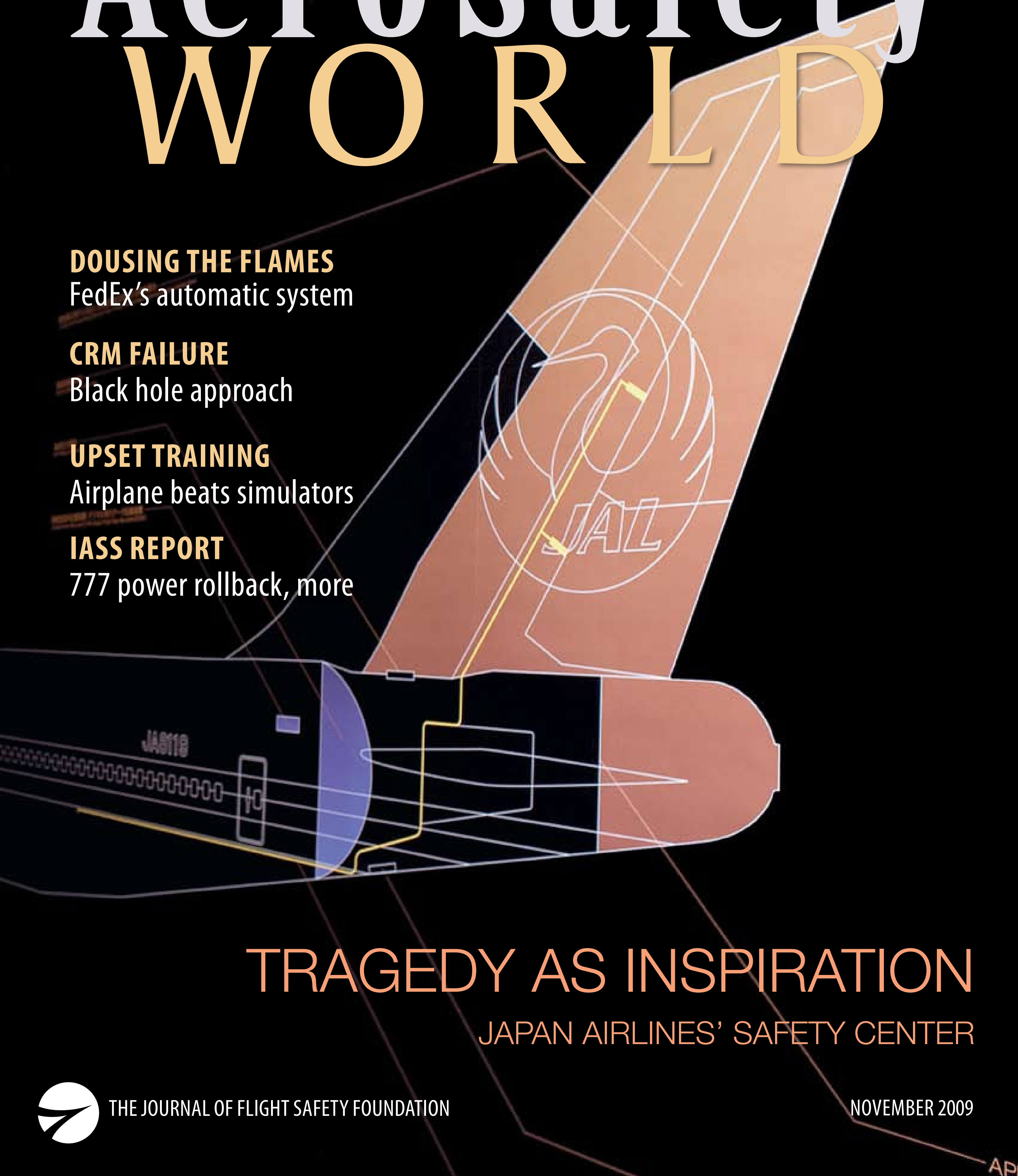
AeroSafety WORLD



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JAPAN AIRLINES' SAFETY CENTER

THE JOURNAL OF FLIGHT SAFETY FOUNDATION

NOVEMBER 2009

REGULATING Fatigue

I had the honor of testifying recently before the U.S. Senate Committee on Commerce, Science and Transportation's subcommittee on aviation, which conducted a hearing on fatigue regulation in commercial aviation. It reminded me what a tough job it is to write decent regulations in the middle of a public debate. Right now, fatigue rules are undergoing a fundamental rewrite by both the U.S. Federal Aviation Administration (FAA) and the European Aviation Safety Agency. This effort is long overdue. Researchers have been telling us for at least 15 years that our fatigue regulations are out of date.

For most of those 15 years, the problem has been special interests and an extreme lack of trust. On both sides of the Atlantic, there has been a great deal of concern that labor or management or both would take advantage of fundamental changes in flight and duty-time rules. Nobody wanted to make the first move, because no one knew what the result would be. The thinking was that it is easier to live with rules that are known to be flawed rather than risk letting the other side win. I don't think anybody was proud of this epic standoff, but few things are more important than working conditions. Sometimes even the best of us tend to put less important things ahead of safety.

It seems that the gridlock has at least ended in the U.S. There is now enough science on the table for people to trust that the possible outcomes will be fair and reasonable. In addition, the tragedy of the Feb. 12, 2009, Colgan Air crash in Buffalo, New York, made inaction unacceptable, and a dynamic new FAA administrator is ready to serve as a tiebreaker on those issues where the answers are not obvious.

Even with all of this new momentum in the U.S., the problem is still difficult. First of all, the public and the politicians want the industry and the regulator to take on the issue of commuting long distances to flight assignments. That is a problem that may be too tough for regulation to solve. Market demands force airlines to move domiciles quickly, and pilots like to have a stable home, living where they like and commuting to work. Many of us in the industry would like to leave that issue up to professionalism and trust pilots to show up rested. But I have to tell you, that is not an easy position to defend when the parents of a Colgan victim are sitting two rows behind you. They don't want to hear "trust us."

Another tough balance is choosing between solid prescriptive regulations and fatigue risk management systems. A modern regulation needs to address both. It looks like the FAA process will result in the adoption of prescriptive regulations, based on science, that are similar to those from the U.K. That is an essential start, but there also has to be room for sophisticated operators to use a fatigue risk management system to continuously optimize the safety of their operation. This is easy to write but hard to sell to a public that doesn't want to hear anything that sounds like there is more than one acceptable way to fly safely.

There is a lot of momentum behind the current regulatory initiative in the U.S., and there is a lot of agreement among many traditional adversaries. My biggest concern is that the FAA finds a way to sell the right answer to the public.

William R. Voss
President and CEO
Flight Safety Foundation

AeroSafetyWORLD

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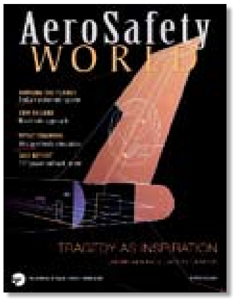

About the Cover
Japan Airlines uses its 747SR crash to foster employees' safety consciousness.
Wayne Rosenkrans

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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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DELICATE Balance

Perhaps the most difficult part of flying any aircraft is maintaining that balance of vigilance, that happy area between hyper-alertness and complacency. Since the process of learning how to fly generally weeds out the overly twitchy, let's first talk about the other extreme.

One of the most dangerous threats in flying is complacency, the knowledge that you've done this kind of thing hundreds, even thousands of times before, and the odds that you'll be successful again are very high, you believe, even as conditions slide downhill into dangerous territory. If you're diligent you'll run through procedures in your mind and, when appropriate, with crewmembers, and you'll have your antennae up for standard problems, thereby greatly decreasing the risk involved. Yet lists are populated with scores of accidents in which pilots, deeply into unstablized approaches, press on, knowing that they've done this before and can do it again, so complacent that they ignore a threat that has been repeatedly highlighted as a major accident precursor. Or, as in the Beech King Air crash discussed in this issue, assuming that their go-around was proceeding well without checking the instruments for a positive rate of climb; they advanced the throttles and felt that settling in the seat of their pants, so the airplane must be climbing, right?

Considering the words "standard problems" in the previous paragraph; on reflection it is obvious that this is not a static set. While training and procedures are designed to mitigate a proven set of threats, a pilot's personal experience enriches that set. If "A" and "B" happen, you know that "C" is the next thing to look for, but experience has taught you to watch out for "Z." Sometimes, even that can fail you if your balance is off.

Vigilance that becomes fixated can become as much of a threat as complacency. Numerous accidents occur even though the cockpit crew is being vigilant, indeed, but unbalanced in their focus. An intense focus on a known problem or threat reduces the attention that can be allocated to the rest of the piloting effort.

Here's a personal example: Working with a transition student, a commercial pilot, doing pattern work in a tandem-seat aircraft, I knew from having lost a friend in a midair collision on the downwind leg of the same runway that the major threat was over my shoulder, around the four-o'clock position, where aircraft entering the pattern would appear. With difficult forward visibility, I wasn't looking straight ahead, but the pilot flying was, and he picked up an errant T-34 headed directly at us, nose-on. He said something colorful and threw the stick forward just in time; the miss was by a very few feet. At our position in the pattern, my student might justifiably have been looking mostly at the runway or at aircraft on base or final, but he balanced his scan nicely, happily to our mutual benefit.

This happened about the time that there were two airline accidents in the United States in which the pilots were so concerned about faulty landing gear indications they neglected to fly the airplanes, with fatal consequences. These events, and my close call, made me realize the importance of balancing the attention given to a known threat.

J.A. Donoghue
Editor-in-Chief
AeroSafety World

Influence Outside Commercial Operations

I wanted to take a minute to let you know I have been enjoying the articles in *AeroSafety World* online. I work as an aviation safety contractor for the U.S. Forest Service fire and aviation management branch. Though this world is pretty far removed from commercial aviation, many of these articles are very educational for me and I've certainly found areas in which they apply to land management aviation operations.

"Asleep at the Wheel" by Linda Werfelman (9/09) caused me to stop and call my friend and mentor Curt Graeber [Ph.D., Boeing Commercial Airplanes and an FSF Fellow] to ask some more pointed questions regarding fatigue in short-haul, high-workload environments.

The article "SMS on Wheels" (by Thomas Anthony, 9/09) was also perfectly timed for a risk assessment project I am working on. We follow the pillar model closely, but the gear/wheel approach made perfect sense.

Anyway, thank you for your efforts. They impact aviation well outside of the commercial aviation world.

Janine Smith

AeroSafety 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>.

CALL FOR PAPERS ➤ 41st Annual Seminar of the International Society of Air Safety Investigators. Sapporo, Japan, Sept. 6–9, 2010. Bob Matthews, <bob.matthews@faa.gov>.

CALL FOR PRESENTATIONS AND PANELISTS ➤ Shared Vision of Aviation Safety Conference. U.S. Federal Aviation Administration. June 1–3. San Diego. Lucy Erdelac, <lerdelac@utrs.com>, <www.aqp-foqa.com/Conferences/2010/index.html>, +1 215.870.2331.

NOV. 15–20 ➤ Annual Safety Seminar 2009. Civil Air Navigation Services Organisation. Krakow, Poland. Chris Goater, <info@canso.org>, +31 (0)23 568 5380.

NOV. 17–19 ➤ Human Factors in Aviation Maintenance Course. Southern California Safety Institute. San Pedro, California, U.S. Rick Anglemyer, <rick.anglemyer@scsi-inc.com>, <www.scsi-inc.com/HFAM.html>, 800.545.3766, ext. 103; +1 310.517.8844, ext. 103.

NOV. 18–19 ➤ Safety Management System Overview Workshop. ATC Vantage. Boston. <registrations@atcvantage.com>, <www.atcvantage.com>, +1 727.410.4759.

NOV. 24–25 ➤ 10th ACI–Europe Airport Operations Conference. Airports Council International–Europe. Barcelona, Spain. Daniel Coleman, <daniel@pps-publications.com>, +44 1293 783 851.

NOV. 25–26 ➤ 2nd European Safety Symposium: From Error Management to Safety Management. U.K. Flight Safety Committee and Baines Simmons. Farnborough, England. <officemanager@bainessimmons.com>, <www.bainessimmons.com/symposium2009.php>, +44 (0)1276 855412.

NOV. 30–DEC. 1 ➤ Crew Management Conference. *Flight International.* London. Cathy Fuller, <cathy.fuller@flightglobal.com>, <www.flightglobalevents.com/crewmanagement?cp=EMC-FGCON_CRW2_20090723>, + 44 (0)20 8652 3749.

DEC. 1–3 ➤ FAA International Runway Safety Summit. U.S. Federal Aviation Administration and American Association of Airport Executives. Washington, D.C. Natalie Fleet, <natalie.fleet@aaae.org>, <www.aaae.org/meetings/meetings_calendar/mtgdetails.cfm?Meeting_ID=091107>, +1 703.824.0500, ext. 132.

DEC. 4–5 ➤ A Practical Approach to Safety Management Systems. Curt Lewis & Associates and Beyond Risk Management. Phoenix. Brendan Kapuscinski, <info@beyondriskmgmt.com>, <www.regonline.ca/SMSPhoenix>, +1 403.804.9745.

DEC. 7–8 ➤ Quality Assurance and Auditing, a Practical Approach. Curt Lewis & Associates and Beyond Risk Management. Brendan Kapuscinski, <info@beyondriskmanagement.com>, <www.regonline.ca/QAPhoenix>, +1 403.804.9745.

DEC. 7–10 ➤ Insight V3 Flight Data Analysis Training Course. CAE Flightscape. Ottawa, Ontario, Canada. <training@flightscape.com>, +1 613.225.0070.

DEC. 8–9 ➤ Human Factors Analysis and Classification System Workshop. Wiegmann, Shapell & Associates. Las Vegas. Diane Kim, <info@hfacs.com>, <www.hfacs.com>, 800.320.0833.

JAN. 18–FEB. 5 ➤ Fundamentals of Accident Investigation Course. Cranfield Safety and Accident Investigation Centre. Bedfordshire, England. Graham Braithwaite, <g.r.braithwaite@cranfield.ac.uk>, +44 (0)1234 754192.

JAN. 19–20 ➤ Aviation Safety Management Systems Overview Course and Workshop. ATC Vantage. Tampa, Florida, U.S. <registrations@atcvantage.com>, <www.atcvantage.com/sms-workshop-January.html>, +1 727.410.4759.

JAN. 19–20 ➤ Risk Management Course. ScandiAvia. Dubai. Morten Kjellesvig, <morten@scandiavia.net>, <www.scandiavia.net>, +47 91 18 41 82.

JAN. 20–22 ➤ Wildlife Hazard Management Workshop. Embry-Riddle Aeronautical University. Orlando, Florida, U.S. Al Astbury, <astbufc5@erau.edu>, <worldwide.erau.edu/professional/seminars-workshops/wildlife-hazard-management/index.html>, +1 386.226.7694.

JAN. 25–27 ➤ 2nd Middle East ANSP Conference. Civil Air Navigation Services Organisation. Dubai. Anouk Achterhuis, <anouk.achterhuis@canso.org>, <www.canso.org/middleeastconference>, +31 (0)23.568.5390.

JAN. 27–29 ➤ Schedulers and Dispatchers Conference. National Business Aviation Association. San Antonio, Texas, U.S. Dan Hubbard, <dhubbard@nbaa.org>, <www.nbaa.org/events/sdc/2010>, +1 202.783.9360.

FEB. 2–7 ➤ Singapore Air Show. Singapore Airshow & Events. Singapore. <angelicalim@singaporeairshow.com.sg>, <www.singaporeairshow.com.sg/>, +65 6542 8660.

FEB. 12 ➤ Managing Human Error in the 21st Century. The Aviation Consulting Group. Myrtle Beach, South Carolina, U.S. <www.tacgworldwide.com>, 800.294.0872; +1 954.803.5807.

FEB. 17–18 ➤ 2nd South Pacific Aviation Safety Management Systems Symposium. Aviation Industry Association of New Zealand. Queenstown, New Zealand. Bob Feasey, <bob.feasey@aia.org.nz>, <www.aia.org.nz/Events/2nd+South+Pacific+ Aviation+Safety+Management+Systems+Symposium.html>, +64 04.472.2707.

FEB. 17–19 ➤ Human Factors in Maintenance Workshop (Phases 1 and 2). Grey Owl Aviation Consultants. Houston. Richard Komarniski, <richard@greyowl.com>, <www.greyowl.com>, +1 204.848.7353.

FEB. 20 ➤ Safety Management Systems Maintenance Workshop. Grey Owl Aviation Consultants. Houston. Richard Komarniski, <richard@greyowl.com>, <www.greyowl.com>, +1 204.848.7353.

FEB. 20–23 ➤ Heli-Expo 2010. Helicopter Association International. Houston. <heliexpo@rotor.com>, <www.heliexpo.com>, +1 703.683.4746.

FEB. 24–25 ➤ Human Factors for Aviation Managers and Technicians Workshop (Phase 1). Grey Owl Aviation Consultants. Morristown, New Jersey, U.S. Richard Komarniski, <richard@greyowl.com>, <www.greyowl.com>, +1 204.848.7353.

FEB. 24–25 ➤ 18th Annual Leadership Conference. National Business Aviation Association. San Diego. <www.nbaa.com/events/leadership/2010>, +1 202.783.9000.

MARCH 3–7 ➤ 2nd International Exhibition and Conference on Civil Aviation: India Aviation 2010. Ministry of Civil Aviation, Government of India, and Federation of Indian Chambers of Commerce and Industry (FICCI). Hyderabad, India. FICCI, <indiaaviation@ficci.com>, +91 11 32910417.

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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 through the issue dated the month of 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.

Serving Aviation Safety Interests for More Than 60 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 1,170 individuals and member organizations in 142 countries.

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Safety News

Accident Investigation

The European Commission (EC) has proposed legislation aimed at making aviation accident investigation bodies more independent and providing more protection for aviation personnel who report sensitive safety information.

The EC said the proposal is intended to provide for independent investigations of accidents "as the surest way of identifying the causes … and answering the fundamental question 'what really happened?'" The proposal also would clarify the roles to be played by national government agencies and European Union (EU) bodies in accident investigation.

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"The current EU rules on investigating air accidents need to be updated to reflect the current realities of Europe's aviation market and the complexity of the global aviation industry," the EC said. "Investigating air accidents takes new kinds of expertise and more resources than a decade ago. The organizational set-up has also changed substantially, with the European Aviation Safety Agency now responsible for certifying aircraft in the EU."

The EC said that the proposed legislation would protect sensitive safety information from "inappropriate use or unauthorized disclosure" and would provide judicial authorities with "more clarity as to the roles of the various bodies involved in investigating air accidents."

It also would make accident investigations more efficient and more cost-effective, provide for a better exchange of information among the national investigation bodies and improve the quality of accident investigations throughout the EU. Other provisions would provide for improved implementation of safety recommendations, the EC said.

In addition, the proposal would provide accident victims and their families with improved access to assistance immediately after a crash, the EC said.

The EU Council of Ministers and the European Parliament must approve the proposal before it will take effect, probably in 2011, the EC said.

Helicopter Work Groups

Flight Safety Foundation, through its Australian Advisory Board, has established the Australian Helicopter Advisory Group to work for improvements in helicopter safety throughout the country.

"With the key guiding principles of being impartial, independent and nonparochial, the [advisory group] will … go a long way towards galvanizing the industry and improving helicopter safety," said Terry Summers, the group's chairman.

The group, which says it "aims to pursue the continuous improvement of helicopter safety and the prevention of accidents," will identify safety issues and work with the Australian helicopter industry to address those issues, and provide a safety-focused independent voice for the industry.

Not Ready for Prime Time

Unmanned aircraft systems (UAS) are "not ready for seamless or routine use" in civilian aviation, Randy Babbitt, administrator of the U.S. Federal Aviation Administration (FAA), says.

Babbitt told a meeting of the Aerospace Industries Association that unmanned aircraft are "the way of the future." Nevertheless, he added that "they're not ready for open access to the [national airspace system]. …

"It's fair to compare the advent of the UAS with the introduction of the jet engine. We're talking about an exponential leap in capability, and that leap needs a contemporaneous jump in technology and procedures to do so safely."

In the year that ended Sept. 30, 2009, there were 20,000 UAS flights in U.S. civilian airspace, Babbitt said. "But in order for us to get to the place where the UAS can become a viable, accepted part of the national airspace system, we have to make sure that sense-and-avoid is more than a given — it must be a guarantee," he said.

U.S. Air Force

He said that the FAA is developing rules for UAS operations and working with other organizations on UAS standards. Safety standards must be the same for all types of aircraft, "even if no one's in the cockpit," he said.

Emergency Designation

Radar data processing systems should be modified to allow air traffic controllers to apply a special designation if a flight is experiencing an emergency, the U.S. National Transportation Safety Board (NTSB) says.

In a letter to the U.S. Federal Aviation Administration (FAA) recommending the modification, the NTSB cited the Jan. 15, 2009, ditching of a US Airways Airbus A320 in the Hudson River minutes after takeoff from Laguardia Airport in New York City.

An emergency designation "causes radar data processing systems to display critical information about the flight, including its location, to other controllers," the NTSB said. "Aircraft experiencing an emergency are given air traffic control priority over all other traffic. To provide the most effective assistance, it is imperative for all controllers to know the location of the affected aircraft to prevent aircraft conflicts and collisions."

The pilots of the US Airways A320 landed the airplane in the river after it ingested birds into both engines. All 155 people in the airplane evacuated; five were seriously injured, and 95 received minor injuries. The NTSB investigation of the accident is continuing.

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Blacklist Update

The European Commission (EC) has updated its list of airlines banned in the European Union to include all carriers from Djibouti, Congo and São Tomé and Principe.

Carriers from the three countries were banned after audits identified safety deficiencies in oversight by national aviation authorities, the EC said.

"We cannot afford any compromises in air safety," said EC Vice President Antonio Tajani. "Citizens have the right to fly safely in Europe and anywhere else in the world. Our aim is not just to create a list of airlines that are dangerous. We are ready to help those countries to build up their technical and administrative capacity to guarantee the safety of civil aviation in their countries."

The update — the 12th revision of the list since it was first issued in 2006 — noted "strengthened progress and cooperation" with Albania, Angola, Egypt, the Russian Federation, Ukraine, Kazakhstan and Kyrgyzstan regarding the safety of their air carriers.

The list bans all carriers from 15 countries: Angola (except for one carrier operating under specific restrictions), Benin, Democratic Republic of Congo, Djibouti, Equatorial Guinea, Gabon (except for three carriers operating under restrictions), Indonesia, Kazakhstan (except for one carrier operating under restrictions), the Kyrgyz Republic, Liberia, Republic of Congo, Sierra Leone, São Tomé and Principe, Swaziland and Zambia. Three other carriers also may operate under restrictions, and five individual carriers are banned from all operations in the European Union.

Wikimedia

ISASI Honors

The International Society of Air Safety Investigators (ISASI) has awarded its 2009 Jerome F. Lederer Aviation Award to Richard B. Stone, a retired Delta Air Lines captain, and to the Australian Transport Safety Bureau (ATSB).

The award, named for the founder of Flight Safety Foundation, is given for "outstanding lifetime contributions to technical excellence in furthering aviation accident investigation and achieving [ISASI] objectives," the organization said.

The ATSB was recognized for its "worldwide reputation for excellence based on its operational independence, objectivity and technical competence in accident investigation" and its "expertise and contribution to the field of human factors at both the individual and organizational level." The bureau also has been a leader in proactive accident investigation and safety enhancement, ISASI said.

Stone, now a consultant for government and industry aviation interests, retired from Delta in 1992. He was involved for more than two decades, as a member of the Air Line Pilots Association, International, in aircraft accident investigation and prevention efforts.

Anti-Icing Proposals

Scheduled airlines would be required to retrofit their aircraft with ice-detection equipment or to take steps to ensure that existing ice-protection systems activate at the appropriate time under a new rule proposed by the U.S. Federal Aviation Administration (FAA).

