AeroSafety WORLD

CALCULATING ERRORS
Mistakes computing performance

DANGEROUS FIBERS
Burning composite concerns

SNOWY CLEVELAND OVERRUN
Fatigue plays a role

RUNWAY STATUS LIGHTS
FAA approves technology

CRITICAL CARE
HELICOPTER EMS SAFETY

THE JOURNAL OF FLIGHT SAFETY FOUNDATION

SEPTEMBER 2008

DOING THE Right Thing

Over the past couple of years, I have used this column to shine light on the threat that aviation safety faces from a lack of political will in certain parts of the world. Often, it is very hard to do the right thing due to pressure from governments, growth or even difficulty in hiring enough qualified people. These are serious problems, and all the safety professionals in the industry need to shine a light on them so that solutions can be found.

Every once in a while, we see courageous political action taken. In past columns, I have talked about the courage of Maimuna Taal of the Republic of The Gambia and the dedication she has shown to aviation safety. Today, I'm shifting my focus to two countries in Southeast Asia that recently grounded unsafe airlines despite — and because of — some of the problems mentioned above.

Indonesia has suffered several terrible airplane crashes over the past few years, with tragic loss of life. We know that the government was looking for solutions but was running into problems such as a shortage of qualified pilots and maintenance personnel, and sometimes a shortage of resources to thoroughly investigate aviation incidents.

Rather than continue to allow unsafe airlines to operate, the Transport Ministry of Indonesia recently conducted safety audits and shut down five airlines based on the audit results. This was a very good decision, and we at Flight Safety Foundation applaud the action. Indonesia has a rapidly growing population and an increasing demand for air services. When a government makes strong, assertive moves such as the shutdowns, we are much more confident that it takes safety seriously and will continue to improve its record.

Thailand, another country struggling with population growth and having a healthy economy fueling a growing demand for air services, suffered a fatal crash in Phuket a year ago that brought international attention to the safety of aviation in that country.

The Thai Civil Aviation Department announced in July that it had grounded One-Two-Go, revoking its air operator certificate. The airline had violated many operating, maintenance and safety regulations, and was further hampered by a lack of proper airline management. In addition, the department revoked the flying licenses of seven foreign pilots and suspended the licenses of two Thai pilots when it discovered that they had falsified their qualifications.

Episodes like these are frightening in conjuring images of other disasters that might have happened, but also heartening because the governments have taken the strong, proactive steps needed to ensure a safe aviation industry.

As important as it is for Flight Safety Foundation to highlight its concerns about aviation safety in certain parts of the world, it is just as important to shine the light on the regulators and governments that are making the tough decisions and doing the right thing. There is still a distance to go for parts of Southeast Asia to achieve the safety record they should have, but these are big and important steps for Indonesia and Thailand.

William R. Voss
President and CEO
Flight Safety Foundation

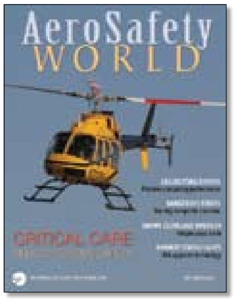
AeroSafetyWORLD

contents

September2008 Vol 3 Issue 9

features

departments



About the Cover
Accidents focus attention of U.S. helicopter EMS.
© Michael Faia/Jetphotos.net

We Encourage Reprints (For permissions, go to <www.flightsafety.org/asw_home.html>)

Share Your Knowledge

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

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

Sales Contacts

Europe, Central USA, Latin America
Joan Daly, joan@dalyllc.com, tel. +1.703.983.5907

Northeast USA and Canada
Tony Calamaro, tcalamaro@comcast.net, tel. +1.610.449.3490

Asia Pacific, Western USA
Pat Walker, walkercom1@aol.com, tel. +1.415.387.7593

Regional Advertising Manager
Arlene Braithwaite, arlenetbg@comcast.net, tel. +1.410.772.0820

Subscriptions: Subscribe to *AeroSafety World* and become an individual member of Flight Safety Foundation. One year subscription for 12 issues includes postage and handling — US$350. Special Introductory Rate — $280. Single issues are available for $30 for members, $45 for nonmembers. For more information, please contact the membership department, Flight Safety Foundation, 601 Madison St., Suite 300, Alexandria, VA 22314-1756 USA, +1 703.739.6700 or membership@flightsafety.org.

AeroSafetyWORLD

telephone: +1 703.739.6700

William R. Voss, publisher,
FSF president and CEO
voss@flightsafety.org, ext. 108

J.A. Donoghue, editor-in-chief,
FSF director of publications
donoghue@flightsafety.org, ext. 116

Mark Lacagnina, senior editor
lacagnina@flightsafety.org, ext. 114

Wayne Rosenkrans, senior editor
rosenkrans@flightsafety.org, ext. 115

Linda Werfelman, senior editor
werfelman@flightsafety.org, ext. 122

Rick Darby, associate editor
darby@flightsafety.org, ext. 113

Karen K. Ehrlich, web and print
production coordinator
ehrlich@flightsafety.org, ext. 117

Ann L. Mullikin, art director and designer
mullikin@flightsafety.org, ext. 120

Susan D. Reed, production specialist
reed@flightsafety.org, ext. 123

Patricia Setze, librarian
setze@flightsafety.org, ext. 103

Editorial Advisory Board

Anniversary

It was 100 years ago this month that aviation suffered the first fatal accident in a powered airplane that could actually fly, differentiating this death from those of brave pioneers who lacked the technology to sustain flight.

On Sept. 17, 1908, Thomas E. Selfridge, a U.S. Army first lieutenant and promising aviator, having already been rated as a dirigible pilot, died when the airplane Orville Wright was demonstrating in Virginia crashed after a propeller failure caused structural damage to the airplane.

Selfridge died from head injuries suffered when he was thrown against an aircraft structural member. Seeing a problem, the Army declared that future pilots should wear helmets, starting the investigate-and-correct cycle that still follows every accident.

From the beginning of aviation, pilots have been among the most committed advocates of aviation safety. While it has elements of being an offhand, flip comment, the expression "pilots are always the first at the scene of an accident" is undeniably true.

Individually, and in groups, pilots are indispensable components of the aviation system safety structure. Pilots are the veritable "canaries in the coal mine" providing early warnings that something is wrong. Then they help steer the development of answers down practical paths. Enthusiastic participation in incident reporting systems around the world is not driven just by pilots seeking amnesty from punishment, as amnesty is not always part of the deal, but by a fervent quest to keep themselves, their fellow crewmembers and their passengers alive and well.

There has been criticism of pilot groups, however, for what has been said to be the use of safety issues to advance their side of labor/management disputes. One of the longest-lasting such issues was when cockpits were going from three crewmembers to two.

The pilots' basic point was that workload, especially during times of stress, required three people up front, while management said that the pilots' goal was nothing more than the protection of unnecessary jobs. I leave it to others to decide if there was an ultimate truth behind either position, but what is clear is that pilot insistence on keeping cockpit workloads to manageable levels, even during times of extreme stress, paid off. Modern cockpits are so automated that, during normal operations, pilots become challenged to stay "in the loop," aware of their situation and aircraft status.

Rarely do pilots raise a valid safety issue that ultimately does not carry the day. The one failure that stands out in my mind started when environmental rules compelled manufacturers to cut engine exhaust smoke. Pilots correctly said, wait a minute, those smoke trails are vital in visually locating and tracking traffic. Anyone living during the 1960s, watching DC-8s and 707s trail large, oily plumes that went on for miles, had to admit they were hard to miss. In a world drowning in its own effluence, the pollution had to go, but pilots helped continue the fight to assure separation that eventually produced the traffic-alert and collision avoidance system.

Pilots, we trust, will continue to play key roles in maintaining and enhancing aviation safety in ways that remain firmly focused on real threats and real solutions.

J.A. Donoghue

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

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.

Member**Guide**

Flight Safety Foundation
601 Madison St., Suite 300, Alexandria, VA, 22314-1756 USA
tel: +1 703.739.6700 fax: +1 703.739.6708

www.flightsafety.org

Member enrollment — ext. 105
Ann Hill, director, membership and development — hill@flightsafety.org

Seminar registration — ext. 101
Namratha Apparao, membership services coordinator — apparao@flightsafety.org

Seminar sponsorships — ext. 105
Ann Hill, director, membership and development — hill@flightsafety.org

Exhibitor opportunities — ext. 105
Ann Hill, director, membership and development — hill@flightsafety.org

FSF awards programs — ext. 105
Ann Hill, director, membership and development — hill@flightsafety.org

Technical product orders — ext. 101
Namratha Apparao, membership services coordinator — apparao@flightsafety.org

Library services/seminar proceedings — ext. 103
Patricia Setze, librarian — setze@flightsafety.org

Web Site — ext. 117
Karen Ehrlich, web and print production coordinator — ehrlich@flightsafety.org

SEPT. 3–4 ➤ 20th FAA/ATA International Symposium on Human Factors in Maintenance and Ramp Safety. U.S. Federal Aviation Administration and Air Transport Association of America. Orlando, Florida, U.S. <www.airlines.org/operationsandsafety/events/2008hfsymposium.htm>.

SEPT. 4 ➤ De/Anti-Icing Seminar. National Air Transportation Association. Boise, Idaho, U.S. <www.nata.aero/events/event_detail.jsp?EVENT_ID=1661>.

SEPT. 7–11 ➤ 56th International Congress of Aviation and Space Medicine. Institute of Aviation Medicine, Royal Thai Air Force. Bangkok, Thailand. <icasm2008@gmail.com>, <www.icasm2008.org/welcome.html>, +66 (0)2714 2590-1, ext. 13, 15.

SEPT. 8–11 ➤ ISASI 39th Annual Seminar: Investigation: The Art and the Science. International Society of Air Safety Investigators. Halifax, Nova Scotia, Canada. <www.isasi.org/asasi2008.html>.

SEPT. 10–11 ➤ Crisis Preparedness Conference and Aeropolitical Conference for Legal Issues Facing the Aviation Industry. Latin American Air Transport Association (ALTA). Miami. Valerie Garcia, <vgarcia@alta.aero>, <www.alta.aero/crisispreparedness>, <www.alta.aero/aviationlaw>, +1 786.522.7824.

SEPT. 10–11 ➤ 8th Annual CIS, Central and Eastern European Airline Engineering and Maintenance Conference. Aviation Industry Group. Prague, Czech Republic. Lucy Ashton, <lucya@aviation-industry.com>, <www.aviationindustrygroup.com/index.cfm?pg=306&archive=false&offset=1>, +44 (0)207 931 7072.

SEPT. 15–18 ➤ Flight Simulator Engineering and Maintenance Conference. ARINC. Salt Lake City. Sam Buckwalter, <sbuckwal@arinc.com>, <www.aviation-ia.com/fsemc>, +1 410.266.2008.

SEPT. 16 ➤ De/Anti-Icing Seminar. National Air Transportation Association. Cleveland. <www.nata.aero/events/event_detail.jsp?EVENT_ID=1701>.

SEPT. 16–17 ➤ Asia Pacific Aviation Training Symposium (APATS): Training for Safety in a Commercial World. Halldale Media. Bangkok, Thailand. Chris Long, <chrislong@halldale.com>, <www.halldale.com/APATS.aspx>, +44 (0)1252 532000.

SEPT. 16–19 ➤ 34th European Rotorcraft Forum. Council of European Aerospace Societies and the Royal Aeronautical Society. Liverpool, England. <raes@raes.org.uk>, <www.aerosociety.com/cmspage.asp?cmsitemid=ConferenceAndEvents_ERF34>, +44 (0)20 7670 4300.

SEPT. 21–24 ➤ ACI World/North America Annual Conference and Exhbition. Airports Council International-North America. Boston. <meetings@aci-na.org>, <www.aci-na.org/boston08/welcome-to-boston.html>, 888.424.7767, +1 202.293.8500.

SEPT. 22–25 ➤ 51st Annual Non-Destructive Testing Forum. Air Transport Association of America. Seattle. <www.airlines.org/operationsandsafety/events/2008+NDT+Forum+Web+site.htm>.

OCT. 4–5 ➤ Flight Operations Manual Workshop: Employing the International Standard for Business Aircraft Operations. National Business Aviation Association. Orlando, Florida, U.S. Sarah Dicke, <sdicke@nbaa.org>, <web.nbaa.org/public/cs>, +1 202.783.9000.

OCT. 6–8 ➤ 61st Annual Meeting and Convention. National Business Aviation Association. Orlando, Florida, U.S. Donna Raphael, <draphael@nbaa.org>, <web.nbaa.org/public/cs/amc/2008>, +1 202.783.9000.

OCT. 7–9 ➤ Aircraft Accident Investigation Course. University of North Dakota Aerospace Foundation and Air Line Pilots Association, International. Grand Forks, North Dakota, U.S. Frank Argenziano, <argenzia@aero.und.edu>, +1 701.777.7895.

OCT. 8–9 ➤ 3rd Aviation Emergency Response Conference. Association of Asia Pacific Airlines. Hong Kong. <www.aapairlines.org/AAPA_3rd_Aviation_Emergency_Response_Conference.aspx>.

OCT. 9 ➤ Maintenance Manual Workshop. National Business Aviation Association. Orlando, Florida, U.S. Donna Raphael, <draphael@nbaa.org>, <web.nbaa.org/public/cs>, +1 202.783.9000.

OCT. 15–18 ➤ 25th International Meeting of Aerospace Medicine. Mexican Association of Aviation Medicine and the Iberoamerican Association of Aerospace Medicine. Zacatecas, Mexico. Luis A. Amezcua Gonzales, M.D. <lamezcua@att.net.mx>, <www.amma.org.mx>, +52-55 55.23.82.17.

OCT. 20–22 ➤ Air Medical Transport Conference. Association of Air Medical Services. Minneapolis. <www.aams.org/AM/Template.cfm?Section=Education_and_Meetings>, +1 703.836.8732.

OCT. 21 ➤ Accident Prevention via Human Factors Training. National Air Transportation Association. San Diego. <www.nata.aero/events/event_detail.jsp?EVENT_ID=1582>.

OCT. 23–24 ➤ 5th Flight Safety Seminar on Confidential Report Systems. Spanish Professional Pilot Association (COPAC). Madrid. <comunicacion1@copac.es>, <www.copac.es>, +34 91 590 02 10.

OCT. 27–30 ➤ International Air Safety Seminar (IASS). Flight Safety Foundation, International Federation of Airworthiness and International Air Transport Association. Honolulu. Namratha Apparao, <apparao@flightsafety.org>, +1 703.739.6700, ext. 101.

OCT. 27–31 ➤ EAAP Conference 2008. European Association for Aviation Psychology. Valencia, Spain. <eaap@dlr.de>, <www.eaap.net/conferences>, +49 40-5130960.

OCT. 27–29 ➤ 46th Annual Symposium. SAFE Association. Reno, Nevada, U.S. Jeani Benton, <safe@peak.org>, <www.safeassociation.com>, +1 541.895.3012.

NOV. 2–5 ➤ ATCA 53rd Annual Conference and Exposition. Air Traffic Control Association. Washington, D.C. Claire Rusk, <claire.rusk@atca.org>, <www.atca.org/event_items.asp?month=10&year=2008&comm=0>, +1 703.299.2430.

NOV. 10–12 ➤ ATAC 2008 Annual General Meeting & Trade Show. Air Transport Association of Canada. Calgary, Alberta. <atac@atac.ca>, <www.atac.ca/en/events/agm/index.html>, +1 613.233.7727.

NOV. 11–12 ➤ European Aviation Training Symposium (EATS): Exploring and Promoting European Best Practice in Aviation Training and Education. Halldale Media. Vienna, Austria. Chris Lehman, <chris@halldale.com>, <http://www.halldale.com/EATS.aspx>, +44 (0)1252 532000.

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

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.

FSFSeminars 2008-09

Exhibit and Sponsorship Opportunities Available

IASS 2008

October 27–30, 2008

Joint Meeting of FSF 61st annual International Air Safety Seminar,
IFA 38th International Conference, and IATA

Sheraton Hotel and Resort Waikiki, Honolulu, Hawaii

EASS 2009

March 16–18, 2009

Flight Safety Foundation, Eurocontrol and European Regions Airline Association
21st annual European Aviation Safety Seminar

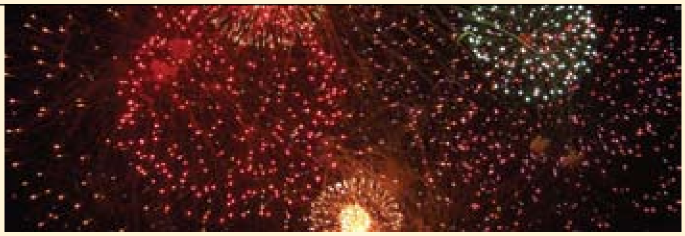
Hilton Cyprus Hotel, Nicosia, Cyprus

CASS 2009

April 21–23, 2009

Flight Safety Foundation and National Business Aviation Association
54th annual Corporate Aviation Safety Seminar

Hilton Walt Disney World, Orlando, Florida



© Paul Topp/iStockphoto.com; Jeremy Voisey/iStockphoto.com; Tom Kelly/iStockphoto.com

Long haul. High altitude.

AeroSafetyWORLD advertising

Your advertisement in *AeroSafety World* goes a long way. You'll reach nearly 30,000 primary readers in the global aviation industry, 100,000 including pass-along readers.

And it reaches the top floors, cruising altitude for executive decision makers.

Hedge your ad costs. Don't pay next year's higher prices.

