" might have played a role in an incident involving the flight crew of a modern regional jet during a nonprecision instrument approach in nighttime visual meteorological conditions. During initial approach, the pilots apparently saw what they perceived to be their destination airport and began a visual descent toward the runway lights.

The crew was heading for the wrong airport. The aircraft's terrain awareness and warning system (TAWS) did not have this airport in its database and generated a "TERRAIN, PULL UP" warning when the aircraft reached the programmed obstacle/terrain clearance floor.[1]

A TAWS database can be configured to an operator's requirements. In this instance, the airport that the aircraft was approaching was not in the database because the length of its runway was less than the regional jet operator's minimum requirement of 3,500 ft (1,068 m).

The situation encountered by the flight crew offered several opportunities for error. The VOR/DME (VHF omnidirectional radio/distance measuring equipment) approach procedure provides the choice of a procedure turn beginning at the VORTAC (VOR/tactical air navigation) or a 7.0 nm DME arc to establish the aircraft inbound on the final approach course, 220 degrees. The crew flew the arc. At the turn-in point from the arc to the final approach course, the distance to the VORTAC is 7.0 nm; the distance from the VORTAC to the runway also is 7.0 nm (Figure 1). Located slightly less than 7.0 nm from the turn-in point is the small airport that the crew mistook for the destination airport.

The following are possible explanations for the flight crew's error:

- Fatigue might have reduced their capacity for careful thought, resulting in a loss of mental timing and a loss of positional awareness. The crew might have been unable to maintain an accurate mental picture of the approach. Their cross-checking of the aircraft's position with navigation instrument indications might have been inadequate or nonexistent.
- While turning inbound from the arc, the crew might have expected to see a runway, and "wishful thinking" contributed to the misidentification.

The crew's apparent loss of positional awareness might have taken the form of a mental map shift that resulted from nearly identical distances from the turn-in point to the VORTAC, from the turn-in point to the small airport and from the VORTAC to the destination airport. These could have been misidentified on the electronic flight instrument system (EFIS) map display.

The runway headings at the destination airport and the small airport are within 30 degrees. Terrain could have masked any distinguishing or differentiating lighting features at the two airports. Thus, the similarity of the runway headings could have contributed to the crew's disorientation.

If the crew had used a flight management system (FMS) route, waypoints would have been positioned at the arc turn-in point, the VORTAC and the runway. Most EFIS map formats follow the convention of using "DIST" to identify distance between waypoints and "DME" to identify VORTAC or DME range values. If the crew's mental attention was low, they could have interchanged these identifications.

Familiarity with the approach procedure also might have contributed to the crew's error. They might have expected a 7.0 nm "DIST" value to the runway waypoint. At the turn-in point, the crew likely mistook a 7.0 nm "DME" value for the expected 7.0 nm "DIST" value. The pilots seem to have inadvertently shifted their mental position by seven miles to the VORTAC — the mental map shift — and began the descent toward the wrong runway.

Lessons to Be Learned

Beware of habit and complacency — "We have always done it this way" — and expecting to see something.

Mental resources and the ability to think carefully are reduced by fatigue and stress. In this condition, humans are susceptible to errors in positional awareness, situational awareness, timing and monitoring. Pilots must refocus their attention on lateral and vertical position before beginning an approach.

Conscious effort must be made to avoid distraction or fixation on the nearest or brightest lights. Visual approaches always should be cross-checked with navigation instruments. ●

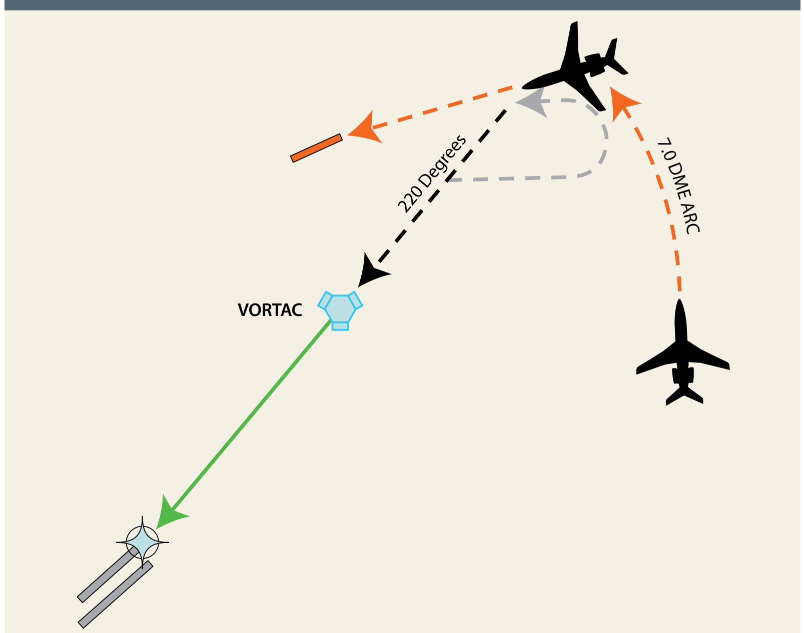
[This series, which began in the July issue of *Aviation Safety World*, is adapted from the author's presentation, "Celebrating TAWS Saves, But Lessons Still to Be Learned," at the 2006 European Aviation Safety Seminar and the 2006 Corporate Aviation Safety Seminar.]

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."

Note

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.

Aircraft Flight Path



Source: Dan Gurney

Figure 1

AUTOMATION

A study is seeking answers to continuing and evolving questions about the optimal human/machine interface.

BY MARK LACAGNINA

Acknowledging that improvements have been made during the past 10 years in the design of flight deck automation systems and in training pilots to use them, the U.S. Federal Aviation Administration (FAA) Performance-based Operations Aviation Rulemaking Committee and the Commercial Aviation Safety Team (CAST) have launched a study to identify how far we have come and where we need to go, not only to solve persistent problems but also to ensure that modern aircraft are flown safely and efficiently as new operating and navigational procedures are introduced.

The study specifically will update a 1996 report by the FAA Human Factors Team. The report, "The Interfaces Between Flightcrews and Modern Flight Deck Systems," was reprinted by Flight Safety Foundation in the September–October 1996 issue of *Flight Safety Digest*.

We have made significant improvements since the 1996 study," Nicholas Sabatini, FAA associate administrator for aviation safety, told *Aviation Safety World*. "But we need to get even

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better as we expand new operations like RNAV [area navigation] and RNP [required navigation performance]. Human factors will be critical for the success of these and other future operations."

Co-chairs of the working group performing the study are Kathy Abbott, Ph.D., of FAA — who was a co-author of the 1996 report — David McKenney of the Air Line Pilots Association and Paul Railsback of the Air Transport Association.

Abbott told *ASW* that among improvements made since the 1996 study are new regulations governing the design of flight guidance systems in transport category airplanes. Replacing design standards adopted in 1964 for autopilots, U.S. Federal Aviation Regulations Part 25.1329, effective April 2006, states, in part, that flight guidance systems cannot cause an unsafe reduction in airspeed or create a potential hazard when pilots attempt to override them. The new regulation also states, "The flight guidance system functions, controls, indications and alerts must be designed to minimize flight crew errors and confusion concerning the behavior and operation of the flight guidance system."

Error and Confusion

Flight crew error and confusion were involved in a fatal accident that prompted the 1996 study: the April 26, 1994, China Airlines Airbus A300 accident at Nagoya, Japan. The first officer was hand-flying an ILS approach with the autothrottles engaged. The approach was stabilized until the airplane reached about 1,070 ft and the first officer inadvertently selected the TOGA (takeoff/go-around) mode, resulting in an increase in thrust. The first officer disengaged the autothrottles and manually reduced thrust. The airplane rose slightly above the glideslope, and one of the pilots, apparently seeking to regain the glideslope, engaged the autopilot — with the TOGA mode still selected. The crew apparently did not realize that the autopilot was trimming the horizontal stabilizer nose-up. The first officer applied forward pressure to the control column to counter the nose-up pitch commanded by the autopilot, but the autopilot, opposing the first officer's control input, trimmed the horizontal stabilizer to its full nose-up position. The captain took control and, deciding that landing the airplane would be difficult, initiated a go-around. The airplane began to climb with a high nose-up pitch attitude that reached 52 degrees. Although the throttles were advanced, airspeed decreased to 78 kt; the airplane stalled and descended to the ground, killing 264 occupants and seriously injuring seven others.

Among the findings of the 1996 study were that pilots often misunderstood the capabilities, limitations and operation of automation equipment, and when — and when not — to use the various levels of automation. The Human Factors Team found that pilots frequently were surprised by the behavior of their equipment and asked questions such as "Why did it do that?" and "What is it doing now?" The team also found that pilots frequently were unaware of the mode in which their equipment was operating, their projected flight path and the aircraft's energy state.

In the terms of reference for the new study, FAA and CAST said that "incident reports suggest that flight crews continue to have problems interfacing with the automation and have difficulty using these systems." The working group will review actions that have been made to address the more than 50 recommendations generated by the 1996 study.

Training Aid?