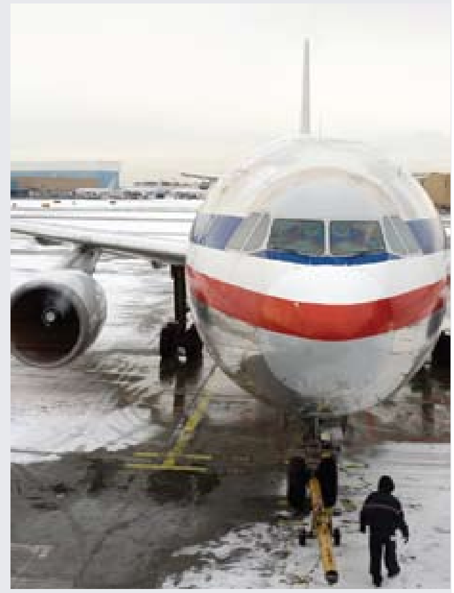
The proposed rule would require ice-detection systems to alert flight crews every time an activation of an ice-protection system is necessary. In aircraft without ice-detection systems, flight crews would be required to activate the ice-protection system "based on cues listed in their airplane's flight manual during climb and descent, and at the first sign of icing when at cruising altitude," the FAA said.

The proposed rule would affect in-service aircraft with takeoff weights of less than 60,000 lb (27,216 kg). Most larger aircraft already have equipment that meets the requirements, the FAA said. Technically, 1,866 airplanes could be affected by the proposed rule, but many already have the required equipment. Some other, older airplanes probably will be retired from service before the projected 2012 compliance date, the FAA said.

"This is the latest action in our aggressive 15-year effort to address the safety of flight in icing conditions," said FAA Administrator Randy Babbitt. "We want to make sure all classes of aircraft in scheduled service remain safe when they encounter icing."

An August 2009 change in certification standards calls for new transport category airplane designs to require either automatic activation of ice-protection systems or a method of informing pilots when ice-protection systems should be activated.

In related action, the FAA said it will expand the classes of aircraft that will be prohibited from taking off with "polished frost" — frost that has been buffed so that it becomes smooth — on their wings, stabilizers and control surfaces. That rule, which affects 188 aircraft operated by 57 companies, will take effect Jan. 30, 2010. Major air carriers and regional carriers previously were banned from operating with polished frost.



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"The FAA has advised pilots not to take off with frost or ice contaminating their wings for years because it made good sense; now, it's the law," Babbitt said.

In Other News …

The Civil Aviation Safety Authority of Australia (CASA) is developing new guidelines for managing **wildlife hazards** near airports, in the aftermath of a report by the Australian Transport Safety Bureau that showed the number of bird strikes nearly doubling over a five-year period. CASA also said that the reporting of bird strikes is inconsistent. … Eurocontrol has signed agreements with Belgium, France and Germany to establish a civil-military **performance measurement** service. The Pan-European Repository of Information Supporting Civil-Military Performance Measurements (PRISMIL) will enable governments to "review their airspace procedures and assess their performance in terms of flexible use of airspace operations in compliance with the Single European Sky requirements," Eurocontrol said. … The U.S. National Transportation Safety Board has recommended that **helicopter emergency medical services** (HEMS) operations involving government-owned aircraft should be subject to the same level of safety oversight applied to civil HEMS operations.

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Edward W. Stimpson

Edward W. Stimpson, past chairman of the Flight Safety Foundation Board of Governors, former U.S. representative to the International Civil Aviation Organization and former president of the General Aviation Manufacturers Association, died of cancer Nov. 25 at his home in Idaho. He was 75.

Stimpson retired in November as chairman of the FSF Board (*ASW*, 10/09, p. 22).

FSF President William R. Voss praised Stimpson for his lifelong dedication to aviation safety, noting, "Anyone who flies … owes a debt of gratitude to the work Amb. Stimpson did during his career."

Compiled and edited by Linda Werfelman.

Photos: Wayne Rosenkrans

Precious Lives

Japan Airlines Safety Promotion Center compels reflection on solemn responsibilities of aviation professionals.

BY WAYNE ROSENKRANS | FROM TOKYO

Introductory panels about JAL Flight 123 include the "black boxes" recovered from the crash site.

More than 74,000 visitors have toured the Japan Airlines (JAL) Safety Promotion Center since its opening in April 2006. The proportion from outside the company exceeds 40 percent, says Yutaka Kanasaki, director of the museum-like facility near Tokyo International Airport, Haneda. Many are fascinated by the concept, especially the reasoning behind JAL's decision to prominently recount the story known throughout Japan as the "Osutaka Mountain accident." On a southeast ridge of this mountain 24 years ago, this crash of a Boeing 747SR-100 resulted in more loss of life than in any single-airliner accident in history.[1]

The center is designed, foremost, to provide safety awareness and education for the airline's employees, Kanasaki said during a November tour for *ASW*. "Today, 90 percent of our total number of employees — about 50,000 — have never experienced an accident," Kanasaki said. "People entering our company only know Flight 123 from the viewpoint of history. After visiting our Safety Promotion Center, however, they understand an accident as a real thing. Every visitor, including the JAL employee, studies here what safety is."

The experience for employees involves historical and technical education, contemplation of aircraft wreckage and personal effects, and examination of their personal role within the airline's efforts to reduce accident risk.

"Our center has three missions," Kanasaki said. "The first one is to stop the fading out of the memory of the sadness of the aircraft accidents that Japan Airlines experienced in the old days. We are very sorry but Japan Airlines has experienced eight fatal accidents since the foundation of the JAL Group. The last was Flight 123 in 1985. In each accident, many passengers and crew lost their precious lives. The second mission is to inspire JAL employees to establish safety in their minds. The third is to transfer the lessons learned from these accidents to the next generation of people in the JAL Group."

Hideaki Miyachi, a Boeing 747-400 captain and director of the Planning Group, JAL Corporate Safety and Security, said that unlike in some major accidents, everyone concerned quickly became aware of the most likely causes in the case of Flight 123. "Three weeks after the accident, Boeing informed us that an improper repair had been done for tail strike damage that occurred in June 1978," Miyachi said. "So everybody knew soon that the aft pressure bulkhead had been damaged and — due to the Dutch rolling and uncontrollable condition — that most of the tail had separated in flight and sunk in Sagami Bay. Boeing reacted very quickly and expressed that their repair was the major reason."

Three factors influenced JAL to create the Safety Promotion Center. From December 2004 to December 2005, several errors during flight operations prompted the Civil Aviation Bureau in Japan's Ministry of Land, Infrastructure, Transport and Tourism to issue a business improvement order.

"The March 2005 order from the government directed JAL to improve the company's attitude toward safety," Kanasaki said. "We established the Safety Advisory Group outside of our company. The group then gave us a proposal at the end of 2005 requesting that JAL exhibit the wreckage of Flight 123 for safety awareness education of JAL employees."

Another factor was that some of the bereaved families of Flight 123 many years earlier had requested that JAL exhibit the wreckage for basically the same purpose. Third, the personal sentiments of JAL Group's former CEO Toshiyuki Shinmachi came into play in favor of a permanent exhibit.

Attendance Required

External advice and comments from general visitors, those from outside the JAL Group, influenced a related company policy. Regardless of job title, new employees are required to take the tour as part of the center's safety awareness course. "Almost all general visitors said that the JAL employee must never forget the pain of the victims and the sadness of the bereaved families," Kanasaki said. "These are very heavy words to the JAL employee, and we must keep these words forever to keep flight safety, I believe. Awareness of the same feelings as the bereaved family or the victim is the first step to understand safety."[2]

The lower half of the complete aft pressure bulkhead exhibited helps explain the catastrophic in-flight failure.

So far, about 70 percent of JAL employees have taken the course. Some long-time employees also have visited the center in conjunction with evacuation training and ditching training, Miyachi said. "Every single pilot and every single cabin crewmember visited this center in 2008," he said.

One new employee, a maintenance technician, left a comment saying that before his visit, he believed that his job was to "maintain the machine." "After the visit, he said he understood that his job is not only the maintenance of a machine but also to keep the safety of passengers' lives — a very big change in his emotion, I believe," Kanasaki said.[3]

Tour Highlights

Operated by Corporate Safety and Security, the center occupies part of the second floor of a mid-rise office building in the Haneda Maintenance Area. Tours begin in the Library Room, containing the official accident report in Japanese and its English translation; historical and technical books about air transport safety and human factors; and other documents, reports and nonfiction books associated with Flight 123.

Along one wall, panels summarize 10 major accidents that have occurred worldwide since airlines began operating turbine-engine airplanes. The adjacent panel chronologically shows the JAL accidents alongside 38 other fatal accidents involving large commercial jets. Other panels summarize the airline's seven fatal accidents before Flight 123, including the probable cause of each and safety actions taken.

The Display Room is the largest area. Its centerpiece is both halves of the recovered aft pressure bulkhead. They are mounted horizontally for close inspection because of the bulkhead's critical role in the accident. Surrounding panels explain the causes of the accident and measures taken to prevent a recurrence.

Other major exhibits of the Display Room include a scale model of the airplane in JAL livery of the time, the vertical stabilizer root section, the vertical stabilizer upper section, the lower rudder's upper section, sections of the aft fuselage, and four damaged passenger seats.

The introductory wall in the Display Room presents a multi-panel summary of the Flight 123 accident, showing the estimated flight path overlaid with excerpts transcribed from the cockpit voice recorder; a graph of selected data from the 74-parameter digital flight recorder (DFDR) validating the sequence of events; a diagram of areas of the aft fuselage and tail that separated during flight; diagrams of aircraft parts, which have hand-painted numbers, coded to indicate the sites where they were recovered and the parts never recovered; and a cabin layout showing which seats were occupied by the crewmembers and passengers killed, and those occupied by passengers who survived.

The tour begins at a panel on which a white line shows the estimated flight path of Flight 123, a normal departure and climb to Flight Level 240 (approximately 24,000 ft) from Haneda, then a descent to Flight Level 220 and an erratic 32 minutes of uncontrollable flight from soon after the aft pressure bulkhead ruptured to the crash site.

The main point of the reassembly and display of specific pieces of wreckage is to show how they contributed to understanding what happened. "The root section of the vertical stabilizer leading edge connected the tail section with the fuselage, for example," Kanasaki said. "Parts of the vertical stabilizer leading edge, no. 5 to no. 11, were found and retrieved from the crash site. Pieces numbered 13, 14, 15 and 16 are parts of the vertical stabilizer; no. 13 was found and retrieved from the mountainous area in the Tokyo suburbs. Numbers 14, 15 and 16 were found and retrieved from the crash site. The no. 17 wreckage, the upper section of the lower rudder, was retrieved from Sagami Bay."

The DFDR-derived graph of aircraft altitude, airspeed, longitudinal acceleration and roll attitude data — along with video narration and a flight crew–air traffic control (ATC) voice re-enactment — give visitors a minute-by-minute sense of what the flight crew experienced while attempting to maintain stable flight, turn, climb, descend and communicate with ATC. "The longitudinal acceleration data continue normally until the data skips, meaning that some impact force was applied in the forward direction," Kanasaki said.

A video associates this impact force with rupture of the aft pressure bulkhead and air pressure from the cabin destroying the empennage, including the vertical stabilizer and the fuselage tail section. Fifty-five percent of the vertical stabilizer was lost, and the four hydraulic lines — which supplied hydraulic pressure to an actuator for the upper and lower rudders — were severed causing total loss of fluid.

"From this time, all other data show the abnormal situation," Kanasaki said. "The pitch instability — phugoid motion — and the roll attitude data also showed the [Dutch roll] oscillation from this time, a combination of yawing and rolling."

On the tour, the exhibit of the upper and lower halves of the aft pressure bulkhead, combined with a video and scale models of repairs conducted after the 1978 tail strike, explain how the instantaneous failure along the joint caused cabin air to open a hole of about 2 to 3 sq m (22 to 32 sq ft) in the bulkhead.

A three-dimensional terrain model depicts three points of impact — the airplane struck a single larch tree, made a U-shaped gouge in a ridge line, then descended at 340 kt into a remote forest of larch trees 1,565 m (5,135 ft) above sea level about 2.5 km (1.4 nm) north-northwest of Mount Mikuni at the boundary of Gunma, Nagano and Saitama Prefectures.

Splice Plate Lesson

Explaining this catastrophic failure of the aft pressure bulkhead, Kanasaki said that the splice plate repair — as designed by the Boeing aircraft-on-ground team and approved by JAL and aviation authorities — would have provided a continuous load path except for changes during installation that did not conform to the approved design.

"The stress between the upper and lower halves of the bulkhead was concentrated in the

Kanasaki, top, and Miyachi.

center row of the three rows of rivets," he said. "An excessive load was applied in the center row and made a small crack around the rivet holes. Due to the repeated application of cabin pressurization during every takeoff and landing, the crack propagated little by little, and seven years later — at the 12,319th flight after the repair — the aft pressure bulkhead ruptured from this repaired area." A tail compartment pressure-relief vent door functioned as designed "but was too small to relieve the high pressure from the big hole in the aft pressure bulkhead," he added.

Displays positioned around the bulkhead halves highlight the complex corrective and proactive measures implemented. International and government-mandated measures focused on enhancement of maintenance programs, aircraft modification and organizational reinforcement for safety enhancement.

For example, Boeing design modifications for newly manufactured 747s included the use of reinforced aft pressure bulkheads and changes to routing of hydraulic lines. Modifications suitable for retrofit included adding a cover plate for the maintenance inspection access hole inside the vertical stabilizer and adding a hydraulic fuse to prevent fluid loss from one system if downstream plumbing ever were damaged. The U.S. Federal Aviation Administration's Lessons Learned Library at <accidents-ll.faa.gov> also has an analysis of international improvements prompted by JAL Flight 123 among 40 worldwide accidents selected for safety education.

One corner of the Display Room has glass showcases containing keys, pens, eyeglasses, wristwatches and small debris, and panels showing five final handwritten messages. "Japan Airlines keeps about 2,700 personal items that remained but whose ownership we could not identify," he said. "We selected 17 of these items to show how big the impact of the crash was. The five watches show the correct time of the impact, they stopped at 1856.

"Debris was collected by one member of a bereaved family who picked up items every time he visited Osutaka Mountain. They have been donated by him. Three panels have the actual last messages written by five passengers. One is written on a timetable of Japan Airlines. A sixth message is a memo written by one of the cabin attendants. She expected an emergency landing and wrote the content of the emergency announcement on her notebook."

Emotional Evolution

JAL has been open to suggestions about the center and further refinements. During its first two years, for example, each tour concluded at the personal effects area but some visitors left comments asking for reconsideration of the emotional impact of this order of presentation.

In January 2008, the company's response was to add Display Room 2. "The newer exhibits show how close monitoring of aircraft has succeeded in limiting further damage or loss of lives," Kanasaki said. "One display is a list of four accidents in which every safety factor worked well due to the best effort by the people involved. The other display is a chronological table that shows the relationship between these accidents and related technical improvements." The improvements are broken down and graphically linked to subjects such as aircraft structure, warning systems and fire mitigation.

Policy updates on recurrent training at JAL recently have directed employees to participate at their earliest opportunity in the center's updated two-day safety promotion course, which includes a day trip to historically important sites outside Tokyo that are associated with the Flight 123 accident.[4]

To read an enhanced version of this story, go to the FSF Web site <www.flightsafety.org/asw/nov09/jal-center.html>.

Notes

1. Operated as JAL Flight 123, the airplane crashed at approximately 1856 local time Aug. 12, 1985, among the mountains of Ueno Village, Tano County, Gunma Prefecture, during a scheduled passenger flight from Tokyo International Airport, Haneda, to Itami International Airport, Osaka, Japan. A total of 505 passengers and 15 crewmembers were killed, and four passengers received serious injuries. The aircraft was destroyed, and a fire occurred at the crash site.

2. The night of the Flight 123 crash, Kanasaki was a junior-level aircraft maintenance technician suddenly called back to work at Haneda, Miyachi said. Kanasaki gathered heavy jackets, boots, gloves and other equipment for a first-response team. The next day, he was dispatched to Yokohama, where he sketched recovered parts on the shore of Sagami Bay and faxed his drawings to company specialists.

3. Two other new employees of JAL Group left comments saying, "The most important meaning [was] to find that our job has strong linkage with the passenger's life," and "I will visit … again whenever I forget a mission of my job."

4. Sites include the Ueno Village Memorial Park, which contains an interment vault, engraved names of passengers and crewmembers killed, and a monument sculpted to represent hands pressed together in prayer; the Osutaka Mountain trail, marked with a plaque containing excerpts from commemorative remarks by former U.S. National Transportation Safety Board Chairman James E. Burnett Jr.; the Flight 123 monument at the crash site; and a prayer bell.

ATC Crisis Management Training Pays Off

Prior training proves its worth in a real-life event.

BY DICK VAN ECK

In the Netherlands, air traffic control (ATC) supervisors of the Area Control Centre Amsterdam (ACC) went through a tough training scenario in which one unlikely event followed another to create an almost out-of-control situation. The question remained: How would they handle a real crisis while on duty?

On Feb. 25, 2009, many of the participants were put to the test.

It was a morning peak-traffic hour at Amsterdam Airport Schiphol, with about 100 departing and arriving aircraft to be controlled, a routine day at the ACC facility of ATC the Netherlands.

Suddenly the routine was broken. Turkish Air 1951, a Boeing 737-800 on final approach for Runway 18R, crashed 1 nm (2 km) short of the runway.[1]

There was a moment of disbelief, followed by all the actions necessary for arranging and guiding rescue services, accepting the consequences of the sudden closure of the airport, stopping all traffic on the ground, managing traffic in the air, initiating go-arounds, managing holding aircraft in the stacks, and guiding aircraft to alternate aerodromes.

The ACC supervisor on duty took all the actions necessary for the altered traffic flow and took charge of the ATC crew. The next priority was handling the external attention an aircraft accident brings — incoming calls from colleagues, management and sometimes even family members seeking information. Calls from the press had to be routed to the designated spokesman. A checklist detailed all the internal and external authorities that had to be informed.

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Bas Czerwinski/Associated Press

The accident involving Turkish Air Flight 1951 was only the beginning of an exceptionally demanding workload for controllers at Amsterdam Schiphol.

After 45 minutes, the airport operations manager, in conjunction with local authorities, concluded that flight operations at the airport could be resumed, although only in a low-capacity mode with one landing runway.

Then a "pan-pan" call was received from an Airbus A330 flight crew experiencing a major hydraulic failure.

The aircraft received priority handling, with guidance to the landing runway. It made an uneventful landing but was unable to clear the runway. Following traffic had to go around, and the traffic flow was disturbed once again.

An alternate, smaller runway was made available for aircraft of medium size, and Boeing 737s and Airbus A320s were allowed to land. The heavies had to divert to alternate airports.

In the control rooms — tower, approach and center — some air traffic controllers directly involved with the accident were relieved by colleagues, and some were questioned by investigators.

Looking back, the ACC supervisor on duty remembered that he had felt confident during those hectic hours, even though the experience was far beyond routine.

Flashback to Crisis Training

A few weeks before, he had been one of the participants in a course titled "Crisis Training for Supervisors." He believed himself an improved manager as a result of that training; his increased ability to recognize the nature of events and control the flow of activity made him feel more confident in his position.

How different were the circumstances for the ACC supervisor on duty Oct. 4, 1992, when a Boeing 747 freighter crashed into an Amsterdam suburb during an attempt to make it to the airport after critical structural damage had occurred.[2]

The correctness of that supervisor's actions were questioned in the formal accident report and, in the years following, ATC the Netherlands used this fact to drive ongoing improvements.

Slowly but thoroughly, training goals, methods, tools and checklists were developed. Also, the Dutch National Aerospace Laboratory–NLR and experts in crisis handling were invited to help create a complete crisis training plan for supervisors.

In 2008, two employees at *Luchtverkeersleiding Nederland* (LVNL/ATC the Netherlands) were selected to formulate and conduct the first crisis training for supervisors on the Dutch ATC simulator. The two were Pauline Visser and Diko Holstvoogd, both supervisors and air traffic controllers in the Dutch Area Control Centre.

"Most surprising to me was how each individual approached the crisis in her or his own manner, of course within the limits of standard procedures. And with satisfying results; apparently there is no one best way," Visser said.

A Quick Sequence

The training was given on the ATC simulator with some technical adaptations for specific needs. Several controllers handled routine traffic simulations as the training started. Then unusual events occurred in a quick sequence, confronting the supervisor with a crisis scenario.

The scenarios included, among other events, a communication failure on a 747 and its interception by two F-16s of the Royal Dutch Air Force. Then, another controller reported a similar problem with another aircraft, a scenario inspired by the events of Sept. 11, 2001, in the United States. All the necessary coordinating efforts were being simulated as part of the scenario when, suddenly, another aircraft made an emergency call and needed the highest priority handling as the government made the decision to close Dutch airspace due to the imminent threat of terrorism.

The existing air traffic had to go somewhere, and how do you close airspace? The external world was included in the scenarios: Simulated calls came from the news media, management, the Air Force, a representative of the prime minister and worried "relatives."

The safe handling of air traffic is the supervisor's utmost priority. His or her decisions, actions and commands must be clear and concise for the duty controllers. Next, the controllers' well-being and the quality of their job performance must be monitored, especially under extreme and unusual situations.

After accidents involving ATC, investigators always examine the supervisor's actions. Their professional responsibility includes the fact that liability — and even the threat of criminal prosecution — could become part of an investigation.

"The participants' drive to perform well during this training course was at an extremely high level," Holstvoogd said. "One candidate was so involved in this scenario that, by mistake, he managed to get the real-life airport operations manager on the phone, explaining all the disasters. Of course, this man had no idea it was an exercise."

Simultaneous Emergency and Normal Control

Handling flights in distress is, sooner or later, part of the controller's job. These flights require and receive the utmost attention. However, at the same time all other flights that are part of the traffic stream have to be handled with the same efficiency and safety level as under normal circumstances. The controllers' workloads reach peak levels as routines, plans and standards are suddenly disrupted. This applies to the flight crews as well. Diversions, holding patterns, fuel starvation concerns; the workload is high for everyone. Nonetheless, one seldom hears of any failures under these circumstances.

One aspect of the crisis training consists of continuous and personal guidance by trained specialists and psychologists in critical-incident debriefings. Each candidate showed a different approach in coping with a stream of stress-inducing messages. There are rules and guidelines for everyone on how to deal with this. This personal assistance during the training was appreciated and helpful to the participants.

The goal of the exercises was to prepare supervisors for the tasks they need to accomplish during a crisis. This preparation was achieved by recognition, knowledge and actual performance. Each participant was pre-briefed and debriefed in person. All of them were enthusiastic about the course. Before the training, there was a reserved response from controllers; afterward, the course management received only compliments.

A continuation of the course is planned in 2010, perhaps with an extended scenario including tower, approach and airport participation.

Dick van Eck is a retired air traffic controller and former general manager, ATC training, with ATC the Netherlands.

Notes

1. Turkish Air Flight 1951 was approaching Amsterdam Schiphol at the end of a flight from Istanbul, Turkey. The airplane struck the ground and broke into three pieces but no fire ensued. Nine people, including the pilots, were killed. The cause is under investigation.

2. The El Al 747 cargo airplane had taken off from Amsterdam Schiphol after a stopover on a flight from New York to Tel Aviv, Israel. During the climb through 6,500 ft, the no. 3 engine separated from the wing and struck the no. 4 engine, which in turn separated. The pilots attempted to maneuver for a return to Schiphol, but with the loss of two engines and partial loss of control surfaces, the attempt failed. The airplane crashed into a high-rise apartment complex, killing the pilots and the only other occupant, an El Al employee. Ground fatalities were estimated at 39, the exact figure uncertain because the building was partially inhabited by illegal immigrants whose numbers were unknown to authorities.

Topsy Turvy

BY LINDA WERFELMAN

Time in a simulator can enhance a pilot's upset recovery skills, but there's no substitute for aerobatic training.

Although simulator training significantly improves a pilot's ability to recover an airplane from a serious upset, a large disparity exists between the performances of pilots who undergo upset recovery training in a simulator and those who have actual aerobatic experience, aeromedical researchers say.[1]

Release of their study, conducted for the U.S. Federal Aviation Administration (FAA) Office of Aerospace Medicine (OAM), came several weeks before the U.S. National Transportation Safety Board's (NTSB's) issuance of a safety recommendation calling for U.S. Federal Aviation Regulations (FARs) Part 135 commuter and on-demand operators and Part 91K fractional ownership operators to incorporate into their training programs the same type of upset recovery training already used by Part 121 air carrier operators.