Ad rates will rise in 2009, but orders placed by December 31, 2008 will be at the 2008 rates.

Call or e-mail our advertising representatives for further information.

Europe, Central USA, Latin America
Joan Daly, joan@dalyllc.com, tel. +1.703.983.5907

Northeast USA and Canada
Tony Calamaro, tcalamaro@comcast.net, tel. +1.610.449.3490

Asia Pacific, Western USA
Pat Walker, walkercom1@aol.com, tel. +1.415.387.7593

Regional Advertising Manager
Arlene Braithwaite, arlenetbg@comcast.net, tel. +1.410.772.0820

Safety News

Blank Screens


© Airbus S.A.S.

Citing recent incidents in which Airbus A320 electronic displays blanked out and aircraft systems became inoperable, the U.S. National Transportation Safety Board (NTSB) is recommending action to require compliance with an Airbus service bulletin to provide for automatic reconfiguration of the AC essential bus power supply after a failure.

The NTSB, in similar safety recommendations to the European Aviation Safety Agency (EASA) and the U.S. Federal Aviation Administration (FAA), said that the two agencies should "require all operators of Airbus A320 family aircraft to modify these aircraft in accordance with Airbus Service Bulletin A320-24-1120."

Additional recommendations called on the two agencies to require Airbus to develop a modification that would provide an additional power source to operate the standby attitude indicator for at least 30 minutes in the event of an AC 1 electrical bus failure and require operators to incorporate the modification as soon as possible.

In addition, the NTSB said the agencies should "require all operators of A320 family aircraft to develop new procedures, if necessary, and to provide flight crews with guidance and simulator training regarding the symptoms and resolution procedures for the loss of flight displays and systems in conjunction with an AC 1 electrical bus failure."

One incident cited by the NTSB occurred Jan. 25, 2008, when a United Airlines A320 returned to Newark Liberty International Airport (EWR) in New Jersey, U.S., soon after departure in daytime visual meteorological conditions (VMC), because three of the six electronic displays went blank and several aircraft systems, including all radios, were inoperative.

"The pilots leveled the aircraft at their first assigned altitude of 2,500 ft, elected to return to the field and landed at EWR with several aircraft systems inoperative, including the airplane's transponder, the traffic alert and collision avoidance system and the standby attitude indicator," the report said.

A preliminary investigation found that there was a fault in the AC 1 electrical bus, which caused a loss of power in other electrical buses in the airplane and the resulting failure of a number of displays and systems.

The NTSB cited a similar incident involving a British Airways A319 after departure from London Heathrow Airport in nighttime VMC on Oct. 22, 2005 (see story, p. 57) and said that Airbus has identified 49 similar events, seven of which resulted in failure of all six flight displays.

Concorde Criminalization

Flight Safety Foundation and two pilots' unions have denounced the decision by French prosecutors to file criminal charges against Continental Airlines, two Continental employees and three former aviation officials in connection with the fatal July 25, 2000, crash of an Air France Concorde in Paris (*ASW,* 3/08, p. 12).

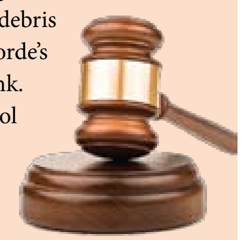
Published reports said that a trial is expected to begin early in 2009 for the airline, its employees, the former head of training for the French civil aviation authority and two former senior members of the Concorde program for Airbus.

The International Federation of Air Line Pilots' Associations (IFALPA) said that it "deplores" the decision to prosecute and that prosecution will "do nothing to improve the safety of the air transport system."

The Air Line Pilots Association, International (ALPA) denounced France's "archaic approach to this tragic event" and called it "a step backwards for global aviation safety."

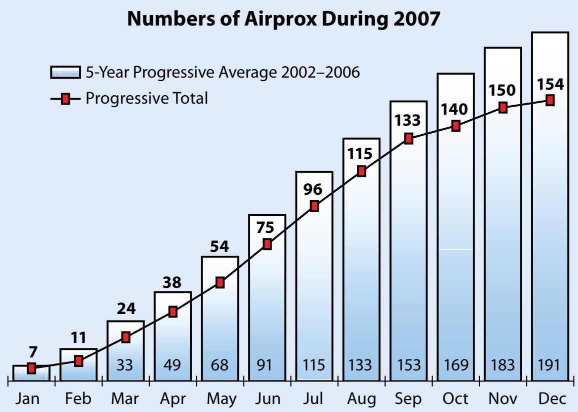
Flight Safety Foundation President and CEO William R. Voss said, "These manslaughter charges appear rather dubious and shortsighted. Absent willful intent or highly egregious conduct, we seriously question the basis for putting companies and aviation professionals through the ordeal of criminal prosecutions. In addition, we're very concerned that criminal prosecutions will discourage the free flow of information from operators to management to regulators, to the detriment of aviation safety."

The crash killed all 109 people in the airplane and four on the ground. The French Bureau d'Enquêtes et d'Analyses (BEA) said the crash occurred when the Concorde — on its takeoff roll — ran over a piece of metal that had fallen off a Continental McDonnell Douglas DC-10 that had departed on the same runway. The resulting tire failure sent tire pieces and other debris into one of the Concorde's engines and a fuel tank. Fire and loss of control preceded the airplane's crash, the BEA said.


© Nick Schlax/iStockphoto.com

Slight Decline in U.K. Airprox Incidents

The U.K. Airprox Board recorded 154 airprox incidents in 2007, down from 159 the previous year. For the second consecutive year, commercial air transport aircraft were not involved in any "actual risk of collision" incidents.



Source: U.K. Airprox Board

The 154 incidents included 65 involving at least one commercial air transport aircraft; of the 65 incidents, five were characterized as "risk-bearing" — the lowest number in the 1998–2007 reporting period, the board said. In 2006, 75 incidents involved commercial transport aircraft.

The report "reveals that the improvements in flight safety of recent years are being maintained and in many cases, bettered," said Airprox Board Director Peter Hunt.

The board defines an airprox as "a situation in which, in the opinion of a pilot or controller, the distance between aircraft, as well as their relative positions and speed, have been such that the safety of the aircraft was, or may have been, compromised."

More Than 'See and Avoid'

The "see and avoid" principle is not always sufficient to ensure safety of flight, and regulators should consider on-board collision protection systems and other technological means of identifying potential conflicts in congested airspace near Toronto, the Transportation Safety Board of Canada (TSB) says.

The TSB recommendation followed investigation of the Aug. 4, 2006, midair collision west of Caledon, Ontario, of a Cessna 172P and a Cessna 182T in which all three people in the two airplanes were killed.

"Until technological or other solutions are mandated, a significant risk of collision between VFR aircraft will continue to exist in controlled airspace around Canada's high-density airports," said Don Enns, the TSB regional manager of air investigations.

Understanding 'Mistrim' Takeoffs

Pilots of Bombardier Challenger airplanes should be trained to recognize the importance of proper takeoff stabilizer trim settings and to understand the characteristics of both normal and "mistrim" takeoffs, the U.S. National Transportation Safety Board (NTSB) says.

The NTSB cited a Feb. 2, 2005, accident in which a Bombardier Challenger 600 overran a runway at Teterboro Airport in New Jersey, U.S., crashed through an airport perimeter fence and struck a vehicle on a six-lane highway before hitting a building and coming to a stop. Nine people in the airplane and one person in the building received minor injuries in the crash, and the airplane was destroyed.

During its investigation, the NTSB examined the airplane's rotation characteristics during a normal takeoff and a mistrim takeoff, in which the center of gravity (CG) is at one limit of its allowable range and the stabilizer position is set to the opposite CG limit.

NTSB investigators found that, "in the mistrim scenario, with the CG at the most forward limit and with the horizontal stabilizer at the nose-down limit … the airplane did not rotate, even with full nose-up elevator control, until it was significantly above the nominal rotation speed. … The [NTSB] is concerned that the delayed rotation characteristics of this condition may cause pilots to believe that their airplanes will not fly, leading them to abort takeoff at a speed well above the takeoff decision speed … with possibly catastrophic results."

© Adrian Pingstone/wikimedia.org

As a result of the investigation, the NTSB issued safety recommendations calling on the U.S. Federal Aviation Administration (FAA) to encourage operators of Challenger airplanes to provide training that informs pilots about mistrim takeoff characteristics. An accompanying recommendation said that the FAA should include in the final version of Advisory Circular 25-7C language that accomplishes the intent of a European Joint Aviation Requirements notice of proposed amendment stating that "reasonably expected variations in service from the established takeoff procedures," including out-of-trim conditions, should not result in unsafe flight characteristics.

Fuel Tank Safety

Operators and manufacturers of transport category airplanes with center fuel tanks will be required to take steps to greatly reduce the risk of a catastrophic fuel tank explosion, according to a final rule published by the U.S. Federal Aviation Administration (FAA).

The rule establishes "a performance-based set of requirements that set acceptable flammability exposure values in tanks most prone to explosion or require the installation of an ignition mitigation means in an affected fuel tank." It calls for commercial passenger airplanes to be equipped with technology that will neutralize or eliminate flammable gasses from fuselage fuel tanks located under the wing.

In its discussion of the problem, the rule cites fuel tank explosions in two airplanes — a Trans World Airways Boeing 747 near Long Island, New York, U.S., on July 17, 1996, and an Avianca 727 in Bogotá, Colombia, on Nov. 27, 1989. The two accidents killed a total of 337 people.

In each of those crashes and in several others, investigators found that at the time of the explosion, the center wing fuel tank contained flammable vapors in its ullage — the portion of the tank not containing liquid fuel.


© Dan Barnes/iStockphoto.com

After the TWA crash, FAA researchers developed a system of replacing oxygen in the fuel tank with inert gas — a process known as inerting that, by eliminating flammable vapors, also eliminates any potential for ignition. The Boeing Co. has developed a similar system.

"We want to do everything possible to make sure safety examiners won't have to investigate another plane shattered by an exploding tank," U.S. Transportation Secretary Mary Peters said.

Mark V. Rosenker, chairman of the U.S. National Transportation Safety Board (NTSB), which for years had advocated adoption of a fuel tank inerting requirement, said that the FAA action "represents a significant step toward avoiding future aviation accidents of this nature."

Maintenance Red Tape

The Civil Aviation Safety Authority of Australia (CASA) says it has streamlined procedures used in licensing qualified aircraft maintenance personnel with experience outside Australia or in the military. CASA's actions are aimed at increasing numbers of licensed aircraft maintenance engineers in Australia.

Under the new procedures, licensed maintenance personnel from six nations — Canada, France, Germany, Italy, the Netherlands and the United Kingdom — will no longer be required to undergo additional technical examinations before being permitted to work in Australia.

"The aviation industry always needs engineers and by cutting red tape, we can open up new opportunities for new people with the right qualifications to fill critical vacancies," said CASA CEO Bruce Byron.


© Arne Thaysen/iStockphoto.com

In Other News …

The **European Aviation Safety Agency** has issued the first European single production organization approval certificate to Airbus. The "single" certificate replaces national production organization approvals that had been issued by French, German, Spanish and U.K. national aviation authorities. … The **U.S. Federal Aviation Administration** says it plans to install runway status lights at 20 more major airports over the next three years and to provide up to US$5 million to test cockpit displays intended to enhance pilots' awareness of runway positions (see story, p. 46). … **Flight Safety Foundation** and the **AviAssist Foundation** have begun a campaign to raise awareness of aviation safety issues among lawmakers in East and Southern Africa.

Compiled and edited by Linda Werfelman.

CRITICAL CARE

BY LINDA WERFELMAN

Frustrated by a cluster of fatal crashes, the U.S. helicopter EMS industry and the government are pressing for safety improvements.

Helicopter emergency medical services (HEMS) operations have increased dramatically in the United States in the past decade, accompanied in recent months by a spate of fatal crashes.

Industry safety experts say that, with investigations still in progress, there appear to be few similarities linking the six fatal HEMS accidents recorded since December 2007 by the U.S. National Transportation Safety Board (NTSB; see "Recent Fatal HEMS Accidents," p. 14).[1] But that hasn't stopped industry representatives from launching a new search for risk reduction tools and procedures.

One of the recent accidents was a midair collision in daytime visual meteorological conditions (VMC) during approach to a hospital helipad; one occurred in night instrument meteorological conditions (IMC); and four occurred in nighttime VMC but in different phases of flight — one accident helicopter was heading to a temporary landing zone to pick up a patient, another was en route to a hospital with a patient aboard, a third had just left a hospital after delivering a patient and was returning to its home base, and the fourth was maneuvering during a voluntary mission to aid in the search for a missing hunter. Two were twin-engine aircraft; the others, single-engine. Two flights were conducted under U.S. Federal Aviation Regulations (FARs) Part 91 for general aviation, and the others under Part 135, air taxi and commuter regulations, which has stricter weather and visibility minimums as well as crew rest requirements.

Three additional HEMS accidents, none involving fatalities, also occurred in the same time period.

The variety of circumstances surrounding the accidents is representative of the industry itself, said Dawn Mancuso, executive director of the Association of Air Medical Services (AAMS), who noted that HEMS operations are conducted


© iStockphoto

in "such a variety of aircraft, a variety of settings — different topographies, with a variety of patients and crew configurations and all kinds of things."

Christopher Eastlee, AAMS government relations manager, added, "We don't see one single, common causal factor in all these accidents … and we don't see a single … piece of technology on the market — or on the horizon — that would have prevented all or most of these accidents. … You have to say that human factors plays a big role, so no matter what new equipment comes into this operation, training in risk management and proper crew resource management is always going to be a huge concern."

Industry experts, U.S. government regulators and accident investigators have said in several major reports in recent years that HEMS operations are unique because of their emergency nature and because they frequently involve flights to and from unfamiliar locations in inclement weather and low visibility. Their recommendations for increased safety have focused on human factors issues, such as crew resource management and improvements in safety culture, and wider use of technological advances.

'Understanding the Baseline'

In the aftermath of what, at press time, was the most recent fatal HEMS crash — the June 29 midair collision of two Bell 407s in Flagstaff, Arizona — the U.S. Federal Aviation Administration (FAA) and AAMS sponsored safety meetings to discuss immediate and long-term responses to the increased number of accidents.

An AAMS session in Dallas in late July focused on the human element, with the goal of "understanding the baseline of where we are today," said AAMS President Sandy Kinkade. The meeting provided a framework for development of an action plan, she said.

Among the subjects on the agenda was air medical resource management (AMRM) — a variation of crew resource management tailored specifically for EMS operations. Meeting participants discussed standardized AMRM training, including the value of longer training sessions, and the special factors involved in providing AMRM training to a multigenerational work force, Kinkade said.

Also on the agenda were improved communications, including the handling of weather information and traffic avoidance, as well as providing standardized training for communications centers; and standard operating procedures, including the use of checklists and defined, standardized and regionalized weather minimums.

Other topics included the effects on safety of training, including line-oriented flight training (LOFT); safety management systems, including the benefits of a just safety culture; competition within the industry; and other human factors issues.

"There's a consensus that there isn't a silver bullet — there isn't one action that's going to stop there from ever being another accident or incident," Mancuso said. "But what we're trying to do is take measure of what we've done so far and identify things we can do in the future that will mitigate as much risk as possible."

120 Accidents

FAA data indicate that about 750 EMS helicopters are in operation, with most of their flights conducted under FARs Part 135, although operators often ferry and reposition helicopters under Part 91, as long as only flight crewmembers and medical crewmembers — and no patients or other passengers — are aboard.[2]

Data compiled by the International Helicopter Safety Team (IHST) and presented during the AAMS safety meeting showed that, from Jan. 1, 1998, through June 30, 2008, there were 120 accidents involving HEMS aircraft — about 57 percent of which were twin-engine helicopters. Of the 371 people aboard the helicopters, 114 (30.7 percent) were killed.[3]

During the same 10½-year period, the data show that accidents increased from six in 1998 to 17 in 2003, then decreased to between 10 and 13 per year from 2004 through 2007 (Figure 1, p. 15). Fatalities ranged from a low of two in 2001 to a high of 18 in 2004. During just the first six months of 2008, however, there were eight accidents and 17 fatalities.

HEMS flight hours increased every year from about 190,000 in 1998 to about

Recent Fatal U.S. Helicopter EMS Accidents

Dec. 3, 2007 — A Eurocopter BK 117C1 is presumed to have struck the ocean about 3 nm (6 km) east of Whittier, Alaska, during a flight to transport a patient from Cordova to Anchorage. The body of the flight nurse was found, along with some helicopter wreckage, several days after the accident; the pilot, paramedic and patient are missing and presumed also to have been killed. Night instrument meteorological conditions prevailed, and company flight following procedures were in effect for visual flight rules operations. The helicopter was reported missing after the pilot failed to make a routine position report.

Dec. 30, 2007 — The pilot, paramedic and flight nurse were killed and a Bell 206L-3 was destroyed when it struck the ground while maneuvering in night visual meteorological conditions near Cherokee, Alabama. The flight was initiated to locate a missing hunter, who might have been injured or suffering from exposure. The helicopter crewmembers used their searchlight to illuminate the area, located the hunter and planned — with the helicopter 100 to 150 ft (31 to 46 m) above the trees — to shine the light on the hunter until rescue personnel on the ground could find him. The helicopter descended vertically into the woods and crashed.

Feb. 5, 2008 — The pilot, flight nurse and flight paramedic were killed when a Eurocopter AS 350B2 struck water near South Padre Island, Texas, while maneuvering for approach. The helicopter had been en route to pick up a patient at a temporary landing zone. Night visual meteorological conditions prevailed for the positioning flight.