Abbott said that improvements have been made in pilot-training programs but that current training programs vary. "Training is not consistent," she said. Thus, among the tasks that the working group may pursue is the development of an automation training aid. The decision to pursue this task has not yet been made. The study currently is envisioned as requiring about 30 months to complete; at press time, the working group was conducting its third meeting.

"It's too early to discuss the training aid," Abbott said. "But if we do something, we would use the result of our analyses to see what areas of training are not getting sufficient emphasis now." ●

GROWING PAINS

The process of creating a Europe-wide aviation regulatory authority has not been smooth; given the need, anything but success seems unthinkable.

BY ANNE PAYLOR | FROM LONDON

The European Aviation Safety Agency (EASA) has developed from an idea into an entity, and while great progress has been made in taking over duties performed by the Joint Aviation Authorities (JAA), much needs to be accomplished before EASA can become a true pan-European aviation safety regulator. If Europe can come to grips with remaining obstacles, the scope of EASA's regulatory mandate ultimately will outstrip its predecessor's.

EASA was created to ensure that all aircraft operating in European airspace comply with common and harmonized standards of safety, creating a level playing field for all European operators to ensure that none are saddled with more stringent safety regulation than others.

Standards of safety regulation across the numerous states that make up the European Union (EU) traditionally have varied greatly. Initial efforts toward some level of harmonization resulted in the formation of the Joint Airworthiness Authorities (JAA), which later swapped "Airworthiness" for "Aviation" in its name as its mandate swelled, but differing interpretations of harmonized standards adversely affected the efficiency of regulation and increased compliance costs for the sector.

The decision therefore was taken to create a single specialized safety agency to establish common requirements for the regulation of safety and environmental sustainability in civil aviation. The agency would be independent on technical matters; have legal, administrative and financial autonomy; and act as an enabler to the legislative and executive process.

Although a creation of the EU, EASA's geographic scope, like JAA's, extends beyond the EU states. The 33 full EASA members consist of all 25 EU member states, some neighboring states plus Norway and Iceland. Switzerland may have joined EASA by the time this story is read. Another 12 states are expected to join EASA, including Romania and Bulgaria which will become members automatically when they join the EU, expected in January. Croatia's EU membership is anticipated in early 2008.

There are essentially three routes to EASA membership:

- EU membership,
- Multilateral agreement, or
- Unilateral agreement with the EU, e.g. Switzerland.

EASA was formally established in July 2002, and began operating in September, 2003, assuming

Photo: Fraport AG

responsibility for airworthiness and environmental certification of aircraft, engines and parts; drafting safety legislation and providing technical advice to the European Commission (EC) and EU member states; granting approval and oversight of aircraft design organizations worldwide and of production and maintenance organizations outside the EU; and providing and approving inspections, training and standardization programs, data collection, analysis and research to improve aviation safety.

This included all post-certification activities, such as approval of changes to, and repairs of, aeronautical products and their components, as well as the issuing of airworthiness directives to correct potentially unsafe situations. Therefore, all type-certificates now are issued by EASA and are valid throughout the EU.

Where it does not have resources itself, the agency contracts national aviation authorities (NAAs), which historically have filled this role, to provide necessary services. Ultimately, the goal is for EASA to do as much as possible. By 2008, the agency expects to have recruited enough expertise to be able to undertake more than 90 percent of its work in-house. But EASA acknowledges it will never be as large as its U.S. counterpart, the Federal Aviation Administration (FAA), and says it will always rely on cooperation with NAAs and accredited organizations.

Although there is consensus in the industry that a "one-stop-shop" for aviation certification and oversight is a cherished goal for Europe, EASA's baptism has been one of fire. Industry has been quick to point out a number of pitfalls that developed, in part, due to the rather clumsy way EASA has been pressured into existance. A raft of issues remain to be addressed.

Mike Ambrose, director general of the European Regions Airline Association (ERA) highlighted a few of the concerns for *Aviation Safety World*. "One of the potential problems that needs addressing very quickly is whether EASA will have the right level of resources. An energetic recruitment program is under way, but expansion of EASA's role is being accelerated in advance of the availability of resources."

Nearly 300 people from 19 states have been recruited to date, and the agency envisages a maximum complement of 600, even taking into account long-term plans for EASA to take under its wing the safety and interoperability of air navigation services, air traffic management and airports beginning in 2010.

The ERA is also particularly concerned that EASA has "no authority to insist on harmonized and consistent interpretation of its regulations, or to apply sanctions or some form of punishment on delinquent states," Ambrose said. "It is up to individual NAAs to implement the regulations. But if their interpretation differs or if they ignore the EASA regulations altogether, then it creates unequal operating conditions for the airlines. EASA's powers versus those of the NAAs is one area that has yet to be resolved." To some, this recalls a similar complaint against the historic variability of FAA regulations as enforced by its various regions.

EASA can report any offending state to the EC, and it is up to the commission to take

"EASA's powers versus those of the NAAs is one area that has yet to be resolved."

EASA Logo

action. Ambrose said this process is "time consuming and cumbersome," and he believes EASA needs to "have some teeth."

"Associated with that, how do you ensure consistency in interpretation and implementation? Do we need an EASA representative in the local office of each NAA? If so, what resources will NAAs actually need, and will they be prepared to downscale to avoid duplication of effort with EASA? If not, the airlines could end up paying for a double layer of regulation. We need to ensure safety regulation is streamlined and eliminate any duplication of effort and resources between EASA and NAAs," Ambrose said.

The International Air Transport Association (IATA) agrees and stresses that the benefits of having a single authority would only be achieved "if the national authorities scale back their activities, and provided that everybody is clear on who is doing what," said IATA spokesman Anthony Concil. "In that respect there is still some work to be done."

Ambrose said it is "up to industry to keep applying pressure on the commission to give EASA the powers that it needs and that the EC is currently keeping for itself."

EASA itself is lobbying the EC to review its funding arrangements. In line with other European agencies, EASA is expected to be self-funding, but spokesman Daniel Höltgen said there might need to be recognition at a political level that not all agencies operate on the same basis.

"Most of the EU agencies are consultative bodies and research organizations," Höltgen said. "Few have actually taken a competence [authority] away from the national authorities like EASA has. If industry wants to certify an aircraft, it has no option but to come to EASA. We need a different funding regime from other agencies."

For 2006, EASA has been allocated a budget of €66.5 million (US$85.6 million), which breaks down into €31.5 million (US$40.6 million) from the European Commission, €33.5 million (US$43.1 million) from fees and charges, and €1.5 million (US$1.9 million) from other contributions.

However, industry believes that in the longer term, and particularly in view of proposed expansion of EASA's scope of responsibility, projected funding levels could be insufficient and could ultimately impact safety. For example, there is currently a significant anomaly between the EASA charge rate and the charge rates of some NAAs doing the work for EASA. The agency is only able to allocate a flat rate charge of €99 (US$127.50) an hour to the cost of these services, but many NAAs work on a cost recovery system and their actual charge rate might be considerably higher than EASA's — in some instances more than 100 percent higher. The funds EASA is allocating for these services may be less than half the actual cost, which will soon leave the agency short of money.

The ERA believes EASA may have to reevaluate its charge rate, and in any event probably should not be expected to be self-funding from the outset, a notion largely echoed across industry.

Höltgen argued that the EU should accept that "safety is in the public interest, so should not be charged to industry." He said that continued airworthiness probably should not be charged to a specific client and pointed out that certification costs in many countries are subsidized by the state. "Actual licensing will remain a national activity, so the commission may have to re-think the idea that all certification costs are covered by industry."

Alternatively, EASA would have to raise charges across the board, which Höltgen said was not politically acceptable. However, EASA has assured industry that it intends to adopt a more competitive selection process when contracting with NAAs to undertake a particular certification task in the future.

The Association of European Airlines (AEA) believes the funding issue "risks undermining EASA's credibility and could, in the long term, put safety at risk."

There is also a concern that plans approved late last year to expand EASA's role to include operations regulation, flight crew licensing and oversight of non-EASA region operators beginning in 2008 will increase the agency's financial burden.

François Gayet, secretary general of the AeroSpace and Defence Industries Association of Europe (ASD) expressed concern that EASA would not be able to fulfill these new responsibilities "unless adequate funding is provided … since it is already clear that the level of community funding is not sufficient to even support EASA's current tasks."

But progress is being made. EASA feels it is turning a corner and beginning to win industry confidence. It is in the throes of a massive "meet the industry" campaign, involving road shows, workshops, and meetings with organizations and industry bodies.

One potential transition gap flagged by the airlines has been closed. If it had gone unresolved some regulatory activities involving the Operational Sectorial Team (OST) and the Licensing Sectorial Team (LST) would have ground to a halt with the winding down of the JAA this summer. Following a meeting of the airlines with JAA and EASA last November, EASA agreed to keep running those and other key JAA working groups, and to maintain and update JAA's oversight of operations (Ops) until EASA's role is defined and it develops the ability to assume it. As a result, the JAA liaison office within EASA, whose primarily role is to represent any JAA members that have not yet joined EASA, will continue to administer the OST and LST.

The JAA office is scheduled to close at the end of this year, but the liaison office within EASA will be maintained either until all JAA members have joined EASA or until 2010, whichever is later.