The study evaluated performances by two groups of pilots who received upset recovery

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training — one group in a "high-end centrifuge-based" simulator and the other group using a desktop computer. A control group received no upset recovery training. Members of all three groups then were asked to fly a Super Decathlon — a single-engine aerobatic airplane — and to recover with minimal loss of altitude from serious in-flight upsets.

In three of the four test upsets, pilots trained in an Environmental Tectonics GL2000 simulator lost less altitude than pilots trained using a desktop computer with Microsoft Flight Simulator (MFS) software and recovered more quickly from the upset (Table 1). Nevertheless, according to the FAA report on the study, "they did not statistically outperform [pilots who received the computer training] to the degree anticipated.

"More important, perhaps, neither trained group performed as well in altitude loss as we would have expected."

The report said that the differences in altitude loss shown in the table "seem to call in question the implicit assumption that airline simulator-based upset recovery training programs impart flying skills sufficient to make it probable that a typical line pilot can recover an airliner from a serious upset with minimum altitude loss."

The participants in the study were students at Embry-Riddle Aeronautical University; each held a current instrument rating and had completed a course for pilots in basic aerodynamics. None had prior experience with aerobatics or advanced upset recovery training. Although the research involved general aviation pilots and a flight test in a general aviation airplane, the FAA said that the findings also have "important implications for heavy aircraft upset recovery trainers."

In this experiment, the participants' time was divided between "no-motion" time, which was used to teach rote skills, and "motion" time, which was used to teach motion-critical skills while also allowing participants to adjust to the motion of the simulator. Training time was limited because some participants suffered from motion sickness.

In reviewing their findings, the researchers said that the GL2000-trained pilots might have registered stronger performances if the experiment had been conducted under slightly different circumstances, including providing the pilots with more time to practice rote responses to upsets before the motion component of the simulator was activated. The researchers said that they would make that change if they repeat the experiment, and that they also would modify the training to alternate motion sessions and no-motion sessions in half-hour segments, depending on how well individual participants were adjusting to the motion, and would extend the training period to three days instead of two.

The researchers noted that, unlike many of their predecessors, today's U.S. airline pilots typically do not have military flying backgrounds that included "extensive opportunity to perform aerobatic flight maneuvers.

"For military trained pilots, there are no *unusual* attitudes, only *unexpected* attitudes. By contrast, most air transport pilots flying today have never experienced the extreme pitch and bank angles and high g forces associated with severe airplane upsets. Indeed, most have never been upside down in an airplane even once."

The researchers noted that, in informal conversations, a "significant number" of airline pilots said that they consider their company-provided upset recovery simulator training "better than nothing

Average and Observed Minimum Altitude Losses for Each of the Four Upsets

	Altitude Loss in Feet			
Data Source	Nose-Low Upright	Nose-High Upright	Nose-Low Inverted	Nose-High Inverted
GL2000-trained pilot average	600	213	885	368
MFS-trained pilot average	565	331	949	382
Control group pilots average	728	340	1,069	465
Observed minimum during safety pilot training	220	–50	350	–30

MFS = Microsoft Flight Simulator; GL2000 = Environmental Tectonics flight simulator

Source: U.S. Federal Aviation Administration Office of Aerospace Medicine

Table 1

but far from what would be desirable if training costs were not a paramount consideration."

The report added that, "although aerobatic training has not so far been authoritatively related to upset recovery success in a transport type airplane, aerobatic flight in a light airplane would provide an opportunity for pilots to practice maneuvering in extreme attitudes across wide airspeed and energy level ranges. This might in turn lead to greater confidence and maneuvering proficiency on an actual upset situation."

The report cited Boeing data[2] showing that loss of control (LOC) — which often results from an aircraft upset — has been a primary cause of hull losses and passenger fatalities in air transport operations worldwide. The data showed that LOC was the cause of about 25 percent of crashes and 40 percent of fatalities from 1998 through 2007, the report said. The report also cited similar percentages for LOC accidents involving U.S. general aviation aircraft. In Australia, LOC accounted for a greater proportion of general aviation accidents and fatalities, the report said, citing the findings of a 2007 OAM report.[3]

Training programs for airline pilots typically include simulator instruction on upset recovery, and earlier studies have found "significant training transfer" for general aviation pilots who complete training using MFS software on desktop computers.

Training in an Environmental Tectonics GL2000 simulator was a key element of an upset recovery study.

"Upsets are known to be a primary cause of fatal commercial air transport accidents," the report said. "Passenger and air crew safety considerations mandate that air transport pilots be able to recover from the infrequent but potentially catastrophic upsets that inevitably will occur from time to time in air transport operations. Although our research implies that simulator-based upset recovery training is a value-added activity and that introducing higher levels of fidelity may to some extent enhance skills transfer, additional work is needed to optimize ground-based flight training devices and their utilization to ensure they provide highly effective upset recovery training."

Safety Recommendations

The NTSB recommendation for expanded upset recovery training was a result of its investigation of the June 4, 2007, crash of a Cessna Citation 550 into Lake Michigan about three minutes after departure from General Mitchell International Airport in Milwaukee, Wisconsin, U.S., for a flight to Willow Run Airport near Ypsilanti, Michigan. Everyone in the Marlin Air Citation — two pilots and four passengers who were members of a medical organ transplant team — was killed.

The flight was conducted on an instrument flight rules (IFR) flight plan, with marginal visual meteorological conditions on the ground and instrument meteorological conditions aloft.

The NTSB said that information on the cockpit voice recorder indicated that, almost immediately after takeoff, the captain recognized a flight control problem that continued throughout the brief flight while the crew tried to troubleshoot and to maneuver for a return to the airport.

Abnormal Situation

The NTSB said the probable cause of the accident was "the pilots' mismanagement of an abnormal flight control situation through improper actions, including failing to control airspeed and to prioritize control of the airplane, and lack of crew coordination."

Investigators were unable to determine exactly what type of flight control problem the crew experienced, but the two most likely scenarios involved the inadvertent engagement of the autopilot or runaway electric pitch trim, the NTSB said.

However, the NTSB said in a letter to FAA Administrator Randy Babbitt that accompanied the safety recommendation, "Regardless of what the initiating event was, evidence from Cessna flight test records, post-accident simulator tests and the NTSB's post-accident performance study indicated that the result should have been controllable if the captain had not allowed the airspeed and resulting control forces to increase while he tried to troubleshoot the problem."

The captain had maintained control of the airplane "without much exertion" immediately after takeoff, when the airspeed was relatively slow, the NTSB said, "but he increasingly struggled as the airplane accelerated and the control forces increased. …

"If the pilots had simply maintained a reduced airspeed while they responded to the situation, the aerodynamic forces on the airplane would not have increased significantly; at reduced airspeeds, the pilots should have been able to maintain control of the airplane long enough to either successfully troubleshoot and resolve the problem or return safely to the airport."

Earlier Recommendation

A previous NTSB safety recommendation, issued in 1996 in the aftermath of several upset-related air carrier accidents, led to an FAA-industry project to develop the *Airplane Upset Recovery Training Aid*, designed to provide pilots with information on how to recognize and avoid situations likely to lead to upsets and how to recover aircraft control after an upset. The training aid, revised in 2008, presents information about high altitude aerodynamics and safe flight techniques for most jet airplanes that operate above Flight Level 250 (about 25,000 ft). Airbus, Boeing and Flight Safety Foundation led the working group that developed the information.

The FAA issued a notice of proposed rulemaking early in 2009 that called for minimum standards for training air carrier pilots in upsets and loss of control, with references to the training aid. Noting that the training aid initially was intended for operators of airplanes with at least 100 seats, the NTSB said that the information also is relevant to smaller jet airplanes, including the accident airplane, that are operated in the same environments inhabited by air carrier aircraft operated under FARs Part 121.

The NTSB said that similar training requirements must be adopted for commuter and on-demand companies operating under Part 135 before the FAA's response to the 1996 safety recommendation will be considered acceptable.

"Pilots would benefit from training and readily accessible guidance indicating that, when confronted with abnormal flight control forces, they should prioritize airplane control (airspeed, attitude and configuration) before attempting to identify and eliminate the cause of the flight control problem," the NTSB said. "The NTSB recommends that the FAA require all … Part 91K and Part 135 operators to incorporate upset recovery training (similar to that described in the *Airplane Upset Recovery Training Aid* used by many Part 121 operators) and related checklists and procedures into their training programs."

Notes

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3. Rogers, Rodney O.; Boquet, Albert; Howell, Cass; DeJohn, Charles. *Preliminary Results of an Experiment to Evaluate Transfer of Low-Cost, Simulator-Based Airplane Upset Recovery Training*, FAA Technical Report DOT/FAA/AM-07/28.

The FSF *Operator's Guide to Human Factors in Aviation* debuts on a Eurocontrol Web site.

A New Human Factors Tool on SKYbrary

BY TZVETOMIR BLAJEV

SKYbrary, an Internet-based initiative of Eurocontrol, the International Civil Aviation Organization (ICAO), the U.K. Flight Safety Committee and Flight Safety Foundation (FSF), is designed to be a comprehensive source of aviation safety information, freely available to users worldwide. The site, <www.skybrary.aero>, now contains nearly 2,500 articles and reference documents, with an average of 30 new articles being added every month.

This knowledge base already has proven to be a useful resource for safety managers at airlines and air traffic service providers, as well as training organization managers, who typically link SKYbrary references into their course material. Recently, the U.S. Federal Aviation Administration Academy incorporated links to SKYbrary material for its International Runway Incursion Prevention Course.

The SKYbrary Human Factors category is fast becoming a key resource for aviation safety professionals, thanks to the work of the Foundation, its European Advisory Committee (EAC) and SKYbrary's team of editors. Central to this development has been the integration into SKYbrary of the FSF *Operator's Guide to Human Factors in Aviation* (OGHFA), more than 100 articles and supporting presentations developed by the EAC. Direct access is via <www.skybrary.aero/index.php/Portal:OGHFA>.

OGHFA presents human factors issues in a manner tailored to the needs of the aviator — information and best practices based on established knowledge, supported by real-life examples. SKYbrary editors are integrating OGHFA within the wider human factors resource section of SKYbrary, linking articles to each other to allow easy access to this growing information pool for maximum professional benefit. Further contributions are sought to broaden and deepen this pool.

Focusing on the factors that influence people's behavior in work and personal life will help them identify the factors that are most relevant to avoiding errors.

OGHFA articles are organized into four categories:

Crew Actions and Behavior, which includes articles focused on the behavioral aspects of flying. This behavior is subject to a number of different influences.

Personal Influences involves the "internal state" of each individual flight crewmember (e.g., knowledge, fatigue, stress, emotion, mode awareness, spatial orientation, system awareness, time horizon, social interactions, complacency, boredom, distraction, fatigue, currency, knowledge, medical state, and morale). This section includes articles explaining how the human body works and human performance limitations.

Organizational and Environmental Influences are factors beyond the control of the crew but within the control of the airline (e.g., commercial pressure, company communications, ground handling, ground services, maintenance, technical support, training) and those factors affecting a flight that cannot be considered to be within the control of a pilot or an airline organization (e.g., airport facilities, air traffic control [ATC] communications, ATC services, weather conditions and other aircraft). This category includes articles which examine human performance as part of a team and organizational culture.

Informational Influences are the content and form of the operational information available to a crew (e.g., paper and electronic checklists, manuals, navigational charts, standard operating procedures, and software). This section includes articles focused on training and threat management skills.

These 42 primary articles are supported by 32 situational examples, which detail accidents or incidents, analyzed in a way to help place the human factors issues, as well as defenses and best practices, into operational context. Checklists, self-study guides and training materials are included to further support the needs of individuals and instructors.

The main objective of OGHFA is to create a strong bridge between theory and practice that is context-sensitive, concrete, practical and easy to access.

The OGHFA material is contained in a distinct portal within SKYbrary but linked to the SKYbrary human factors category, allowing ongoing integration of new articles, documents and reference materials. This approach enables the inclusion of many articles related to human factors from a wide range of sources, opinions and cultures.

Building this knowledge is an ongoing process; although Eurocontrol has a comprehensive collection of material, human factors is a huge subject area. Further contributions from Flight Safety Foundation members would be welcome.

While work continues to complete the content in current operational categories, several new categories are under development, including cabin safety, emergency planning, human error and legal process, and safety culture.

Each week, Eurocontrol highlights a specific article in SKYbrary, often related to news events or a seasonal safety threat. Over 5,000 aviation professionals subscribe to a weekly e-mail service announcing the weekly highlight. SKYbrary is visited by more than 1,000 people each day, with visits exceeding 2,000 on days when aviation safety is in the news or following the weekly SKYbrary e-mail.

Tzvetomir Blajev is the Eurocontrol project manager for SKYbrary, Eurocontrol coordinator of safety improvement initiatives and a Foundation Fellow.

Grappling with the Unexpected

BY WAYNE ROSENKRANS | FROM BEIJING

Ice-induced engine rollbacks, runway excursion alerts and proposed aid to criminal investigations capture industry attention.

Although the U.K. Air Accidents Investigation Branch (AAIB) has not completed its final report on a Jan. 17, 2008, accident at London Heathrow Airport, a Boeing Commercial Airplanes official in a seminar presentation here briefed an industry audience on the significance of key laboratory test results. Ice in the fuel system apparently caused dual engine rollbacks on the Boeing 777-236ER that forced the flight crew to land short of Runway 27L.

Mark Smith, an air safety investigator for the company, said that the tests have shown that ice was generated in the airplane fuel system from suspended free water — the water droplets normally in fuel when industry-standard jet fuel is uploaded. In a phenomenon not understood before these tests, however, this water turned to ice that collected on the walls of 2-in (5-cm) and 1.5-in (3.8 cm) diameter fuel lines, then was released downstream as a high concentration of swirling ice flakes, termed an "ice snake," that apparently caused a flow restriction at the inlet to the engine's fuel-oil heat exchanger, he said.

The purpose of the briefing was to help provide understanding of data that led to conclusions and recommendations in *AAIB Interim Report 2,* published in March 2009. The accident airplane was being operated as a British Airways flight from Beijing to London.

"We believe every airplane is doing this, not just the 777, and that it is a new, unforeseen threat," Smith told a joint meeting of the 62nd annual FSF International Air Safety Seminar (IASS), International Air Transport Association (IATA) and International Federation of Airworthiness 39th International Conference.

"Ice was simply what [investigators] were left with after we eliminated everything else. Ice was generated within the entire fuel system — everything upstream of the fuel-oil heat exchanger — then the restriction occurred at the face of the engine fuel-oil heat exchanger. This is the theory of what caused the accident. Suspended free water is the threat for this icing phenomenon we're seeing. Water is present in all fuel — like humidity in the air — and we cannot get rid of it."

The function of the fuel-oil heat exchanger is "to take hot oil from the engine and use the cold fuel flowing from the tank to cool the oil and, conversely, for the hot oil to warm the fuel," he said. The restriction phenomenon was observed in a 70-ft (21-m) test run of fuel line and associated fuel system components.

Boeing also has investigated a second event that occurred in November 2008 on a Delta Air Lines 777 also equipped with Rolls-Royce Trent 800 engines. In this event, a single-engine rollback occurred at cruise. The engine recovered power after the flight crew conducted Boeing procedures developed during the AAIB's investigation. They are the only known events, he said.

"What is important to understand is what occurred on very short final [at Heathrow]," Smith said. "At about 700 ft on final approach, one engine rolled back. About seven seconds later at 550 ft, the second engine rolled back. 'Roll back' is a key term here. The engines did not flame out. They continued to produce power; they did not go sub-idle. They continued to produce power at a thrust level that was above idle but below the thrust that was commanded by the throttles and below the thrust that was necessary to maintain airspeed."

Experimentation on a test rig that simulated 777 fuel lines and their operating environments showed that one temperature range caused ice in fuel to behave as "sticky ice." "The ice in the sticky range will accumulate, and it is that temperature range where we get our biggest accumulations [at the face of the fuel-oil heat exchanger]," he said. Engineers also found randomness in the extent of ice formation that could not be explained.

One countermeasure has been to modify the face of the fuel-oil heat exchanger so that none of the 1,200 2-mm (0.08-in) tubes that pass through the oil protrude beyond the face, where in tests some ice appeared not to melt normally because of the distance between the ends of the tubes and the hot face plate. Only the Rolls-Royce engine uses this heat exchanger design that is subject to ice choking.

China Safety Reports

Top: Wayne Rosenkrans; bottom: J. A. Donoghue

Top: Li Jiaxiang; bottom: Li Jian

Li Jiaxiang, administrator of the Civil Aviation Administration of China (CAAC), summarized at IASS the current role of safety in achieving the government's far-reaching air transport goals. "In the past, China advocated a safety week, safety month or safety year, but now we think that that has been a limitation," he said. "If we only focus on safety in phases, we make it hard for people to concentrate on safety all the time. Since last year, we have introduced pioneering concepts of safety management systems [SMS] from advanced countries and other civil aviation organizations, specifically promoting the concept of continuous safety — which means to make safety work our regular work."

He credited the government's "Reform and Opening Up Policy" of the past 30 years for the civil aviation industry's latest annual growth rate of 17.2 percent, the highest among all industrial sectors of China. "In the third quarter of 2009, civil aviation maintained double-digit growth in passenger volume [and] cargo volume as well as international flights. For the first three quarters, China's civil aviation made a profit of $1.35 billion (¥9.21 billion). This positive trend is reflected in continuous upgrading of the position of aviation within the national transportation system. It also means that quality of life of Chinese people has improved, and they prefer aviation when they take a journey."

In addition to establishing or updating regulations, the CAAC has worked to improve personnel qualifications, establish and improve the processes of flight management and oversight, and assign safety responsibility within the overall aviation system through new measures and practices, Li Jiaxiang said.

"We refer to many countries, especially those that have good practices in SMS, to improve oversight regulations and practices of China," he said. "I frequently remind my Chinese colleagues that flight safety is a career with a starting point but without an ending. I am very appreciative of recognition of China by our friends. On the other hand, I am worried that colleagues will become proud … self-satisfied about China's achievements in flight safety. We have a saying: 'Search more for problems so one may err less; talk less of achievements so one may achieve more.'"

Safety has a prominent role in China's strategic plans through 2020, added Li Jian, a captain and deputy administrator of the CAAC. "At the end of October, our civil air transport accumulated 17.4 million safe flight hours in 59 months and achieved a rate of 0.21 major accidents per million hours in the last decade," he said. "Even in the global economic crisis, we still have kept civil aviation developing and safe."

In the near term, the CAAC will focus on four areas: development and implementation of its strategic safety plan and further long-range plans; intensification of scientific and technological innovation and support to civil aviation safety; popularization of SMS; and intensification of work to build safety culture.

"The CAAC will standardize and systematize all civil aviation governing organizations, enhance safety oversight and push for long-term SMS development," Li Jian said. Increased investments will help spread valuable research and development achievements, including prioritized work on the next-generation air traffic management system and China's roadmap for performance-based navigation.

To promote and direct safety culture development, the CAAC also has developed a safety policy concerning liability determination and safety information management among other issues. "Our *Policy on Civil Aviation Safety Oversight* has new provisions for methods and standards of safety monitoring, safety auditing, safety oversight and a safety information reporting system free of punishment," Li Jian said.

William R. Voss, president and CEO of Flight Safety Foundation, was one of several

Several IASS presenters advocated adjustments to existing safety strategies in light of recent accidents.

leaders of international organizations who recognized the IASS host country's safety performance. "China is a place where no one listens passively," Voss said. "They listen actively. They take the advice you give and move forward upon it, and they change the direction of aviation in the region. Everyone respects the safety record that we have seen here."

All developing countries addressing pent-up demand for air travel face an extremely difficult balancing act, Voss added. "Personally, I respect the disciplined and thoughtful approach that China has taken during times of great growth," he said. "When demand is at the door and [countries] are being pushed for more and more capacity, I can only recall one country — China — that has stepped back and said, 'Safety is first. We will only expand at the rate that we can do so safely.'"

He contrasted these positive reports of recent years with what global aviation safety nearly experienced. "We have to acknowledge that if the year [2009] had ended in July instead of in December, we would have had the worst aviation safety record in a decade," Voss said. "There have been a lot of unexpected incidents and accidents … pilots reacting in unexpected ways to unexpected events … new types of failures and new types of reactions."

Günther Matschnigg, IATA's senior vice president, safety, operations and infrastructure, also noted the challenges and comparisons to the recent Chinese safety record. "The industry is losing, unfortunately, this year another $11 billion," he said. "Together with last year, it is about $29 billion in losses. The forecast for 2010 is another $3 billion to $4 billion loss. The question is, 'How will a 15 percent revenue shortfall impact safety?'"

Considering IATA's global accident data for the first 10 months of 2009 in this economic environment, airlines had an "incredible performance" in safety, Matschnigg said. "The total accidents have decreased by more than 40 percent and the total fatal accidents have decreased by about 45 percent. The overall rate, as we count it, has decreased to the level … of 0.52 fatal and 0.54 overall [Western-built jet hull losses per million sectors]. Unfortunately, the number of total fatalities has increased to 669. If you look at North Asia and China, in particular, it is the second year without an accident, and I sincerely congratulate [the CAAC leaders] for more than 17 million flight hours without an accident in this country."

Wayne Rosenkrans

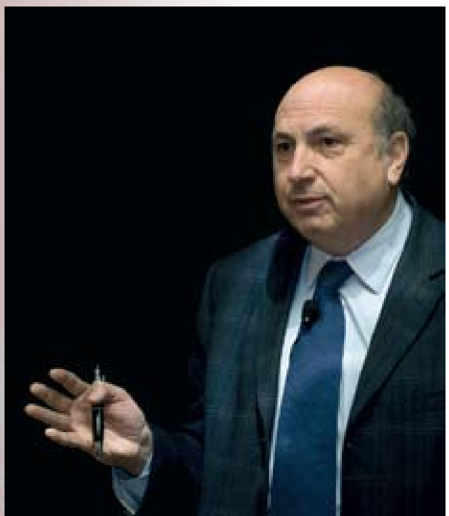
Matschnigg

The *IATA Six-Point Safety Strategy* will be "adjusted slightly" in 2010 because of some of the types of accidents that occurred in 2009, he added, with content changes on global data sharing, SMS, fatigue risk management and training. The newly launched IATA Global Safety Information Center initially provides members content consolidated from IATA Operational Safety Audit reports, IATA Safety Audit for Ground Operations reports, the IATA Safety Trend Evaluation Analysis and Data Exchange System, flight data analysis, ground damage reports and the IATA Accident Report.

New Slant on Criminalization

Gerard Forlin, a United Kingdom–based lawyer who has represented corporate clients in more than 200 safety-related events, recommended that airlines take another hard look at the growing trend toward criminalization of accident investigations.

"Last August, within three days of the takeoff accident at Barajas International Airport, Madrid, a judge was involved in looking at various engineers and maintenance issues in an investigation for manslaughter," Forlin said. "That would not have happened a few years ago. In the aftermath of an accident, criminal investigators now are looking to see whether there is corporate


Wayne Rosenkrans

Lelaie

manslaughter or manslaughter individually. The days of blaming the front line operator — the pilot, the air traffic controller — haven't ended, but they're beginning to end."

Airlines, crewmembers, air traffic controllers and aviation executives should not expect to win over police, prosecutors, coroners and investigative judges to their point of view. Instead, they should focus on common ground where criminal prosecution can be warranted in narrow circumstances, Forlin said.

In his experience, these officials see commercial aviation as no different from mining, nuclear power or any other industry. "I am afraid this is now a train out of control," he added. "So what we need to do as an industry, as a global position, is to deal with the reality and try our best to sort out and harmonize our approach to the inevitable criminal prosecutions that are going to increasingly follow."

The industry position should be that prosecutors should not seek manslaughter charges, for example, against defendants such as airlines, industry executives, pilots or air traffic controllers, "unless it is really gross negligence, not on a human level, but where profit has been put before safety," he said. "We must say, 'Prosecute when safety has been put under the altar of profit. We will agree with you then, and we will back you and help you. For the rest, leave us alone … or safety is driven underground.' It is catastrophic if that happens because without open confidential reporting, we are going to have more aircraft accidents."