May 10, 2008 — The pilot, flight nurse and physician were killed and a Eurocopter EC 135 was destroyed when it struck a wooded hillside after takeoff from La Crosse (Wisconsin) Airport. The helicopter was being returned to its home base at the University of Wisconsin Hospital Heliport in Madison after being used to transport a patient to a hospital in La Crosse. Night visual meteorological conditions prevailed, and light rain was falling at the time of the crash.

June 8, 2008 — The pilot, flight nurse, flight paramedic and patient were killed when a Bell 407 crashed in a wooded area near Huntsville, Texas, after takeoff from Huntsville Memorial Hospital. The helicopter, which was being operated at night in marginal visual meteorological conditions, was destroyed.

June 29, 2008 — Two Bell 407 EMS helicopters collided while on approach to the Flagstaff (Arizona) Medical Center helipad, killing both pilots, two patients and three medical crewmembers. Daytime visual meteorological conditions prevailed for the flights. A surveillance camera at a hospital parking garage showed one helicopter approaching from the north and the other approaching from the south before the collision, about 0.25 nm (0.13 km) from the hospital.

— LW

Source: U.S. National Transportation Safety Board

420,000 in 2007, the IHST data show. At the same time, the accident rate has fluctuated between about 2.5 per 100,000 flight hours in 2007 to more than 5.5 per 100,000 flight hours in 2003. During the first six months of 2008, the accident rate was 3.8 per 100,000 flight hours In 2007, the accident rate for the entire U.S.-registered helicopter fleet was 6.8 per 100,000 flight hours.

During the first six months of 2008, the individual risk of fatal injury in HEMS operations reached a 10½-year high of 2.6 per 100,000 occupant exposure hours.

The IHST data also show that 54 percent of the 120 accidents occurred at night, 43 percent during the day and 3 percent at dusk. Sixty percent occurred when visibility was 10 mi (16 km) or better, 24 percent occurred with visibility between 3 and 9 mi (5 and 14 km), and 16 percent occurred when visibility was classified as "poor — less than 3 to 9 mi or rain, fog, smoke." At night, however, 35 percent of accidents occurred in conditions of poor visibility.

More accidents occurred en route — 34 percent — than during any other phase of flight, including at the scene of a motor vehicle accident or another off-airport pickup site, 30 percent; at a hospital, 23 percent; or at an airport, 13 percent (Figure 2, p. 16). The pilot was most frequently cited as an accident causal factor — in 65 percent of all HEMS accidents (Figure 3, p. 16).

Piloting and decision-making skills in "outside factors" — for example, continuing a flight after inadvertent entry into IMC, spatial disorientation, aircraft handling and controlled flight into terrain (CFIT) — were responsible for 37.5 percent of all HEMS accidents. "Aircraft strikes" — for example, tail rotor and main rotor strikes, wire strikes and objects from inside a helicopter striking the rotors — accounted for 25 percent. Maintenance and engine or systems failures were responsible for 17 percent of accidents, and "unknown" situations — those that were not understood — accounted for 9 percent.

Government-Industry Partnership

The FAA, in a position statement issued after the Arizona crash, said that there were no immediate

© Ross D. Franklin/Associated Press

Accident investigators survey the wreckage of the June 29, 2008, midair collision of two Bell 407 emergency medical services helicopters in Flagstaff, Arizona.

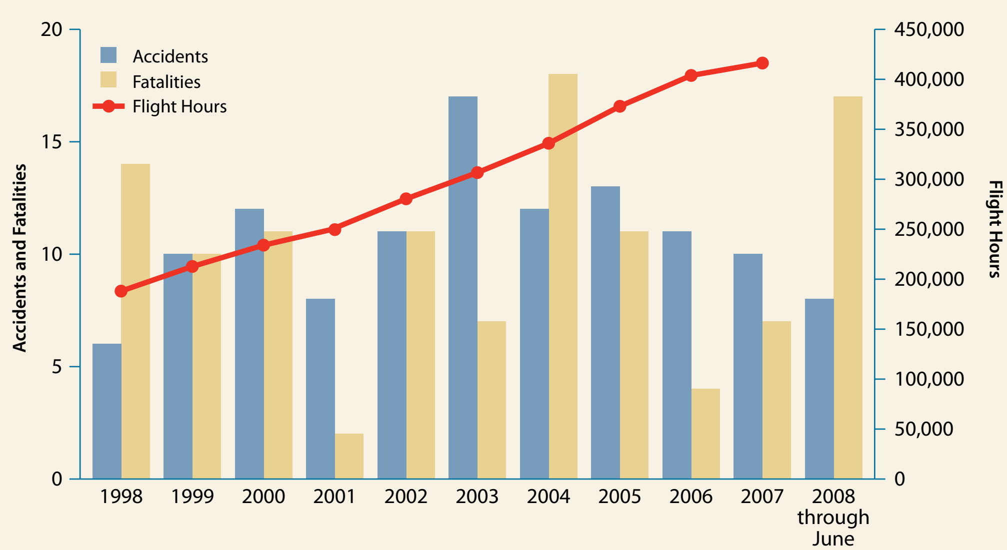
plans for changes in the rules regulating HEMS. Instead, the FAA said its immediate focus would be in areas that required no new rule making:[4]

- Encouraging risk management training to help flight crews make "more analytical" decisions about whether to begin a mission;
- Encouraging improved training for night operations and inadvertent flight into deteriorating weather;
- Providing airline-type FAA oversight of HEMS operators; and,
- Promoting the increased use of technology, including night vision goggles (NVGs), terrain awareness and warning systems (TAWS), and radio altimeters (also called radar altimeters).

Some of these technologies have moved into operation more quickly than others, said Gary Sizemore, president of the National EMS Pilots Association (NEMSPA) and a pilot for an EMS operation in northern Florida.

The FAA has been working since 1994 on projects and design approvals called supplemental type certificates (STCs) involving the installation of NVGs in helicopters and says that it has approved 15 STCs for EMS helicopters. Sizemore estimated that 25 to 28 percent of HEMS operations have NVG programs. His is not among them.

U.S. Helicopter EMS Accidents, Fatalities and Flight Hours



Note: Based on 92% of fleet with average aircraft hours per year ranging from 428 to 478 hours per aircraft.

Source: International Helicopter Safety Team, via Roy G. Fox, Bell Helicopter

Figure 1

"It would make a great deal of difference for us," said Sizemore, who has flown with NVGs in the past. "We fly out one way about 57 miles over nothing but pine forest. The other direction, there's about 70 miles of reclaimed swampland. It's pretty dark out there."

In addition to NVG certification, helicopter operators must have FAA approval of their training program for crewmembers who will use NVGs.

The NTSB has identified a number of accidents that might have been avoided if pilots had been using NVGs, which would have enabled them to see obstacles such as ridgelines and wires. In a 2006 study of 55 EMS accidents in the United States between January 2002 and January 2005, the NTSB found that the use of NVGs and other night visual imaging systems (NVIS) such as thermal imaging equipment, night vision cameras and some head-up displays, might have helped the pilots of 13 accident aircraft "more clearly observe obstacles and take evasive action to avoid the accidents."

For example, the NTSB cited the Dec. 23, 2003, crash of an Agusta A109A, which struck mountains near Redwood Valley, California, during a flight in high winds and heavy rain to pick up a patient. The pilot and two flight nurses were killed, and the helicopter was destroyed. The NTSB said that the probable cause of the accident was the pilot's "improper in-flight planning and decision to continue flight under VFR [visual flight rules] into deteriorating weather conditions, which resulted in an inadvertent in-flight encounter with IMC and a collision with rising terrain while attempting to reverse course."[5]

The NTSB also said that if the Redwood Valley pilot had been using NVIS, he "would likely have been able to identify the walls of the canyon, negotiate the terrain and avoid the accident."

Nevertheless, the board has never recommended requiring the use of NVGs and other types of NVIS· because, although they often are highly effective in night VMC, they do not work well in some situations, such as in populated areas with many streetlights or other forms of ambient light. Nevertheless, the NTSB has praised the FAA for encouraging the use of NVIS and has said that it hopes the technology will be more widely used in appropriate settings.

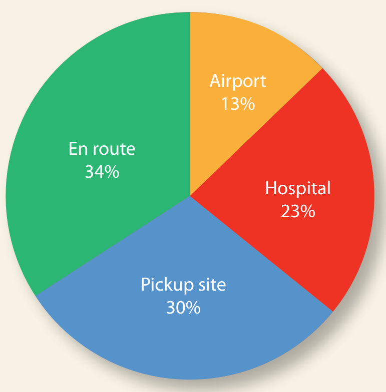
In a 2007 safety recommendation, the NTSB called on the FAA to require HEMS operators to install radio altimeters to increase pilots' awareness of height and prevent an inadvertent descent below a specified height, especially during low-altitude operations or hovering flight at night or in inclement weather. The NTSB cited the fatal Jan. 10, 2005, crash of a Eurocopter EC 135P2 near Oxon Hill, Maryland. The NTSB said that the probable cause of the accident was the pilot's "failure to identify and arrest the helicopter's descent," which resulted in CFIT. A contributing factor was the helicopter's inoperable radio altimeter.[6]

Radio altimeters have become increasingly common, Sizemore said, estimating that they are installed in 95 percent of EMS helicopters today.

Helicopter TAWS units — designed specifically for low-altitude flight environments — remain relatively rare, however, he said.

The NTSB said that of the 55 accidents in its 2006 study, 17 might have been avoided if the EMS airplanes and helicopters had been equipped with TAWS. The report cited the

U.S. Helicopter EMS Accident Locations

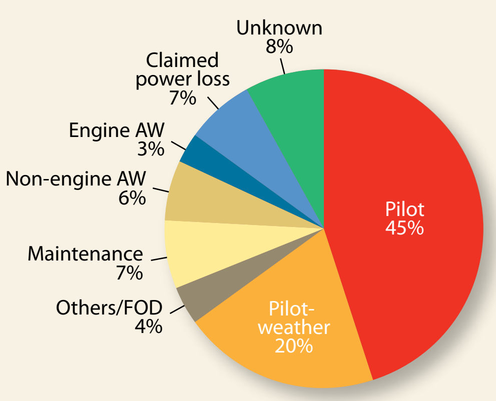


Note: Based on 120 accidents involving U.S.-registered civil emergency medical services helicopters, Jan. 1, 1998–June 30, 2008.

Source: International Helicopter Safety Team, via Roy G. Fox, Bell Helicopter

Figure 2

U.S. Helicopter EMS Causal Factors



AW = airworthiness issue
FOD = foreign object damage

Note: Based on 120 accidents involving U.S.-registered civil emergency medical services helicopters, Jan. 1, 1998–June 30, 2008.

Source: International Helicopter Safety Team, via Roy G. Fox, Bell Helicopter

Figure 3

Aug. 21, 2004, crash of a Bell 407 into mountains 27 nm (50 km) southwest of Battle Mountain, Nevada. The pilot, two medical crewmembers, a patient and the patient's mother were killed, and the helicopter was destroyed. The NTSB said the probable cause of the accident was "the pilot's failure to maintain clearance from mountainous terrain."[7]

The NTSB also said that a reconstructed flight profile indicated that if the helicopter had been equipped with TAWS, aural cautions and warnings would have begun 30 seconds before impact and would have "provided adequate time to allow the pilot to take appropriate action to avoid impact with the terrain."

The FAA, however, said that it has not moved to require TAWS in helicopters because of the "number of issues unique to VFR helicopter operations that must be resolved" including the potential for false alerts and "nuisance warnings" at the low heights at which helicopters typically operate. RTCA (formerly the Radio Technical Commission for Aeronautics) issued minimum operational performance standards earlier this year, and effective HTAWS units have begun to become more widely available.

The NTSB recommendation was included in a special investigative report on EMS operations, also including operations involving airplanes. The report included other recommendations to the FAA that subsequently were incorporated into bills introduced this year in the U.S. Senate and House of Representatives:[8]

- That all EMS flights, including positioning flights, be conducted in accordance with FARs Part 135, if anyone other than the pilots is aboard. The 2006 NTSB study of 55 accidents found that 35 occurred during Part 91 operations with medical crewmembers — but no patient — aboard. "Because Part 135 requirements impose additional safety controls that are not present under Part 91 requirements, the [NTSB] concludes that the safety of EMS operations would be improved if the entire EMS flight plan operated under Part 135," the NTSB said.
- That all EMS operators develop and implement flight risk evaluation programs. The NTSB said that a flight risk evaluation program would require the pilot and possibly one of his or her colleagues to "assess the situation without being influenced by the sense of urgency that can accompany the initial call requesting services."
- That EMS operators establish dispatch and flight-following procedures, including providing current weather information and assistance to flight crews in making in-flight risk-assessment decisions. The NTSB's 2006 study said that formalized flight dispatch procedures might have "mitigated the results" of 11 of the 55 accidents.

In addition, the legislative packages contain provisions to eventually require installation of digital flight data recorders and cockpit voice recorders in helicopters used in EMS operations.

'Absolute, Hard Record'

"For decades, these aircraft have been operating without any recorders at all," said Richard Healing, a member of the NTSB when it first ordered the 2006 special investigation report on EMS operations and now a consultant on transportation issues. "When there's an accident, there's no absolute, hard record of what went on that might have caused the accident."

In addition to the valuable information that digital flight data recorders would provide for accident investigators, Healing said that the HEMS industry as a whole would benefit from flight operational quality assurance (FOQA) programs, which rely on frequent downloads from quick-access recorders to retrieve data recorded during routine flights. The data analyzed are the same types that are stored in flight data recorders for accident investigation.

"The only way the industry will change anything is if there's shared data that indicate that whatever change you anticipate making will result in an improvement," Healing said. "If you don't have data, you never have that evidence and therefore you're not likely to create positive change."

Notes

1. Guzzetti, Jeff. "Recent EMS Accidents: An NTSB Perspective." Presentation to the FAA–AAMS EMS Safety Meeting, Washington, D.C., U.S., July 11, 2008. Guzzetti is the NTSB deputy director of regional operations.
2. FAA. *Fact Sheet: EMS Helicopter Safety*. June 30, 2008. <www.faa.gov/news/fact_sheets/news_story.cfm?newsid=6763>.
3. Fox, Roy G. *10.5-Year U.S. HEMS Safety*. Presentation to the HEMS Safety Summit, Dallas, July 25, 2008. Fox is chief of flight safety for Bell Helicopter Textron and a member of IHST.
4. FAA.
5. NTSB. *Special Investigation Report on Emergency Medical Services Operations*. NTSB/SIR–06/01, Jan. 25, 2006.
6. NTSB. Safety Recommendations A-07-111 and A-07-112, Dec. 21, 2007.
7. NTSB. *Special Investigation Report on Emergency Medical Services Operations*.
8. Ibid.

Undiminished Activity

BY J.A. DONOGHUE | FARNBOROUGH, ENGLAND

Economic slowdowns in the developed world are largely unnoticed as the developing world sustains the momentum.

Casual observers relying on general media reports from the air show probably could not help being confused. First there were the predictions that activity would be reduced as the world's aerospace community cinched up its belt to survive the downturn, then the predictors' initial reports confirmed that they were right, and then the final outcome, with several major new programs launched and equipment orders announced totaling nearly US$89 billion, more than double the previous show's record. Airbus alone booked more than $40 billion in orders.

The disconnect between predictions and reality had a lot to do with the nationality of the predictors, largely North American and European, who believed their regions' economic downturns would be reflected in the show's activity. And, in truth, there was very little ordering from those regions. But the strong economic growth shown in rapidly developing regions continues unabated, and so did orders from Asia and the Middle East, meaning that the areas with strong aviation growth and a major backlog of ordered airplanes will have an even greater need for trained personnel.

Somewhat surprising even to show veterans was the launch during supposedly down times of several programs — Bombardier giving the go-ahead to its 100–149 passenger CSeries with a geared turbofan engine for it from Pratt & Whitney, the PurePower PW1000G, and CFM International, a joint venture of GE and SNECMA, launching its Leap-X turbofan that seems to put the Boeing 737/Airbus A320 replacement cycle in motion. Further, the CFM partnership was extended to the year 2040.

In short, many of the companies exhibiting at Farnborough behaved as if their current business is quite healthy and that forecasts of continued growth for decades to come are being either affirmed or increased.

Boeing's revised Current Market Outlook (CMO) showed a significant shift in buying patterns, "with replacement airplanes taking a greater share of demand (43 percent) than we previously forecast (36 percent), and a smaller fleet size at the end of the 20-year

J.A. Donoghue

period (35,800 airplanes) than we predicted in the previous outlook (36,400 airplanes)." The increased number of retired aircraft will provide a ready pool for conversion to freighters, the Boeing analysis said, but even so the number of freighters needed by 2027 will total 3,358, of which 2,495 will be conversions from passenger aircraft despite the fact that Boeing's predicted annual average freight traffic growth is now set at 5.9 percent, down from last year's 6.1 percent.

The passenger aircraft fleet at the end of that period will be made up of aircraft that, on average, are larger than those in the existing fleet as fuel costs force airlines to not only modernize faster than previously thought, but also to go up in size, resulting in an annual fleet growth of only 3.2 percent to handle passenger numbers expected to rise at an annual rate of 5 percent, the CMO said.

Buying into the notion that the future is bright, Bombardier surprised many announcing the CSeries launch without a firm order for the aircraft, although Lufthansa has signed a letter of interest for 30 aircraft plus 30 options.