A number of other issues still must be resolved. For example, while the extension of EASA's role to cover operations and flight crew licensing has been clearly defined, how it is to maintain oversight of third country operators has yet to be fleshed out. Decisions remain to be made on how to evaluate third country operators, whether actual inspections are undertaken in non-EU member states or, like the FAA, EASA will request information from non-EU carriers on a mutual-recognition basis.

EU Ops 1 is a proposal to empower EASA by making operations oversight and licensing part of EU law. The proposal has been under review by the EC for some time even as EASA was developing its own rules. It seems clear now that EU Ops 1 likely will be in place by year's end, overriding the internal EASA effort. Once it is published, states have 18 months to adopt it and put it into force.

Until that period is up and until EASA develops its ability to do the job — a period that may stretch two years — Ops remains the responsibility of the JAA. If, for some reason, the troublesome EU Ops 1 process hits a snag, EASA should have its own implementing rules ready by 2008; some of what EASA develops will be needed in any case to flesh out the broad responsibilities outlined in EU Ops 1.

For industry, three outstanding issues remain: First, the roles and responsibilities of the NAAs and EASA must be clearly defined and enforcement procedures established; second, funding issues must be settled in a way that ensures EASA has the resources necessary to undertake current and future responsibilities; and third, EASA must clearly demonstrate that it has the expertise to fulfill the expanded roles with which it has been tasked before its mandate is further expanded.

ERA's Mike Ambrose stressed: "There is no going back. We cannot put the toothpaste back in the tube: EASA has to be made to work. We never expected an agency to come into being without teething troubles, and many of its problems have been exacerbated by pressure to get something up and running and by NAAs protecting their own self interests. But we want to see EASA succeed. It can harmonize and equalize the terms and conditions of safe operations throughout Europe. But it can also help maximize the profile of European aviation worldwide. The stronger EASA is, the more it can be a credible alternative to the FAA. That cannot be anything but good for Europe's aviation industry." ●

Anne Paylor is a veteran writer on aviation matters who lives near London.

Good on You, Mates

An ATSB comparative study finds that Australia has a very low fatal accident rate — but so do the United States, Canada, the United Kingdom and New Zealand.

BY RICK DARBY

Australian civil aviation is widely considered to be among the safest in the world. The Australian Transport Safety Bureau (ATSB) recently set out to determine how its fatal accident rates compare with similar data from the United States, Canada, the United Kingdom and New Zealand.[1]

The ATSB report found that the Australian fatal accident rate for air carriers in the 1995–2004 period — the most recent 10 years for which data were available — was slightly higher than that of the United States (but with a qualifier); slightly lower in most years for all operations than in Canada; and higher than in the United Kingdom for public transport operations. A comparison of fatal accidents and fatalities in high-capacity regular public transport (RPT) between Australia and New Zealand showed that Australia, with no fatalities, had the lower rate.

"Only those countries that define a fatal accident in accordance with the [International Civil Aviation Organization, Annex 13] definition were used in the analyses," said the report.

The researchers, using accident databases from ATSB and accident investigation agencies and civil aviation authorities of the other countries, adjusted source data for differences in countries' operational definitions.[2] Because of the nature of the source data, however, the same categories could not be compared among all the countries.

Figure 1 shows fatal accident rates for Australian and U.S. air carriers. "The highest rate for Australia occurred in 1996, when Australia recorded 0.4 fatal accidents per 100,000 hours flown," the report said. "The highest rate for the U.S. was in 1995 and 1996, when 0.2 fatal accidents per 100,000 hours flown occurred. The U.S. recorded a consistently low rate of around 0.1 fatal accidents per 100,000 hours flown from 1997 to 2004."[3]

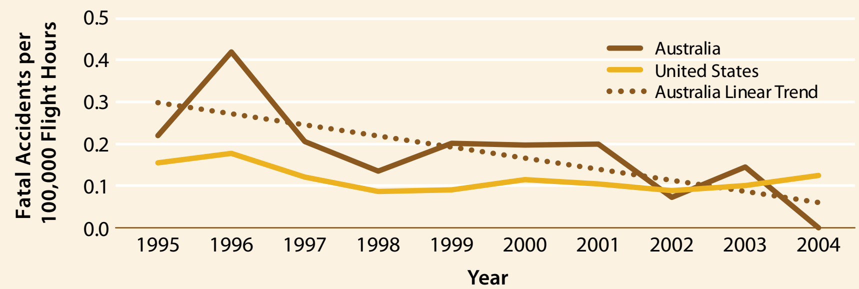
The report said that Australia's higher fatal accident rate for air carriers was skewed because the rates for both countries are strongly influenced by the commercial charter (Australia) and on-demand (United States) categories, which tend to have higher accident rates.

"Australia's commercial charter operations represented 32 percent of the total air carrier activity, while scheduled airline services comprised the remainder," the report said. "For the U.S., on-demand services represented 15 percent of the total air carrier activity and the remainder comprised scheduled airline services. … If Australia's activity profile mirrored that of the U.S., Australia's overall fatal accident rate would fall below that of the U.S."

The fatal accident rate for all operations[4] in Canada was higher than that for Australia, as shown by the respective linear trend[5] lines in Figure 2. "The highest rate for Australia was

Fatal Accident Rates, Australia and United States

Air Carriers, 1995–2004

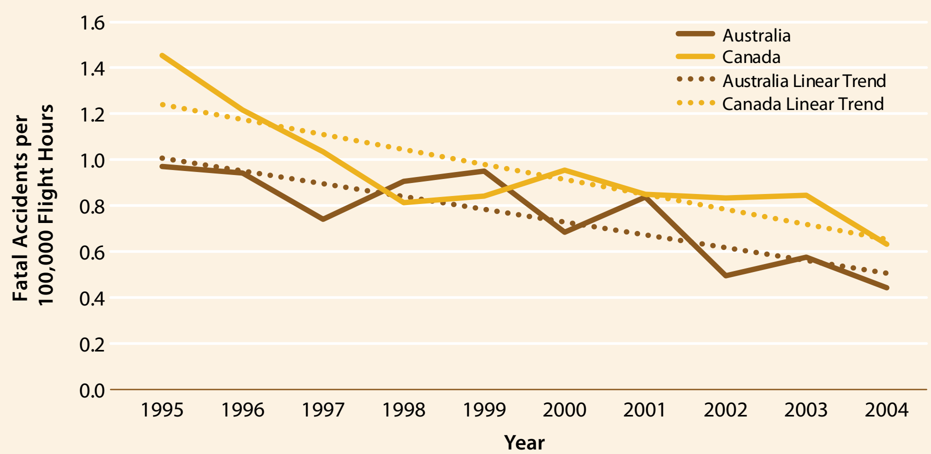


Source: Australian Transport Safety Bureau

Figure 1

Fatal Accident Rates, Australia and Canada

All Operations, 1995–2004



Source: Australian Transport Safety Bureau

Figure 2

in 1995 and 1999, when 1.0 fatal accidents per 100,000 hours were recorded," the report said. "Canada also recorded its highest rate in 1995, with 1.5 fatal accidents per 100,000 hours flown. The lowest rate for Australia was in 2004, with 0.4 fatal accidents per 100,000 hours flown. The lowest rate for Canada was in 2004, when 0.6 fatal accidents per 100,000 hours flown occurred. Both countries experienced a significant decline in the rate of fatal accidents during this period."

For helicopters, Australia had a higher fatal accident rate than Canada, 1.9 per 100,000 flight hours versus 1.2 for Canada. For airplanes, Australia had a lower fatal accident rate, 0.5 per 100,000 flight hours versus 0.9 for Canada (Figure 3, page 52).

The report compared fatal accident rates for Australian and U.K. public transport[6] aircraft (Figure 4, page 52). "The highest rate for Australia was recorded in 1996, when Australia recorded 0.4 fatal accidents per 100,000 hours flown," the report said. "The highest rate for the U.K. was 0.1, which occurred in 1995, 1996, 1998, 1999 and 2000. The lowest rate for Australia was in 2004, when no fatal accidents occurred. The lowest rate for the U.K. was in 2003 and 2004, when no fatal accidents were recorded." The linear trend line shows a significant decline in the fatal accident rate for Australia during the period.

The report compared fatal accidents for high capacity RPT[7] in Australia and New Zealand. Australia had no fatal accidents. New Zealand had two fatal accidents and seven fatalities during the period, in which annual flight hours for the category averaged 744,404 for Australia and 208,790 for New Zealand, which had a rate of 0.96 fatal accidents per 100,000 flight hours.

"Overall, the findings showed that Australia's fatal accident and fatality rates were mostly similar to the corresponding rates of the other countries examined," the report said. "Using North America and the United Kingdom to represent world's best practice and as a benchmark of aviation safety, the findings demonstrate that Australia has a good safety record." ●

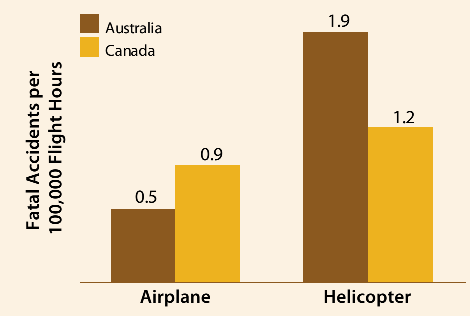
Notes

1. *International Fatality Rates: A Comparison of Australian Civil Aviation Fatality Rates with International Data.* Australian Transport Safety Bureau (ATSB), Transport Safety Discussion Paper B2006/0002. Aug. 11, 2006. Available on the Internet at <www.atsb.gov.au/publications/2006/B20060002.aspx>.
2. For example, data for U.S. air carriers, defined as those operating under U.S. Federal Aviation Regulations Part 121 and Part 135, were considered to be equivalent to combined Australian regular public transport (RPT) and commercial charter (passenger and cargo) operations.