Prosecutors today may want to make an example of one airline, he said, as a means of changing the safety behavior of many airlines.

Runway Excursion Answers

A number of the IASS presentations cited runway excursion accidents as a significant challenge, requiring measures identified in the new *Runway Excursion Risk Reduction Toolkit* (*ASW,* 8/09, p. 12). Two explained relevant new technologies.

Claude Lelaie, experimental test pilot, SVP Product Safety, Airbus, introduced the company's runway overrun protection system, which was certificated in October by the U.S. Federal Aviation Administration (FAA) for the A380. The system originated from concepts employed in the A340-600 brake-to-vacate system, which was intended to reduce runway occupation time, brake wear and braking energy, he said.

"From statistics within Airbus, the majority of aircraft accidents are runway excursions," Lelaie said. "Some of the reasons are autobrake settings and wind shear, but the vast majority are approach unstable, long flare, long derotation, and so on. There are many causes."

With the brake-to-vacate system armed, the runway overrun protection system activates so exact lines across a runway where the aircraft will stop are computed when the aircraft descends below 500 ft, and the system then generates an immediate warning if a risk of excursion is computed from that time to landing.

"In flight, this allows the system to trigger a go-around," he said. "If it appears that there is a risk of overrun when you are on the ground, and the system detects that there is a risk of overrun, there is nothing else you can do except to stop. It automatically selects max braking [on the A380], and you have max braking at touchdown, which is very impressive. You have an audio alert to select max reverse or to keep max reverse at low speed [below 80 kt] because it is not urgent to protect the engine, it is urgent to remain on the runway."

If the aircraft is moving too fast for the wet or dry conditions, or is above the glideslope, an amber "wet bar" and a magenta "dry bar" appear in the primary flight display and move up or down to indicate where the aircraft will stop, including off the runway. "In the case of the wet bar moving out of the runway, that means on a wet or damp runway, you will not be able to stop on the runway," Lelaie said. "The procedure is quite simple, go around if the runway is wet or damp."

The primary flight display also has text annunciations, and the system provides the same alert as a repetitive audio callout — "runway too short, runway too short" — "to really push the pilot to go around," he said.

"In the case of the A340 accident at Toronto, the crew would have had two warnings on short final with this system, and if they still had decided to land, they would have been pushed to have max reverse immediately instead of after 11 seconds," he said. "Then they would have had a runway excursion at a speed much lower than what they had. We believe that with this protection, crews will avoid the vast majority of the runway excursions that we have today.

"For this reason, we have decided to prepare a retrofit kit that [we] will install on all our fly-by-wire systems in 2011–2012. On the single-aisle family, the A320, and the A330 and A340 families, the braking would be manual and the pilot would be pushed to conduct manual braking with a strong audio warning."

Another FAA-approved solution for mitigating runway excursions — called the stabilized approach monitor system — uses data already aboard thousands of large commercial jets to perform calculations based on fundamental laws of physics, said Don Bateman, corporate fellow–chief engineer of Honeywell International, the manufacturer.

He called for continued effort to address this category of accident on all fronts, including the possible effects of problematic instructions and pressures from air traffic control that "encourage a pilot to make an approach when he or she should not accept the approach," airport and runway design, and airfield lighting and visual aids.

"The industry has about 55,000 Enhanced Ground Proximity Warning Systems (EGPWS) on airplanes — about 90 percent of all the current commercial aircraft," Bateman said. "I look upon that as an asset — a platform we can use … to get the pilot's attention that something isn't right."

The system requires no changes to the hardware and normally no changes in wiring or to the cockpit displays. "If you get high and you've got less than 3 nm [5.5 km] to the runway, and you don't have your flaps down, that is typically violating standard operating procedures," he said. "So the system can say 'flaps, flaps.'"

If the crew is on a 5, 5 1/2 or 6 degree flight path, the system will annunciate "too high, too high" and duplicate that alert in text on the navigation display. "Likewise, if the airplane is 40 or 50 kt above V_{REF} [landing reference speed] the system can say 'too fast, too fast,'" Bateman said. "If the crew gets to 3 1/2 or 4 nm [6.4 or 7.4 km] and still is not 'in the box,' either for speed or slope to the runway, the system can say, 'unstable, unstable.'"

Similarly, when the airplane is over the runway but has overflown the touchdown zone, the system can issue the alert "long landing, long landing" if specified by the operator, and call out the distance remaining to the end of the runway, either in meters or in feet, he said.

Roadmap Workshops

Kicking off a series of IASS reports about regional safety initiatives throughout the world, Bill Bozin, vice president, safety and technical affairs, Airbus Americas, provided details of several workshops that introduced the *Global Aviation Safety Roadmap* to aviation stakeholders in a number of countries from late 2008 to late 2009.

"The *Roadmap* has become unique because it is the one accepted way to proceed … a good blueprint to use," he said. "Hopefully, it reassures people that their money and their efforts, whether in time or treasure, are well spent and well directed."

Conducting workshops generates viable, self-sustaining industry-government regional safety teams prepared to conduct gap analyses, develop action plans, commit resources, establish priorities and implement plans with measurable outcomes.

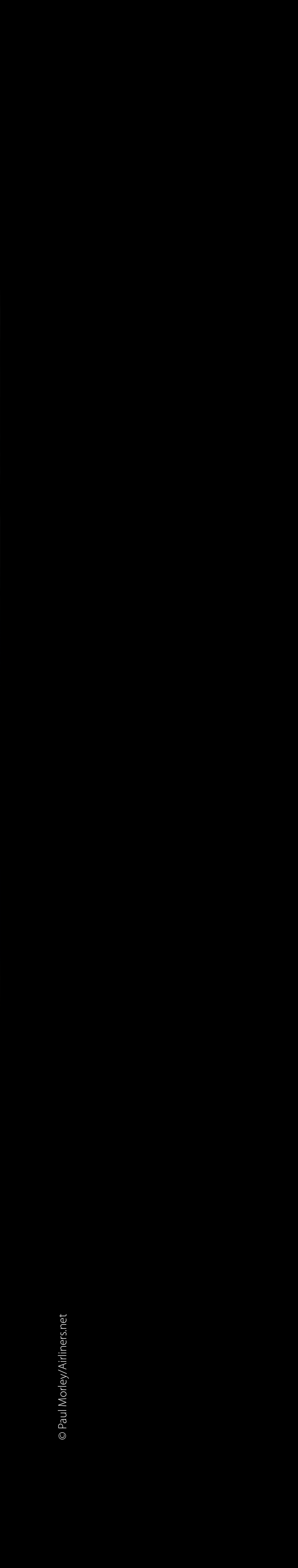
The most recent workshops have been successful as first steps toward comprehensive changes and generating regional and global assistance in some cases, he said. They have in common a narrow initial selection of priority focus areas identified by country representatives; high-level support from government leaders; and high likelihood of positive impact relative to all focus areas to be considered eventually in the *Roadmap* process.

In the period covered by Bozin's briefing, workshops were conducted in Ouagadougou, Burkina Faso; Maputo, Mozambique; and Brazzaville, Congo; and in Moscow for the Commonwealth of Independent States (CIS). The regional participants from states of sub-Saharan Africa chose as focus areas inconsistent regulatory oversight, inconsistent coordination of regional programs, inconsistent use of SMS and insufficient number of qualified personnel. The Interstate Aviation Committee (MAK) in the CIS and workshop participants selected as their priority focus areas the inconsistent use of SMS and insufficient number of qualified personnel. Reports were not yet available from later workshops in Khartoum, Sudan, and Bogotá, Colombia.

Lack of CRM training factored in a muddled approach and go-around.

Teamwork Fades in a BLACK HOLE

BY MARK LACAGNINA



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A fatal accident during an emergency medical services (EMS) flight has prompted the Transportation Safety Board of Canada (TSB) to recommend a requirement for air taxi and commuter aircraft operators to provide their pilots with recurrent training in crew resource management (CRM).

The accident involved a Beech King Air A100 that struck terrain after a go-around was initiated late during an attempted landing on a short gravel strip in Sandy Bay, Saskatchewan, the night of Jan. 7, 2007.

Based on the findings of its investigation, TSB concluded that the flight crew "was unable to work effectively as a team to avoid, trap or mitigate errors and safely manage the risks associated with [the EMS flight]."

The risks included a nonprecision approach into a "black hole" — a dark, featureless area with few visual cues to aid depth perception.

The TSB's final report on the accident said that the absence of visual cues during the go-around might have contributed to an illusion that the twin-turboprop had pitched up excessively, tricking the captain into making a nose-down control input.

Ultimately, a positive rate of climb was not maintained, and the King Air struck trees beyond the runway. All four occupants were injured but were able to get out of the aircraft before it was destroyed by fire. The first officer escaped with minor injuries. The two passengers — emergency medical technicians — suffered serious injuries. The captain was critically injured and died before rescuers arrived.

The sequence of events leading to the accident began at 1830 local time, when the Sandy Bay Health Centre called an ambulance dispatch center to arrange for transportation of a patient from Sandy Bay to Flin Flon, Manitoba. The ambulance dispatch center called Transwest Air, a regional airline and air taxi operator, which confirmed that a King Air and a flight crew were on standby and available for the flight.

The ambulance dispatch center then arranged for the emergency medical technicians to rendezvous with the pilots in La Ronge, which is in central Saskatchewan, 105 nm (194 km) south-southwest of Sandy Bay.

'Negative Information'

Formed by the 2001 merger of Athabaska Airways and La Ronge Aviation, Transwest Air is based in Prince Albert, Saskatchewan, and has satellite bases throughout central Canada. The company operates 39 fixed-wing aircraft and four rotary-wing aircraft, and has 232 employees.

The captain assigned to the EMS flight had 8,814 flight hours, including 449 hours in King Airs. He had applied for employment at Transwest Air after earning an airline transport pilot license in April 2006 and was hired a month later.

"The captain's flying-skill level was initially considered to be lower than expected for his experience level, but his performance during the training was consistently rated as satisfactory," the report said.

Before joining Transwest Air, the captain had been employed as a flight instructor and as an air taxi and commuter pilot for three other companies. The first employer had reprimanded him four times for not complying with company policies or with Transport Canada flight and duty time limits.

Nevertheless, "this employer provided the captain a letter of recommendation acknowledging his two years of employment as a first officer and stating that the captain had performed well," the report said.

The second employer had downgraded him from captain to first officer because of repeated noncompliance with standard operating procedures (SOPs).

The third employer also downgraded him because of "weak systems knowledge, preflight planning shortcuts, fixation on minor problems, dwelling on errors, narrow attention span, and poor decision making," the report said. After being reinstated as a captain, he was reprimanded for "substandard performance" and was refused renewal of his pilot proficiency check because of unsatisfactory crew coordination and compliance with SOPs.

This employer gave the pilot a letter of reference stating that he was "extremely knowledgeable about the aircraft he flew," the report said.

"Based on concerns regarding privacy legislation and the potential for legal action, the previous employers all indicated that they would not have disclosed the negative information about the captain's performance to prospective employers calling for a reference check."

Pilot Shortage

Transwest Air based its decision to hire the captain on his resume and a brief telephone inquiry about his credentials. No one in the company recalled that they had conducted background checks or formal interviews.

"Pilots with current qualifications and experience on King Air aircraft were in demand across Canada," the report said. "During the 12-month period before the occurrence, [Transwest Air] lost three King Air captains and one first officer to other companies."

The captain received 128 hours of line indoctrination with company training pilots and line pilots. "Line indoctrination records showed that the captain initially experienced difficulty in several areas, including preflight planning and IFR [instrument flight rules] operations but made steady progress and completed the line indoctrination program on 28 June 2006," the report said.

The report did not specify the captain's age but noted that he was 28 years older than the first officer.

The first officer had a commercial license and 672 flight hours, including 439 hours in type. He was a customer service agent for another company before joining Transwest Air in April 2005 as an office assistant and ramp agent. He began training as a King Air first officer in March 2006 and was approved for line operations in May.

The captain had flown to Sandy Bay nine times during the day and four times at night. The first officer had flown there five times during the day and three times at night.

"The captain and first officer flew together into Sandy Bay twice in the week before the accident," the report said. "They had flown together the night before the accident, sharing the flight time between them by alternating legs as PF [pilot flying]."

Many of Transwest Air's King Air pilots were aware that the captain and first officer preferred flying with other pilots, rather than with each other. "Some of the pilots were aware of a concern that the captain had about the first officer's landings and were also aware that the captain had taken control from the first officer during several approaches and landings," the report said.

Captains who had flown with the first officer said that they shared the accident captain's

Beech King Air A100

© Peter Nickerson/Jetphotos.net

Beech Aircraft introduced the first of the 100-series King Airs in 1969. Compared with the 90-series twin-turboprops introduced four years earlier, they have more powerful engines, a longer fuselage with a larger rudder and elevator, a shorter wingspan and two wheels on each main landing gear.

The King Air 100 can accommodate up to 13 passengers, but the cabin typically is configured for six or eight passengers. The engines are 680-hp (507-kW) Pratt & Whitney Canada PT6A-28s with three-blade propellers.

The A100 debuted in 1971 with a greater fuel capacity, higher operating weights and four-blade propellers. Maximum weights are 11,500 lb (5,216 kg) for takeoff and 11,210 lb (5,085 kg) for landing. At sea level, maximum rates of climb are 1,963 fpm with both engines operating and 452 fpm with one engine inoperative. Maximum cruise speed at 21,000 ft is 235 kt, and maximum range is 1,287 nm (2,384 km).

Beech ceased production of the 100-series King Airs in 1983 after building about 184 of the original model, 157 A100s and 137 B100s, which have fixed-shaft Garrett TPE331 engines rated at 715 hp (533 kW).

Sources: *Jane's All the World's Aircraft* and *The Encyclopedia of Civil Aircraft* concern about his "inconsistent" landings. However, the first officer's performance was improving, and "they viewed the situation as one of a junior pilot gradually becoming more proficient, not as a hazardous situation," the report said.

Both pilots had complained to their chief pilot about each other's performance. The captain had cited the first officer's landings. The first officer had referred to the captain's nonadherence to SOPs during an instrument approach. Although the chief pilot had verbally counseled each pilot, the underlying issues were not resolved, and the pilots remained "an ineffective and dysfunctional team," the report said.

Nonprecision Approach

The King Air departed under IFR from La Ronge at 1930. Although company policy dictated that the most experienced pilot serve as the PF for the first flight of the day or when runway length was less than 3,500 ft (1,067 m, as at Sandy Bay), the captain designated the first officer as PF before takeoff.

After leveling at 11,000 ft, the crew received the current weather conditions at Flin Flon, which is 57 nm (106 km) southeast of Sandy Bay and the closest weather-reporting facility. Winds were from 050 degrees at 2 kt, visibility was 15 mi (24 km) in light snow, and the ceiling was broken at 2,500 ft.

The report noted, however, that "about three hours after the accident, the ceiling at Sandy Bay was estimated to be 700 to 800 ft AGL [above ground level] by crews arriving to evacuate the survivors."

The first officer temporarily transferred control of the aircraft to the captain while he reviewed and briefed the straight-in nondirectional beacon (NDB) approach to Runway 05.

Although company SOPs prohibited a straight-in approach to a runway without visual glide path indicators, the captain concurred with the first officer's plan. Neither pilot conducted landing performance calculations, and the length and condition of the runway were not discussed.

"The crew had the global positioning system (GPS) programmed direct to the Sandy Bay aerodrome (CY4) waypoint from the GPS database, and the first officer planned to use the GPS distance-to-go to the aerodrome to establish a descent profile of 300 ft per nm [which corresponds to a three-degree glide path]," the report said. "The captain transferred aircraft control back to the first officer following the approach briefing."

Causal factors included a misunderstood GPS waypoint and somatogravic illusion during an attempted go-around.

The GPS receiver aboard the King Air was certified for IFR navigation, and GPS area navigation approaches to Sandy Bay were published. However, the crew was not trained or authorized to conduct GPS approaches.

The report noted that the pilots likely were not aware that the GPS waypoint they were using for distance information was located 1,440 ft (439 m) beyond the approach threshold of Runway 05. Thus, they were aiming to touch down at a point on the runway that was 440 ft (134 m) beyond the normal touchdown point for a three-degree glide path.

No Radar Service

Air traffic control (ATC) radar service was not available at the uncontrolled airport. At 1948, ATC cleared the crew to conduct the NDB approach to Runway 05 and to descend at their discretion. A radio frequency change also was approved.

The first officer established the aircraft in a descent on the 058-degree final approach course, and the captain broadcast an arrival advisory and activated the airport lights.

The NDB is near the approach threshold of Runway 05, a gravel strip 2,880 ft (878 m) long and 75 ft (23 m) wide at an elevation of 1,001 ft. The minimum descent altitude (MDA) for both the straight-in and circling approach is 1,780 ft. The runway did not have approach lights or visual glide path indicators.

"The gravel runway was covered with a layer of compacted snow and a thin layer of fresh and unmarked snow," the report said.

The King Air was about 5.5 nm (10.2 km) from the airport when the first officer called for the landing checks. "The captain indicated that the landing lights would remain off because the aircraft was still in cloud," the report said.

The captain then told the first officer that he saw the lights of the town and a nearby hydroelectric dam. The town is 1.2 nm (2.2 km) southwest of the airport, and the dam is 2.3 nm (4.3 km) southwest of the field.

"Both crewmembers acquired visual reference with the aerodrome at about 4.2 nm [7.8 km] from the runway while the aircraft was still in descent toward the MDA," the report said.

Too High

About 2.5 nm (4.6 km) from the runway, the pilots agreed that the aircraft was on profile for the approach and extended the flaps to the landing position. However, shortly after turning on the landing lights a few seconds later, the captain determined that the aircraft was too high.

The report said that the crew's use of the airport GPS waypoint for distance information might have caused a "spatial awareness error [that] contributed to the aircraft being high on final approach."

The captain reduced power and told the first officer to increase the descent angle. "The captain's coaching continued, and at 2002:05 [38 seconds before impact] the first officer suggested that they conduct a go-around," the report said.

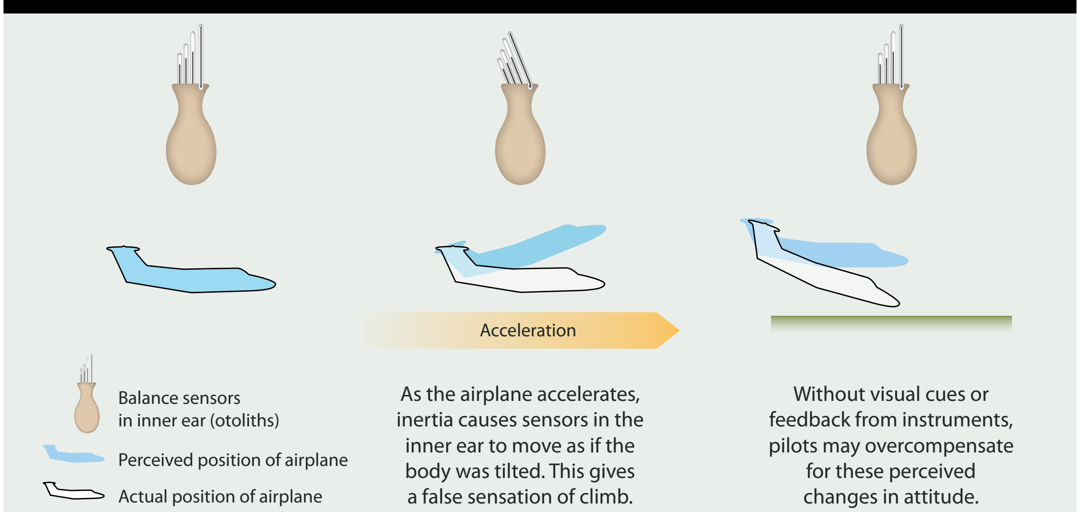
The captain told the first officer to continue the approach. "The captain continued to coach the first officer through the approach and into the landing flare," the report said. "At 2002:15, the captain instructed the first officer to bring the power off and put the aircraft on the runway."

Just after the first officer reduced power to flight idle, the captain apparently saw that the aircraft could not be landed safely on the runway remaining, and he commanded a go-around. However, his communication was nonstandard and ambiguous, and the first officer did not immediately take action.

"At 2002:23, the captain advanced the power levers to a high power setting," the report said. "The first officer perceived pressure on the control column and observed the captain's hand on the control column. Believing the captain to be taking control, the first officer released the control column. Neither pilot verbally announced or acknowledged the transfer of control."

The first officer called for the flaps and landing gear to be retracted, which complied with the aircraft flight manual procedure for a balked landing. The captain responded by saying "positive rate, gear up." The first officer retracted the landing gear and the flaps. The captain then selected the approach flap setting — an action that might have distracted him

Somatogravic Illusion



Source: U.S. Navy, Chief of Naval Air Training, and http://humanneurophysiology.com/

Figure 1

from monitoring the aircraft's climb performance, the report said.

'False Climb' Illusion

The terrain beyond the runway slopes downward, and the first officer recalled seeing the altimeter indicating 100 ft below airport elevation. However, he also "perceived sensations of being pushed back in the seat and the aircraft pitching up, and believed the aircraft was climbing," the report said.

The first officer's perceptions were typical of the *somatogravic illusion*. "Instrument-rated and experienced pilots are not immune to this illusion, which is a subtle and dangerous form of disorientation," the report said. "The illusion occurs because the body relies on sensory organs in the inner ear to maintain balance; and, in the absence of visual cues, signals from these organs can produce a very powerful disorientation (Figure 1).

"In the case of an aircraft that is accelerating during a go-around, the sense organs of the inner ear of the pilot send a signal to the pilot's brain that is interpreted as tilting backward instead of accelerating forward. … The pilot has a very strong sensation of climbing. The illusion of false climb tends to lead the pilot to lower the nose and descend. The aircraft then accelerates, and the illusion can intensify."

The report said that it is likely that the captain also experienced the somatogravic illusion and lowered the aircraft's nose.

At 2002:43, the King Air struck trees near a river bank 2,880 ft (878 m) from the end of the runway and descended into a hillside.

"The collision with the ground was survivable to most of the aircraft occupants because the aircraft decelerated gradually, with the flexing and shredding trees absorbing impact forces as the aircraft traveled through them," the report said.

The fuel tanks were ripped open, however, and a fuel-fed fire eventually consumed all but the rear fuselage and tail of the King Air. Meanwhile, the first officer and one passenger were able to force the cabin door open.

"The occupants evacuated the aircraft with difficulty, with only the clothing they had been wearing," the report said. "The survival and first-aid kits on board were either inaccessible or could not pass through the limited opening of the door." Outside air temperature was about –17° C (1° F).

The first officer and the passenger who helped him open the door dragged the other passenger and the captain away from the burning wreckage. The accident site was not accessible by foot or by road. The first rescuers arrived on snowmobiles at about 2200.

CRM Skills Not Honed

The report said that the crew's lack of coordination and ineffective communication during the approach and go-around were caused in part by the absence of recent CRM training.

The captain had not received CRM training since March 2000, and the first officer had received only 16 hours of instruction in human factors and decision making while attending an aviation college from 2001 to 2003.

Transwest Air did not provide — and was not required by Canadian Aviation Regulations (CARs) to provide — recurrent CRM training for its air taxi and commuter pilots.

Without recurrent training, CRM skills fade. "Measurements of the impact of CRM training show that, after initial indoctrination, significant improvement in attitudes occurs regarding crew coordination and flight deck management," the report said. "Research also shows that, when there is no reinforcement of CRM concepts by way of recurrent training, improvement in attitudes observed after initial indoctrination tends to disappear."

Based on these findings, TSB called on Transport Canada to revise the CARs to require aircraft operators governed by Subpart 703, *Air Taxi Operations*, and Subpart 704, *Commuter Operations*, to provide their pilots with annual, recurrent CRM training that includes threat and error management.

This article is based on TSB Aviation Investigation Report A07C0001, "Collision With Terrain: Transwest Air Beech A100 King Air, C-GFFN; Sandy Bay, Saskatchewan; 07 January 2007." The full report is available from the TSB Web site, <tsb.gc.ca>.