Gary Scott, president of Bombardier Commercial Aircraft, said, "These game-changing aircraft emit up to 20 percent less CO_2, up to 50 percent less NOx, fly four times quieter and deliver dramatic energy savings, up to 20 percent fuel burn advantage as well as up to 15 percent better cash operating costs versus current in-production aircraft." The first CSeries will enter service in 2013, he said.

Scott Carson, president and chief executive officer of Boeing Commercial Airplanes, did not see the CSeries as a threat, although he chose to refer to it as a "100–125-seat" aircraft. "Bombardier took a bold step … but fuel prices will result in an up-gauging of our smaller aircraft."

Carson said that the launch by CFM of its Leap-X turbofan for delivery in the 2016–2017 period "is consistent with what we were talking about" for a 737 replacement or step upgrade, "about 2017–2018."

However, neither Boeing nor Airbus, with the A320 and 737 families' production "largely sold out through 2014," as Carson said, are eager to advance the planned replacement.

J.A. Donoghue

It wouldn't be Farnborough without the Royal Air Force Red Arrows display team, which arrived unannounced early on the first day.

The management of Air France-KLM, however, have voiced frustration reported at the show at delays in launching replacement programs, saying the airline needs a replacement by 2015, a new engine and airframe that will cut fuel burn 20 percent.

CFM said that advanced material development has enabled a better next-generation engine than would have been possible last year. The Leap-X is a conventional configuration turbofan that promises up to 16 percent reduction in fuel burn, a 16 percent reduction in CO_2 and a reduction of 10–15 effective perceived noise decibels over the International Civil Aviation Organization's Chapter 4 noise rules.

However, CFM will proceed on a parallel development track working on technologies needed to produce an open-rotor engine in the same

20–30,000 lb-thrust class (89–134 kN) the Leap-X program has targeted, but promising up to a 26 percent fuel burn reduction if noise and installation challenges can be hammered out.

Rolls-Royce also is working on both a ducted fan and open rotor, and likewise has concerns about open rotor noise issues.

Among the safety-related news at the show was Raytheon's announcement that it will lead a study of the impact of new classes of aircraft on the U.S. Federal Aviation Administration's next generation air traffic control (ATC) system, called NextGen. Four classes of new aircraft — very light jets, super-heavy transports, unmanned aircraft systems (UAS) and supersonic transports — are the subjects of the study, designed to augment the U.S. National Aeronautics and Space Administration's Advanced Concept Evaluation System. First focus of the study will be the development of recommendations for new operational procedures and the establishment of system-level metrics.

Meanwhile, Raytheon is working on UAS control technology, showing a pilot and sensor-operator ground control station that presents a 270-degree view around the aircraft. While much of the initial development work is directed towards military usage, the fact that there have been several UAS midair collisions over Iraq has elevated the importance of developing collision avoidance technology in that arena, as well, Raytheon officials said, easing the task of integrating UAS into civil air space. The current ATC system would find it very difficult to accommodate a number of UAS operations, so Raytheon is working right now to perfect the ground-based control of the aircraft. When NextGen is introduced, the UAS can be more neatly tied into it, officials said.

Bombardier's newly launched CSeries will nudge into the bottom tier of the Boeing 737 and Airbus A320 lineups.

© Bombardier

Rockwell Collins at the show discussed the certification for helicopter use of a traffic-alert and collision avoidance system (TCAS II) in cooperation with Bristow and Shell Aircraft. Collins said the European Aviation Safety Agency certification was the first TCAS II to be approved for helicopter use. The application used without modification the existing TCAS-4000 unit.

Honeywell said that its Runway Awareness and Alerting System (RAAS) has been added to Airbus' e-catalog of options available on all aircraft. RAAS is a software enhancement of Honeywell's Enhanced Ground Proximity Warning System that provides aural identification of runways and warnings if a takeoff is attempted from a taxiway.

Goodrich said its Vigor Health Usage and Management System was selected by Sikorsky for its S-76D executive transport helicopter. The system will monitor the entire aircraft mechanical drive train to detect exceedances to allow preventative maintenance that will head off failures or expensive repairs.

It also was reported at Farnborough that CAE, after a period of study, is nearing the start in Canada of its first multi-crew pilot license training class. Calling the class a "beta program," CAE officials will keep close track on the class' progress.

Also on training, FlightSafety International has launched a new one-day course to support Gulfstream aircraft using Honeywell's PlaneView advanced cockpit technology. The course includes three hours of ground school and four simulator sessions.

Vision System International said it collaborated with Elbit Systems to produce a new series of light helmet-mounted displays labeled HMD-Lite. While many of its uses are military, the company said it also is suited for helicopter and transport usage. The helmet visor projects imagery and symbology, and can be tied into existing avionics with minimal hardware modifications and low cost, the company said.

The runway was in and out of sight, but the crew pressed ahead.

SNOWED

BY MARK LACAGNINA

The view outside the windshield on short final approach was blurred by an intensifying snowstorm. "I don't see the runway, dude," the captain said. "Let's go." The first officer, the pilot flying, said that he had the end of the runway in sight and continued the approach. Numbed by fatigue, the captain did not insist on going around. For the next few seconds, the cockpit voice recorder (CVR) picked up expletives, gasps and groans, rumbling noises and the sounds of impact. A photograph made soon thereafter shows the airplane belly-deep in snow and ensnared by the airport perimeter fence.

The runway overrun occurred on Feb. 18, 2007, at Cleveland Hopkins International Airport. The airplane, an Embraer ERJ-170 operated by Shuttle America, was substantially damaged, and three passengers sustained minor injuries. The other 68 passengers and the four crewmembers escaped injury.

In its final report on the accident, the U.S. National Transportation Safety Board (NTSB) said that the probable cause was "the failure of the flight crew to execute a missed approach when visual cues for the runway were not distinct and identifiable." Among the factors attributed to the overrun were the crew's use of an incorrect minimum altitude for the approach, a long touchdown on the relatively short, snow-covered runway, failure to use maximum braking and reverse thrust, the captain's fatigue, and an airline attendance policy that did not permit pilots suffering from fatigue to remove themselves from flight duty without fear of reprisal.

Insomnia

A former corporate pilot, the captain, 31, had flown for Republic Airways subsidiaries Chautauqua Airlines and Shuttle America since December 2003. He had 4,500 flight hours, including 1,200 hours in type, with all but 100 hours as pilot-in-command. He usually commuted two hours between his home in Louisville, Kentucky, and Shuttle America's base in Indianapolis.

The captain told investigators that his financial situation for the past year had been poor and was getting worse, and that he and his wife had separated the month before the accident. He also revealed that he had a chronic cough and had developed insomnia about a year earlier; the bouts of insomnia usually lasted for several days.

The captain had been on vacation for seven days, and his leave was scheduled to continue through the day of the accident. However, after an unsuccessful attempt to arrange for company jump seat travel to California to visit his infant son, he had called Shuttle America the night of Feb. 17 to request a flight the next day. He was told to report to the Louisville airport at 0525 local time the next morning so that he could be flown as a nonrevenue passenger to Atlanta, where he would begin a two-day trip.

After accepting the assignment, the pilot had an almost sleepless night. "He went to bed at 2000 but did not fall asleep until 0000 … and then awoke at 0100," the report said. "He tossed in bed until about 0200, at which time he decided to get up and prepare for the 0525 report time."

Although he was tired, the captain did not remove himself from duty because he believed that the airline would terminate his employment. A month earlier, he had received written notification that his attendance was unacceptable — with 18 days of unexcused absence from scheduled duty during the previous 12 months — and that "future occurrences would result in corrective action." The report noted that a verbal warning had not preceded the written warning, as required by the airline's attendance policy.

Shuttle America, which operated 47 ERJ-170s and employed 430 pilots, provided no information in its employee handbook about pilots calling in as fatigued or the implications of such action. However, the airline's pilot contract stated that "even though a pilot may be legal under the FARs [U.S. Federal Aviation Regulations], he has the obligation to advise the company that, in his honest opinion, safety will be compromised due to fatigue if he operates as scheduled or rescheduled."

The captain had been on duty almost 10 hours and had been awake for about 31 of the 32 preceding hours when the accident occurred. "The captain's performance during the accident flight was inconsistent with previous reports of his abilities," the report said. "Specifically, several first officers who had been paired with the captain had positive comments about his leadership and piloting skills."

'Unusable' Glideslope

The captain flew with different first officers from Atlanta to Sarasota, Florida, and back to

After landing long and overrunning the short, contaminated runway, the Shuttle America ERJ 170 became entangled in the airport perimeter fence, its nosegear broken.

U.S. National Transportation Safety Board

After Runway 24R at Cleveland Hopkins was closed for snow removal, the flight crew attempted to land on Runway 28, the crosswind runway at the top of the photo.

Atlanta the morning of Feb. 18. The first officer assigned to the third leg, the accident flight, was 46 years old and had flown as a copilot in a twin-turboprop regional airplane before being hired by Shuttle America as an ERJ-170 first officer in June 2005. He had 3,900 flight hours, including 1,200 hours as second-in-command in type.

"The accident flight was the first one in which the captain and the first officer had flown together," the report said. "Shuttle America's common practice is for the captain to be the flying pilot for the first flight of any crew pairing." Nevertheless, the captain asked the first officer to fly the airplane. "The first officer reported that he would have preferred not to be the flying pilot because he had just completed a three-day, six-leg trip sequence but that he agreed because of the captain's references to fatigue and lack of sleep the night before," the report said.

The ERJ-170, operated as Delta Connection Flight 6448, departed from Atlanta on time at 1305, with an expected arrival in Cleveland at 1451. The destination was forecast to have 5 mi (8 km) visibility in light snow showers and an overcast ceiling at 2,500 ft, with temporary conditions of 2 mi (3,200 m) visibility and a 1,200-ft overcast.

"The flight dispatcher provided the crew with a weather update about 1310, via the airplane's aircraft communications addressing and reporting system (ACARS), indicating that visibility [at Cleveland] was unrestricted with no snow," the report said. The same information was included in an update provided by the dispatcher at 1407.

The Cleveland area recently had received about 18 in (46 cm) of snow. Neither pilot had read a notice to airmen (NOTAM) included in their preflight paperwork about snow affecting the glideslope-transmission areas for two runways at the airport. The NOTAM advised that although the glideslopes remained in service, only localizer minimums were authorized for the ILS (instrument landing system) approaches because the "glideslope angles may be different than published."

At 1429, the crew received automatic terminal information service (ATIS) information Alpha, which said that the ILS approach to Runway 24R was in use. Soon thereafter, the 9,000-ft (2,743-m) runway was closed for snow removal, and ATIS information Bravo reported that the ILS approach to Runway 28 was in use. Both ATIS broadcasts said that the glideslope for Runway 28 was "unusable due to snow buildup." The pilots did not discuss this information.

Missed Assessment

A Cleveland approach controller was providing radar vectors to the crew at 1453, when the first officer briefed the Runway 28 ILS approach procedure. The briefing did not include, and the captain did not ask for, the runway length — 6,017 ft (1,834 m) — and the pilots did not review landing distance data.

"Shuttle America did not require landing distance assessments based on conditions at the time of arrival, even though the FAA [U.S. Federal Aviation Administration] had issued a safety alert for operators (SAFO) in August 2006 recommending that such assessments be performed," the report said.[1] The SAFO also recommended adding a 15 percent "safety margin" to the calculated landing distance.

The landing distance calculated by investigators was 4,872 ft (1,485 m), including a 15 percent safety margin. "This calculation was based on the reported winds, a braking action report of 'fair' and the accident airplane's flaps 5 configuration," the report said. "The calculation assumed a touchdown point of 1,400 ft [427 m], the use of maximum reverse thrust until 60 kt and full wheel braking."

The report noted that four transport category airplanes, including two Boeing 737s, had landed safely in the 10 minutes preceding the accident. However, weather conditions deteriorated rapidly during the ERJ-170's approach. At 1453, the approach controller said that ATIS information Charlie was current; the winds were from 290 degrees at 18 kt, visibility was 1/4 mi (400 m) in heavy snow, and the Runway 28 runway visual range (RVR) was 6,000 ft (1,800 m).

The captain had flown to Cleveland Hopkins before but had not landed on Runway 28. "The captain reported that he flew in snow conditions about four months each year and that the conditions on the day of the accident were the worst winter conditions in which he had ever flown," the report said. The first officer had not previously flown to Cleveland. "He had flown in snow conditions before but had not experienced a snow squall during landing until the accident flight."

'It's a Localizer'

At 1458, the crew heard the controller clear the pilots of another airplane for the ILS approach and advise them that the glideslope was unusable. While completing checklist actions, the ERJ-170 crew discussed the apparent contradiction in a clearance to conduct an ILS approach with an unusable glideslope. "It's not an ILS if the glideslope is unusable," the captain said. "Exactly," the first officer said. "It's a localizer."[2]

"During postaccident interviews, both pilots stated that they were confused by the term 'unusable,'" the report said. "Nevertheless, neither [pilot] asked the controller for clarification about the status of the glideslope. … Other Shuttle America pilots who were interviewed after the accident stated that they were familiar with the term 'unusable' in reference to a glideslope, and one check airman stated that he had used this specific term in various simulator scenarios."

At 1500, the approach controller issued a heading to intercept the localizer and cleared the crew to conduct the ILS approach, adding,

"The captain reported that the conditions on the day of the accident were the worst winter conditions in which he had ever flown."

Embraer ERJ-170

© Joey Collura/Airliners.net

The ERJ-170, which first flew in 2002, has 70 to 80 passenger seats and is powered by General Electric CF34-8E5 engines. Standard maximum weights are 79,344 lb (35,990 kg) for takeoff and 72,311 lb (32,800 kg) for landing. Maximum range is 2,000 nm (3,704 km).

The ERJ-190, which has a longer fuselage and wing, and 100 to 114 passenger seats, was introduced in 2004. The "ERJ" designation has been dropped, and production of standard and long-range versions of the 170 and 190 continues. The accident airplane is shown above.

Source: *Jane's All the World's Aircraft* "glideslope unusable." When the captain established radio communication with the airport traffic controller, he said that the airplane was established on the "localizer to two eight." The controller cleared the crew to land and advised that the winds were from 310 degrees at 12 kt and that braking action had been reported as fair.

After acknowledging the clearance, the captain told the first officer, "This is just … feels wrong." The first officer replied, "Yeah, something's [expletive] up."

While conducting the landing checklist at 1501, the captain said that he had ground contact. About a minute later, the first officer said that the glideslope had been captured by the autopilot. "During a postaccident interview, the first officer stated that he and the captain did the 'mental math' [i.e., a distance-height calculation] for a three-degree glideslope and that, on the basis of this calculation, they assumed that the glideslope was functioning normally," the report said. "Also, the captain stated that the cockpit instrumentation showed the airplane on the glideslope with no warning flags."

The published minimum RVR for the ILS approach was 2,400 ft (750 m), and the decision height (DH) was 1,018 ft. The applicable minimum RVR for the localizer approach was 4,000 ft (1,200 m), and the minimum descent altitude (MDA) was 1,220 ft.

Assuming that the glideslope was working properly, the pilots set up for the ILS approach, instead of the localizer approach. "The flight crew should not have disregarded the information provided by the controller and on the ATIS information broadcasts about the glideslope being unusable and should have … set up, briefed and accomplished the approach to localizer (glideslope-out) minimums," the report said.

Below Minimums

The airplane was crossing the final approach fix — the outer marker — at 1502, when the controller advised that Runway 28 RVR was 2,200 ft, which was below minimums for both the ILS and localizer approaches. The captain told the first officer, "We're inside the marker. We can keep going."[3] He then added, "This is [expletive] up."

At 1503, the controller advised that Runway 28 RVR was 2,000 ft. The first officer said, "Jesus." The captain said, "Got to be fun. Got to have twenty-four to shoot the fricken ILS." He then called out 1,000 ft above DH and said that he was "getting some ground contact on the sides [but] nothing out front."

CVR data and postaccident interviews revealed that neither pilot had the runway environment in sight when the airplane reached the MDA for the localizer approach. "It is important to note that [they] would have been required to execute a missed approach if they had been using the localizer approach," the report said.

The radio altimeter apparently had been set to the DH, and, at 1504:46, an electronic callout, "approaching minimums," was generated, followed six seconds later by "minimums." The airplane was about 190 ft above ground level (AGL) at 1504:53, when the captain said, "I got the lights." The first officer replied, "And continuing."

"About 1504:58, the captain [again] announced that the

No one was hurt while deplaning, but NTSB said that using the evacuation slide, rather than a stepladder, would have been safer.

U.S. National Transportation Safety Board runway lights were in sight but then stated that he could not see the runway," the report said. "This statement was immediately followed by, 'Let's go [around].'"

The imprecise terminology of the captain's command might have suggested to the first officer that it was tentative. Nevertheless, the report said, "When the captain called for a go-around because he could not see the runway environment, the first officer should have immediately executed a missed approach, regardless of whether he had the runway in sight."

The report also said, "When the first officer did not immediately execute a missed approach, as instructed, the captain should have reasserted his go-around call or, if necessary, taken control of the airplane."

'Complete Whiteout'

An electronic callout of 50 ft AGL was being generated when the captain asked the first officer if he had the runway in sight. About a second later, however, the captain said, "Yeah, there's the runway. Got it."

Recorded flight data indicated that the airplane crossed the runway threshold at 40 ft AGL and was 1,050 ft (320 m) beyond the threshold at 1505:19 when an electronic callout of 10 ft AGL was generated. The first officer said, "Oh, [expletive], dude." The captain also voiced an expletive.