   The report acknowledged that data sets could not be matched precisely. For example, the report said, "The U.K. data for the public transport category included ambulance, police and search-and-rescue operations, which were not included in the ATSB data."
3. Rates given in the text of the report were rounded; therefore, there are some slight discrepancies between data points in the figures and the numbers in this article.
4. "All operations" included, for Canada, operations involving Canadian-registered civil aircraft and some sport operations. For Australia, it included RPT, general aviation and some sport operations of Australian-registered civil aircraft.
5. A linear trend is a straight line showing the overall tendency of a time series of data points.
6. "Public transport" included, for the United Kingdom, transport of passengers and/or cargo on scheduled or nonscheduled services, or other revenue services including air taxi and pleasure flights. It also included ambulance, police and search-and-rescue operations. For Australia, the category included all RPT and commercial charter (passenger and cargo) operations involving Australian-registered civil aircraft. Ambulance, police and search-and-rescue operations were not included.
7. "High capacity RPT" represented, for New Zealand, all operations involving aircraft with 39 or more seats, including scheduled, unscheduled, passenger and cargo flights. For Australia, the category included operations involving Australian-registered civil aircraft with a maximum seating capacity of 39 or more seats or a maximum payload exceeding 4,200 kg (9,259 lb).

Helicopter and Airplane Fatal Accident Rates, Australia and Canada

1995–2004

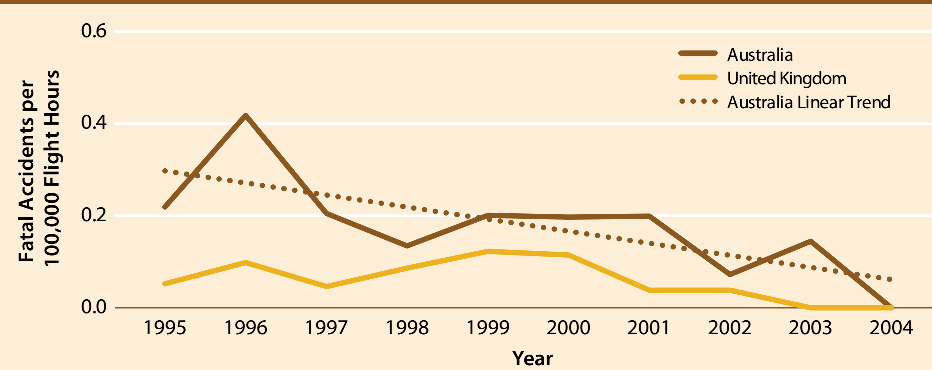


Source: Australian Transport Safety Bureau

Figure 3

Fatal Accident Rates, Australia and United Kingdom

Public Transport Aircraft, 1995–2004

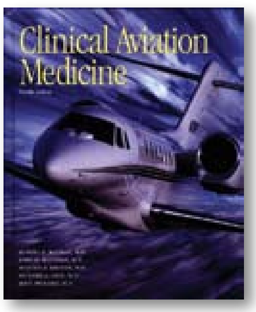


Source: Australian Transport Safety Bureau

Figure 4

Fit to Fly?

The aviation medical examiner's knowledge must encompass both medicine and the particular conditions under which aviators work.



BOOKS

Clinical Aviation Medicine. Fourth Edition

Rayman, Russell B.; Hastings, John D.; Kruyer, William B.; Levy, Richard A.; Pickard, Jeb S. New York: Professional Publishing Group, 2006. 472 pp. References, index.

The aviation medical examiner (AME) must have, besides the general knowledge of any practitioner, good judgment about a crewmember's fitness to fly.

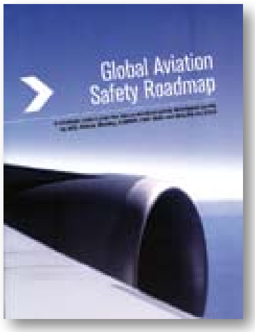
"In order to do so, it is necessary to have an understanding of the stresses of flight, aircraft operations, general medicine and the appropriate medical standards," says Dr. Rayman in his preface. "This book provides guidance to AMEs and flight surgeons, particularly inexperienced ones, who must determine aeromedical disposition, by discussing the more common disease entities and treatment modalities with particular emphasis on their significance in an aviation environment." (Dr. Rayman is a member of *Aviation Safety World*'s editorial advisory board.)

Aviators — the inclusive term used by the authors for all crewmembers — can no more be expected to be in perfect health throughout their careers than those in any line of work. "When a doctor, plumber or other laborer develops an infirmity, a decision is made as to whether the worker should remain on the job," the authors say. "However, with aviators, the nature of their profession necessitates exercising extreme caution when making such decisions. Although a pilot may become afflicted with an infirmity, this need not necessarily terminate his or her ability to fly. The essential question then becomes: Can the aviator afflicted with a disease continue to fly without jeopardizing health and compromising flying safety?"

Making such sometimes-delicate judgments is part of the AME's job, and is influenced by the standards of the regulatory organization. The authors say, "Although in previous decades medical standards tended more toward conservatism — 'it is better to err on the side of safety than sorrow' — that trend slowly and cautiously reversed direction and has since continued to this day toward more liberal ground. Although this policy shift is in a state of flux, it is certain that individual policies will differ among regulatory authorities."

Subcategories of medical significance exist even within aviation. "The stresses of flight, such as acceleration, vibration and noise, lowered barometric pressure, extremes of temperature and humidity, and fatigue, among others, vary considerably depending on the type of aviation operation," the authors say. "Therefore, medical standards for such widely disparate operations rightfully should be, and are indeed, very different."

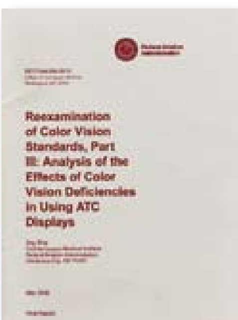
Chapters cover internal medicine, orthopedics, neurology, ophthalmology, otolaryngology,



cardiology, genitourinary, dermatology, psychiatry, oncology and therapeutic medications. Subchapters discuss specific ailments or topics under those headings, especially as they are related to flying. Pressure vertigo, for instance, is an occupational hazard in aviation caused by a sudden pressure increase in the middle ear, typically during climb and descent.

This new edition supersedes the previous one, published in 2000. References have been updated and new material added in areas such as multiple sclerosis, deep venous thrombosis, bleeding peptic ulcers, and others. The chapter titled "Therapeutic Medications in the Aviator," by Dr. Pickard, has been added to this edition and includes a subchapter on herbal medications.

REPORTS



Global Aviation Safety Roadmap

12 pp. Figure, photographs. Available via the Internet as a PDF copy from International Air Transport Association. Contact <ymqsafety@iata.org>.

The Global Aviation Safety Roadmap is a strategy being developed jointly for the International Civil Aviation Organization by Airbus, Airports Council International, The Boeing Co., the Civil Air Navigation Services Organisation, Flight Safety Foundation, the International Air Transport Association and the International Federation of Air Line Pilots' Associations. This document represents a preliminary outline of what the global strategy, or "Roadmap," is intended to accomplish; designates areas on which it will focus; and offers a tentative schedule for accomplishing near-term and medium-term goals.

The Roadmap's objective, the document says, "is to provide a common frame of reference for all stakeholders, including States, regulators, airline operators, airports, aircraft manufacturers, pilot associations, safety organizations and air traffic service providers."

The Roadmap is intended "to assist with the implementation of harmonized, consistent and coherent safety oversight regulations and processes, which properly reflect the global nature of modern air transportation. It highlights the need for State commitment to provide truly independent, adequately funded and effective civil aviation regulators. Moreover, the Roadmap looks to structured programs, which are effectively implemented in an 'open reporting' environment and a 'just culture' for the systematic collection, analysis and dissemination of safety reports and information that will be used solely for the prevention of accidents."

A pocket on the inside back cover contains a graphic presentation of the Global Aviation Safety Roadmap as a timeline divided among industry organizations, regional organizations and States, showing focus areas, and near-term and long-term goals. The text discusses the plan under headings such as metrics, risk measurement, the regional dimension and enablers for success.

Reexamination of Color Vision Standards, Part III: Analysis of the Effects of Color Vision Deficiencies in Using ATC Displays

Xing, Jing. U.S. Federal Aviation Administration (FAA) Office of Aerospace Medicine. DOT/FAA/AM-06/11. Final report. May 2006. 22 pp. Figures, references. Available via the Internet at <www.faa.gov/library/reports> or through the National Technical Information Service.*

This is the third in a series of reports analyzing color vision deficiencies in relation to current FAA air traffic control displays (*Aviation Safety World*, July 2006, page 63, and August 2006, page 56). In this report, analysis was performed for three primary displays and three supporting displays. For each display, the situations where color was used as a primary cue for attention or identification were determined. For those situations, non-color redundant cues, if any, were identified and their effectiveness was compared with colors. Using algorithms developed in Part II of the study, researchers computed the effectiveness of color for color-deficient controllers (CDs) compared with non-color-deficient controllers. If color was used in text on displays, the difference was also compared.