European Regions Airline Association

ERA Director General Mike Ambrose, right, and Rosenkrans

European Regional Airlines Applaud Article

A two-part *AeroSafety World* article on controversial deicing/anti-icing practices in Europe brought recognition to Flight Safety Foundation's publications staff in October during the General Assembly of the European Regions Airline Association (ERA). The ERA Hank McGonagle Journalism Award 2009/10 was accepted in Interlaken, Switzerland, by Wayne Rosenkrans, a senior editor who wrote about the subject under the title "Winter of Discontent." The association presents the annual award for "excellent, accurate and discerning reporting on topical issues related to the intra-European air transport industry."

The article (*ASW,* 10/08, p. 26, and *ASW,* 11/08, p. 15) focused on rare aircraft flight control restrictions caused by the freezing of rehydrated residues left when anti-icing fluids repeatedly dry on aerodynamically quiet internal surfaces. Development of residue-free anti-icing fluid standards could take five years, and competing interests often have divided stakeholders on solutions. Reformers and the European Aviation Safety Agency have called for better incorporation of aircraft design information, maintenance instructions, fluid specifications and operational factors into current practices.

FedEx Express Receives Honeywell *Bendix Trophy*

The Foundation presented the annual Honeywell *Bendix Trophy* for Aviation Safety in October to five members of the Strategic Projects Team in the Air Operations Division of FedEx Express for development of a U.S. Federal Aviation Administration–approved freighter fire suppression system (see p. 39). The team members honored were Art Benjamin, Joel Murdock, Jeff Peltz, Mark Petzinger and Bruce Popp. The award was presented at the National Business Aviation Association Annual Meeting and Convention in Orlando, Florida, U.S.

The system was developed initially for FedEx DC-10 and MD-11 freighters, and eventually will be installed on all the company's new production aircraft prior to entering service. In-flight fire has been a significant risk to cargo airplanes because some areas of typical cargo compartments have been inaccessible. The system uses infrared heat detection and heat modeling to pinpoint a fire, which the system attacks directly with a fire-extinguishing agent.

"This is a game-changer," said William R. Voss, FSF president and CEO. "This system required thousands of hours of testing and development but it was worth it. FedEx pilots now have an enhanced level of protection from cargo fires that could occur."

Administered by the Foundation, the *Bendix Trophy* was re-established in 1998 by AlliedSignal, which later merged with Honeywell, to recognize contributions to aerospace safety by individuals and institutions through innovation in advanced safety equipment and equipment utilization.

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Dousing the FLAMES

FedEx is equipping its aircraft with an automatic fire-suppression system — a first for transport category cargo airplanes.

BY LINDA WERFELMAN

For years, aviation safety advocates have decried the absence of any requirement for active fire-suppression systems on the main decks of transport category cargo airplanes.

The U.S. National Transportation Safety Board (NTSB) has repeatedly issued safety recommendations calling for the installation of such systems, which currently are required by the U.S. Federal Aviation Administration (FAA) only in the cargo compartments of passenger aircraft — not in the Class E cargo compartments most common in U.S. cargo airplanes.

Now FedEx Express, after 10 years of design and development, has begun installing the industry's first on-board automatic fire-suppression system in the airplanes used for its

Fed Ex's fire-suppression system includes an overhead cargo-container injector.

international overwater flights.[1] By late November, the system had been installed on eight FedEx McDonnell Douglas MD-11 freighters, said Bruce Popp, manager of strategic project engineering for FedEx Express.

"We plan to install the fire-suppression system on all of our fleet that fly to international destinations — aircraft that cannot land quickly should a fire take place," Popp said. Installations are being performed at a rate of about one a month, but that pace is likely to increase on the 59 MD-11s and 30 Boeing 777s, and the work is likely to be completed by early 2011, he said.

FedEx describes the system as "a network of infrared thermal sensors, foaming-agent generators and an overhead cargo-container injector." Key elements of the system are its automatic operation, which requires no initiating action by the crew, and the overhead positioning of the extinguishing agent.

If the sensors detect heat in one of the cargo containers, the fire-suppression equipment located above the container is activated and the crew is alerted. An overhead injector pierces the container and fills it with an argon-based foam that extinguishes the fire within several minutes.

The argon foam — biodegradable and noncorrosive, and often the fire-extinguishing agent of choice when damage to electronics and other sensitive equipment must be avoided — does not harm the contents of the container, and other containers in the same airplane are unaffected by activation of the fire-suppression system.

In tests, including those that were conducted as part of the certification process that preceded the FAA's 2006 issuance of a supplemental type certificate (STC) approving FedEx's installation of the equipment, the fire-suppression system quickly extinguished three classes of fires: Class A fires involving ordinary materials such as paper or lumber; Class B fires involving gasoline, kerosene and other flammable or combustible liquids; and Class D fires involving lithium, magnesium, titanium, potassium, sodium and

Argon-based foam is used to extinguish flames within minutes.


© FedEx

other combustible metals that burn at very high temperatures.[2] The FedEx system is the only system currently in use that is effective against Class D fires, the company said.

Electrical equipment — present in a Class C fire —is transported separately, in the lower belly of an aircraft, where Halon bottle fire-extinguishing systems are used.

Because the fire-suppression system is not designed for palletized cargo, FedEx has developed another method of controlling fires, wrapping a fire-retardant blanket around pallets to restrict the amount of oxygen inside. By limiting the oxygen that would feed the fire, the blanket keeps the fire smoldering for at least three to four hours — long enough to allow flight crews even on FedEx's longest overwater routes to divert to an alternate airport and conduct a safe landing.

20 Percent

Data show that 20 percent of all air cargo accidents from 1990 to 2006 involved fire,[3] and Dave Wells, a captain and the FedEx Central air safety chairman for the Air Line Pilots Association, International (ALPA), said that, of six FedEx hull losses, five resulted from fires.

One of the more recent fire-related air cargo accidents involved a United Parcel Service (UPS) McDonnell Douglas DC-8-71 whose three-member crew scrambled from the burning airplane after an emergency landing at Philadelphia International Airport on Feb. 7, 2006. The crewmembers suffered minor injuries from smoke inhalation and the airplane was destroyed. Fire damage was so extensive that the NTSB was unable to identify the ignition source ("Cargo Airplane Fires," p. 42).[4]

The NTSB blamed the absence of a fire-suppression system for the destructiveness of the fire and issued a safety recommendation calling on the FAA to require the installation of fire-suppression systems in the cargo compartments of all cargo aircraft operated under Federal Aviation Regulations Part 121 air carrier operations. The systems have been required since 1998 in the cargo compartments of passenger aircraft.

"The accident airplane was not required to be equipped with a fire-suppression system, and, as a result, the fire, which began as a smoldering fire in one of the cargo containers, was able to develop into a substantial fire that burned through the container and ceiling liner while the airplane was airborne," the NTSB said in the Dec. 17, 2007, safety recommendation. "The Safety Board has had longstanding concerns about the lack of fire-suppression systems in cargo compartments."

In its recommendation, the NTSB acknowledged the FedEx actions to voluntarily develop a fire-suppression system, adding that installation of the systems could mitigate the threat from cargo fires.

In response to the recommendation, the FAA, along with the U.K. Civil Aviation Authority, ordered a study of the likely effects of implementing the recommendation, including a cost/benefit analysis. The study, released in April 2009, focused on Halon fire-extinguishing systems and concluded that their installation likely would be beneficial in reducing fatal and serious injuries, as well as damage to the aircraft, its cargo and property on the ground.

Earlier Crashes

The impetus for the FAA's requirement for smoke-detection and fire-suppression systems for cargo compartments in passenger aircraft was the May 11, 1996, crash of a ValuJet DC-9 in the Florida Everglades.[5] The airplane was destroyed in the crash and all of the 105 passengers and five crewmembers were killed.

As a result of its investigation of that crash, the NTSB called for smoke-detection and fire-suppression systems for all Class D cargo compartments — on cargo airplanes as well as passenger airplanes. The subsequent FAA rule change dealt only with passenger airplanes, however.

The agency also turned aside a 1998 NTSB recommendation — issued after a 1996 fire that destroyed a FedEx DC-10 — that called for on-board fire-extinguishing systems "if they were deemed feasible."

Cargo Airplane Fires

The following are major fire-related accidents in U.S.-registered cargo airplanes:[1]

- A United Parcel Service (UPS) McDonnell Douglas DC-8-71 was destroyed by fire after an emergency landing at Philadelphia International Airport on Feb. 7, 2006. The three flight crewmembers suffered minor injuries from smoke inhalation. The U.S. National Transportation Safety Board (NTSB) did not determine the cause of the fire but said that "the presence of a significant quantity of electronic equipment in the containers where the fire most likely originated led the Safety Board to closely examine safety issues involving the transportation of rechargeable lithium batteries on commercial aircraft, including batteries in airline passengers' laptop computers and other personal electronic devices."
- A Fokker F27-500 on a FedEx flight operated by Mountain Air Cargo from Buenos Aires to Porto Alegre, Brazil, was destroyed by fire on April 27, 2004. The crew diverted to Melo, Uruguay, after a crewmember discovered the fire in the cargo bay but was unable to extinguish it. No one was injured. The cause of the fire is unknown.[2]
- A FedEx McDonnell Douglas DC-10 was destroyed by fire Sept. 5, 1996, after an emergency landing at Newburgh/ Stewart International Airport in Newburgh, New York, U.S. The airplane was at Flight Level 330 (about 33,000 ft) on a flight from Memphis, Tennessee, to Boston when the crew determined that there was smoke in the cabin cargo compartment and diverted to Newburgh. The final report by the NTSB said that the fire continued burning for about four hours after smoke was first discovered and that the most severe heat and fire damage was in a container that contained flammable liquids. Two of the five crewmembers received minor injuries; the others were uninjured. The NTSB said that the probable cause of the accident was "an in-flight cargo fire of undetermined origin."[3]
- A Pan American World Airways Boeing 707 was destroyed by a fire on Nov. 3, 1973, when it crashed short of the runway on final approach to an emergency landing at Logan International Airport in Boston. The crew reported smoke in the cockpit about 30 minutes after departure from Kennedy International Airport in New York. The source of the smoke was not determined, but the NTSB said that it believed that "the spontaneous chemical reaction between leaking nitric acid, improperly packaged and stowed, and the improper sawdust packing surrounding the acid's package initiated the accident sequence." All three crewmembers were killed in the crash.

Notes

1. U.S. Federal Aviation Administration; U.K. Civil Aviation Authority. *A Cost-Benefit Analysis for the Installation of Fire Suppression Systems in Cargo Compartments of Cargo Airplanes*, DOT/FAA/AR-09/17. April 2009.
2. Aviation Safety Network. Accident Description. < http://aviation-safety.net/database/record.php?id=20040427-1>.
3. NTSB. Accident report no. DCA96MA079.

The FAA responded that existing procedures "regarding ventilation and depressurization were sufficient means to control a fire until the flight could land and that an on-board suppression system would add 'considerable' weight to the airplane and reduce the amount of cargo that could be carried on board."

According to some calculations, under current FAA procedures, the flight crew of an airplane with an on-board fire has about 30 minutes to safely land the airplane. However, the FAA says in AC 128-80, *In-Flight Fires*, that the available time may be much less — as little as 15-20 minutes if the fire progresses without intervention.[6]

An Aircraft-Based System

When the NTSB issued its recommendation in 2007, FedEx researchers already had been working for eight years to develop an effective fire-suppression system — and had already received the FAA's STC that paved the way for installation of the fire-suppression systems.

Their studies began in 1999, Popp said, and they initially focused on how to protect individual containers against fire.

"Because we have over 40,000 containers in our system, we quickly realized that the system must be aircraft-based to be viable," he said.

Their first efforts involved a combination of Halon bottles and an alerting system; another would have incorporated pyrotechnic gas generators, which extinguish flames by releasing nitrogen gas when they come in contact with fire.

In 2001, they began exploring the aircraft-based system that they eventually adopted.

"We first needed to develop a sensor that could pinpoint the location of the fire," Popp said. "Then we discovered that Halon was unsuitable for our purpose and we needed to develop a more effective agent, and finally we needed to develop a means to insert the agent into the offending container, with no additional involvement on the part of our loading crews or our pilots."

In final tests, the fire-suppression system succeeded each time in extinguishing the blaze, not just suppressing it for a limited amount of time, Popp said.

Notes

1. The FedEx Express team that developed the fire-suppression system — Joel Murdock, Bruce Popp, Jeff Peltz, Mark Petzinger and Art Benjamin — was recognized by Flight Safety Foundation in October 2009 with the annual Honeywell *Bendix Trophy for Aviation Safety*.

2. FAA. Advisory Circular (AC) 20-42C, *Hand Fire Extinguishers for Use in Aircraft*. March 7, 1984. The classes of fires are defined by the U.S. National Fire Protection Association and in this AC by the FAA. A revision, AC 20-42D, was published for comment in the Federal Register on Oct. 13, 2009.

3. Rosenkrans, Wayne. "Burning Issues." *AeroSafety World* Volume 3 (January 2008): 36–41.

4. NTSB. Aircraft Accident Report NTSB/AAR-07/07: "Inflight Cargo Fire; United Parcel Service Company Flight 1307; McDonnell Douglas DC-8-71E, N748UP; Philadelphia, Pennsylvania; February 7, 2006."

5. NTSB. *In-Flight Fire and Impact With Terrain, ValuJet Airlines Inc., Flight 592, DC-9-32, N904VJ, Everglades Near Miami, Florida, May 11, 1996*. Aircraft Accident Report NTSB/AAR-97/06. The NTSB said that the crash resulted from a fire in the Class D cargo compartment that was ignited by "one or more oxygen generators being improperly carried as cargo." Probable causes of the accident were that the unexpended generators were improperly prepared, packaged and identified before they were delivered to ValuJet; that ValuJet did not properly oversee its contract maintenance program involving hazardous materials requirements; and that the FAA had failed to require smoke-detection and fire-suppression systems in Class D cargo compartments.

6. FAA. *In-Flight Fires*, AC 120-80. Jan. 8, 2004.

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Cargo operators interested in ordering the FedEx fire suppression system for McDonnell Douglas MD-11s or MD-10s, or Douglas DC-10s should contact Ventura Aerospace in Van Nuys, California, U.S. Additional information is available at <www.venturaaerospace.com>.

Fire-suppression foam smothers flames without harming the contents of a cargo container.

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C&S Wholesale Grocers
CSC Transport
Cubana
Cummins
Tom Curran
Michael S. Curtin
Cyprus Aircraft Accident & Incident Investigation Branch
Cyprus Airways
Cyprus Civil Aviation Department
Czech Airlines

D

Michael Daniel
Darden Restaurants
Dasnair
Dassault Aviation
Dassault Falcon Jet
Baudouin d'Aumeries
Nicolas Medina Day
DC Aviation
Dr. Sushant Deb
Lowell Deering
Defence Department Regional Library
Defence Library Service–Albatross
Defence Library Service–Williams
Katia DeFrancq
J. de Lange
Geoff Dell
Delta Air Lines
Denim Air
Denmark Aircraft Accident Investigation Board
Department of Transport & Regional Services–Australia
Deutsches Zentrum für Luft-und Raumfahrt
DGAC–France
DHL Air
DHL International
DHL Worldwide Network
DHS CBP Office of Air and Marine
Alfonso Diaz
Dillard's
Thomas L. Divine
DNV
Dominion Aircraft
Dominion Resources
Dow Corning Corp.
Dragonair
Drummond Co.
Dubrovnik Airport
Dudley Knox Library Serials
Duke Energy
Capt. Thomas A. Duke
Dr. Jacqueline Duley
Duncan Aviation
Dunell Aviation International
Ulf Dunell
Melville Dunn
DuPont
Dutch Airline Pilots Association

E

Alan Eade
East African Safari Air
Eastman Chemical Co.
Eastman Kodak Co.
Eaton Corp.
Edith Cowan University
Andrew Edwards
Doug Edwards
EG&G Technical Services
EgyptAir
EgyptAir Cargo
Egyptair Express for Domestic & Regional Airlines
Egyptian Civil Aviation Authority
El Al Israel Airlines
Dr. Montaser Fayek El-khaldy
Embassy of France (DGAC)–U.S.
Embraer
Embry-Riddle Aeronautical University–Prescott, Arizona
Embry-Riddle Aeronautical University–Daytona Beach, Florida
Embry-Riddle Worldwide –Albuquerque, New Mexico
Embry-Riddle Worldwide–Oklahoma City, Oklahoma
Embry-Riddle Worldwide–Randolph AFB, Texas
EMC Corp.
Emerson Climate Technologies
Emerson Electric Co.
Emirates
ENAC–Ente Nazionale Aviazione Civile
Hideki Endo
Entergy Services
Enterprise Rent-A-Car
ESCO-Zodiac

Estonian Air
Estonian Civil Aviation Administration
Ethiopian Airlines
Etihad Airways
EtQ
Eurocontrol–Belgium
Eurocontrol–France
Eurocopter Deutschland
European Regions Airline Association
EVA Airways Corp.
EVAS Worldwide
Evergreen International Airlines
Express One International
ExxonMobil Corp.

F

Farragut International
Thomas A. Farrier
Federal Office of Civil Aviation–Switzerland
FedEx Express
Chen Seong Kit Felix
FHC Flight Services
Finnair
Finnish Civil Aviation Authority
First Air
FirstEnergy Service Company
First Quality Enterprises
FL Aviation
Adrianne Fleming
Flight Data Services
FlightSafety International
Flight Safety Foundation International (Moscow)
Flight Safety Foundation–Taiwan
FlightSafety Boeing Training International
FlightWorks
Florida Memorial College Library
Florida Power & Light Co.
Flowers Industries
Oscar Flowers
Flying Lion
Fokker Services
Lynda Foley
Robert T. Francis
Fraport–Frankfurt Airport Services Worldwide
Paul Fox
Jeremy Fraser
Julian Fraser
Paul Fremont
Frontier Airlines
Skip Fulton

G

Gael
Rahul Gahukar
Gannett Co.
Mark Garcia
Garuda Indonesia
Bob Gasko
Gaylord Entertainment Co.
GE Aviation
Geico Corp.
General Aviation Manufacturers Association
General Dynamcis
General Electric Co.
General Mills
Germanwings
Walter Gezari
GHS Aviation Group
Lisa Gibbs
Global Aerospace
Orin Godsey
Eric Goodman
Government of Croatia Flight Department
Rob Graham
Ken Gray
Michael Green
Group Holdings
Michael R.O. Grüninger
GTC Management Services
Davide Guida
Guild of Air Pilots and Air Navigators
Gulf Air
Gulfstream Aerospace
John Guselli
Oscar Guzman Garcia

H

Hahn Air Lines
Hainan Airlines Co.
Halliburton Co.
Donald Hammer
Capt. Frank M. Hankins
Hapag-Lloyd Flug
Harley-Davidson Transportation Co.
Hobart Harmon
Harpo Aviation Department
Harris Corp.
James Harris
HART Aviation Services
Jed Hart
Hawaiian Airlines
Hawker Beechcraft Corp.
H. E. Butt Grocery Company
Helicopter Association International
Helios Airways
Hellas Jet
The Hellenic Air Accident Investigation and Aviation Safety Board
Hemus Air
Aminta Hennessy
Heritage Flight
Hess Corp.
Hewlett-Packard Aviation
Hifly
Jeff Hilburn
Hill-Rom
Hilton Hotels Corp.
Richard Hodge
Holger Hoffmann
Alexandra Holmes
Peter Holstein
Mike Holtom
Honeywell
Hong Kong Civil Aviation Department
Hong Kong Express Airways
Lyall Howard
John Howie
Roland Howlett
Eddie Huang
Robert Humbertson
Wim Huson
Yea Fuh Hwang

I

IBM Flight Operations
Iberia Airlines of Spain
Iberworld Airlines
Icelandair
Icelandic Civil Aviation Administration
IFSC–Italian Flight Safety Committee
IHI Corporation
IHS
Poch F.lliscupides
Imperial Oil
IMS Health
Independent Pilots Association
Indian Airlines
Institut Français de Sécurité Aérienne (AIRCO)
Institute of Transportation, MOTC
Instituto Nacional de Aviação Civil
Inter Air
Inter American University of Puerto Rico, School of Aeronautics
Inter Hannover Scandinavian Branch
Interlaken Capital Aviation Services
International Federation of Air Line Pilots' Associations
International Federation of Airworthiness
International Paper
International Safety Systems
International Society of Air Safety Investigators
International Transport Workers Federation
Iran Air
Iran Aseman Airlines
Irish Aviation Authority
Israel Aircraft Industries
Israir Airline and Tourism

J

JALways Co.
Japan Aeronautical Engineers' Association
Japan Airlines
Japan Aircraft Pilots Association
Japan TransOcean Air
Jat Airways
Jayrow (Safety Manager)
JCPenney Co.
JDA Aviation Technology Solutions
Jeld-Wen
Trevor Jensen
Jeppesen
Jet Airways
Jet Aviation
JetBlue Airways Corp.
Jetflite
Richard Jones
Margaret A. Johnson
William B. Johnson
Johnson Controls
Johnson & Johnson
Paul C. Johnson
Shane Johnson
JPMorgan Chase
JSC Siberia Airlines
JSC Volga-Dnepr Airlines

K

KaiserAir
Capt. Georgios Kattidenios
Monica Kelly
Russell Kelly
Kellogg Co.
Kenya Airways
James Kewley
Key Air
KeyCorp Aviation Co.
Kingfisher Airlines
Shabnam Kinkhabwala
Morten Kjellesvig
James Klinect
KLM Royal Dutch Airlines
Jennifer Kniffin
Koch Industries
Paule Assoumou Koki
Korea Air Force Safety Center
Korean Air
Kraft Foods Global
Roman Krishtal
The Kroger Co.
Matthew Kucinski
Kuwait Airways
Nancy R. Kyle

L

La Réunion Aérienne
LACSA–Líneas Aéreas Costarricenses
Laker Airways (Bahamas)
Irene Lam
Lan Airline
Lan Argentina
LanChile Cargo
Lan Ecuador
Lan Peru
John Latta
Lauda Air–Austria
Dr. B.M. Lawrence
Gary Lawson-Smith
Robert Lee
Claude Lelaie
Randy Lewis
Level 3 Communications
LIAT
Liberty Global
Liberty Mutual Group
Libyan Arab Airlines
Lee Chi Lien
Lithuanian Airlines
Liñhas Aéreas de Moçambique
The Limited
Litton Aero Products
LMA (Lloyd's Market Association)
Lo Sheng-Chiang
Lockheed Martin Corporate Aircraft
Peter Logar
Capt. W.R. "Bill" Long
LOT Polish Airlines
Robin Low
LTU
Luchtverkeersleiding Nederland
Luftfahrt-Bundesamt
Lufthansa Cargo
Lufthansa CityLine
Lufthansa German Airlines
Peder Lundstrom
Luxair
Luxembourg Air Rescue

M

Victor Macomber
Scott I. Macpherson
Mahan Airlines Services Co.
Maintenance and Ramp Safety Society
Malaysia Airlines
Malév Hungarian Airlines
Malmo Aviation
Malta Department of Civil Aviation
Mandarin Airlines
Marathon Oil Co.
Olga Marin
The Marmon Group
Marsa Alam International Airport

Marsh
Bradley Marsh
Greg Marshall
Martinair Holland
Maryland State Police Aviation Command
Masco Corp. Flight Department
Salvador Massimiliano
MassMutual
William Mattes
Bruce Mayes
Kenneth E. Mazzola
David McBrien
Bill McCabe
Larry McCarroll
Michael McClintock
McCormick & Company
McDonald's Corp.
Matthew McGowan
Nathan McGraw
The McGraw-Hill Cos.
David McMillan
Kevin McMurtrie
MedAire
Mediterranean Aviation Co.
Stan Medved
Sergey Melnichenko
Mente
Merck & Co.
Meridiana
Andrew Merlot
Metrojet
The Metropolitan Aviation Group
Mexicana Airlines
MGM Mirage
Miami Air International
MIAT Mongolian Airlines
Mike Michaelis
Middle East Airlines–AirLiban
Middle Tennessee State University
Andrew Miller
C.O. Miller
Milliken & Co.
David Minty
P.K. Misra
Mission Safety International
MIT Lincoln Laboratory
The MITRE Corp.
Dr. Kjell Mjos
MK Airlines
M.K. Seneca College
M&N Aviation
Frank Moloney
Monsanto Aircraft Operations
Montenegro Airlines
Robert D. Moreau
Juan Luís Martín Moreno
Morro Vermelho Taxi Aereo
Motorola
Carlos F. Moyano
John Murdoch
David Muthoka
Mutual of Omaha