"During a postaccident interview, the first officer stated that … he momentarily lost sight of the runway because a snow squall came through and he 'could not see anything,'" the report said, noting that the first officer should have conducted a go-around. RVR had dropped to 1,400 ft (400 m).

Groundspeed was 105 kt when the airplane touched down about 2,900 ft (884 m) beyond the runway threshold at 1505:29. The ground spoilers deployed automatically, and the captain applied reverse thrust. However, he applied full reverse thrust for only two seconds before reducing it to idle at an indicated airspeed of about 85 kt.

"In addition, [recorded flight] data showed that the first officer's initial wheel brake application was about 20 percent of maximum and remained relatively steady for about eight seconds before increasing to 75 percent of maximum," the report said. "Braking then increased to about 90 percent of maximum when the captain applied his brakes [with 450 ft (137 m) of runway remaining]. The anti-skid system did not modulate the brake pressure until the captain and the first officer applied their brakes aggressively."

The first officer told investigators that he could not see the end of the runway or any distance-remaining signs during the roll-out. Groundspeed was about 42 kt when the ERJ-170 overran the runway.

"The CVR recorded the sound of numerous impacts starting about 1505:50 and a sound similar to the airplane coming to a stop about 1505:57," the report said. Aircraft rescue and fire fighting (ARFF) personnel arrived about four minutes later. An ARFF official told investigators that his crews faced "blizzard conditions and a complete whiteout" while responding to the accident.

After confirming that no fire or fuel leaks existed, and that no one was seriously injured, the captain decided to keep everyone aboard the airplane until buses arrived to transport them to the terminal. The nosegear had collapsed, and the occupants were evacuated through the front cabin door with the aid of a stepladder.

Three passengers reported neck, back, spine, shoulder and/or arm pain. "Two of these passengers were transported to a hospital after the accident, but neither was admitted," the report said.

Call for Training

Based on the findings of the investigation, NTSB recommended that U.S. air carrier, commuter, air taxi and fractional ownership program pilots receive simulator training on rejecting landings when visual cues rapidly decrease below 50 ft AGL and conducting maximum-performance landings on contaminated runways.

The board also recommended that the FAA work with industry and pilot organizations to develop and adopt a "specific, standardized policy that would allow flight crewmembers to decline assignments or remove themselves from duty if they [are] impaired by a lack of sleep."

This article is based on NTSB Accident Report NTSB/AAR-08/01, *Runway Overrun During Landing; Shuttle America, Inc., Doing Business as Delta Connection Flight 6448; Embraer ERJ-170, N862RW; Cleveland, Ohio; February 18, 2007.*

Notes

1. After the accident, Shuttle America and Embraer developed an automated airplane performance system that uses data entered by the flight crew and sent via ACARS to Embraer, which performs a landing distance calculation and sends the data to the crew within 30 seconds. At press time, an FAA-approved six-month operational trial of the system was ongoing.
2. The report noted that the FAA's *Instrument Procedures Handbook* states that "the name of an instrument approach, as published, is used to identify the approach, even if a component of the approach aid is inoperative or unreliable."
3. FARs Part 121, the air carrier regulations, permits pilots to continue an approach if they receive a report that visibility is below minimums after they have begun the final approach segment.

Errors involving the entry of takeoff data into flight management systems, or other performance calculators, are frequent and occur regardless of aircraft type, equipment type and airline, according to a report released by the French civil aviation authority and accident investigation agency.[1]

These errors typically are detected by use of the airline's operating modes or by "personal methods," such as mental calculations, said the report on the study by Laboratoire d'Anthropologie Appliquée (LAA).

Half of the pilots surveyed at one of the two airlines that participated in the study said that they had experienced errors in parameters or configuration at takeoff, some of which involved the input of aircraft weight into the flight management system (FMS).

The study was prompted by two similar serious incidents — the first involving an Air France Airbus A340-300 at Charles de Gaulle Airport in Paris in July 2004 and the second involving a Corsairfly Boeing 747-400 at Orly Airport in Paris in December 2006.

"The common cause of these two events was the crew entering much lower than normal takeoff weights and values for associated parameters (thrust and speed)," the report said. "The effect in each case was an early rotation with a tail strike on the runway, followed by a return after dumping fuel. Beyond the damage to the aircraft, these takeoffs were undertaken with inadequate thrust and speed, which could have led to a loss of control of the aircraft."

BY LINDA WERFELMAN

Mistakes in determining takeoff parameters are frequent, a French study says, and methods of detecting them are not always effective.

Calculating ERRORS

© Chris Sorensen Photography

Other similar incidents have occurred elsewhere in recent years. Typical incidents involve new-generation aircraft and errors in entering takeoff parameters that went undetected by flight crews, the report said.

The most serious event was the fatal Oct. 14, 2004, crash of an MK Airlines 747-200SF that failed to gain altitude on takeoff from Halifax, Nova Scotia, Canada, because of the flight crew's unknowing use of an incorrect aircraft weight when crewmembers calculated takeoff speeds and thrust settings. All seven crewmembers were killed in the crash and subsequent fire, and the airplane was destroyed (*ASW*, 10/06, p. 18).

The study, which was initiated after the Bureau d'Enquêtes et d'Analyses (BEA) completed its investigation of the 2006 incident at Orly, was designed to review the "processes for errors specific to the flight phase prior to takeoff and to analyze the reasons why skilled and correctly trained crews were unable to detect them," the report said.

Manufacturer Definitions

Both Airbus and Boeing have published documents discussing takeoff speeds. Airbus characterizes takeoff speeds as a "key element of safety for takeoff" and cautions that "using erroneous values can lead to a tail strike, a takeoff rejected at high speed or a climb with reduced performance." Errors in speed calculations frequently result from last-minute changes, time pressure or a heavy workload, and cross-checking calculations can be difficult because of the workload of the pilot flying during pushback and taxi, Airbus said.

The Boeing document said that, if input values are correct, other related errors can occur in several areas, including data conversion, selecting weight on a load sheet, selecting the table to be used in manual calculations or selecting high-lift flaps.

Procedural Analysis

The report included an analysis of procedures used to input and verify takeoff performance data for Air France 777s, A340s and 747s, and Corsairfly 747s; ergonomic inspections to identify conditions that can result in operating difficulties for flight crews; and a review of 10 incident reports that involved the use of inappropriate takeoff parameters.

The incident report reviews paid particular attention to methods of obtaining weight data, calculating takeoff speeds, inputting parameters into the FMS (when one existed) and displaying speeds.

For example, a crew must determine its fuel needs before the airplane is loaded and the weight is known; as a result, they may estimate the required fuel based on the forecast load data, with the last of the fuel being added after the final load has been determined, the report said.

A variable in the function is the quality of communication between the flight crew and ground personnel. Procedures are not identical at all airports, and communication sometimes suffers, the report said.

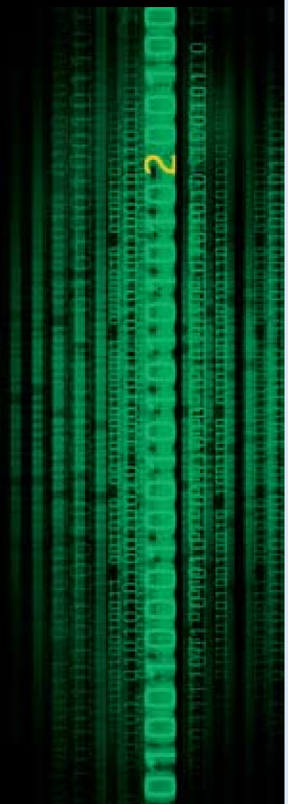
An effective check of the amount of fuel in the airplane can be obtained by observing the FMS or a fuel gauge; the indicated quantity varies as fueling progresses. Gauge accuracy may improve when tanks contain little fuel, the report said, noting that the amount of onboard fuel can be estimated "by adding the fuel remaining to the quantity flowed."

Load sheet data include the aircraft basic weight; the load, which can be known only after embarkation has been completed; and the fuel quantity — the amount of fuel decided on by the flight crew.

"The time the load sheet becomes available is one of the main factors in variability," the report said. "Several versions of this document can follow one another; the forecast report sometimes used for the refueling decision is eventually replaced by a final version issued to the crew after the completion of embarkation."

Calculations

Takeoff weight (TOW) is one item included in calculations of takeoff parameters — calculations that are performed either manually or by computer and either by the flight crew or remotely, with ACARS (aircraft communications addressing and reporting system) transmission, for example.



© Ariusz Nawrocki/Stockxpert.com

Of the 10 incident reports examined in the study, nine described events involving a "major failure" that occurred during calculations, including two events in which the previous flight's weight parameters were used. In another event, the manual used to calculate speed did not match the aircraft type. In six events, an incorrect weight was used in the calculations; for example, zero fuel weight (ZFW) instead of TOW was entered into ACARS or into a laptop computer, the report said.

"These failures highlight the ineffectiveness of controls on this function," the report said. "Even an input with cross-check doesn't guarantee the absence of an error, as one of the studied incidents shows: The captain calls out the value to be input and confirms the input made by the copilot. However, the captain doesn't read the appropriate value, so calls out an erroneous value and the verification of input is ineffective."

The report suggested that a more effective check might be a double calculation. However, the report said, "Not only must the calculation be done twice, but the selection of input data [must be performed twice] as well.

"In one of the incidents studied, the captain carried out a check of the calculation without confirming the TOW and so used the erroneous TOW to check the speeds and hence obtained the same (erroneous) values as the copilot."

Input of FMS Data

Six of the 10 incidents involved airplanes equipped with an FMS. In one incident, a major failure was associated with the input of FMS data: A typing error associated with a late change that was made without a cross-check resulted in an incorrect entry of V1 (defined in the report as "decision speed").

"In the other five cases, the input speed values were erroneous," the report said. "The error arose from the parameter calculation function. … During verification of the calculation, the input of these values is one of the steps where inconsistency of the values with the aircraft load and takeoff condition could be detected. However, simple verification of a match between the elements input and the data shown on the 'card' does not allow the error to be detected."

Some FMSs calculate reference speeds — V1, Vr (rotation speed) and V2 (takeoff safety speed) — and the report suggested that these speeds could be displayed and used for comparisons when flight crews check the speed input function. Nevertheless, the report noted that two incidents involved airplanes equipped with this type of FMS, and the feature did not enable the flight crew to identify mistakes in speed calculations.

Four incidents involved airplanes without an FMS, and in these situations, the reference speeds displayed on the primary flight display (PFD) also are derived from the parameter calculation function, using either the takeoff card or a laptop screen.

Crews can verify that the correct speeds are being displayed by checking those numbers against those on the takeoff card, or by noting the relative position of the speed index and the redundancy of displays, the report said. However, in the four incidents in which the airplanes did not have an FMS, the presence of these elements did not aid in error detection, the report said.

Takeoff Parameters

The report identified five steps in the takeoff phase of flight: acceleration to V1, callout of V1, acceleration to Vr, callout of Vr and rotation at Vr. If the crew detects an anomaly before the airplane reaches V1, the takeoff can be rejected.

"V1 is a reference in the decision to continue or reject takeoff," the report said. "However, this reference comes from a calculated value, and in the event of an erroneous value, safety aspects — either a possible stop before the end of the runway or continuation with an engine failure — are no longer guaranteed."

In one of the incidents, the flight crew determined that the aircraft's behavior was atypical and rejected the takeoff after V1 was displayed but before the airplane actually reached that speed, the report said.

"Even an input with cross-check doesn't guarantee the absence of an error."

In another incident, the pilot not flying (PNF) called out Vr just after the airplane had accelerated to V1. "The failure rises here from the erroneous link made by the PNF between the achievement of V1 and the achievement of Vr," the report said. "This underlines the time pressure placed on the PNF as soon as he detects the signal indicating that Vr has been reached, as well as the inadequate control of this function."

Proposals for Improvement

Analysis of the 10 incidents included the identification of four types of "barriers" designed to prevent errors:

- Physical barriers, such as an aircraft "tail shoe" designed to mechanically protect the fuselage and physically prevent an unwanted event from occurring. Such systems typically present more disadvantages than advantages.

- Functional barriers, which are designed to limit input errors by enabling automated systems to perform basic checks. The report suggested that software controls could be strengthened — for example, software could be developed to check consistency between the V1, Vr and V2 values entered into the system.

- Symbolic barriers in procedures and guidance, which require "interpretive action" to achieve their goal. For example, the report cited the inclusion in all FMSs of a function for the calculation and presentation of reference speeds. The function currently is available only in some FMSs. Nevertheless, the report said that incidents have shown that "the simple presentation of reference speeds by the FMS does not constitute an effective symbolic barrier. Strengthening of this barrier could be considered by providing a warning message in the event of significant differences, or a display of these differences."

- Barriers in safety policy and user knowledge, which may be directed toward strengthening training for emergency situations and enhancing pilot familiarity with — and memory of — takeoff parameters. The results of these barriers are more difficult to measure than the results of other types of barriers.

© Sven De Bevere/aviation-images.com

This MK Airlines Boeing 747 crashed on takeoff from Halifax, Nova Scotia, Canada, in 2004, after the crew unknowingly used an incorrect aircraft weight to calculate takeoff speeds and thrust settings, investigators said.

Airline Survey

A survey of 19 captains and 11 first officers at Corsairfly found that 50 percent had experienced a takeoff that "was or could have been carried out with reduced safety margins because of erroneous parameters."

The most frequently reported errors occurred in two categories:

- Five errors inputting weights into the FMS. Two of the five errors were detected after takeoff, two others were detected before takeoff, and a description of the fifth error said that it was detected when the copilot "was reading speeds following a disagreement with the captain."

- Five errors inputting the runway in use into the FMS. All five were detected before takeoff, although one input error was discovered during of application of thrust at takeoff, with the appearance of the "verify INS [inertial navigation system] position" warning.

Other reported errors involved two cases of mistakes in configuration, two cases in which reference speeds were either miscalculated or not displayed on the PFD and one case of an erroneous thrust display.

When questioned about their "principal constraints … from preparation until takeoff," 15 pilots cited time constraints, 12 cited interruptions and two cited the late delivery of the final load sheet to the cockpit.

Flight Observations

Observations of flight preparations showed that the flight crews' workload increased as departure time approached and that the captain's activities were especially subject to interruption.

Observations also showed that flight crews arrived in the cockpit one hour to 2 ½ hours before takeoff, and that the final load sheet was delivered to them about 20 to 45 minutes before takeoff. Some crews calculated takeoff parameters before arriving in the cockpit. Others waited until after their arrival, and times varied from 16 minutes to one hour before takeoff.

In some cases, calculations were repeated; for example, to account for a tail wind and for wet runway conditions.

On one observed flight, reference speeds were not input into the FMS, the report said.

"During this flight, reference speeds were calculated by the FMS [and] a 'card' was edited by the crew, but speeds were not entered into the FMS," the report said. "During takeoff, the crew used the takeoff card to call out V1, which would have been called out by the equipment if the speeds had been entered, and Vr. This omission highlights the lack of robustness in the system that enables takeoff to be carried out without input of speeds into the FMS."

The report said that theoretically, the final TOW should be used to calculate parameters — a provision that means the calculations cannot be performed until after the crew has received the final load sheet. In five of the 14 observed flights, however, the parameters were calculated before delivery of the load sheet.

There are two types of controls — checking input data and speed data, the report said. Crews typically assigned priority to one or another of these controls, but usually not to both, the report said, adding that there was no control based on a comparison of the final load sheet, the takeoff card or laptop information, and the FMS.

"The final load sheet is actually the reference source, whatever the airline and the equipment used," the report said. "Obtaining this document is the determining step that influences calculation and input of takeoff parameters into the FMS. Making these final data available late generates a great number of tasks to be carried out in a limited time and creates time pressure. To deal with this, airlines and crews adopt different operating methods."

Note

1. LAA. *Use of Erroneous Parameters at Takeoff*, report prepared for the BEA and the Direction Générale de l'Aviation Civile, DOC AA 556/2008. May 2008.

© Dassault Falcon Jet

New Standards for

BY MARK LACAGNINA

The International Civil Aviation Organization (ICAO) has swept away standards and recommended practices for international general aviation airplane operations that it characterized as so woefully outdated, they were "in danger of becoming irrelevant." They have been replaced by mostly performance-based standards developed by specialists from the business aviation community, and ICAO has given its 192 contracting states three years to implement them.

The new standards have been incorporated as Amendment 27 to Annex 6, Part II. The annex also covers international air transport (commercial) operations in Part I and international helicopter operations in Part III.

Part II now has three sections. The first two sections provide definitions of terms and basic standards and recommended practices (SARPs) for all international general aviation airplane operations. Section 3, titled *Large and Turbojet Aeroplanes*, applies to jets and airplanes with maximum takeoff weights over 5,700 kg/12,500 lb. Section 3 applies mostly to corporate aviation management and includes requirements for a safety management system (SMS), a fatigue management system and an operations manual.

Documents produced throughout the nearly four-year development process have consistently referred to the safety record of corporate aviation operations. "Corporate aviation has heretofore been largely self-regulated and has enjoyed an excellent safety record," said ICAO Secretary General Taïeb Chérif in an April letter announcing the adoption of Amendment 27. "The industry best practices contributing to this record of success are extensively drawn upon in creating the provisions of Section 3."

Relic From the '60s

If corporate aviation has been doing such a good job with minimal regulation, why were new standards needed? Two reasons, one of which already has been mentioned: Although several other amendments had been made since Part II was introduced 40 years ago, "this part is still geared toward a general aviation environment prevalent in the 1960s — that is, light aircraft typically operated for recreational purposes, domestically as well as internationally," Chérif said. "General aviation has changed significantly since then."