The main findings of the study were that "(1) Critical color-coded information may not capture the attention of CDs in many applications; (2) There are instances where CDs may not reliably identify types of information that are encoded in colors; and (3) In many instances, color use makes text reading slower and less accurate for CDs. These results indicate that CDs may not be able to use color displays as efficiently as users with normal vision." In addition, most non-color redundant cues were not as effective as color or not effective at all, the report says.

A Layman's Introduction to Human Factors in Aircraft Accident and Incident Investigation

Adams, David. Australian Transport Safety Bureau B2006/0094. Final report. June 2006. 33 pp. Available via the Internet at <www.atsb.gov.au/publications/2006/B20060094.aspx>.

This report is intended as a "plain English" discussion of its subject. "The purpose of applying human factors knowledge to [accident] investigations is not only to understand what happened in a given accident, but more importantly, why it happened," says Adams, a consultant.

"Some people believe that if a human is given a reasonable task to complete and [he or she is] adequately trained, then the individual should be able to repeatedly perform the task without error," Adams says. "However, applied research and accident investigation reports from around the world demonstrate that this view is incorrect. Competent humans conducting even simple tasks continually make errors, but in most cases they recognize the errors they have made and correct them before any consequence of the errors is realized. …

"It is believed by many human-science professionals that human error is a normal part of human performance and is related to the very qualities that make us human. That is, our brains allow us to quickly assess large amounts of information and make varying judgments and decisions about that information. However, our ability to vary our judgments and decisions is influenced by many factors, and these factors often lead us to make errors."

The report analyzes what typically is meant by the term *human factors* and describes the development of human factors research from the origin of powered flight to the present. As human factors understanding has become more sophisticated, Adams says, it has raised new problems. For instance, although fatigue is now recognized as a factor that can degrade pilot performance, it leaves no physical evidence. What role, if any, fatigue played in a fatal accident is often hard to determine. Investigators must still pursue such issues based on indirect evidence, Adams says, because we cannot afford to ignore them.

Human Factors Implications of Unmanned Aircraft Accidents: Flight-Control Problems

Williams, Kevin W. U.S. Federal Aviation Administration (FAA) Office of Aerospace Medicine. DOT/FAA/AM-06/8. Final report. April 2006. 9 pp. Figures, references. Available via the Internet at <www.faa.gov/library/reports> or through the National Technical Information Service.*

Unmanned aerial vehicles — more recently called "unmanned aircraft systems" — are proliferating (*Flight Safety Digest*, May 2005, page 1). According to this FAA report, unmanned aircraft "have suffered a disproportionately large number of mishaps relative to manned aircraft." The report presents the findings of a technical literature search on three types of flight control problems associated with unmanned aircraft systems: the external pilot's difficulty with counter-intuitive aspects of the needed control inputs; transferring control from one controlling system to another during flight; and automation of flight control.

Possible solutions for the first problem include designing the ground control station so that its "mapping" would always be consistent with aircraft movement, or eliminating the need for an external pilot through automation. Both present their own problems, the report says.

"The problem of transfer of control centers around the fact that the receiver of control is not always fully aware of the status of the system," the report says. "The problem can be solved by designing the displays in such a way that all critical system parameters are available to the pilot during the transfer."

Automation problems result when unanticipated circumstances lead to the system behaving as it was designed to, but not in the way that was expected. The report says possible solutions are of two kinds.

"The first is to design the system in a way that keeps the pilot more aware of what the aircraft is going to do during the flight," says the report. Such solutions, it adds, must counteract the "out-of-the-loop" syndrome in which humans working with automation have a diminished ability to detect system errors and respond by performing the task manually.

"The second solution to the automation problem is to design the automation to be more flexible so that, even when a particular contingency has not been anticipated, the system is still able to generate an appropriate response," the report says. "This is a challenge for those developing 'intelligent' systems, and this field is still in its infancy."

Static Sector Characteristics and Operational Errors

Goldman, Scott; Manning, Carol; Pfleiderer, Elaine. U.S. Federal Aviation Administration (FAA) Office of Aerospace Medicine. DOT/FAA/AM-06/4. Final report. March 2006. 15 pp. Figures, tables, references. Available via the Internet at <www.faa.gov/library/reports> or through the National Technical Information Service.*

In recent years, FAA has conducted a number of studies to identify factors associated with operational errors (OEs) at its air route traffic control centers (ARTCCs). This report describes preliminary analyses that used sector characteristics and OE data from the Indianapolis ARTCC. Data for the study were derived from a three-year sample of final OE reports and a set of static sector characteristics. Static sector characteristics, the only sector characteristics for Indianapolis Center available to the researchers in this study, are those that do not change according to the traffic situation. They include, for example, sector size, shape, number of miles of jetways and airways, and the number of major and minor airports.

"Altitude strata, sector size and number of major airports produced a regression model that accounted for 43 percent of the variance in sector OE incidence," the report said. "Sector altitude strata and sector size had a similar level of influence in the model, while the number of major airports was the least influential predictor. However, all three variables were significant predictors. Higher altitude sectors had more errors than lower altitude sectors (though super-high altitude sectors had fewer). Smaller sectors had more errors than larger sectors. Sectors with more major airports had more errors than those with fewer major airports."

Without additional data about dynamic, as well as static, sector characteristics and comparisons with other centers, the results have limited usefulness for recommendations, said the report.

WEB SITES

Airbus Safety Library, Flight Operations Briefing Notes, <www.airbus.com/en/corporate/ethics/safety_lib>

Flight Operations Briefing Notes, contained in the Safety Library section of the Airbus Web site, were developed by Airbus within the framework of the Flight Safety Foundation Approach-and-Landing Accident Reduction (ALAR) Task Force, reflecting conclusions and recommendations of the task force and the U.S. Commercial Aviation Safety Team (CAST), ALAR Joint Safety Implementation Team (JSIT).

"The Flight Operations Briefing Notes have been designed to allow an eye-opening and self-correcting accident prevention strategy," the introduction says. The information is posted as a reference for flight crewmembers, cabin crewmembers, flight operations personnel and others, regardless of their role, type of equipment and operation.

Briefing notes provide an overview of safety enhancements to "aircraft operations from gate to gate," Airbus says. Examples are operational and training standards, operating and flying techniques, threats and hazards awareness, and accident prevention strategies.

Currently, briefing notes appear under two headings: flight operations (which addresses several aspects, such as runway and surface operations) and cabin operations. Ramp operations notes and maintenance notes will be published in the future.

References to the FSF *ALAR Tool Kit* and *Flight Safety Digest* (August–November 2000) briefing notes on ALAR and approach-and-landing accidents are identified.

Briefing notes contain illustrations, statistics, color photographs, references and suggested reading material. Documents may be printed or downloaded to the user's computer.

European Aviation Safety Agency (EASA), <www.easa.eu.int/home/index.html>

Among its tasks, EASA establishes regulations and guidance on safety and type-certification of aircraft, engines and parts approved for operation within the European Union (EU) member states. It performs oversight and approval of aircraft maintenance organizations outside the EU.

EASA has assumed responsibility from the Joint Aviation Authorities (JAA) for Joint Aviation Requirements (JARs) pertaining to airworthiness and maintenance and converted them into EASA requirements. Currently, 16 JARs have been converted to certification specifications (CSs) and posted, in English only, on line. To access them, click on the certification category at EASA's home page.

Each CS is identified with its new EASA designation and corresponding JAA name. All documents related to a specific CS are identified and may be viewed in full text, printed or downloaded to the user's computer at no cost. For example, CS-25, *Large Aeroplanes* (formerly JARs Part 25), contains the rule or main document, amendments, notices of proposed amendments, comments on the CS and EASA responses, explanatory notes and archived information. Additional tables show the status of European Technical Standard Orders and other CSs related to certification.

EASA refers researchers to a JAA Web site page, <www.jaa.nl/publications/changes_publications.html>, for information about JAA documents not affected by agency changes. ●

Sources

* National Technical Information Service
5285 Port Royal Road
Springfield, VA 22161 USA
Internet: <www.ntis.gov>

— Rick Darby and Patricia Setze

Ice Blocks Pilot's View During Approach

Business jet struck terrain before reaching the runway.

BY MARK LACAGNINA

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

JETS

Improper Use of Windshield Heat Cited

Cessna 551 Citation II. Substantial damage. Two minor injuries, three uninjured.

The pilot conducted a global positioning system (GPS) approach to Runway 17 at Ainsworth (Nebraska, U.S.) Municipal Airport, where weather conditions included a 500-ft overcast and 1.75 mi (2,800 m) visibility with mist the morning of Jan. 1, 2005.

The applicable minimum descent altitude (MDA) for the Citation was 3,000 ft — 500 ft above airport elevation.