N

Kirk Nance
Ronald G. Naranjo
Ian Nash
National Aerial Firefighting Centre
National Aeronautic Association of the USA
National Aerospace Laboratory (NLR)–Netherlands
National Air Transportation Association
National Association of Flight Instructors
National Business Aviation Association
National Center for Atmospheric Research
Nationwide Insurance
Nav Canada
NAVIAIR
Todd Nelson
Netherlands Civil Aviation Authority
NetJets
New Zealand Civil Aviation Authority
New Zealand House of Representatives
New Zealand Transport Accident Investigation Commission
Nippon Cargo Airlines
Norfolk Southern Corp.
Casey Norman
Capt. Robert Norris
Northrop Grumman Corp.
Northwest Airlines
Northwestern University Library
Norway Civil Aviation Authority
Novartis
William Nuttall

O

Thomas O'Brien
Office Depot Aviation
Jack Olcott
Olympic Airlines
Oman Aviation Services Co.
Omni Air International
Onur Air
Stephen Ormerod
John Overton
Owens Corning
Owens-Illinois General

P

Pakistan International Airlines
Dhamseth Pallawela
Michael Parker
Parker Drilling Co.
Parker Hannifin Corp.
PAR Travel Tech
Partner Reinsurance Co.
Pegasus Airlines
David Phillip Pelchen
Timothy Penney
Pentastar Aviation
PepsiCo
Gregor Pesch
Jim Petosa
Petrobras
Petroleum Air Services
PetSmart
Pfizer
Philippine Airlines
Piaggio Aero
The Pictsweet Co.
Pilatus Aircraft
Pilatus Australia
Pinnacle Airlines
Pioneer Hi-Bred International
David Platten
Joseph Playford
PLUNA Líneas Aéreas Uruguayas
PMI Global Services
Polish Air Navigation Services Agency
Polyspring Enterprises Co.
Port Authority of New York & New Jersey
Portugália Airlines
PPG Industries
P.P. Porty Lotnicze
Pratt & Whitney
Precision Air Services Limited
Presage Group
Presidential Flight–Abu Dhabi
Prestige Jet
Prime Jet
Robert L. Prince
Principal Financial Group
Printpack
David George Prior
PrivatAir–Switzerland
Procter & Gamble
Professional Aviation Maintenance Association
Progress Energy
PT (Persero) Angkasa Pura II
Purdue University Aviation Technology Department

Q

Qantas Airways
Qatar Airways
Ken R. Qualls
Michael J. Quiello

R

R Cubed Consulting
Rabbit-Air
RAF Centre of Aviation Medicine
James M. Rainbow
Rand Corp.
Raytheon Co.
Recreational Aviation Australia
Capt. Erik Reed Mohn
Regional Airline Association
Haytham Remawi
Kenneth Andrew Repke II
Régional
Rob Rich
Erik Rigler
Rio Tinto
RJ Reynolds Tobacco Co.
Robert Bosch
Robertson Aviation
Capt. David Robertson
Rockwell Automation
Rockwell Collins
Rocky Mountain Helicopters
Rolls-Royce North America
Alan Ross
Rossiya–Russian Airlines
Royal Air Maroc
Royal Brunei Airlines
Royal Flight of Oman
Royal Jet
Royal Jordanian Airlines
RUAG Aerospace
Amilton Camillo Ruas
William Runciman
Douglas Runyon
JR Russell
Jacqueline Rutter
Rwandair Express
Ryanair

S

Saab Aircraft
SA Airlink
Sabena Flight Academy
Safair
Saferflight
Safe Flight Instrument Corp.
Safegate Airport Systems
Safety Focus Group
Safety Operating Systems
Safety Wise Solutions
Safi Airways
Sagem Défense Sécurité
Sahara Airlines
Massimiliano Salvador
Samsung Techwin
Geoff Sartori
Roberto Sarmiento
Renata Sarno
SAS Scandinavian Airlines Norway
SATA
Jun Sato
Saudi Arabian Airlines
Saudi Aramco
SCANA Corp.
Scandinavian Airlines System
Matthias Schedler
Schering-Plough Corp.
Ronald Schleede
Scott Schleiffer
Christiane Schreibert
The Schwan Food Co.
Douglas Schwartz
Werner Schweizer
Sears
Juan Sendagorta
Sentient Flight Group
Shandong Airlines
Shanghai Airlines
Sharjah Civil Aviation Department (DCA Sharjah)
John Sharp
Shaw Communications
Shaw Managed Services
Neil James Shaw
Shell Oil Company
Shenzhen Airlines
Jacqueline Shepard
Beverly A. Shihara
Sichuan Airlines
Capt. Andrew Siddell
Alexander Sidlowski
Signature Flight Support
Keith Siler
SilkAir
Sindicato Nacional de Pessoal de Voo da Aviaçao Civil–Portugal
Sindicato Nacional dos Aeronautas
Singapore Airlines
Singapore Airlines Cargo
Mandesh Singh
Rajash Singh
Sirocco Aerospace International
Liam Sisk
Skycare Aviation Safety Society (India)
Skippers Aviation
SkyRiver Management
Skyservice Airlines

Skyways Express
SMQ Airport Services
SN Brussels Airlines
SNECMA
George Snyder
Dr. Quay Snyder
Hiroshi Sogame
Sonair
Daniel Sonntag
Sony Aviation
Raul Sosa
Anton Benjamin Sosic
South African Airways
South African Civil Aviation Authority
Southeastern Alberta Institute of Technology
Southern Methodist University
Southwest Airlines
Southwest Airlines Pilots' Association
Spanair
Peter Spurgin
Sprint Nextel
John Spurgin
SriLankan Airlines
Starlite Group
State Farm Insurance–Air Transport
Statens Haverikommission
Steelcase North America
Daniel Stieger
Doug Stott
St. Philips College
Sudan Airways
Rodney Sullivan
SUN-AIR of Scandinavia
Sundt Air, Norway
Superstructure Group
Supervalu Aviation
Surinam Airways
Swedish Transport Agency, Civil Aviation Department
Swets Information Services
Swiss Air Ambulance
SwissAlpa–AEROPERS
Swiss International Air Lines
Swiss Pool for Aviation Insurance
Syrianair

T

TAAG–Linhas Aereas de Angola
TACA International Airlines
Anthony Taggart
Taiwan Civil Aeronautics Administration
TAM Brazilian Airlines
TAME–Linea Aerea del Ecuador
TANS–Transportes Aereas Nacionales de la Selva
TAP Portugal
Target Corp.
Gary Tarizzo
TAROM–Romanian Air Transport
Joseph Teixeira
Teledyne Controls
Telstra Childflight
Jesper Terp
Texas Instruments
Thai Airways International
Thales Aerospace
Thales Services SAS
Thomas Cook Airlines
Stephen Tomkins
Catherine Thompson
Dr. Jeffrey E. Thompson
Ted Thompson
Hugh Teel Jr.
Mac Tichenor
The Timken Co.
TNT Airways
Darwansjah Toligi
Torong Guyana Co.
Jane K. Toth
Transaero Airlines
TransAsia Airways
Transavia.com
TransCanada
Trans-Exec Air Service
Transwede Airways
Transport Canada
Transportation Safety Board of Canada
Transportes Aéreos del Mercosur
Transportes Aeromar
Travelers
NS Travers-Griffin
John Trevett
Karma Tshetrim
Colin Tuckerman
Tudor Investment Corp.
TUI Airlines (Arkefly, Corsairfly, Hapagfly, Jetairfly, Thomson Airways, TUI Aviation GmbH, TUIFly Nordic AB)
Tunisair
Turkish Airlines

U

U.K. Civil Aviation Authority
U.S. Federal Aviation Administration
U.S. National Transportation Safety Board
U.S. Naval Research Laboratory–Monterey
U.S. Naval Safety Center
Carlos Montufar Ugalde
Ukraine International Airlines
UNISA Aviation Academy/Center for Sleep Research
United Airlines
United States Aviation Underwriters
United States Steel Corp.
University Aviation Association
University of North Dakota
University of Southern California
University Zagreb, Faculty of Transport and Traffic Sciences
UnumProvident Aviation Department
Dr. A.R. Upadhya
UPS Airlines
US Airways
UT Air
UTFlight

V

V1 Aviation Training
Paolo Valdes
Ray Valeika
Valero Energy Corp.
The VanAllen Group
Vancouver Airport Authority
Andreas van de Sand
Sander Vandeth
Varig Logistica
Vaughn College of Aeronautics
Peter Venuleth
Vereinigung Cockpit–German Air Line Pilots' Association
Verizon
Terrence Vickers
Victory Aviation
Vienna International Airport
Vietnam Airlines
John Vincent
Virgin America
Virgin Atlantic
Virgin Blue Airlines
Virgin Nigeria Airways
Vladivostok Air
Alfred Vlasek
David L. Vornholt
VRG Linhas Aereas

W

Waitt Media
Anthony Walker
William Wallace
Wal-Mart Aviation
Don-Marshall Wanjoku
Washington Airports Task Force
WCF Aircraft Corp.
Abednego M. Wenjere
Michael J. Wetsman
Glenn Wicks
Juergen Wiese
William R. Welch
WestJet Airlines
Whirlpool Corp.
Capt. Bruce Whitby
Michael White
Whiteco Industries
Widerøe's Flyveselskap
Urs Wildermuth
The Williams Cos.
Hans Willemsen
Will Wohler
Women in Aviation International
Woodside Energy
Mark Wulber

X

Xerox Corp.
Xiamen Airlines

Y

Terry Yaddaw
Yemen Airways
Steven Khoo Hock Yew

Z

Zambian Airways
Zauril Aviation
Zeno Air
Ziff Brothers Investments
Zimex Aviation
Robert Zomonita
Franc Zeljko Zupanic

Students

Petra Becker
Anthony Chan
Julie Falsken
Philip A. Garcia
Ryan Hill
Neal Jelsona
Morten Kjellesvig
Max Knobloch
Brittney Pacheco
Shivneel Prakash
Justin Thielen

BY RICK DARBY

Madrid Accident Overshadows EASA Data

Fatal accidents in member states remained below the 10-year average in 2008.

Airplanes registered in member states of the European Aviation Safety Agency (EASA) had three fatal accidents in 2008, the same number as in 2007, according to data released in EASA's annual safety review.[1,2] But on-board fatalities for 2008 totaled 160, in contrast with 25 the previous year. Most of 2008's fatalities resulted from the crash of a McDonnell Douglas MD-82 in Madrid on Aug. 20 that took 154 lives.[3]

The total number of EASA airplane accidents in commercial air transport was lower in 2008 than in 2007, though greater than the 1997–2006 average (Table 1). The number of fatal accidents was half that of the 1997–2006 average.

The fatal accident rates for both EASA airplanes and those registered elsewhere in the world in scheduled passenger operations trended downward in the 1999–2008 period (Figure 1). Throughout the period, the fatal accident rate was lower for EASA airplanes.

The proportion of EASA airplane accidents among worldwide fatal airplane accidents in 2008 was 6 percent. It had

Accidents and Fatal Accidents, EASA Member State Airplanes

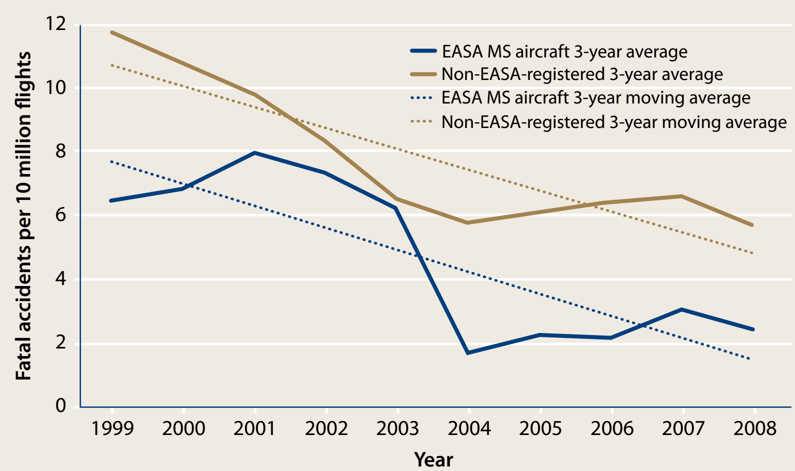
Period	Number of Accidents	Fatal Accidents	On-Board Fatalities	Ground Fatalities
1997–2006 (average)	32	6	105	1
2007 (total)	37	3	25	1
2008 (total)	35	3	160	2

EASA = European Aviation Safety Agency

Source: European Aviation Safety Agency

Table 1

Fatal Accident Rate, Scheduled Passenger Operations, Airplanes

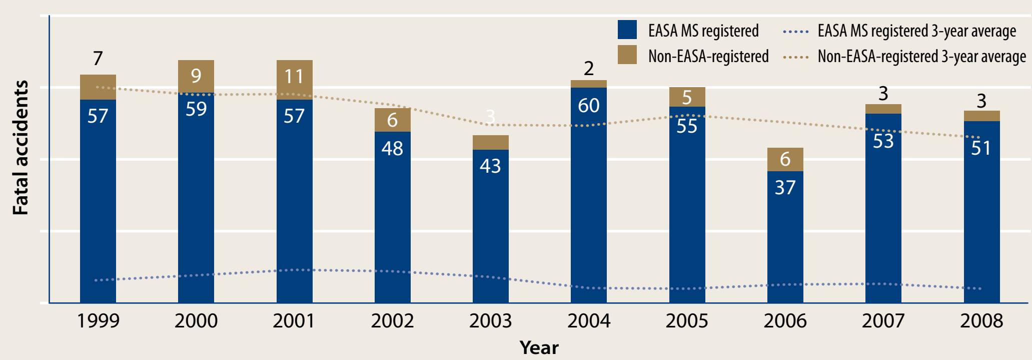


EASA = European Aviation Safety Agency; MS = member state

Source: European Aviation Safety Agency

Figure 1

Fatal Accidents, Commercial Air Transport, 1999–2008

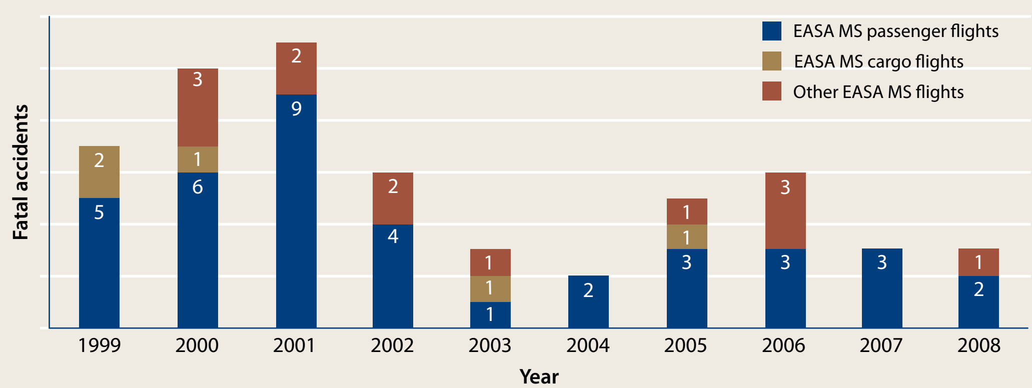


EASA = European Aviation Safety Agency; MS = member state

Source: European Aviation Safety Agency

Figure 2

Fatal Accidents by Type of Operation, EASA Member States



EASA = European Aviation Safety Agency; MS = member state

Source: European Aviation Safety Agency

Figure 3

been as high as 16 percent in 2001 and 14 percent in 2006 (Figure 2).

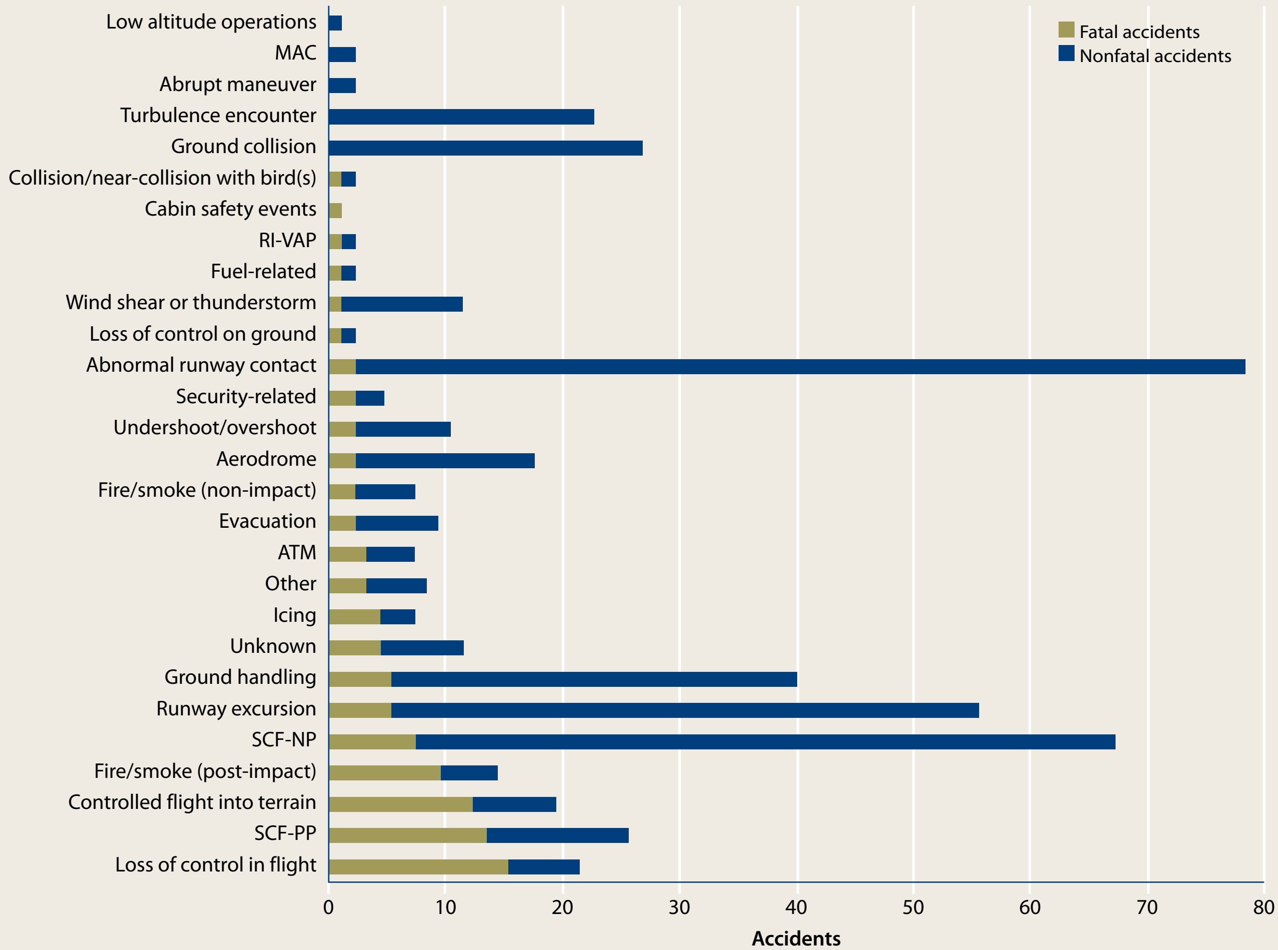
During that same 1999–2008 decade, the number of fatal accidents involving EASA airplanes varied among passenger, cargo and "other" operations such as on-demand and positioning flights (Figure 3). In 2008, a third involved cargo operations; in 2007, none; in 2006, half. Because of the small numbers, the review cautions that these may be random variation.

Among the worldwide fatal accidents, excluding EASA airplanes, the review suggests that "passenger commercial air transport flights appear to have a declining proportion in the total number of fatal accidents." It says that "other" commercial air transport operations "have an increasing proportion of the total. … It is worth noting that the proportion of accidents in this category is significantly higher than the proportion of aircraft conducting such operations."

The review analyzed fatal and nonfatal accidents involving EASA airplanes according to causal categories developed by the Commercial Aviation Safety Team/International Civil Aviation Organization Common Taxonomy Team (CICTT) to facilitate uniform accident and incident reporting (Figure 4).[4] A single accident could be assigned to more than one category if it was considered to have multiple causal factors.

The categories associated with the highest number of fatal airplane accidents in the 1999–2008 stretch were "loss of control in flight," "powerplant system or component failure or malfunction" — hereafter called "component failure" — and "controlled flight into terrain." For total accidents, the most frequent associated categories were "abnormal runway contact," "non-powerplant component failure," "runway excursion" and "ground handling."

Accident Categories, EASA Member State Airplanes, 1999–2008



ATM = air traffic management/communication, navigation and surveillance; EASA = European Aviation Safety Agency;
MAC = airprox/terrain avoidance and warning system alert/loss of separation/near-midair collision/midair collision; RI-A = runway incursion — animal;
RI-VAP = runway incursion — vehicle, aircraft or person; SCF-NP = system/component failure or malfunction (non-powerplant);
SCF-PP = system/component failure or malfunction (powerplant)

Note: Categories were established by the Commercial Aviation Safety Team/International Civil Aviation Organization Common Taxonomy Team. An accident could be assigned to more than one category.

Source: European Aviation Safety Agency

Figure 4

Accidents, EASA Member State Helicopters

Period	Number of Accidents	Fatal Accidents	On-Board Fatalities	Ground Fatalities
1997–2006 (average)	8	3	12	0
2007 (total)	7	1	7	0
2008 (total)	8	2	4	0

EASA = European Aviation Safety Agency

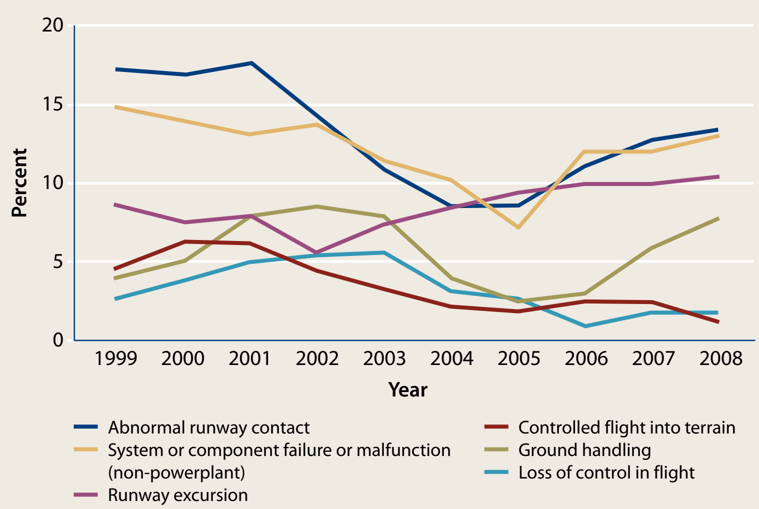
Source: European Aviation Safety Agency

Table 2

In recent years, the trend lines show an increase in "abnormal runway contact," "non-powerplant component failure," "ground handling" and "runway excursion" (Figure 5, p. 52).