Safety and fatigue management systems are on the books for general aviation.

INTERNATIONAL GA

Modernization of Annex 6, Part II, long had been on ICAO's task list but had been delayed by both a lack of resources to do the job properly and higher-priority tasks on the list. "We recognized that Part II was fast becoming a dinosaur," said Duncan Monaco, an operations officer at ICAO. "It was written back in 1968 and has not kept up with changes in the industry."

Another driving force for new standards was concern about various regulatory bodies that were taking it upon themselves to fill the void created by the dinosaur. "Annex 6, Part II was so out of date that it was resulting in organizations like the Joint Aviation Authorities [JAA] and others developing their own rules," said Donald Spruston, director general of the International Business Aviation Council (IBAC). "We were quite concerned, primarily with the work done in Europe by the JAA, because the intent initially was to develop rigid rules along the lines of the rules for commercial operations."

The efforts to "commercialize" international general aviation operations likely would have resulted in a requirement that corporate operators obtain an air operator certificate. "This would have a significant impact on the workload of the regulators, which would mean that the operators would be delayed trying to get certification or approval," Spruston said. "We also pointed out to the JAA, to ICAO and others that the safety record in corporate aviation was as good as the airlines; therefore, why impose the additional workload and burden of requiring an air operator certificate?

"We felt that ICAO needed to do something. And it wasn't that they disagreed; they were fully in accord with what we were saying."

Performance-Based Goal

Ultimately, the ICAO Secretariat called on the business aviation community for help in rewriting Part II. "ICAO normally develops changes to its annexes with assistance from panels and study groups that are managed directly by the Air Navigation Commission and the Secretariat," Monaco explained. "This traditional approach can be time-consuming, so in this case we used a different approach by drawing more heavily on industry expertise to help us develop a proposal that could be considered by the Air Navigation Commission."

Accepting the invitation, IBAC and the International Council of Aircraft Owner and Pilot Associations (IAOPA) formed an ad hoc advisory group comprising about 10 business aviation specialists. "They were essentially the movers and shakers within their region of the world and very interested in regulations and standards," said John Sheehan, IAOPA's secretary general. "As you might expect, when we gathered these people together, there were some very strong opinions about what was required. Our discussions often engendered a lively exchange."

Among the issues that sparked debate was to whom the higher standards of Section 3 should apply. For example, there was much discussion about including turboprops, Sheehan said. Consensus was reached on this and other issues. As a result, in addition to applying Section 3 to large airplanes and jets, Amendment 27 *recommends* that it also be applied to "corporate aviation operations involving three or more aircraft that are operated by pilots employed for the purpose of flying the aircraft." Use of the term "aircraft" indicates that the corporate fleet could include helicopters as well as airplanes.

A common objective among the advisory group members — and ICAO — was that *prescriptive* standards should be avoided. "We desired rules that were more *performance-based* — in other words, that would show how you meet the final result as opposed to a prescriptive methodology for meeting the final result," Spruston said.

Sheehan gave the following explanation of the difference: "Prescriptive rules say, 'You must do this. You must have this piece of equipment. You can only go this fast.' That sort of thing. A performance-based standard says, 'OK, here is the goal. You can get to that goal in any number of acceptable ways. You pick the way to do it.'"

The SMS standard is a good example. Section 3 simply says, "An operator shall establish and maintain a safety management system that is appropriate to the size and complexity of the operation." ICAO's *Safety Management Manual* (Doc. 9859) and "industry codes of practice" are cited as guidance for developing an SMS.

Industry codes of practice is one of the new terms incorporated in Part II, defined as "guidance materials developed by an industry body for a particular sector of the aviation industry to comply with the requirements of ICAO SARPs, other aviation safety requirements and the best practices deemed appropriate." IBAC's *International Standard for Business Aviation Operations* (IS-BAO) is a good example of an industry code of practice.

Collaborative Effort

The advisory group spent a year developing the proposed rewrite of Part II. "The proposal was sent to all of our member associations, reviewed, assessed and reviewed again within the governing board of IBAC," Spruston said. "Once we were comfortable that we had done the development well, we sent it to the ICAO Secretariat.

"From that point on, they took responsibility for further review, but we participated with them through all of that process. We conducted briefings to the Air Navigation Commission, prepared material for distribution to states and answered questions as they came up. It was a very collaborative process as well as a fairly long process from the time we submitted the proposal and the time it was finally accepted by the ICAO Council. But it was a good challenge, because it required that we continually go back and look at what we had written and ensure that we were able to justify things that were questioned."

The ICAO review resulted in mostly minor changes to the proposal developed by the advisory group. "The end result was that there was some restructuring and moving around," Spruston said. He noted one exception that involved a standard that restricts the continuation of instrument approaches — commonly called an *approach ban*, although ICAO does not use the term.

Initially grafted onto Part II from Part I, the approach ban prohibits continuation of a precision approach beyond the outer marker or a nonprecision approach below 300 m/1,000 ft above airport elevation unless the reported visibility or controlling runway visual range is above the published minimum.

Most of ICAO's contracting states have implemented the approach ban for commercial operations, but none has implemented it for general aviation. So, the advisory group took it out of Part II. "Some of the issues considered during the discussion of the approach ban were the inaccuracy of weather reporting, the fact that runway end visibility can be considerably different than the weather report," Spruston said. "There was a whole list of things that we could show that made the existing provision a burden, which is why no country ever implemented it."

Nevertheless, the Air Navigation Commission was reluctant to remove a standard that had been on the books for so long. "There were many meetings and sessions devoted to the subject, and the discussion took many turns, but the final result was that they decided to keep the provision as it existed and to initiate a full review of the approach ban issue," Spruston said. "This approach ban issue was essentially the only part of the industry modernization proposal that was not accepted."

ICAO's review of the approach ban will include its applicability in all three parts of Annex 6. "After reviewing the proposal to modify the approach ban for general aviation in the Air Navigation Commission, we decided that the issue should apply to all three parts of Annex 6 — meaning commercial, general aviation and helicopter operations — and agreed to reopen the debate accordingly," Monaco said. "There are some good arguments for making some changes, and perhaps even doing away with it altogether. We expect that the Operations Panel will begin analyzing the approach ban issue for all of Annex 6 in the near future."

Meanwhile, the approach ban remains in Section 2 of Part II and, thus, applies to all international general aviation operations.

Also on hold are standards for international fractional ownership operations. "We need to do more research before we, ICAO, make a decision on how to treat these operations," Monaco said. "The states are handling it individually well enough for the time being, but we do need to fold it into Annex 6 at some point, and we need to do it in a way that meets the needs of both regulators and industry; we don't want to implement something that turns out not to be a benefit."

Among the considerations is whether the standards should be included in Part I, Part II or in a new, fourth part devoted exclusively to fractional ownership operations.

Stepping Up

Will state implementation of any of the provisions in Amendment 27 to Annex 6, Part II likely cause problems for operators? "I would guess that the most significant issue for operators that do not have well-established processes will be the need to establish a safety management system," Spruston said. "That is probably the biggest change."

An SMS is defined in the new Part II as "a systematic approach to managing safety, including the necessary organizational structures, accountabilities, policies and procedures."

Spruston and Sheehan noted that many corporate aviation departments that fly internationally in large airplanes and jets already have an SMS that will meet the new standard. For those that don't, IBAC soon will offer a tool kit that will go beyond the guidelines currently provided in the IS-BAO.

"That is the one part of the IS-BAO where we found that operators were seeking more help," Spruston said. "So, we decided to develop more detailed guidance on SMS to help the operators that were struggling with the basic material in the standard. The tool kit provides a very detailed process for implementation — step-by-step guidance, checklists on how to do it — and a lot of supporting material." October is the target for production of the tool kit.

Incorporating a fatigue management system in the SMS might puzzle some corporate operators. Ray Rohr, director of regulatory affairs for IBAC and a member of the Part II modernization advisory group, said, "I think the states are going to have to put in some basic limits on flight and duty time, and then allow operators to work from there in developing a fatigue management system."

Rohr said that among existing industry codes of practice that can help in developing such a system are the fatigue countermeasures developed by a Flight Safety Foundation task force, based on research by the U.S. National Aeronautics and Space Administration (*Flight Safety Digest*, 2/97). He also noted that the ICAO Operations Panel currently is developing guidance material for fatigue risk management.

ICAO initially planned to make the new SARPs for international general aviation operations applicable this year. "There was some push-back about this because of the complexity of the changes, so we agreed that we would delay applicability until 2010 to give everybody plenty of time to implement the new standards," Monaco said. Amendment 27 will become applicable on Nov. 18, 2010, and ICAO has given the states until Oct. 18 of that year to provide notification of any "differences" — that is, to list the standards that will not be implemented or implemented differently than recommended by the new Part II.

IASS

OCTOBER 27–30, 2008

Honolulu, Hawaii

The forecast is for plenty of sunshine in Honolulu during the Flight Safety Foundation 61st annual International Air Safety Seminar (IASS) on October 27–30. But while you'll probably want to get in a little beach time, the main attraction is what it has always been at the IASS: leading-edge, knowledgeable and important presentations by aviation safety specialists, plus an opportunity to meet colleagues from around the world.

Preliminary Agenda

Monday, October 27

Opening Reception — Sheraton Waikiki Hotel, Diamond Head Lawn

Tuesday, October 28

"Welcome and Seminar Opening" — H. Keith Hagy, chairman, FSF IAC, and director, Engineering and Air Safety Department, Air Line Pilots Association, International

William R. Voss, president and CEO, Flight Safety Foundation

Frank Turner, president, International Federation of Airworthiness

Günther Matschnigg, senior vice president, safety operations and infrastructure, International Air Transport Association, and member, FSF Board of Governors

Keynote Address — Nick Sabatini, associate administrator for aviation safety, U.S. Federal Aviation Administration

Awards Ceremony

Session I — Global Update

Session Chairman: Andrew McClymont, trustee, International Federation of Airworthiness

"2008: The Year in Review" — James M. Burin, director of technical programs, Flight Safety Foundation

"Global and Regional Safety Initiatives" — R. Curtis Graeber, Industry Safety Strategy Group, Boeing Commercial Airplanes, and Glenn W. Michael, air traffic manager, U.S. Federal Aviation Administration

"The Criminalization of Aviation Accidents" — Kenneth P. Quinn, Pillsbury Winthrop Shaw Pittman

Session II — Loss of Control

Session Chairman: Capt. David C. Carbaugh, chief pilot, flight operations safety, Boeing Commercial Airplanes

"Illusions, Disorientation, Loss of Control" — Capt. Dick McKinney, IOSA flight operations auditor, SH&E

"Spatial Disorientation Accidents in Large Commercial Jets: Case Studies and Countermeasures" — William J. Bramble Jr., senior human performance investigator, U.S. National Transportation Safety Board

"An Evaluation of the Effectiveness of Airplane Upset Recovery Training" — Capt. William C. Roberson, senior safety pilot, Boeing Commercial Airplanes

"A Systematic Approach to Development of Full-Flight Simulation-Based Upset Recovery Training" — Capt. Brian Ward, managing director of training, FedEx

"ADS-B Strategies for Global Implementation" — Steve Brown, ADS-B co-chair, FAA Aviation Regulatory Advisory Committee (ARC) and senior vice president, operations, National Business Aviation Association

Wednesday, October 29

Session III — Data Analysis and Sharing

Session Chairman: Ho Ching-Sheng (Danny C. Ho), executive vice president, safety and security division, EVA Airways

"The Art of Accident Classification" — Dieter Reisinger, M.Sc., director, quality operations, Austrian Airlines

"Pioneering a Non-Punitive FOQA Program in Mainland China" — Steven Fan, deputy general manager, flight technical in charge of FOQA, and director, Shanghai Airlines; Capt. Frank M. Hankins, senior instructor pilot, Boeing China

"ASIAS: Government–Industry Collaboration on Aviation Safety Data Analysis and Sharing" — Don Gunther, senior director, safety and regulatory compliance, Continental Airlines, and industry co-chairman, Commercial Aviation Safety Team

"Risk Management Choices: Where to Invest?" — Hazel Courteney, Ph.D., head of research and strategic analysis, U.K. Civil Aviation Authority

"Skybrary: Safety Knowledge Initiative Supported by Flight Safety Foundation, Eurocontrol and International Civil Aviation Organization" — Tzvetomir Blajev, coordinator of safety improvement initiatives, Eurocontrol; John Barrass, consultant/editor

Session IV, Part 1 — Panel Discussion of SMS

Panel Moderator: David Mawdsley, aviation safety advisor, Superstructure Group

Panelists:

Peter Simpson, manager air safety, Cathay Pacific Airways

Robert Dodd, general manager, group safety, Qantas Airways

Jacqueline Booth-Bourdeau, chief, technical program evaluation and coordination, Transport Canada Civil Aviation

Gerhard Gruber, manager, rescue and airport operations, Vienna International Airport

Jorge Leite, director of quality, maintenance and engineering, TAP Portugal

Session IV, Part 2 — Maintenance and Human Factors

Session Chairman: Brian L. Perry, vice president (technical), International Federation of Airworthiness

"Moving From the Penalty-Driven Culture: A Maintenance and Ground Operations Perspective" — Jerry P. Allen Jr., managing director, Baines Simmons Americas

"Are We Learning the Safety Lesson?" — Michael Skinner, deputy director (engineering), CHIRP

Thursday, October 30

Session V — Emerging Challenges

Session Chairman: Chris Baum, manager, engineering and operations, Engineering and Air Safety Department, Air Line Pilots Association, International

"A Collective Approach to Aircraft Maintenance Programs" — Steve Swift, principal engineer, airframe durability, Civil Aviation Safety Authority, Australia

"Errors and the Influence of Working Patterns and Fatigue" — Philip Hosey, Technical Committee member, and Frank Jauregui, VP Americas, International Federation of Airworthiness

"Organizational Design for Safety Oversight Effectiveness: The Human Factor" — Jacqueline A. Duley, senior associate, Booz Allen Hamilton

"RNP Training and Operational Issues and Guidance" — Marc Henegar, director, RNP/RNAV initiatives, Air Line Pilots Association, International

"Unmanned Aerial Systems: Identifying and Mitigating Hazards" — Jeff Guzzetti, deputy director for regional operations, and Dana Schulze, chief, Major Investigations Division, U.S. National Transportation Safety Board

Session VI — Runway Safety

Session Chairman: Jim Terpstra, senior vice president (retired), executive aviation consultant, Jeppesen

"The Runway Safety Initiative" — Earl Weener, Ph.D., fellow, Flight Safety Foundation

"A Review of Some Technological Aids to Support the FSF Runway Safety Initiative" — Don Bateman, corporate fellow-chief engineer, flight safety technologies, Honeywell Aerospace

"Keeping It Safe: Direct-to-Pilot Warnings of Runway Incursions" — Kathleen A. McGarry, senior human factors engineer, human-centered research and engineering, CAASD/MITRE

"Improve Runway Safety" — Scott Dunham, air traffic control investigator, Operational Factors Division, U.S. National Transportation Safety Board

"Wake Vortex Flight Testing" — Capt. Claude Lelaie, senior vice president, product safety officer, Airbus

Seminar Closing — John W. Saull, executive director, International Federation of Airworthiness

Downwind Debris

The full implications of shattered or burning fiber composite materials sometimes are not considered adequately in the protective measures, strategies and tactics of civilian aircraft rescue and fire fighting (ARFF) services and accident investigators, says a report by the Australian Transport Safety Bureau (ATSB). Tapping readily available information, however, airports and airlines can raise awareness of composite-specific risks before conducting evacuations/rescues from damaged large commercial jets, aircraft fire fighting, accident investigations and site cleanup operations. The report also discusses fiber composites in light general aviation aircraft and military aircraft, and accident investigation techniques for all types of composite aircraft.

Since the earliest industry experience with fiber composites 50 years ago, standards have evolved in aircraft design, manufacturing and maintenance that enable the aerospace industry to safely capitalize on composite materials' greater strength and stiffness, lighter weight, durability and resistance to fatigue relative to aluminum and other metals (*ASW,* 3/07, p. 17). *Fiber composite* refers to laminates made of alternating layers of long, strong reinforcing fibers — usually glass or carbon — woven into a ply with a binder, a tough plastic glue that shapes the fibers into a carbon/epoxy or glass/phenolic matrix, for example. The binder also bonds the plies of matrix together into stiff structures of the desired thickness. In many applications, two sheets of laminate are bound to a core of plastic foam, aluminum or Nomex honeycomb to create structures of the required shape and strength.

Material safety data sheets list the precautions for normal handling, fabricating and repair for each type of fiber composite, and those relevant to other possible activities involving human proximity to fiber composites in fires, crashes and other emergencies.

"There is a lot of conflicting or incorrect information in the aviation community about the safety and capability of fiber composite

Fire damage to an F/A-18 Hornet fighter illustrates fiber composite debris.

Australian Government Department of Defence

Australian study summarizes post-crash health risks from fiber composites in transport aircraft.

BY WAYNE ROSENKRANS

U.S. Air Force

materials," the report said. "First responders involved in post-crash cleanup operations [in the late 1990s] expressed concerns about the long-term effects from exposure to carbon fibers released from burning composites. Fiber dust can pose an inhalation risk similar to asbestos. Released fibers or splinters are needle-sharp and can cause skin and eye irritation. In the event of a post-crash fire, smoke and toxic gases are also released from decomposing composites, presenting further health risks."