The pilot said that he encountered icing conditions during the approach and engaged all the anti-ice and deicing equipment. He said that "at some point, the icing conditions became more than the equipment could handle." The airplane descended out of instrument meteorological conditions 300–400 ft above ground level (AGL).

"The pilot elected to land the airplane instead of executing the published missed approach procedure," said the report by the U.S. National Transportation Safety Board (NTSB).

The pilot said that he had difficulty seeing the runway because ice had accumulated on the windshield.

The airplane was in a right turn when it struck terrain 439 ft (134 m) from the runway threshold. The pilot and two passengers were not injured; two other passengers received minor injuries.

Outside air temperature was minus 8 degrees C (18 degrees F). "After the accident, there was ice accumulation on all booted airframe surfaces, [and] the upper portions of the windscreens were contaminated with ice measuring about 3/8 inch [10 mm] thick," the report said. "The remaining airframe portions, including the heated surfaces, were free of ice accumulation."

NTSB said that the probable causes of the accident were "the pilot's decision to continue below the [MDA] and his failure to fly the published missed-approach procedure." A contributing factor was "the pilot's improper use of windshield heat, which resulted in the windshield becoming obscured with ice during the instrument approach in icing conditions," the report said.

Copilot Incapacitation Unexplained

BAe 146-300. No damage. One minor injury, 82 uninjured.

The airplane was departing from Belfast, Northern Ireland, on Feb. 2, 2006, when the copilot, the pilot flying, detected an odor and subsequently experienced a dry throat, burning eyes, a tingling sensation in his fingers and a sensation of being hot. "After donning his oxygen mask, he slid his seat back and took no further part in the flight," said the report by the U.K. Air Accidents Investigation Branch (AAIB). "No other personnel on the flight were affected, including the commander, who carried out an uneventful return and landing at Belfast."

The report said that the copilot remained conscious, but the supplemental oxygen did not appear to relieve his ailments. He began to recover while first aid was administered after landing. The results of blood tests were inconclusive.

An examination of the airplane found an oil leak in the auxiliary power unit (APU) bay and small deposits of unspecified origin in the ducts leading from the air-conditioning packs to the cabin and flight deck. "It is possible, although not confirmed, that fumes generated by the APU or engines could have been the initiating factor, considering that deposits were found in the air-conditioning ducting," the report said. "Although an oil leak was found in the APU bay, it is unlikely that this oil had found its way into the air supply system."

Snowplow Driven Into Airplane

Cessna S-550 Citation. Substantial damage. No injuries.

The Citation, engaged in an air-ambulance flight, was landed at the Ted Stevens Anchorage (Alaska, U.S.) International Airport in visual meteorological conditions (VMC) the afternoon of Jan. 15, 2006. The flight crew was being marshalled to a parking area on the company's ramp when the airplane's left wing tip and aileron were struck by a snowplow that was being driven in reverse. The snowplow was being used to clear an adjacent ramp.

The captain, first officer, two medical crewmembers and the passenger/patient were not injured. NTSB said that the probable cause of the accident was the "failure of the driver of the snowplow vehicle to maintain adequate visual lookout."

Smoke Warning Prompts Diversion

Bombardier CRJ200. No damage. No injuries.

The aircraft was departing from London Heathrow Airport with four crewmembers and 50 passengers for a flight to Düsseldorf, Germany, on April 22, 2006, when the flight crew received a warning about smoke in the cargo compartment. The crew returned to Heathrow, landed and stopped at the first available runway exit.

Aircraft rescue and fire fighting personnel found no sign of fire or smoke in the cargo compartment. The aircraft was towed to the ramp, and passengers were disembarked normally.

The AAIB report said that the false smoke warning probably was caused by the cargo compartment smoke detector reacting to dust, condensation or electromagnetic interference. "This aircraft had been fitted with a new design of smoke detector, which was intended to reduce its susceptibility to these factors," the report said. Installation of the redesigned smoke detector was required by an airworthiness directive issued by Transport Canada in September 2001, following several false cargo smoke warnings in CRJ200s.

A similar incident had occurred in another aircraft in the operator's fleet on March 16, 2005. "These recent incidents suggest that the new design [smoke detector] has not been effective," the report said.

TURBOPROPS

Destabilized Approach Leads to Tail Strike

ATR 72-200. Substantial damage. No injuries.

The copilot was hand-flying the aircraft on an instrument landing system (ILS) approach to Runway 27 at the Guernsey (England) Airport on Sept. 17, 2005. VMC prevailed with surface winds from 020 degrees at 11 knots. The aircraft was about 500 ft AGL when the copilot told the commander that he intended to maneuver slightly below the ILS glideslope.

The copilot, who had 4,000 flight hours, including 500 flight hours in type, told investigators that he perceived the runway to be short. "Even with the slight tailwind component, the landing distance available [1,453 m (4,767 ft)] was significantly greater than the landing distance required [949 m (3,114 ft)]," the AAIB report said.

The copilot reduced power, and the aircraft descended below the glideslope. He increased the nose-up pitch attitude to 6.5 degrees just before touchdown. "The aircraft landed hard on the runway and bounced; in the course of the initial touchdown, the lower rear fuselage struck the runway surface," the report said. "The commander later recalled that there had been no flare and that, although he had been 'guarding' the controls, he had not had sufficient time to take control and prevent the heavy landing."

The report said that the approach was stabilized until the copilot flew the aircraft below the glideslope. "This was not necessarily cause for a go-around but should, perhaps, have given the commander reason to pay particularly close attention to the copilot's actions," the report said.

The pilot lost all forward visibility while flaring the airplane to land.

Taxiway Sign Struck During Go-around

Beech Super King Air 200. Substantial damage. No injuries.

The airplane was on a business flight from Greensboro, North Carolina, U.S., to Martinsburg, West Virginia, on Oct. 26, 2004. Three people were aboard. Weather conditions at Martinsburg included 1/4 mi (400 m) visibility and 100 ft vertical visibility. The pilot entered a holding pattern near the airport to wait for the conditions to improve, the NTSB report said.

"After about 20 minutes, the weather seemed to improve, and because the pilot could occasionally see the ground, he decided to conduct an instrument approach," the report said. The pilot was cleared to conduct the ILS approach to Runway 26.

The pilot said he obtained visual contact with the runway environment about 50 ft above decision height but lost all forward visibility while flaring the airplane to land. He was initiating a go-around when the airplane struck a taxiway sign. "The airplane continued to accelerate and climb, but when the pilot selected the landing gear handle to the 'UP' position, only the nosewheel and right main landing gear indicators indicated gear-up, while the left main landing gear remained in a transient condition," the report said.

The pilot diverted to Washington Dulles International Airport. The left main landing gear collapsed during the landing, and the aircraft skidded to a stop on the runway. The left engine firewall and forward pressure bulkhead were damaged.

NTSB said that the probable cause of the accident was "the pilot's improper in-flight decision to continue the instrument approach and landing [at Martinsburg]."

Lesson Taken Too Low

Embraer EMB-120 Brasilia. No damage. No injuries.

A first officer with 200 flight hours, including five flight hours in type, was receiving line training by the company's chief training captain during a scheduled flight with seven passengers from Manchester, England, to the Isle of Man on March 31, 2005. The crew was cleared to conduct the localizer/DME (distance measuring equipment) approach to Runway 08. The airport had 4,000 m (2.5 mi) visibility in smoke, scattered clouds at 600 ft AGL and a broken ceiling at 2,000 ft AGL.

During the approach, the commander, the pilot flying, noticed that the navigation radios were still tuned to the frequency for a VOR (VHF omnidirectional radio) 5.2 nm (9.6 km) west of the localizer. "Believing it would make a good training point, he did not identify the mistake to the first officer," the AAIB report said. "As a result, the crew used the incorrect DME, descending the aircraft in the procedure to 475 ft over the sea, more than five nm (nine km) short of the runway, with terrain one nm (two km) ahead rising to approximately 600 ft."

After the tower controller asked the crew if they had the ground ahead in sight, the commander initiated a climb to 1,600 ft. The localizer frequency was selected, and the crew continued the approach to an uneventful landing.

PISTON AIRPLANES

Pilot Had Complained of Fatigue

Piper Seneca II. Destroyed. One fatality.

Daytime VMC prevailed for the cargo flight from Grand Junction to Durango, both in Colorado, U.S., on June 9, 2005. Recorded air traffic control radar data showed that the airplane's rate of climb decreased from 500 fpm to about 140 fpm during the 24 minutes before the airplane struck mountainous terrain at about 12,800 ft near Telluride.

The NTSB report said that the 27-year-old commercial pilot, who had 2,726 flight hours, had flown the route 22 times. NTSB said that the pilot's "failure to maintain clearance from terrain" was the probable cause of the accident and that fatigue was a contributing factor.

"According to family members, friends and colleagues, the pilot was 'tired' and displayed symptoms of 'burnout,'" the report said. "One colleague reported that during an extended flight, the pilot had fallen asleep while acting as pilot-in-command. Several other passengers that had flown with the pilot reported that he had fallen asleep during their flights. Friends and family members … were concerned about his 'lack of time to sleep.' They reported that the pilot had been awakened 'in the middle of the night to come back to work' on several occasions. On the morning of the accident, the pilot made several requests for someone to accompany him during his flight because he was tired."