The safety review says, "In many cases, runway excursions are consequential events in accidents, and therefore, a large number of accidents are assigned this category. There has been an increase in the rate of accidents associated with 'flight preparation, loading or ground servicing.' … Accidents attributed as 'controlled

Accident Category Rates, EASA Member State Airplanes, 1999–2008



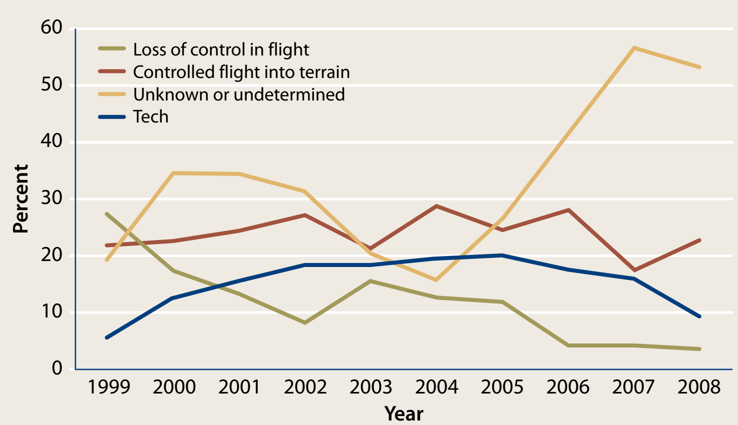
EASA = European Aviation Safety Agency

Note: Categories were established by the Commercial Aviation Safety Team/International Civil Aviation Organization Common Taxonomy Team. An accident could be assigned to more than one category.

Source: European Aviation Safety Agency

Figure 5

Top Four Helicopter Fatal Accident Categories, 1999–2008



EASA = European Aviation Safety Agency

Note: Data include EASA-registered and Non-EASA-registered helicopters in commercial transport operations. "Tech" is a combination of powerplant and non-powerplant component failures.

Source: European Aviation Safety Agency

Figure 6

flight into terrain' appear to have an overall decreasing rate."

In 2008, there were eight accidents involving EASA helicopters, two of them fatal (Table 2, p. 51). Both were increases over 2007.

Fatal accidents involving EASA helicopters represented 12 percent of all helicopter accidents in 2008. That compared with 33 percent in 2005, 21 percent in 2006 and 7 percent in 2007.

The top CICTT category associated with all helicopter accidents — fatal and nonfatal — was "other," which the safety review says were mainly collisions with objects on the ground during takeoff and landing.[5] The categories, developed for accidents involving large commercial airplanes, had no specific designation for such events. "Loss of control in flight" and "powerplant component failure" were the next most commonly assigned categories.

For all fatal helicopter accidents, the most frequently cited category was "unknown," which the safety review ascribed to insufficient reporting. "Controlled flight into terrain" was next most frequent, followed by "loss of control in flight" and "other."

"Powerplant" and "non-powerplant component failure" were combined into a single category called "tech" for a trend analysis of the top four categories (Figure 6). "Loss of control in flight" and "tech" have been in a down trend beginning in 2006. "Controlled flight into terrain" shows no discernible overall trend during the 10-year period beginning in 1999.

Notes

1. The report, *Annual Safety Review 2008*, is available via the Internet at <www.easa.europa.eu/essi/documents/AnnualSafetyReview2008_en.pdf>.
2. EASA member states are the 27 European Union states plus Iceland, Liechtenstein, Norway and Switzerland. Data in this article concern commercial transport aircraft with a maximum certified takeoff weight of more than 2,250 kg/5,000 lb. State of registry, rather than accident location, determines inclusion in the data.
3. For simplicity, aircraft registered in an EASA member state are called EASA airplanes and EASA helicopters in the following text.
4. The CICTT categories are given in Appendix 2 of the safety review and are online at <www.intlaviation-standards.org>.
5. The data are presumably for the 1999–2008 period, although this is not specifically stated.

Sample Case

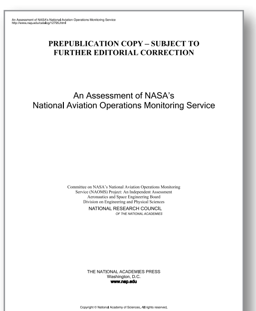
Researchers were not the masters of all they surveyed.

REPORTS

Questionnaire Trouble

An Assessment of NASA's National Aviation Operations Monitoring Service

National Research Council of the National Academies. Washington, D.C.: The National Academies Press, 2009. Pre-publication copy, subject to further editorial correction. 146 pp. Available via the Internet at <www.nap.edu/catalog/12795.html>.



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An Assessment of NASA's
National Aviation Operations Monitoring Service

Committee on NASA's National Aviation Operations Monitoring Service (NAOMS) Project: An Independent Assessment
Aeronautics and Space Engineering Board
Division on Engineering and Physical Sciences
NATIONAL RESEARCH COUNCIL
OF THE NATIONAL ACADEMIES

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The National Aviation Operations Monitoring Service (NAOMS) comprised a survey of pilots by the U.S. National Aeronautics and Space Administration (NASA) that began in April 2001 and concluded in December 2004. Its results probably would have rested in benign neglect had not the Associated Press (AP) requested, through the Freedom of Information Act, details of the survey. NASA refused the request, saying, "Release of the requested data, which are sensitive and safety-related, could materially affect the public confidence in, and the commercial welfare of, the air carriers and general aviation companies whose pilots participated in the survey."

An AP article, citing an unnamed source familiar with the survey results, said that "the pilots reported at least twice as many bird strikes, near-midair collisions and runway incursions as other government monitoring systems show."

A U.S. House of Representatives committee held a hearing on NAOMS, during which the NASA administrator expressed disagreement with the wording of NASA's denial and said that the information request was rejected because "the data likely contained confidential commercial information." He said that a redacted, de-identified version of the data would be released.

The administrator added that "none of the research conducted in the NAOMS project, including the survey methodology, has been peer-reviewed to date. Accordingly, any product of the NAOMS project, including the survey methodology, the data and any analysis of that data, should not be viewed or considered at this stage as having been validated."

NASA asked the National Research Council (NRC) of the National Academies to "assess the NAOMS survey methodology and to analyze the publicly available survey data to determine their potential utility." An NRC committee formed for the task released this draft report.

"The sampled pilots were contacted first by mail with a pre-notification letter from the NAOMS team," the report says. "This letter was followed by a telephone call during which the survey was administered. … The survey questionnaire included a computer screen to allow checking for qualifying activity during the *recall period* — which consisted of [a period] varying initially from 30 to 90 days but fixed at 60 days after March 2002. The survey was conducted by professionally trained interviewers using a computer-assisted telephone interview system."

The report found that the NAOMS overall methodology — a sample survey — was a valid way of collecting relevant data. It says, "Generally speaking, NAOMS was an attempt to capture the experiences of frontline personnel (pilots, flight attendants, air traffic controllers and mechanics) regarding flight operations and aviation safety. In the committee's view, such information could be potentially useful, particularly in those segments of aviation [such as general aviation] that are not well covered by the other databases. In addition, carefully planned surveys can provide useful information not only about specific events, but about the views and perceptions of the frontline personnel on flight operations. However, care must be taken to solicit information only when they are in a position to provide accurate and consistent responses."

The NAOMS team had selected pilots meeting certain criteria from the U.S. Federal Aviation Administration (FAA) Airmen Certification Database for its sample. There were actually two surveys, one of air carrier (AC) pilots operating under U.S. Federal Aviation Regulations [FARs] Part 121, and another of general aviation (GA) pilots. But, says the report, "The flights of interest in the GA questionnaire were those conducted under FARs Part 91 and 135. However, because FARs Part 135 governs the operation of scheduled commuter carriers and on-demand 'for hire' air taxi and charter providers, including flights operated under Part 135 in the general aviation survey extended the notion of general aviation well beyond normal usage of the term."

"The questionnaires were designed so that events and experiences from markedly different segments of the aviation industry were aggregated together (and cannot be disaggregated)."

Ideally, the report says, the sampling frame would have been the list of all flight legs during the recall period. "However, collecting data for a simple random sample of flight legs would not have been economical or even feasible," the report said. "The NAOMS team decided to draw samples of pilots and to ask them about all events that occurred during the recall period."

Thus, pilots and not flight legs were the primary sampling unit, which resulted in what statisticians call a cluster sample. "Such a cluster sample of flights differs from a simple random sample in several ways," the report says. "In particular, the flight legs of any particular pilot are either sampled or not sampled as a group. This typically reduces the information content relative to a simple random sample of the same size because the responses within clusters are likely to be correlated." In other words, the same data sources are being sampled more than would be the case in a random sample.

The AC pilot sample was limited to U.S.-based pilots who had an airline transport pilot certificate, multi-engine rating and a flight engineer (FE) certificate. "However, some active AC pilots do not meet all these criteria," the report says. "Many AC pilots, including captains and first officers, do not hold an FE certificate."

Most modern aircraft have eliminated the flight engineer as a crewmember. As a result, pilots who had an FE certificate, and were therefore eligible for the survey, were likely to be senior pilots whose FE certificates were a legacy of their early careers. Such pilots were also more likely to be flying widebody aircraft, the report says. The survey's inclusion criteria "excluded many active air carrier pilots and appears to have led to biases such as over-representation of widebody aircraft and under-representation of small aircraft in the NAOMS sample," the report says.

In its analysis of the NAOMS questionnaires — separate ones for AC and GA pilots, with the same "structure" but different questions as appropriate — the NRC review committee found four types of problems.

First, "the questionnaires were designed so that events and experiences from markedly different segments of the aviation industry were aggregated together (and cannot be disaggregated)." Because of the unconventional definitions of AC and GA, and the wide variety of flights that fall under the term *air carrier*, "the inability to link safety-related events to the aircraft type or operating environment in which the event occurred severely hinders any meaningful analysis of event rates or trends in event rates by aircraft type or by segment of aviation," the report says.

Second, "some of the questions asked pilots for information they would not likely have had without a post-flight analysis." Some perceptions recalled by pilots might not have reflected the nature and cause of the event as revealed by flight data analysis — information pilots do not normally have access to, the report says.

Third, "some of the questions had vague or ambiguous definitions of what constituted an event to be measured." The report says that those included "long questions with complex structure that would be difficult to understand in a computer-assisted telephone interview; questions that appear to combine multiple, unrelated events; questions about events that are not well defined; and questions containing vague terms."

Fourth, "some of the questions did not have a clear link between the measured event and aviation safety."

The redacted data — edited to eliminate pilot identification or confidential commercial information — were released in two phases, about nine months apart. The report says that the nature of the redaction differed in its two phases, hampering analysis of the data overall. It finds other data anomalies:

"The time of survey response is grouped into years … , so estimates of event rates can be computed only by years. This limits the ability to track the changes in event rates over shorter time scales, determine the effects of changes in the aviation system on event rates and assess seasonal and similar types of effects."

The quality of the data was further compromised by other factors, the report says.

"Substantial fractions of the non-zero counts of events had implausibly large values, as did the reported flight legs and hours flown," the report says. "Simple audits to alert for such values should have been used during the computer-assisted telephone interviews and data-cleaning steps to reduce the occurrence of these problems." Further, "it appears that respondents often rounded their answers to convenient numbers; for example, there were unusually high occurrences of numbers with final digits of '0' and '5.'"

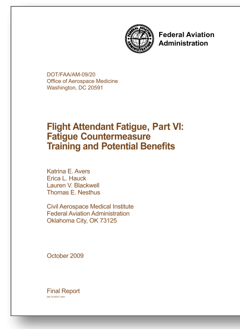
In summarizing, the report said that the NRC committee "did not find any evidence that the NAOMS team had developed or documented data analysis plans or conducted preliminary analyses as additional data became available in order to identify early problems and refine the survey methodology. … The publicly available NAOMS data should not be used for generating rates or trends in rates of safety-related events in the National Airspace System. The data could, however, be useful in developing a set of lessons learned from the project."

— Rick Darby

Beyond 'Hours of Service' Regulations

Flight Attendant Fatigue, Part VI: Fatigue Countermeasure Training and Potential Benefits

Avers, Katrina E.; Hauck, Erica L.; Blackwell, Lauren V.; Nesthus, Thomas E. U.S. Federal Aviation Administration (FAA) Office of Aerospace Medicine. DOT/FAA/AM-09/20. Final report. October 2009. 17 pp. Figure, tables, references, appendixes. Available via the Internet at <www.faa.gov/library/reports/medical/oamtechreports/2000s/media/200920.pdf>.


Federal Aviation Administration
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Flight Attendant Fatigue, Part VI: Fatigue Countermeasure Training and Potential Benefits

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October 2009

Final Report

The cabin crewmember's physiology is a square peg that must fit into a daily round of multiple flight legs, extended duty time, early departures, late arrivals, jet lag, nonstandard schedules and other strains. However, "despite operational requirements, the body's biological need for sleep to maintain alertness does not change," the report says. "Individuals are not physiologically prepared to operate effectively on the 24/7 schedules that define today's flight operations."

In an emergency, cabin crewmembers are responsible for passenger safety, and fatigue can degrade performance when it is most needed to survive an accident.

"The FAA has traditionally sought to manage fatigue through hours of service (HOS) regulations," the report says. "The increasing number of fatigue-related [U.S. National Aeronautics and Space Administration] Aviation Safety Reporting System reports, however, suggests that HOS regulations are insufficient for systematically managing fatigue for flight attendants."

Systematic fatigue management cannot be reduced to a purely numerical formula, the report says. It takes support from all parties involved: "For example, the FAA is responsible for fatigue management regulations, while the operators have a responsibility for work schedule design, workload distribution, working conditions and training. The cabin crewmembers are responsible for optimizing their rest opportunities to get the sleep they need to be fit for work and for implementing personal fatigue countermeasures as needed to mitigate fatigue and maintain alertness."

The researchers conducted a review of existing fatigue countermeasure programs in an effort to determine the critical elements that should be included. Using designated criteria, 49 programs were analyzed.

"Not all fatigue-related factors were included with the same degree of frequency across programs," the report says. "Topic areas such as sleep, circadian rhythms, nutrition, work hours and substance abuse (e.g., caffeine, alcohol) were cited more frequently, while commuting, workload and hydration topics were cited less frequently."

The report concludes that "airlines should implement training as outlined in Appendix B" — which includes recommended topics and subtopics — "and training should be integrated into broader fatigue risk management strategies."

— Rick Darby

WEB SITES

Garlic for Flight Safety

2009 Bird Strike North America Conference, <www.birdstrikecanada.com/CanadaConference.html>

Garlic is said to repel vampires. It may also be a tool in the never-ending effort to control bird strikes.

Natural garlic oil makes grass taste bitter to Canadian geese, which then move on to other locations, said Bill Milne's poster board presentation at the 2009 Bird Strike North America Conference. He added that garlic oil is also unpopular with European starlings.

The 11th joint meeting of Bird Strike Committee Canada and Bird Strike Committee USA was held recently in Canada to exchange statistics, ideas and information on wildlife mitigation and control techniques, new technologies, habitat management, training, and other influences on aviation safety.

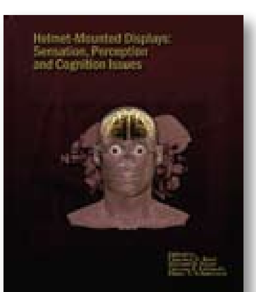
"Bird Strike Committee Canada [is] a not-for-profit organization dedicated to flight safety by

reducing collisions with birds," says its Web site. Bird Strike Committee USA describes itself as a volunteer organization composed of members from the U.S. Federal Aviation Administration, Department of Agriculture and Department of Defense; airlines and airports; and the aviation industry. The organizations hold separate meetings throughout Canada and the United States and alternate annual joint meetings.

Current and previous conference presentations and bird strike facts and statistics are available from Bird Strike Committee Canada <www.birdstrikecanada.com> and Bird Strike Committee USA <www.birdstrike.org>. This year's conference presentations focused on "Risks and Strategies to Reduce Risk," "Aircraft Design and Consequences" and "Populations, Management and the Courts." Presentations are full text and may be read online or downloaded at no cost. Meeting abstracts and poster presentations appear in the 2009 program, which may be downloaded from the Canada committee's Web site.

— Patricia Setze

BY OUR CONTRIBUTORS



It's All in Your Head

Helmet-Mounted Displays: Sensation, Perception and Cognition Issues

Rash, Clarence E.; Russo, Michael B.; Letowski, Tomasz R.; Schmeisser, Elmar T. (editors). Fort Rucker, Alabama, U.S.: U.S. Army Aeromedical Research Laboratory. 972 pp. Figures, tables, references, glossary, index.

Clarence E. Rash's most recent article for *AeroSafety World* is "Stressed Out" (8/09), with Sharon D. Manning.

MD-83 Clips Approach Lights on Departure

Errors, omissions affected the flight crew's takeoff calculations.

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 by official investigative authorities on aircraft accidents and incidents.

JETS

'Pressured by the Production Target'

McDonnell Douglas MD-83. No damage. No injuries.

The flight crew's emphasis on "production" — getting the job done — influenced takeoff performance calculations that failed to show the aircraft was too heavy to depart safely from the chosen runway, said an incident report published recently by the Swedish Accident Investigation Board (SHK).

The MD-83 lifted off near the end of the runway and struck several approach lights while struggling to become airborne. None of the 169 passengers and six crewmembers was injured, and there was no damage to the aircraft, according to the report.

The incident, classified as "very serious" by SHK, occurred the night of Sept. 9, 2007, during departure for a charter flight from Åre/Östersund (Sweden) Airport to Antalya, Turkey. The charter flight had been arranged by a Swedish travel agency and contracted to a Turkish charter airline, which in turn had entered an agreement with an Austrian company to lease the aircraft and crew.

The contract flight crew, former employees of the Turkish airline, held Turkish pilot certificates that had been validated by Austria. The commander, 38, had 9,260 flight hours, including 8,160 hours in type. The copilot, 32, had 2,060 flight hours, including 1,820 hours in type.

Night visual meteorological conditions (VMC) prevailed for the departure. The weather conditions were the same that the crew had experienced an hour earlier, when they landed the aircraft on Runway 12 at Åre/Östersund while completing the positioning flight from Antalya. Surface winds from 130 degrees at 8 kt favored takeoff from Runway 12, but the crew planned to depart in the opposite direction, from Runway 30, which provided "a more favorable climb-out profile from a performance point of view, as there were no obstacles in the climb-out direction," the report said.

However, the crew did not correct their takeoff performance calculations to account for the 8-kt tail wind that resulted from their choice of Runway 30. The takeoff performance calculations and the weight-and-balance calculations were performed by the copilot and checked by the commander. "The copilot stated that he — without remembering why — had used zero wind as a base value when he was calculating the various takeoff alternatives," the report said.

Investigators found several discrepancies in the crew's calculation of the MD-83's takeoff weight. The load sheet prepared by the crew indicated that the takeoff weight was slightly below the 155,620-lb (70,589-kg) limit for takeoff from Runway 30 under the existing conditions. However, investigators' calculations showed that the aircraft's actual takeoff weight was 6,940 lb (3,148 kg) greater than the limit.

Among the discrepancies on the load sheet was the omission of 29 bags in the forward cargo compartment. The report said that the most significant consequence of this omission was the miscalculation of the aircraft's center of gravity — and, thus, the required horizontal stabilizer and flap settings.

The crew used the full length of the runway — 2,500 m (8,202 ft) — for takeoff, applying full power before releasing the brakes. Both pilots told investigators that the MD-83 seemed to accelerate normally. The commander said that he rotated the aircraft slowly to avoid a tail strike and that the aircraft felt "nose-heavy" during rotation — a consequence of mis-setting the horizontal stabilizer.

"Data from the flight recorder showed that the aircraft rotated at about two degrees per second, against the recommended rate of about three degrees per second," the report said. The data also showed that the main landing gear lifted off the runway 30 m (98 ft) from the departure threshold and crossed the end of the runway at a height of less than 30 cm (12 in).

"Neither the crew nor air traffic control reported anything abnormal during the takeoff, and the flight continued as planned to Antalya," the report said. "Afterward, it was established that the aircraft had collided with the approach lights for the opposite runway. Damage had been made to lights and reflective poles up to a distance of 85 m [279 ft] from the runway end."

"Neither the crew nor air traffic control reported anything abnormal during the takeoff."

The report said that, when planning the departure, the crew likely knew that some passengers and/or baggage would have had to be offloaded to meet weight limits and performance requirements but were "pressured by the production target — the ambition to take all the passengers and baggage — in the belief that the deviations would not have any consequences in terms of the takeoff."

Spurious Warnings Plague Flight Crew

Airbus A319-111. No damage. No injuries.

En route with 78 passengers from Barcelona, Spain, to Liverpool, England, the afternoon of Feb. 6, 2007, the A319 was crossing the southern coast of England when an aural master warning sounded and a message on the electronic centralized aircraft monitor (ECAM) indicated a discrepancy with the no. 2 engine's exhaust gas temperature (EGT).

"The copilot continued to fly the aircraft on autopilot while the commander reviewed the ECAM checklist action items," said the report by the U.K. Air Accidents Investigation Branch (AAIB).

Shortly after generating the first caution message, the ECAM warned that the no. 2 engine EGT was above the limit. "The action items for this condition required the no. 2 (right) engine thrust lever to be moved to idle and the engine to be shut down," the report said. "The commander retarded the thrust lever and was considering the implications of shutting down the engine when the 'ENG 1 EGT OVER LIMIT' caution message appeared."

The displayed engine parameters, however, were normal. The commander concluded that the warnings likely were false, and he restored cruise power on the no. 2 engine.

Meanwhile, the aural master warning continued to be generated about four times a minute. The normal indications on the pilots' primary flight displays and navigation displays were replaced with messages similar to those that appear during alignment of the inertial reference systems. Other messages appeared, as well, warning the crew to use manual pitch trim only and to check the aircraft's attitude, for example.

The commander informed air traffic control (ATC) of the situation, declared an emergency and requested direct routing to London Stansted Airport, which had better weather conditions and longer runways than Liverpool.

The controller advised the crew that Runway 23 was in use at Stansted, and the commander programmed the flight management system (FMS) for the approach to that runway. After being handed off to another controller, however, the crew was told that Runway 05 was active. The requirement to reprogram the FMS added to the commander's workload at a critical time, the report said.

"The ECAM continued to produce various cautions and associated aural tones throughout the rest of the flight, too frequently to be read, acted upon or canceled," the report said. "The commander briefed the senior cabin crewmember and informed the passengers of the intention to divert, a task complicated by the frequent sounding of aural tones."

The copilot armed the autopilot approach mode while flying an assigned heading to intercept the instrument landing system (ILS) final approach course. However, the commander determined that the aircraft would overshoot the extended runway centerline. He took control and hand flew the final approach and landing without further incident. "The commander commented that the aircraft flew normally under manual control," the report said.

Investigators examined engine trend-monitoring data recorded before the incident and found no sign of a developing engine problem. Data recorded during the incident flight showed no engine faults. These findings confirmed that the warnings generated during the incident flight were false.

Extensive testing of the A319's electronic instrument system (EIS) pointed to an intermittent fault in one of the display management computers (DMCs) as the likely cause of the false warnings.

The incident aircraft had been involved in a similar but less complicated event on Sept. 29, 2006. The crew of that flight had received spurious messages about discrepancies related to one engine and had suspected a DMC problem. The messages stopped after the crew selected another of the three DMCs aboard the A319. "The reported symptoms could not be reproduced during subsequent troubleshooting, and the aircraft was returned to service," the report said.

The report said that the 2007 incident was more complex, and "the combination of symptoms observed by the crew did not obviously point toward a DMC fault." As a result of the investigation, the AAIB recommended that Airbus introduce either an addition to the quick reference handbook or a memory drill "to emphasize that EIS DMC switching may be an appropriate response to abnormal display unit operation."

Deflated Strut Causes Nose Gear to Jam

Bombardier Challenger 601. Substantial damage. No injuries.

The flight crew was completing an emergency medical services flight to Québec City/Jean Lesage International Airport the morning of March 20, 2008, when they received visual and aural warnings that the nose gear had not extended.

"The flight crew did a low fly-pass, and the tower controller and an aircraft maintenance engineer confirmed the nose gear anomaly," said the report by the Transportation Safety Board of Canada.

The crew conducted the appropriate checklists and made three unsuccessful attempts to correct the problem using the normal and emergency landing gear extension procedures. The crew then prepared the six passengers — three patients, a physician and two nurses — for landing with the nose gear retracted.

VMC prevailed at the airport when the crew landed the aircraft. "Damage was limited to the nose landing gear doors and the nose landing gear well structure," the report said.

Investigators determined that the gear-extension problem was related to a modification of the Challenger for operation on unpaved runways. Bombardier had developed the modification kit, which included installation of two gravel deflectors on the nose gear. "The deflectors are used to protect the aircraft exterior surfaces and engines against damage that can be caused by solid particles that are projected during takeoffs and landings," the report said. "Only eight of 255 [Challenger] models that were built are equipped with this kit."