From the standpoint of firefighter/investigator response to transport aircraft crashes, a rule-of-thumb distinction between two broad categories of composites has proven useful. Major load-bearing structures and skins for fuselages, wing boxes, control surfaces and empennages typically are made of carbon/epoxy materials. Many cabin fixtures and furnishings are made of glass/phenolic materials.

The carbon/epoxy materials will "burn easily and produce thick, toxic smoke" and possibly noxious gases as the epoxy bonding matrix burns away. "Carbon/epoxy … has poor fire resistance, easily igniting and burning when exposed to fire," the report said. "The smoke from epoxies and vinyl esters can be extremely dense, making it difficult and disorienting for first responders to fight the fire. Toxic gases produced by decomposing bonding matrix materials are one of the most serious hazards for first responders and people in the vicinity of the accident site. … The greatest [toxic gas] hazard is the carbon monoxide released in the fire … epoxy-based composites release the highest amount of carbon monoxide."[1]

In contrast, the composite cabin materials have intrinsically low flammability. "Glass/phenolic structures have excellent fire-resistance properties, superior to most next-generation advanced composite materials," the report said.

Airborne Fiber Debris

The report makes distinctions between crash impact/fire scenarios involving an aircraft built largely of structural composites and those involving an aircraft built primarily with an aluminum structure (*ASW*, 4/08, p. 37). For fiber composites, a key concern is the physical characteristics of fiber shards and debris at ground level, and fibers and dust released into the air from structures shattering during impact, explosions or fire because of potentially serious skin and eye irritation. "More importantly, glass fibers can pose an inhalation threat … if handled improperly," the report said. "Less is known about the health effects of inhaled carbon fiber dust; however, laboratory tests show that unlike glass fibers, carbon fibers do not cause pulmonary fibrosis in animals.[2]

"After an accident, fiber composite materials can reduce passenger survivability of an accident due to the unique hazards they pose. … [Composite] fibers are very small and lightweight, and are likely to be in the atmosphere. They are also easily carried by wind currents and may travel substantial distances from the crash site. … In the event of a crash and post-impact fire, it is critically important for emergency services to evacuate passengers to a location upwind of the accident and away from fiber composite debris. Timely action will minimize passengers' exposure to these risks."

The Australian study learned from an informal telephone survey that a disparity existed among states and emergency services in their levels of awareness of fiber composite issues in aircraft accidents. International[3] and national health and safety information on relevant equipment choices, procedures and training was used extensively by military services but not consistently by civilian agencies. "This survey found that knowledge of composite hazards and appropriate response methods are very disjointed between different emergency services in different states," the report said.


© Boeing Commercial Airplanes

The fuselage and wing are fiber composite structures on the Boeing 787.

Aircraft-Specific Briefings

The report recommends that personnel sent to the site of a composite aircraft accident be briefed on the aircraft type and its major composite components before they begin this phase of their work. "There should not be any rush for accident investigators to enter the site until personnel have been briefed on the hazards present and the risks posed by fiber composites," the report said.

In the current fleet of large commercial jets built since 1985 and operating in Australia, the report said, first responders and accident investigators could encounter examples of composite materials in structures such as:

- Vertical fins made of carbon-fiber reinforced plastic on the Airbus A310 and A300-600 series, and other types of composites forming the wing leading edge, control surfaces and fairings;
- Empennage, control surfaces and engine cowlings on the A320 series;
- Empennage, control surfaces, keel beam and engine cowlings on the A330/A340 series;
- A composite center wing box and an extensive list of other fiber-composite components on the A380;

- Empennage, control surfaces and engine cowlings on Boeing 777s;
- Floor panels of cabins and cargo holds in 767s and some 747s;
- The fuselage and wing of the 787;
- Vertical fin box and ailerons on the Lockheed L-1011; and,
- Composite upper rudder on the McDonnell Douglas DC-10/ MD-11.

In the near future, some large commercial jets also will have a new generation of engines built with composite fan blades, containment casings and cowlings. Cabin components molded from glass/phenolic materials typically comprise overhead lockers, cabin ceiling and paneling, galley structures, cabin partitions and doors, the report said.

Dressed for Success

Personal protective equipment should include breathing apparatus, specially designed clothing and related procedures for decontamination. Health and safety require "wearing appropriate protective equipment, protecting electrical equipment, moving bystanders away from the crash site and applying fixant solution to all damaged composite structures to limit dust dispersal." A fixant is a substance — such as water-diluted liquid floor wax or polyacrylic acid — that traps dust and loose fibers as it dries after application with backpack-carried spray equipment and chemical stripper solutions. Aqueous film-forming foam or other ARFF foam normally would be preferred to standard fixant, however, for fiber debris and dust on an asphalt or concrete airport surface.

The ATSB specifies what accident investigators are required to wear at the crash site of a composite aircraft. The list comprises "rubber gloves beneath heavy leather gloves (as fibers may penetrate the skin, causing irritation); safety goggles; a [sturdy] pair of boots; full-face dust and mist respirator capable of filtering particles[4] below 3 microns [0.0001 in] in size (plus a supply of spare filters); self-contained breathing apparatus; chemical/biohazard protective suit; and Neoprene overalls." Training covers specific methods of donning this equipment, washing/showering on site before decontamination, and safely removing and disposing of contaminated items.

"Failure to wear adequate personal protective equipment is likely to cause severe bouts of coughing and choking, extreme eye irritation and long-term health problems caused by tissue and organ damage from exposure" to some of more than 100 toxic gases that may be generated by decomposition of various types of carbon/epoxy composites, the report said.[5]

The ATSB also specifies that anything used at the accident site be suitable for on-site decontamination, so some items typically taken to the site of an all-metal aircraft crash — such as writing pads and tool kits — must be excluded. The guidelines also call for the establishment of a temporary restricted airspace in the vicinity of the accident to prevent news media and other air traffic from inadvertently dispersing composite fiber dust over a wide area before the fixant has been applied to damaged or destroyed composite structures.

"After entering the crash site, the investigators' first priority should be to protect all electrical equipment," the report said. "Released composite fibers are highly conductive, and their small size means that they can easily interfere with and damage electrical components."

The report provides a comprehensive list of Australian and international source material with advice on the types of information each can provide. Among these is the ATSB's "Fire Safety of Advanced Composites for Aircraft," published in 2006, which "compares the fire resistance of composite materials against key criteria: time to ignition, limiting oxygen index, heat release rate, flame spread rate, smoke and toxic gas release."

This article, except where noted, is based on ATSB Aviation Research and Analysis Report no. AR–2007–021, "Fiber Composite Aircraft — Capability and Safety," by R.P. Taylor; this ATSB Transport Safety Investigation Report was published June 9, 2008.

Notes

1. The report cited Mouritz, A. "Fire Safety of Advanced Composites for Aircraft," a report to the ATSB, Department of Transport and Regional Services, Canberra, Australia, 2006.
2. The report cited Gandhi, S.; Lyon, R. "Health Hazards of Combustion Products From Aircraft Composite Materials," U.S. Federal Aviation Administration, Department of Transportation, Washington, 1998.
3. International Civil Aviation Organization (ICAO). "Hazards at Aircraft Accident Sites," ICAO Circular 315, 2008.
4. The dimensions of respirable glass fibers determine the degree of hazard. "Glass fibers with diameters smaller than 3 microns and shorter than 80 microns [0.0031 in] can be inhaled deep into the alveolar region of the lungs," the report said. "Fibers shorter than 15 microns [0.0006 in] are cleared naturally from the lungs by cellular activity. However, glass fibers between 15–80 microns remain in the lungs and can lead to pathological effects such as pulmonary fibrosis, which causes diseases such as mesothelioma and asbestosis. Respirable fibers may in addition adsorb toxic chemicals from the decomposing matrix material, which then enter the lungs and possibly cause acute or chronic effects. Temporary skin and eye irritation can be caused by exposure to sharp, fragmented fibers longer than 4–5 microns [0.00016–0.00020 in]."
5. The report cited Mouritz, A.; Gibson, A. "Solid Mechanics and Its Applications: Fire Properties of Polymer Composite Materials," Springer, Berlin, 2006.

New Initiative for Latin America and Caribbean Airlines

BY JUAN CARLOS DUQUE

Airlines with headquarters in Latin America and the Caribbean face tremendous additional challenges compared with some other parts of the world. More than 40 nations differ among themselves in regulations concerning flight crew licensing; flight, duty and rest time limitations; application of operational specifications; safety oversight; requirements for operational certification; and others. Some governments fail to adopt new technologies such as area navigation into their regulations, precluding operators from using advances they know how to use. Unstable political environments result in changing regulations. Foreign exchange is volatile. There is a lack of trust, discouraging foreign investment. The list goes on.

Latin America and the Caribbean clearly have the means to achieve the highest safety standards.

Among the many components of the aviation business, there is one absolute prerequisite — safety. Latin America and Caribbean air carriers in the past have suffered from a negative reputation in this area, an accurate assessment based on global accident indicators and safety classification systems. But today's outlook for the region is more hopeful. Latin America and the Caribbean clearly have the means to achieve the highest safety standards, alongside those of the best performing regions in the world.

For the moment, the horizon is still cloudy; there is much work to be done. The region's accident figures are still among the worst in the world, including the third worst in jet and the worst in turboprop categories, with some of the worst fatality indicators for the past decade during recent years.

The region has 5 percent of the world's traffic, but its accident rates are 17 times higher than the rest of the world. Although the absolute number of accidents is less than in regions of the world with the best accident rates, the ratio of accidents to traffic is way out of proportion. The figures used when referring to air safety are not abstract numbers. We are dealing with the loss of human lives, loss of equipment, closing of companies, loss of employment and unfavorable consequences for tourism, as well as a series of other negative economic, social and political effects that are impossible to quantify.

The unfavorable risk indexes, which have remained steady in the region over the past decade compared with other regions, are also a problem for any carrier trying to compete with powerful airlines from other regions, no matter how excellent its individual safety record. Insurance premiums are millions of dollars higher than the average for safer regions. If current U.S. rates were applied, the cost saving for the Latin American fleet would amount to US$12.4 million per year. Restrictions are placed on airlines wanting to join alliances and sign commercial agreements. It is difficult to gain the trust of passengers from other regions, who worry about taking more risk, so they prefer carriers based in the United States or Europe.

Both airline operators and civil aviation authorities realize the urgent need to change the path of Latin American and Caribbean aviation. Different initiatives, some of which have arisen from the International Civil Aviation Organization and others from the airlines themselves, are now joining the *Global Aviation Safety Roadmap* initiatives to enhance their impact and break the negative safety indicator cycle.

Today, technology and experience in accident prevention have resulted in the development of very favorable processes aimed at improving the quality of the operations to a global level, which is necessary for a region such as ours to achieve positive change.

The implementation of the International Air Transport Association (IATA) Operational Safety Audit (IOSA) has become the industry standard for integrating the highest operational safety standards among airlines. This commitment was initially undertaken by IATA member airlines and has extended to other associations such as the Latin American Air Transport Association (ALTA) where, since its beginning, we have believed strongly that it should be a requirement for the entire industry, including our airline members.

IOSA's scope is increasing every day in the region as the highest quality periodic audit, especially as other regional authorities have started integrating this standard into their operational requirements. However, even though airlines have resolutely committed to the IOSA standards, it is like taking a photo every two years; it is a brief moment in the life of an airline. What happens to an airline's operations between the two-year audits?

There's the potential for a drop in standards. Some airlines will "dress up" to receive IOSA auditors. After the audit preparation and development phase are completed and the auditors have finished their review, some airlines, despite their best intentions, will inevitably slide into a period of relaxation if this is the only program they are going to rely on to maintain the quality of their operations.

This is why it is necessary to implement an ongoing system of quality operations. ICAO and IATA have understood this for several years, prompting recommendations to implement a safety management system with defined deadlines to safeguard the operational standards between audits.

ALTA member airlines want to guide their improvement and development to the highest quality of operational standards within a short time frame, adopting more comprehensive practices to take Latin America and the Caribbean to safety levels of the highest standards.

Although the states, and more specifically their civil aviation authorities, are beginning to make progress in adopting the highest aviation standards, thanks to ICAO's Universal Safety Oversight Audit Program and to the *Global Aviation Safety Roadmap*, the airlines must take proactive steps now and not wait for the region's aviation environment to change on its own.

Juan Carlos Duque is ALTA's manager of safety and operations. He can be reached at <jduque@alta.aero>.

This is why ALTA has designed the Latin America and Caribbean Safety Enhancement Initiative (SEI). This initiative will start with the approval of all ALTA members, continue with a review of each airline's maturity level, and be followed with the implementation of the necessary modules to integrate all of the quality systems according to short- and medium-term efforts to ensure that the highest international standards are met and adhered to on an ongoing basis.

ALTA is counting on the support of a diverse roster of industry players and stakeholders to successfully implement this initiative. The highest quality operations ultimately will become a very strong regional trend and be a prerequisite for membership in organizations such as IATA and ALTA. We strongly believe that this next step will help reduce the safety gap between the Latin America and Caribbean region and the leading regions of the world. We encourage all those interested in joining this critical project to contact us so we can, together, reach this important goal.

Timing is EVERYTHING

The FAA's decision to deploy runway status lights over the next three years aims to further reduce the risk of collision.

BY WAYNE ROSENKRANS

When the U.S. Federal Aviation Administration (FAA) awards a contract in late 2008 to install runway status lights (RWSL) at 22 major U.S. airports[1] in 2009–2011, the worldwide aviation community will be anxious to hear about the new system's effectiveness in preventing runway incursions. From 2001 to February 2008, the FAA spent US$25.8 million to complete its research, development and operational evaluation of RWSL.

Available technology did not enable a nationwide deployment in the mid-1990s — the last time the FAA studied RWSL. Today, about two-thirds of the high-hazard runway conflicts can be addressed "without adversely impacting runway capacity or controller workload," the FAA said. The difference today is that airport surface detection equipment, model X (ASDE-X) — a surface surveillance system designed to identify and display traffic and, in enhanced versions, automatically alert air traffic control (ATC) to imminent ground collisions — has proved to be a key enabler.

"We have an approval and a commitment of capital to go out and invest hundreds of millions of dollars in getting RWSL to these airports," said Jaime Figueroa, field demonstration manager, surface technology assessment, FAA Air Traffic Organization (ATO) Operations Planning. "That's very significant because the decision says we have already persuaded ourselves — both technically and from a business-case standpoint — that this is a solution we need to deploy."

If the deployment repeats the success of systems already tested at Dallas-Fort Worth (DFW) and San Diego international airports, one result will be a compelling case for updating international standards to add RWSL to existing defenses against the human errors and other causes of runway incursions.

Saves So Far

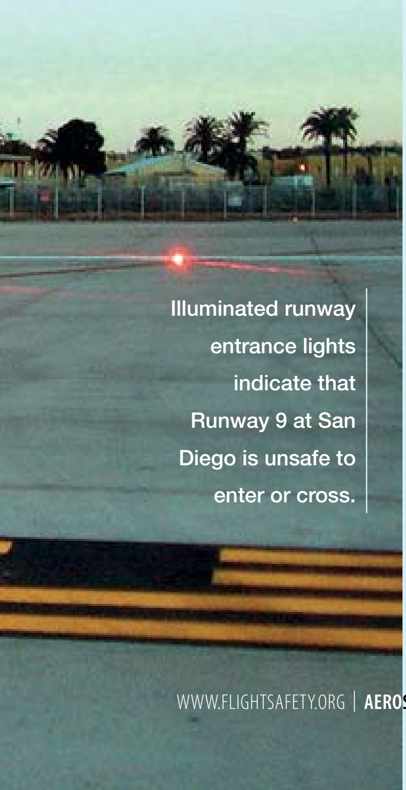
The FAA cites two occurrences in 2008, both at DFW, as prime examples of RWSL providing safety-critical situational awareness quickly enough to prevent a runway collision with complete independence from air traffic control:

- A controller cleared the crew of a Saab 340 for takeoff on Runway 36R from the intersection at Taxiway Bravo. Moments later, the

U.S. Federal Aviation Administration

U.S. Federal Aviation Administration

Takeoff hold lights at DFW warned two flight crews about aircraft crossing Runway 18L/36R after they received takeoff clearance.



Illuminated runway entrance lights indicate that Runway 9 at San Diego is unsafe to enter or cross.

controller — believing incorrectly that the 340 had been issued a position-and-hold clearance — cleared the flight crew of a McDonnell Douglas MD80 to cross Runway 36R at Taxiway Yankee. The 340 crew then radioed ATC that, although cleared for takeoff, they "saw the red lights" of RWSL and therefore did not begin the takeoff. The closest proximity of the two airplanes was 9,275 ft (2,827 m).

- ATC cleared the flight crew of a large commercial transport jet for takeoff, but the crew rejected the takeoff early in the takeoff roll. The FAA said that the captain later reported, "We began to roll, and I noticed the RWSL lights. … I aborted the takeoff at maximum speed below 80 kt. I looked down the runway and saw an aircraft crossing the runway left to right … [an unspecified Bombardier CRJ-series regional jet]. I noticed [the red lights] *before* I saw the intruding RJ. The RWSL worked — this is awesome. Put them everywhere."