Wind Shear Encountered on Takeoff

Aero Commander 500B. Substantial damage. One serious injury, two minor injuries, one uninjured.

VMC prevailed, but there were thunderstorms northeast of the Grand Canyon (Arizona, U.S.) National Park Airport when the tower controller cleared the pilot for takeoff on Runway 21 on May 28, 2003. The controller told the pilot that winds were from 300 degrees at 10 kt. The NTSB report noted that density altitude was 9,481 ft.

After takeoff, the pilot observed that the airplane had stopped climbing and was heading toward trees. He maneuvered the airplane toward a clearing, but the left wing struck a tree and the airplane descended to the ground.

Performance information in the airplane flight manual indicated that under the existing conditions, the Aero Commander should have been able to climb at 1,100 fpm. "A full analysis of the weather conditions indicated that due to developing convection over the runway, the airplane likely encountered a wind shear (increasing tailwind) event that seriously degraded the takeoff and climb performance," the report said.

The airport did not have a low-level wind shear alert system but recorded wind information from four sensors. "During the aircraft's departure, the [runway] approach end sensor recorded winds at 068 degrees at one knot; the middle sensor recorded winds at 293 degrees at five knots; and the departure sensor recorded winds at 302 degrees at two knots," the report said. "At the next data sampling (10 seconds later), the departure end sensor recorded a wind increase of 10 knots, and the approach end recorded a wind shift from a headwind to a tailwind at 10 knots."

Instructor Suffers Seizure

Beech D95A Travel Air. Destroyed. Two fatalities.

After completing a touch-and-go landing during a multi-engine training flight at the Lancaster (California, U.S.) airport the evening of Jan. 30, 2003, the crew requested and received clearance to conduct a simulated single-engine full-stop landing.

The tower controller said that the airplane appeared to be low on the approach and that its wings were "rocking back and forth," the NTSB report said. The airplane then veered left during an apparent go-around. The bank angle increased substantially, and the airplane descended and struck a hangar.

NTSB said that the probable cause of the accident was loss of control due to incapacitation of the instructor. The report said that the instructor had undiagnosed cancer of the lungs and brain. A pain medication, tramadol, was found in the pilot's blood. "The medication is known to increase the risk for seizures, particularly in patients with other potential seizure risks," the report said. "The effects of brain swelling and the medication likely produced seizure activity in the instructor which could have significantly interfered with aircraft control and made it difficult or impossible for the student to have adequately controlled the aircraft."

HELICOPTERS

Stabilizer Spar Fails, Hits Tail Rotor

Enstrom F-28A. Substantial damage. No injuries.

The helicopter was being flown at about 1,000 ft on a sightseeing flight in Fethard, Tipperary, Ireland, on June 28, 2005, when the pilot heard a loud bang. The helicopter yawed right, and the pilot found that it was not responding to anti-torque pedal inputs. He used the collective and the throttle for directional control, said the report by the Irish Air Accident Investigation Unit.

The pilot conducted an autorotative approach to a field. "The landing was heavy, and the left front shock absorber lost its charging connection with the force of impact," the report said. "During the landing, the main rotor blades struck the tail boom."

Examination of the wreckage indicated that the horizontal stabilizer spar had failed in fatigue and had struck the tail rotor. The report noted that the pilot and passenger, who were not injured in the accident, were wearing four-point harnesses.

Distraction Cited in Wire Strike

Aerospatiale AS350-B2. Substantial damage. One serious injury.

The pilot was returning to home base during a public-use patrol flight over the Rio Grande River on Jan. 12, 2006. He decided to search an area near Eagle Pass, Texas, U.S., where he had noticed two law-enforcement airboats operating on the river.

As the helicopter neared the area, the pilot recalled that he had seen two sets of unmarked power lines during his outbound patrol flight. He crossed one set of power lines and began orbiting the airboats. The pilot then saw the other set of power lines and began a climb to clear them.

"However, the maneuver was initiated too late, and the tail rotor impacted the wires, resulting in the separation of the tail rotor gearbox, tail rotor assembly and vertical fin," the NTSB report said. "The pilot managed to keep the helicopter in controlled flight and elected to execute an autorotation to a clearing." The helicopter came to rest, upright, in three ft (one m) of water after the landing. The pilot received serious injuries and was helped out of the helicopter by the airboat crews.

Fuel Exhaustion Causes Flameout

Bell 206B. Substantial damage. No injuries.

Nighttime VMC prevailed for the private flight from Pawnee to Vinita, both in Oklahoma, U.S., on May 1, 2006. The pilot said that the helicopter was seven mi (11 km) from the destination airport when the fuel boost pump caution light illuminated. He said the fuel gauge indicated that 15 gallons (57 liters) of fuel remained, so he continued flying toward the airport. The helicopter was on final approach when the engine flamed out.

"The pilot entered an autorotation, but due to his low altitude, he realized the descent angle would have placed the helicopter onto a busy four-lane highway," the NTSB report said. "He increased the collective, which increased altitude, and he was able to cross over the highway and a fence; however, this maneuver reduced inertia in the main rotor system. As a result, the pilot flared over a wet, grassy field [at] about 30 feet, leveled the helicopter and landed with some forward speed."

The skids dug into the ground, and the helicopter stopped abruptly and flipped over. Investigators found no fuel in the fuel nozzle or external fuel filter, and found no sign of a fuel spill. NTSB said that the probable cause of the accident was "the pilot's improper in-flight planning, which resulted in a total loss of engine power due to fuel exhaustion" and that a contributing factor was "the lack of suitable terrain for the forced landing." ●

Preliminary Reports

Date	Location	Aircraft Type	Aircraft Damage	Injuries
Aug. 1, 2006	Anaktuvuk Pass, Alaska, U.S.	de Havilland DHC-2 Beaver	substantial	6 none
The airplane struck the shore during takeoff from a lake for a charter flight. The pilot reportedly believed that the floats would not support the airplane during a water landing, so he landed the airplane on a runway at Bettles. The float-support structure failed, and the tail struck the runway.				
Aug. 2, 2006	Louisville, Kentucky, U.S.	MD Helicopters 500N	substantial	1 minor, 1 none
During an instructional flight, the student conducted a stabilized approach and brought the helicopter to a hover about 10 ft above an open field. The instructor said that the helicopter then "dropped straight down … and rolled onto its right side." The student received minor injuries.				
Aug. 3, 2006	Bukavu, Congo	Antonov An-28	destroyed	17 fatal
En route on a passenger flight from Lugushwa, the airplane was descending to land at Bukavu when it struck a mountain. Low clouds reportedly were in the area.				
Aug. 3, 2006	Angola, Indiana, U.S.	Cessna Citation Ultra	minor	3 none
The airplane ran off the edge of the runway after birds were ingested by the left engine on takeoff.				
Aug. 3, 2006	Busby, Montana, U.S.	Bell 206L-1	substantial	4 none
The pilot said that, during a public-use wildfire-reconnaissance flight, he conducted a power-assurance check at 8,000 ft. He heard a loud grinding noise before a loss of power occurred. The helicopter touched down hard during the emergency landing in an open field, and the main rotor struck and severed the tail boom.				
Aug. 4, 2006	Pownal, Vermont, U.S.	Embraer 110 Bandeirante	destroyed	1 fatal
The pilot was conducting a positioning flight from Binghamton, New York, to Bennington, Vermont, which had 10 mi (16 km) visibility, scattered clouds 500 ft above ground level (AGL) and an overcast at 900 ft AGL. He conducted the VOR (VHF omnidirectional radio) approach to Runway 13 to minimums and a missed approach. During the second approach, the airplane did not descend from 3,400 ft, the initial approach altitude, upon reaching the initial approach fix about 6.3 nm from the runway but began to descend after reaching the airport. The airplane struck a mountain at 2,100 ft, 6.5 nm southeast of the airport.				
Aug. 4, 2006	near Jandakot, Australia	Pilatus PC-12/45	none	none
The airplane was 50 nm (93 km) southeast of Jandakot during a flight to Albany when the crew reported that they were using supplemental oxygen and returning to Jandakot because of smoke in the cabin.				
Aug. 4, 2006	Happy Camp, California, U.S.	Aviation International Rotors CH-54A	substantial	2 fatal
During a fire fighting operation, the helicopter was being maneuvered near a water-pickup site when a tail rotor blade separated. The tail rotor gearbox then separated, and the helicopter descended to the ground.				
Aug. 8, 2006	São Paulo, Brazil	Fokker 100	minor	79 none
Soon after taking off for a flight to Rio de Janeiro, the left front passenger door opened and separated from the airplane. The crew returned to São Paulo and landed without further incident.				
Aug. 8, 2006	Culebra, Puerto Rico	Beech 18	substantial	2 none
About 1.5 hours after departing from St. Johns, Antigua, for a flight to San Juan, the pilot noticed a strong fuel odor. Soon thereafter, a loss of power from both engines occurred. The pilot tried unsuccessfully to restart the engines, then feathered the propellers and ditched the airplane near the shore. Both occupants exited into a life raft before the airplane sank in 50 ft (15 m) of water.				
Aug. 10, 2006	Jackson, Mississippi, U.S.	Boeing 767	none	247 none
While taxiing for departure, the airplane ran off a taxiway into mud. The passengers disembarked on stairs and were taken by bus to the terminal.				
Aug. 10, 2006	Honolulu, Hawaii, U.S.	Bombardier CRJ200	NA	none
The flight crew rejected the takeoff because of a spoiler-configuration malfunction.				
Aug. 10, 2006	Philadelphia, U.S.	Bombardier CRJ200	NA	none
The flight crew shut down the left engine for unspecified reasons and made an uneventful landing.				
Aug. 10, 2006	Denver, U.S.	Beech Super King Air 200	NA	none
The airplane was being taxied onto the runway for departure when the pilot notified the control tower that the airplane was on fire. The pilot and three passengers evacuated the airplane on the runway.				