Examination of the nose gear revealed that the strut (shock absorber) had collapsed because of a gradual loss of nitrogen pressure. Investigators determined that the likely cause of the pressure loss was a loose nut on the strut-filler valve. During the flight to Québec City, the strut had collapsed sufficiently to allow the nose gear to be released by its uplock latch. The nose gear had rotated as it fell onto the gear doors, and the gravel deflectors had jammed inside the wheel well, preventing gear extension.

The gravel deflectors had jammed inside the wheel well, preventing gear extension.

"The clearance between the gravel deflectors and the nose landing gear well structure is very narrow when compared to similar aircraft that are not equipped with gravel deflectors," the report said. "Another oleo pneumatic shock absorber (oleo strut) compression could result in the same situation occurring again."

Fast Approach Sets Stage for Overrun

British Aerospace 146-200. Substantial damage. No injuries.

The combined effects of a faster-than-appropriate touchdown speed, nondeployment of the lift spoilers and the flight crew's perception of a wheel-brake system failure and use of the emergency system caused the aircraft to overrun the available landing distance after all four main landing gear tires burst, said the AAIB report.

The serious incident occurred at London City Airport the morning of Feb. 20, 2007. The aircraft was inbound from Paris with 55 passengers and five crewmembers. VMC with light surface winds prevailed in London, but the runway was reported as wet. The copilot incorrectly calculated a reference approach speed (VREF) of 119 kt. The correct value for VREF was 110 kt, the report said.

Although the commander recalled that he selected the lift spoilers, they did not deploy.

The crew received vectors for the ILS approach to Runway 10, which has an available landing distance of 1,319 m (4,327 ft). Pavement extends 189 m (620 ft) beyond the available landing distance and includes a runway end safety area (RESA) that is bordered by a dock.

The crew gained visual contact with the runway as the BAe 146 descended below 1,000 ft. "The aircraft touched down at the far end of the touchdown zone, at 119 kt, and in an approximately level pitch attitude," the report said. It bounced and touched down again 2.5 seconds later.

Recorded flight data indicated that the control columns were moved forward of the normal position, which reduced the weight on the main wheels — and, hence, wheel-braking effectiveness. Although the commander recalled that he selected the lift spoilers, they did not deploy. This also reduced braking.

The commander believed that the lower-than-normal deceleration was a result of brake system failure. "He recalled pressing the brake pedals to their full travel but sensed that there was 'not a hint of deceleration,'" the report said. He selected another hydraulic system to power the brakes, but the aircraft continued "coasting down the runway."

The commander then selected the emergency brake system, and the aircraft seemed to decelerate slowly. "During the final part of the roll, all four main landing gear wheels locked, and the tires were worn down by the friction with the surface until they burst," the report said. The airport traffic controller saw smoke coming from the landing gear and alerted the fire and rescue service.

The aircraft came to a stop about 160 m (525 ft) from the dock. There was no fire, and the aircraft was evacuated using mobile steps.

"Examination of the aircraft after this incident found no faults in the flying controls or wheel braking systems [and] no defects that could explain the reason for the lift spoilers not deploying on landing," the report said.

However, investigators found that very little force was required to move the airbrake/spoiler lever out of the lift spoiler position. "Indeed, during the aircraft tests, it was noted that just nudging the lever while in the lift spoiler detent caused the deployed lift spoilers to retract," the report said. "With this lack of resistive force, it is possible that [the lever] could be nudged or vibrated out of the selection, thereby stowing the deployed spoilers."

The report noted that a modification recommended by the manufacturer in 1988 to increase the force required to move the airbrake/spoiler levers in BAe 146 and Avro RJ series aircraft out of the lift spoiler position had not been accomplished in the incident aircraft.

Collision Occurs During Tow on Snowy Runway

McDonnell Douglas DC-9-50. Substantial damage. No injuries.

After landing on a snow-covered runway at Madison, Wisconsin, U.S., on Dec. 3, 2008, the aircraft slid past the assigned taxiway. The flight crew received permission from ATC to make a 180-degree turn. "During the turn, the airplane began sliding on the snow, and the flight crew stopped the airplane about 90 degrees into the turn," said the report by the U.S. National Transportation Safety Board (NTSB).

The airline sent a tug to tow the DC-9 to the gate, and airport workers spread sand in front of the airplane. However, when the tug was attached and began to move, the tug and the airplane slid on the snow and jackknifed toward each other. "The tug impacted the left side of the airplane's fuselage, causing a puncture to the skin and damage to internal structural members," the report said. "The tug was subsequently reconnected, and the airplane was towed to the gate, where the passengers deplaned normally."

TURBOPROPS

Pilot Mishandles Engine Failure

Embraer 110P1 Bandeirante. Destroyed. One serious injury.

Night VMC prevailed when the airplane lifted off the runway at Manchester, New Hampshire, U.S., for a cargo flight on Nov. 8, 2005. Immediately after the pilot retracted the landing gear, he heard an explosion and saw gauge indications of a loss of power from the left engine. He also saw that the left propeller had feathered automatically.

The pilot said that although he brought the right engine to full power, he "could not hold V speeds" and heard the stall-warning horn sounding continuously, the NTSB report said. "He further stated that although he 'stood on the right rudder,' he could not stop the airplane's left turning descent."

The Bandeirante descended into a department store garden center and struck several large metal storage containers. "The cockpit separated from the rest of the fuselage, slid through the back fence and out of the garden center, and came to a stop on its right side," the report said. Bystanders helped the pilot from the wreckage. There was no fire, and no one on the ground was hurt.

The pilot had conducted the takeoff with the flaps extended to 25 percent of their full travel, in compliance with the company's operating procedures. Performance calculations conducted by investigators indicated that "the airplane, with flaps set at 25 degrees, would have been able to climb at more than 400 fpm if the pilot had maintained best single-engine rate of climb airspeed and if the airplane had been trimmed properly," the report said.

However, the findings of the investigation indicated that the pilot had "misapplied the flight controls," the report said. "The pilot's comment that he 'stood on the rudder' suggests that he either had not trimmed the airplane after the engine failure or had applied trim opposite the desired direction. The activation of the stall-warning horn and the pilot's statement that he 'could not hold V speeds' indicate that he also did not lower the nose sufficiently to maintain best single-engine rate of climb [VYSE] or best single-engine angle of climb airspeed [VXSE]."

Examination of the airplane revealed that the engine failure had been caused by fatigue fracturing of the first-stage sun gear in the propeller reduction gearbox.

Maintenance records showed that the planet gear, which revolves around the sun gear, had been replaced during an overhaul of the engine in 1998 because it had "frosted and pitted gear teeth." In accordance with accepted practice at the time, the sun gear was inspected, found not to be defective and reinstalled.

"However, since then, the engine manufacturer determined that if either the sun gear or planet gear assembly needs to be replaced with a zero-time component, the corresponding mating gear/assembly must also be replaced with a zero-time component," the report said. "Otherwise, the different wear patterns on the gears could potentially cause 'distress' to one or both of the components."

In addition, the engine manufacturer, Pratt & Whitney Canada, in 2002 issued a service bulletin requiring replacement of several components in PT6A 30-series engines at specified intervals. Notably, the service bulletin required replacement of the first-stage sun gear in the Bandeirante's PT6A-34 engines at 12,000 hours.

However, the company that operated the accident airplane had a previously approved on-condition maintenance program and was not required to comply with the service bulletin. The sun gear in the accident airplane failed at 22,065 hours.

NTSB concluded that the "grandfathering" of the company's maintenance program and "inadequate oversight" of the company by the U.S. Federal Aviation Administration (FAA) were contributing factors in the accident (*ASW*, 10/09, p. 9). "If the FAA had been properly monitoring [the company's] maintenance program it might have been aware of the operator's inadequate maintenance practices that allowed, among other things, an engine with a sun gear well beyond what the manufacturer considered to be a reliable operating time frame to continue operation," the report said.

Excessive Sink Rate Precedes Undershoot

Dornier 328-100TP. Substantial damage. No injuries.

The flight crew was conducting a scheduled flight with 36 passengers from Manado, North Sulawesi, Indonesia, to Fak-Fak, Papua, the morning of Nov. 6, 2008. The first officer, who was receiving training to serve as pilot-in-command (PIC) in type, was the pilot flying.

The report by the Indonesian National Transportation Safety Committee (NTSC) said that the 1,120-m (3,675-ft) runway at Fak-Fak's Torea Airport did not have a RESA at either end, as required by the International Civil Aviation Organization.

During short final approach to the runway, the first officer selected "a power setting that created propeller disking, resulting in an excessive rate of sink, before the aircraft was above the touchdown area," the report said. "The PIC (pilot monitoring/flight instructor) did not monitor the operation of the aircraft sufficiently to ensure timely and effective response to the pilot-induced excessive sink rate."

Cockpit voice recorder data indicated that after calling 100 ft radio altitude, the PIC had shouted, "Too short … too short … I have it." The report said that the PIC increased power, but the Dornier's main landing gear touched down on rock-covered terrain that was 5 m (16 ft) from the runway threshold and 30 cm (12 in) lower than the runway. The left main landing gear fractured in two places, and the aircraft slid about 500 m (1,640 ft) before coming to a stop on the runway. There was no fire, and the passengers were evacuated through the main cabin door and service door.

Based on the findings of the investigation, NTSC recommended that the airline ensure that its pilots receive crew resource management (CRM) training, as well as training based on the Flight Safety Foundation *Approach-and-Landing Accident Reduction (ALAR) Tool Kit*.

PISTON AIRPLANES

Rapid Ice Build-Up Forces Landing

Beech B60 Duke. Substantial damage. No injuries.

Clear ice accumulated rapidly while the Duke was in instrument meteorological conditions at 16,000 ft during a business flight from Scottsbluff, Nevada, U.S., to Saratoga, Wyoming, on Nov. 29, 2008. "In an effort to get out of the icing conditions, the pilot requested and received clearance to progressively lower altitudes," the NTSB report said. "He requested a turn, and this was denied by the controller as there were two other airplanes in the vicinity with similar icing problems."

The airplane was at 9,000 ft when the pilot acquired visual contact with some ground features. "At this point, both windshields were completely covered with clear ice, as were the unprotected portions of the aircraft, and both engines were operating at full power," the report said.

The pilot decided to land the Duke on a highway. On approach, however, the airplane struck a power line that severed the upper half of the rudder and vertical stabilizer. The pilot landed the airplane on a terraced field next to the highway. The landing gear separated when the airplane struck a ditch, but the pilot and passenger escaped injury.

Circuit Breaker Fails to Trip

Piper Chieftain. Minor damage. No injuries.

The Chieftain was climbing through 7,000 ft after departing on a commercial flight from Boscombe Down, Wiltshire, England, the morning of May 30, 2008, when the pilots detected the odor of something burning and then saw smoke and flames emerging from the overhead panel. They disengaged all nonessential electrical equipment and turned back toward the airport.

"The copilot tackled the fire with a [Halon 1211] fire extinguisher, but the fire continued to smolder throughout the descent," the AAIB report said. An airport fire crew was standing by when the pilots landed the aircraft without further incident.

Examination of the aircraft revealed that a motor in a cockpit air-recirculation fan had malfunctioned, but the 10-ampere circuit breaker guarding the circuit had failed to trip. "The excessive current drawn by the fan had caused the wiring to overheat, producing the smoke and flames," the report said.

The circuit breaker was found to have significant heat damage, which was attributed to long exposure to electrical current "well in excess" of 10 amps. The report noted that the incident aircraft was exempt from a 1982 service bulletin that required installation of fuses rated less than 10 amps to help protect the fan circuit. After the incident, the operator installed the fuses in the incident aircraft.

Loose Clamp Leads to Hydraulic Failure

Aero Commander 500B. Substantial damage. No injuries.

Inbound in VMC on a charter flight from the Dominican Republic on June 1, 2008, the pilot observed indications that the left main landing gear had not fully extended and locked on approach to Charlotte Amalie, U.S. Virgin Islands. He tried unsuccessfully to extend the left gear using the normal and emergency gear-extension systems, and by bouncing the right main gear on the runway.

The left main gear separated during the subsequent landing, but none of the seven people aboard the Aero Commander was injured.

The NTSB report said that the malfunction of the gear-extension system was caused by a loss of hydraulic fluid through fatigue cracks that had formed in an aluminum hydraulic tube that had accumulated more than 18,000 service hours. Although two clamps are required, the tube had only one, and it was loose. Vibratory loads had caused the tube to crack.

The report said that the probable cause of the accident was the failure of maintenance technicians to detect the inadequate clamping and fatigue cracks during an annual inspection of the Aero Commander five months, and 62 flight hours, earlier.

HELICOPTERS

Tail Rotor Pedal Lock Neglected

Hughes 369. Destroyed. One fatality, one serious injury.

Shortly after lifting off from a fishing vessel near Honiara, Solomon Islands, the morning of Dec. 28, 2008, the helicopter began to spin. A witness, the helicopter's maintenance technician, saw the pilot "trying to grab the pedal lock" and later told investigators that the pilot likely had forgotten to remove the tail rotor pedal lock before takeoff.

The helicopter descended out of control, and the fixed floats separated when it struck the surface of the Solomon Sea. The helicopter then sank and was not recovered. "The pilot, a Philippine national, was not found and is presumed dead," the NTSB report said. "The passenger, a Chinese national, sustained serious injuries."

Loose Fitting Causes Power Loss

Bell 206B JetRanger. Substantial damage. Two minor injuries.

About eight minutes after the helicopter departed from Lantana, Florida, U.S., for a television traffic-reporting flight the morning of Nov. 11, 2008, the engine lost power. The pilot initiated an autorotation and maneuvered the JetRanger toward a road in an industrial park.

"To clear power lines near the forced-landing area, the pilot used collective to extend the helicopter's glide," the NTSB report said. "The helicopter then touched down hard, severing the tail boom."

Examination of the JetRanger revealed that the pneumatic line leading from the power turbine governor was not attached to the fuel control unit. The report said that the B-nut on the fitting likely had not been secured properly after it was removed to facilitate inspection of the engine gearbox during maintenance performed three days before the accident.

<table>
<tr><th colspan="5">Preliminary Reports, September 2009</th></tr>
<tr><th>Date</th><th>Location</th><th>Aircraft Type</th><th>Aircraft Damage</th><th>Injuries</th></tr>
<tr><td>Sept. 1</td><td>Jackson, Mississippi, U.S.</td><td>Robinson R44</td><td>destroyed</td><td>1 fatal, 1 serious</td></tr>
<tr><td colspan="5">Two U.S. Federal Aviation Administration inspectors were conducting a proficiency flight when the helicopter descended rapidly on approach and struck trees and a vacant house.</td></tr>
<tr><td>Sept. 2</td><td>Kurnool, India</td><td>Bell 430</td><td>destroyed</td><td>5 fatal</td></tr>
<tr><td colspan="5">The helicopter struck a hill in heavy rain during a flight from Hyderabad to Anuppalle.</td></tr>
<tr><td>Sept. 4</td><td>Mumbai, India</td><td>Boeing 747-400</td><td>minor</td><td>21 minor, 208 none</td></tr>
<tr><td colspan="5">Fuel leaking from the no. 1 engine ignited after the 747 was pushed back from the gate. The injuries occurred during an emergency evacuation.</td></tr>
<tr><td>Sept. 4</td><td>Sugar Land, Texas, U.S.</td><td>Cessna 421C</td><td>minor</td><td>1 none</td></tr>
<tr><td colspan="5">The pilot landed the 421 without further incident after an elevator pitch trim runaway and separation of the trim cable occurred during descent.</td></tr>
<tr><td>Sept. 7</td><td>Long Apung, Indonesia</td><td>GAF Nomad N24A</td><td>destroyed</td><td>5 fatal, 4 serious</td></tr>
<tr><td colspan="5">The maritime patrol airplane was en route from Long Bawan to Tarakan when it crashed under unknown circumstances.</td></tr>
<tr><td>Sept. 7</td><td>Monte Bianco, Italy</td><td>Aerospatiale SA 315B</td><td>destroyed</td><td>2 fatal, 1 serious</td></tr>
<tr><td colspan="5">The crew was performing power line maintenance when the helicopter crashed on the Toula Glacier.</td></tr>
<tr><td>Sept. 9</td><td>Onikeyevo, Ukraine</td><td>Antonov An-2R</td><td>destroyed</td><td>3 none</td></tr>
<tr><td colspan="5">The utility biplane, which had an expired airworthiness certificate, crashed and burned after the engine failed on takeoff from a farm road.</td></tr>
<tr><td>Sept. 11</td><td>Mount Okuhotaka, Japan</td><td>Bell 412EP</td><td>3 fatal, 2 none</td><td></td></tr>
<tr><td colspan="5">After two crewmembers disembarked from the hovering police helicopter to rescue a climber, the tail rotor struck rocks and the 412 crashed.</td></tr>
<tr><td>Sept. 14</td><td>Stuttgart, Germany</td><td>Fokker 100</td><td>substantial</td><td>78 none</td></tr>
<tr><td colspan="5">After several unsuccessful attempts to extend the main landing gear, the flight crew conducted an emergency landing on a foamed runway.</td></tr>
<tr><td>Sept. 14</td><td>Nairobi, Kenya</td><td>Cessna 404</td><td>destroyed</td><td>1 fatal, 1 serious</td></tr>
<tr><td colspan="5">The airplane stalled and crashed on takeoff for a training flight.</td></tr>
<tr><td>Sept. 15</td><td>Castro Verde, Portugal</td><td>Piper PA-34-220T</td><td>destroyed</td><td>3 fatal</td></tr>
<tr><td colspan="5">An autopilot pitch-trim malfunction might have occurred before the Seneca crashed during a night training flight.</td></tr>
<tr><td>Sept. 15</td><td>Sheffield, Massachusetts, U.S.</td><td>Cessna 208</td><td>destroyed</td><td>6 minor</td></tr>
<tr><td colspan="5">The right wing struck a tree and separated when the pilot conducted an emergency landing in a field after the engine lost power. The occupants exited before the Caravan was engulfed in flames.</td></tr>
<tr><td>Sept. 16</td><td>Hayward, California, U.S.</td><td>Beech King Air B200</td><td>destroyed</td><td>1 none</td></tr>
<tr><td colspan="5">The King Air struck terrain and burned after an apparent loss of power during takeoff.</td></tr>
<tr><td>Sept. 18</td><td>Savoonga, Alaska, U.S.</td><td>CASA 212CC</td><td>substantial</td><td>2 none</td></tr>
<tr><td colspan="5">Surface winds were from 010 degrees at 28 kt, gusting to 33 kt, when the cargo airplane veered off the right side of Runway 05 during landing and came to rest in a ditch.</td></tr>
<tr><td>Sept. 22</td><td>Qarchak, Iran</td><td>Ilyushin 76M</td><td>destroyed</td><td>7 fatal</td></tr>
<tr><td colspan="5">The Il-76 might have collided with a Saeghe fighter during a military-exhibition flight over Tehran. Control was lost when a radar dish separated from the rear fuselage and struck the vertical stabilizer.</td></tr>
<tr><td>Sept. 22</td><td>Page, Arizona, U.S.</td><td>Agusta A109</td><td>substantial</td><td>1 none</td></tr>
<tr><td colspan="5">The pilot had observed low-fuel warnings before both engines flamed out near the destination. The helicopter touched down hard during the forced landing.</td></tr>
<tr><td>Sept. 24</td><td>Durban, South Africa</td><td>BAe Jetstream 41</td><td>destroyed</td><td>4 serious</td></tr>
<tr><td colspan="5">The airplane crashed near a school after the flight crew reported an engine problem during takeoff for a positioning flight. One person on the ground was injured.</td></tr>
<tr><td>Sept. 24</td><td>Tucson, Arizona, U.S.</td><td>Eurocopter AS 350-B3</td><td>substantial</td><td>4 none</td></tr>
<tr><td colspan="5">The emergency medical services (EMS) helicopter touched down hard after the pilot lost tail-rotor control while landing on a hospital helipad.</td></tr>
<tr><td>Sept. 25</td><td>Georgetown, South Carolina, U.S.</td><td>Eurocopter AS 350-B2</td><td>destroyed</td><td>3 fatal</td></tr>
<tr><td colspan="5">After transporting a patient to Charleston, the EMS helicopter crashed in night instrument meteorological conditions while returning to its home base in Conway.</td></tr>
<tr><td colspan="5">This information, gathered from various government and media sources, is subject to change as the investigations of the accidents and incidents are completed.</td></tr>
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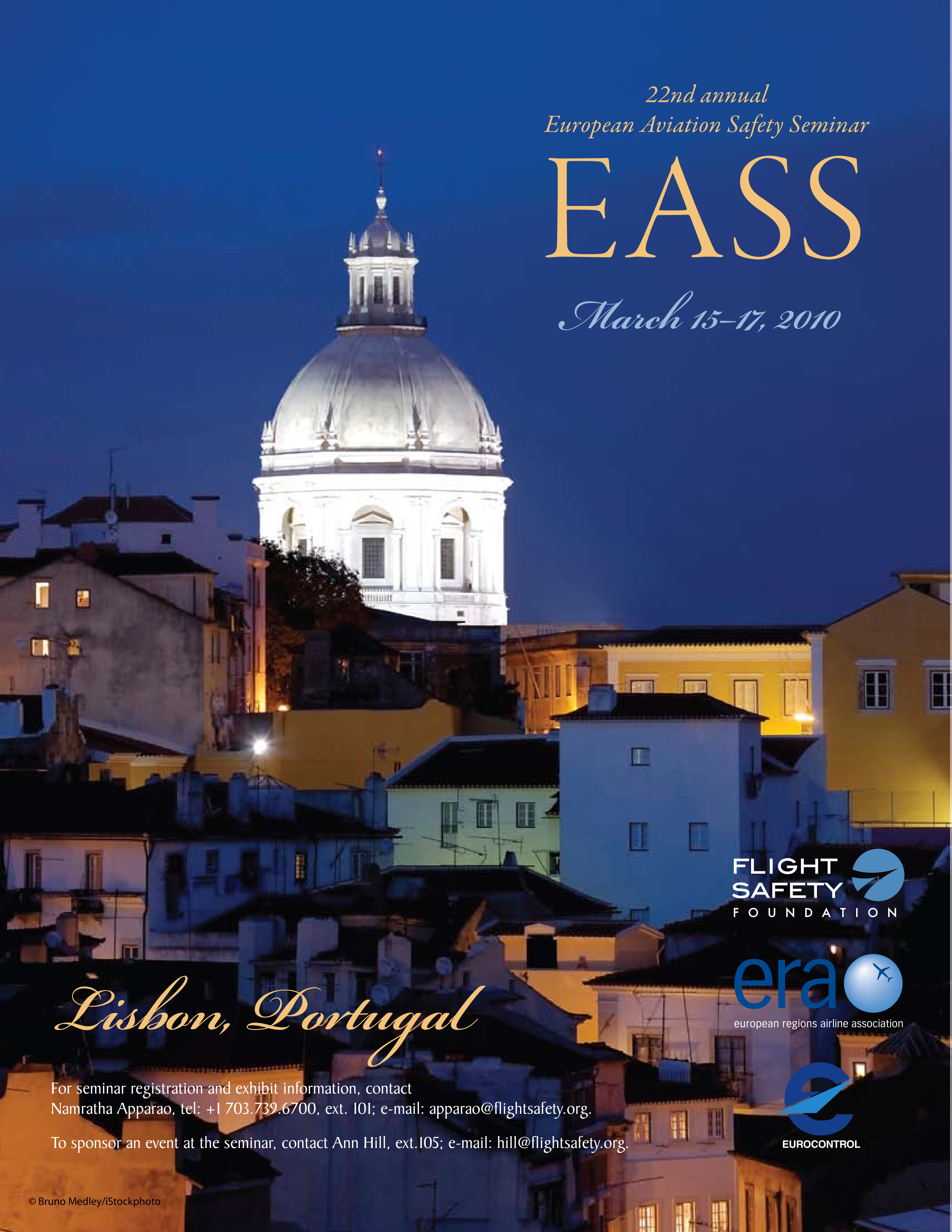
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