Continued on next page

Preliminary Reports

Date	Location	Aircraft Type	Aircraft Damage	Injuries
Aug. 10, 2006	Salt Lake City, U.S.	Bell 206L-3	substantial	3 none
The pilot was hovering the helicopter prior to takeoff, waiting for company traffic to pass, when the helicopter drifted backward and the tail rotor struck a hangar.				
Aug. 11, 2006	Saipan, Northern Mariana Islands	Piper Cherokee 6	destroyed	5 serious, 2 minor
The airplane was departing from Saipan at 0215 local time for a charter flight to Tinian when the engine failed. The pilot conducted an emergency landing about 0.25 nm (0.46 km) from the runway. The airplane was destroyed by a post-impact fire.				
Aug. 12, 2006	Ozona, Texas, U.S.	Bell 206L-1	substantial	1 none
The pilot was landing on a mountain slope when the helicopter slid backward and the tail rotor blades struck a rock outcrop. The tail rotor gearbox and the aft portion of the tail boom separated from the helicopter.				
Aug. 12, 2006	Amarillo, Texas, U.S.	Learjet 31A	minor	2 none
The main landing gear tires burst on takeoff, and the airplane ran off the runway.				
Aug. 13, 2006	Piacenza, Italy	Lockheed L-100-30	destroyed	3 fatal
The airplane was at 24,000 ft on a cargo flight from Algiers, Algeria, to Frankfurt, Germany, when it descended steeply to the ground. Thunderstorms were reported in the area.				
Aug. 13, 2006	Yellow Pine, Idaho, U.S.	Eurocopter AS350-B3	destroyed	4 fatal
The helicopter was on a public use flight and was returning to base after replacing personnel at a mountaintop fire-watch station when it struck terrain.				
Aug. 13, 2006	Lahaina, Hawaii, U.S.	Hughes 369D	substantial	1 none
The tail rotor struck the ground while the helicopter was being landed during a fire fighting operation.				
Aug. 14, 2006	Los Angeles, U.S.	Boeing 747-400	substantial	307 none
The airplane was taxiing when its no. 4 engine was struck by a main-deck-loading vehicle.				
Aug. 14, 2006	Sault Ste. Marie, Michigan, U.S.	Piper Aztec	destroyed	4 fatal
The airplane was on an instructional flight and had been cleared to conduct a VOR approach to Chippewa County Airport, which had 1.25 mi (2,000 m) visibility and a 300-ft ceiling. The preliminary report said that approach minimums are one mi visibility and 1,260 ft, or 260 ft AGL. The airplane was circling to land when it struck terrain and exploded. The instructor, student pilot and two passengers were killed.				
Aug. 17, 2006	Grain Valley, Missouri, U.S.	Fairchild Metro III	substantial	1 minor, 1 none
The main landing gear struck a fence during approach and collapsed on the runway.				
Aug. 18, 2006	Brisbane, Australia	Boeing 737-400	none	none
During climb, the flight crew shut down the left engine because of a low oil pressure indication and returned to Brisbane.				
Aug. 18, 2006	Metaline Falls, Washington, U.S.	Kaman HH-43F	destroyed	1 fatal
The helicopter was engaged in a logging operation and was dropping logs from about 200 ft AGL when ground personnel heard a loud boom and saw the helicopter descend onto the log pile.				
Aug. 22, 2006	Donetsk, Ukraine	Tupolev Tu-154M	destroyed	170 fatal
The airplane was at Flight Level 360 during a flight from Anapa, Russia, to St. Petersburg when the pilot declared an emergency. Media reports said that the pilot reported an on-board fire and that the airplane was in heavy turbulence. The airplane descended and struck terrain.				
Aug. 23, 2006	La Junta, Colorado, U.S.	Adams A500	minor	3 none
The airplane overran the runway after the left main landing gear tire deflated on landing.				
Aug. 26, 2006	Daytona Beach, Florida, U.S.	Mitsubishi MU-2	destroyed	2 fatal
The airplane struck terrain under unknown circumstances after the pilot reported that he was unable to maintain altitude. The preliminary report said that the airplane was on a business flight from Bloomington, Indiana, to Grand Harbor, Bahamas.				
Aug. 27, 2006	Lexington, Kentucky, U.S.	Canadair CRJ100	destroyed	49 fatal, 1 serious
VMC prevailed when the flight crew was cleared for takeoff on Runway 22, which is 7,000 ft (2,135 m) long, but departed at 0607 local time from Runway 26, which is 3,500 ft (1,068 m) long. The airplane struck terrain in a heavily wooded area beyond the departure end of the runway.				

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.

International Federation of Airworthiness

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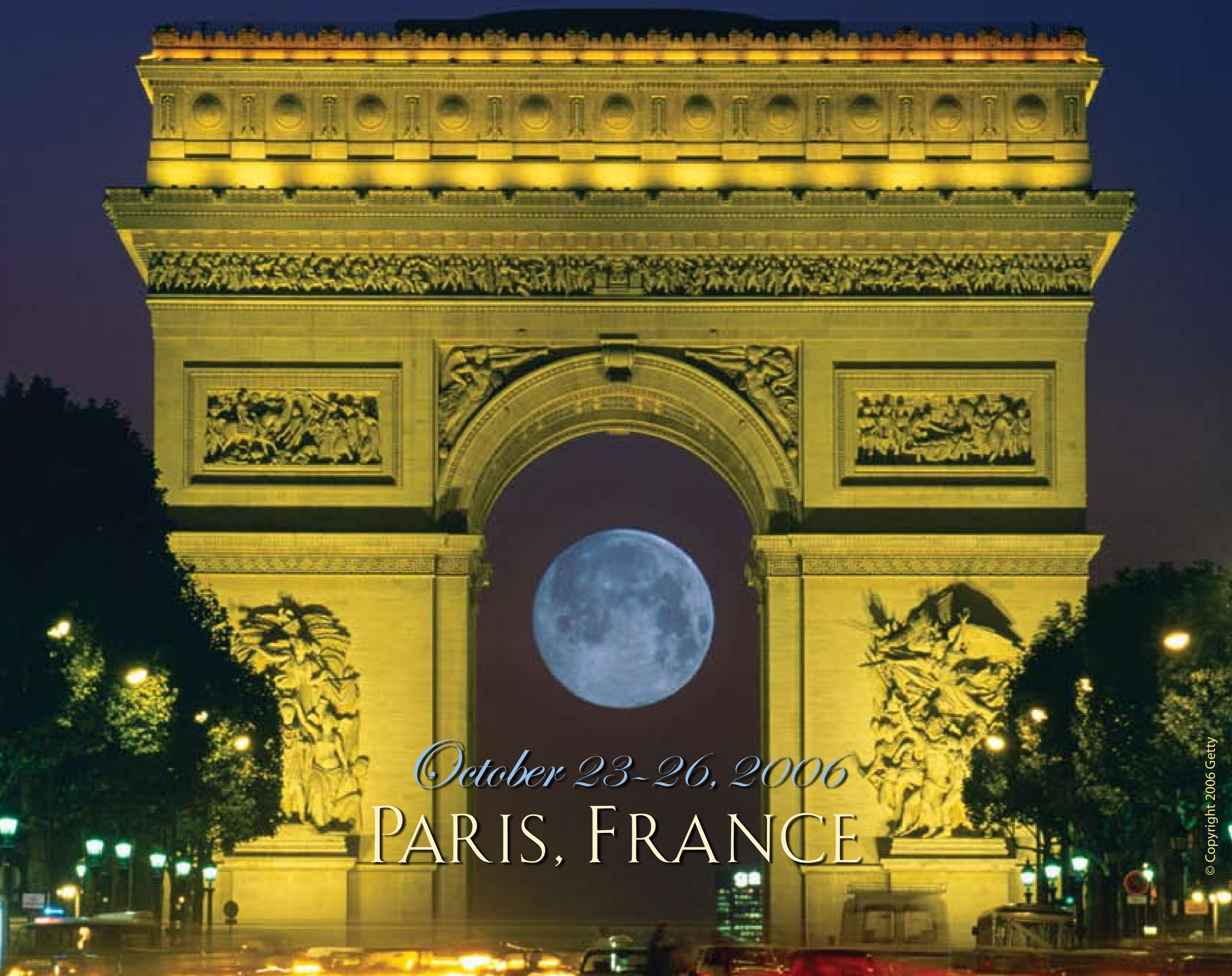

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