The FAA's strategy of applying evolving technology for runway incursion prevention also includes the enhanced final approach runway occupancy signal (FAROS), low-cost ground surveillance and cockpit moving-map solutions, all still under development. "Until a more comprehensive solution comes along, the FAA and [Los Angeles International Airport (LAX)] are continuing to look at stopgap measures such as runway status lights to improve safety," said Robert Sturgell, the FAA's acting administrator. "Runway status lights are one way to drive down incursions … one more layer of defense, but [not] the first line of defense." Reconfiguration of airport runways and taxiways is the highest priority solution for some airports, he said.[2]

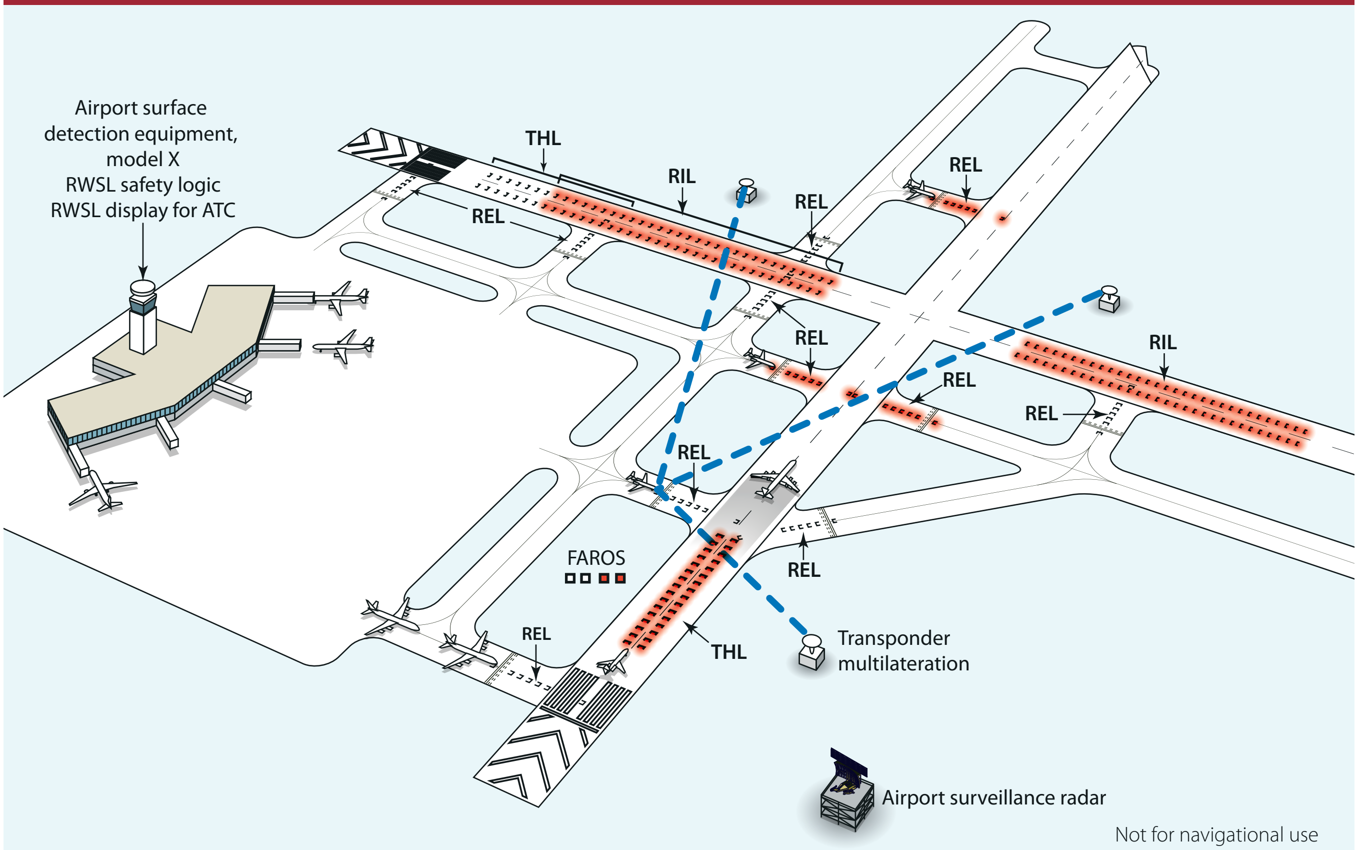
How It Works

An RWSL system (Figure 1, p. 48) comprises approach radar, surface radar and transponder multilateration; data processing safety logic; and red lights that communicate runway status. Unlike ASDE-X and the older airport movement area safety system (AMASS), RWSL is not designed for conflict detection, and the RWSL display in the airport tower is not a tool for the controller to resolve situations. "With every operation on a runway — whether there is a conflict or not — RWSL illuminates the red lights," Figueroa said.

For operational use, official details on RWSL systems at DFW and San Diego appear in the FAA *Notices to Airmen* (NOTAM). General background for pilots has been published by Lincoln Laboratory of the Massachusetts (U.S.) Institute of Technology — the FAA's principal RWSL contractor — on a Web site <www.rwsl.net>.

One NOTAM for July 31, 2008 — which describes an initial configuration of takeoff hold lights (THLs) installed on DFW Runway 18L/36R — said in part, "RWSL is an automatic, advisory backup system expected to prevent or reduce the severity of runway incursions. RWSL conveys the runway occupancy status, indicating when a runway is unsafe to enter [or cross] through the use of in-pavement warning [runway entrance lights (RELs)] and when it is unsafe to take off through the use of in-pavement warning

Runway Status Lights Operational Concept



RWSL = Runway status lights; REL = Runway entrance lights; THL = Takeoff hold lights; RIL = Runway intersection lights (under development); FAROS = Final approach runway occupancy signal (under development); ATC = Air traffic control

Source: U.S. Federal Aviation Administration

Figure 1

THLs. The RELs are a series of five red, in-pavement lights spaced evenly along the taxiway centerline from the taxiway hold line to the runway edge. … THLs are directed toward the approach end of the runway and are visible to pilots in position for takeoff, just commencing departure or on final approach to land. There are four sets of THLs, each comprising a series of 11 red in-pavement lights at 100-ft [30-m] spacing along the runway centerline. The four sets of THLs are operational at the full-length and intersection departure positions.

"Status lights have two states: on (lights are illuminated red) and off (lights are off) and are switched automatically based on information from the airport surface surveillance systems. It is important that transponders be turned on and kept on while taxiing in the movement area so that beacon-based position and aircraft identification data are available to RWSL."

Situational awareness is critical to the concept. "Pilots should remain clear of a runway when an REL along their taxi route is illuminated," the NOTAM said. "Pilots should not take off when a THL on the runway ahead is illuminated. Lights that are off convey no meaning. The system is not, at any time, intended to convey approval or clearance to proceed onto a runway or to take off from a runway. Pilots remain obligated to comply with all ATC clearances, except when compliance would require crossing an illuminated red REL or THL. In such a case, the crews should *hold short* of the runway for RELs or *stop* the aircraft for THLs (if possible), *contact ATC,* and await further instructions."

The NOTAM also covers situations in which pilots have begun to enter a runway, conduct a takeoff or complete a landing at the moment the RWSL red lights illuminate. Instructions include taking action according to the pilot's best judgment of safety when the usual response is not practical with full understanding that red lights indicate the runway is unsafe to cross or enter, and contacting ATC at the earliest opportunity.

Unique Airport Configurations

Now that RELs and THLs have passed engineering tests and met human factors performance criteria, the RWSL systems at DFW and San Diego are being completed, and all the other airports will install RELs on some or all taxiways and THLs on one or both ends of some or all runways under the FAA's schedule and budget for RWSL deployment.

"The FAA approved delivery of RELs and THLs in some mixture to [all] 22 airports," Figueroa said. "Some airports need RELs at every intersection of every runway. Some need RELs at just a few intersections because there may be other crossing points that are infrequently crossed or maybe never crossed. Other airport [officials said,] 'We only need full-length THLs or we only need them at one end of a runway because 90 percent of the time, we operate only north to south, so there is no point in investing in a south to north capability.'"

The system scheduled to be installed in February 2009 at LAX includes RELs and THLs, as well as the first operational evaluation of RELs for high-speed exit taxiways. Similarly, the system to be installed in November 2009 at Boston includes RELs and THLs, as well as the first operational evaluation of runway intersection lights (RILs). "RILs are a variation, a new component of runway status lights intended to provide protection at airports with crossing runway geometries," Figueroa said, and they require modified safety logic.

Some of the 22 airports will have to change from ASDE-3/AMASS to ASDE-X. "RWSL deployment is being scheduled such that ASDE-X will be installed and available well in advance of RWSL installation at most airports," Figueroa said.

International Interest

The U.S. National Transportation Safety Board (NTSB) since July 2000 has urged the development of technologies that directly increase the awareness of pilots and airfield drivers of collision threats on the ground. The NTSB supports RWSL as part of an overall response so far deemed unacceptable. NTSB member Steven Chealander said, "Direct warning is crucial because it gives both controllers and those operating the aircraft increased time to react. … [NTSB] investigations have found that AMASS/ASDE-X are not adequate to prevent serious runway collisions because too much time is lost routing valuable information through air traffic control. … All of the runway incursion prevention technology being developed and tested by the FAA that would give a direct warning to the cockpit, such as runway status lights and the final approach runway occupancy signal, and automatic dependent surveillance–broadcast are years from being installed, and they will not be installed at all airports with passenger service."[3]

Among organizations supporting the RWSL concept are the U.S. Commercial Aviation Safety Team; the Industry Safety Strategy Group, which recommends the technology to airports worldwide in *Implementing the Global Aviation Safety Roadmap;* and the Air Line Pilots Association, International.

Eurocontrol has begun to consider RWSL as an added functional capability to the advanced

Complex intersecting runways at Boston Logan will get the nation's first runway intersection lights in late 2009.

© Bjoern Schmitt/Airliners.net

surface movement guidance and control system (A-SMGCS) specification and, during 2008, has hosted workshops aimed at developing a concept of operations for what they call "safety net" additions to the A-SMGCS Level 2 specification, Figueroa said. Representatives from Eurocontrol, individual European states and Japan have visited DFW and San Diego and expressed interest to the FAA in testing similar concepts.

"Eurocontrol has been very interested in this capability, so recently they began developing an operational concept that is not quite A-SMGCS level 3 but more an A-SMGCS Level 2–plus," he said. "Level 2, now being deployed in many countries throughout Europe, is the equivalent of ASDE-X with safety logic. Many major airports in Europe have the equivalent technology."

The U.S. representative to the ICAO Visual Aids Panel will continue to share data and work with international partners to begin the process of developing RWSL standards and recommended practices, ensure a uniform concept and minimize internationally any implementation differences, according to Figueroa.

Initial Deployment Readiness

Federal government reports in 2007 and 2008 raised concerns about whether an accelerated, interdependent deployment of ASDE-X and RWSL could be achieved. One, a U.S. Department of Transportation inspector general report, identified concern about the differences between the RWSL interface to the prototype ASDE-X equipment installed at DFW and the RWSL interface to the operational ASDE-X being deployed nationwide. "The FAA is confident that interfacing to an operational ASDE-X will not be a major problem," Figueroa said.

Another concern has been the need to install transponders in all airport vehicles that operate on airport movement areas. Not on the lists of safety concerns is interference by transponders with airborne traffic alert and collision avoidance systems; all existing ASDE-X multilateration sensors already depend on the ground operation of transponders, and they also identify and determine the position of aircraft flying within 5 mi (8 km) of the airport.[4]

"The RWSL system is stable and meeting its intended functional operational capability," Figueroa said. "We are trying to make the DFW system more robust and less prone to failures, such as a couple of power interruptions. We are going to be [adding some equipment redundancy] when we install RWSL and connect it within the next six months or so to the ASDE-X at LAX. We have done some early tests, and we do not foresee major problems." Plans call for these improvements to be replicated gradually at the other airports.

Some airports scheduled for RWSL systems also have runway guard lights at runway-taxiway intersections. Unlike Europe (*ASW,* 8/08, p. 27), however, relatively few of them have stop bars.[5] Guard lights have presented no problems. The simultaneous use of RWSL and stop bars appears feasible to the FAA but an operational evaluation still will be required, Figueroa said.

A comprehensive educational campaign augmented the FAA's official channels of information, such as notices to airmen and Jeppesen chart inserts, to target the multiple categories of RWSL users operating at San Diego and DFW airports. For the rest of the aviation community, the FAA's *Aeronautical Information Manual* probably will introduce RWSL during the upcoming deployment; educational outreach will continue as required with few changes to information until RILs or similar new functionality has been added, Figueroa said.

The new RWSL systems are not expected to yield much safety data for study because the thousands of daily activations of RELs, THLs and RILs at a single airport will be normal occurrences. "There would be tons of [useless] data if we tracked all the activations," Figueroa said. "More significant to us are the saves that get documented, showing that a conflict was developing and that an incursion would have happened but for the system. There is value in [reviewing] the traffic conditions and at what point the red lights activated. Those become a more compelling metric."

Notes

1. The list includes Atlanta Hartsfield, Baltimore-Washington, Boston Logan, Charlotte-Douglas, Chicago O'Hare, Dallas/Fort Worth, Denver, Detroit, Fort Lauderdale, Houston Bush, John F. Kennedy, La Guardia, Las Vegas, Los Angeles, Minneapolis, Newark Liberty, Orlando, Philadelphia, Phoenix, San Diego, Seattle-Tacoma and Washington Dulles international airports.

2. Sturgell, Robert A. "Red Means Stop." Remarks during news media event at Los Angeles International Airport, Feb. 26, 2008.

3. Chealander, Steven R. NTSB member remarks before the Commerce, Science and Transportation Committee; Aviation Operations, Safety and Security Subcommittee; U.S. Senate. April 10, 2008.

4. Office of Inspector General, U.S. Department of Transportation. "FAA's Implementation of Runway Status Lights." Report no. AV-2008-021, Jan. 14, 2008.

5. The FAA requires stop bars if airports will conduct low-visibility operations in conditions less than 600 ft [180 m] runway visual range (RVR), and the stop bars must be operated by ATC when conditions are less than 1,200 ft (350 m) RVR.

Lack of Available Safety Equipment Faulted in Accidents

A U.K. CAA worldwide fatal accident review finds that after safety equipment, poor visibility ranked second among circumstantial factors.

BY RICK DARBY

The failure to install available safety equipment ranked highest among circumstantial factors in fatal accidents involving civil jet and turboprop airplanes worldwide from 1997 to 2006, the U.K. Civil Aviation Authority (CAA) says.[1]

"Poor visibility or lack of external visual reference" closely followed, and "failure in CRM [crew resource management]" was ranked third.

A circumstantial factor is "an event or aspect which was not directly in the causal chain of events but could have contributed to the fatal accident," the CAA's "Global Fatal Accident Review" says. "A fatal accident may have been allocated any number of circumstantial factors in any combination."[2]

Of the 283 fatal accidents analyzed, 229, or 81 percent, had at least one circumstantial factor, and the average number of circumstantial factors per fatal accident was 2.4. During the study period, jets were involved in 108 fatal accidents, or 38 percent of the total; turboprops in 140, or 49 percent of the total; and business jets in 35, or 12 percent of the total.

Ten circumstantial factors accounted for 78 percent of all fatal accidents and 97 percent of those that had at least one circumstantial factor assigned (Table 1). "Non-fitment of presently available aircraft safety equipment" — hereafter abbreviated as "aircraft safety equipment" — was involved in 94 fatal accidents, 33 percent of the total.

In 80 of those 94, or 85 percent, the safety equipment lacking was one of the latest terrain awareness and warning systems (TAWS), such as the enhanced ground-proximity warning system (EGPWS). The count included instances when the aircraft was not required to have the equipment installed or the equipment was not available at the time. "The intention was to identify fatal accidents where use of more-advanced technology or extending the coverage

Top 10 Circumstantial Factors, Worldwide Civil Aviation Fatal Accidents, 1997–2006

Rank	Circumstantial Factor	Number of Fatal Accidents	Percentage of Total
1	Non-fitment of presently available aircraft safety equipment	94	33
2	Poor visibility or lack of external visual reference	89	31
3	Failure in crew resource management	81	29
4	Other weather	79	28
5	Company management failure	76	27
6	Inadequate regulatory oversight	69	24
7	Incorrect/inadequate procedures	31	11
8	Inadequate training	30	11
9	Inadequate regulation	26	9
10	Non-fitment of presently available air traffic control system or equipment	25	9

Note: These circumstantial factors are not mutually exclusive.

Source: U.K. Civil Aviation Authority

Table 1

Top 10 Circumstantial Factors, Worldwide Civil Aviation Fatal Accidents, by On-Board Fatalities, 1997–2006

Rank	Circumstantial Factor	On-Board Fatalities	Percentage of Total
1	Poor visibility or lack of external visual reference	2,833	33
2	Non-fitment of presently available aircraft safety equipment	2,787	32
3	Inadequate regulatory oversight	2,552	30
4	Other weather	2,374	28
5	Company management failure	2,208	26
6	Failure in crew resource management	2,137	25
7	Inadequate training	1,588	18
8	Inadequate regulation	1,497	17
9	Non-fitment of presently available air traffic control system or equipment	1,281	15
10	Nonprecision approach flown	1,070	12

Note: These circumstantial factors are not mutually exclusive.

Source: U.K. Civil Aviation Authority

Table 2

Top Circumstantial Factors, Worldwide Civil Aviation Fatal Accidents, by Aircraft Class, 1997–2006

Circumstantial Factor	All Accidents	Jets	Turboprops	Business Jets
Non-fitment of presently available aircraft safety equipment	1 | 4 | 33%*	1 | 39 | 36%	4 | 38 | 27%	1 | 17 | 49%
Poor visibility or lack of external visual reference	2 | 89 | 31%	2 | 32 | 30%	2 | 40 | 29%	1 | 17 | 49%
Failure in crew resource management	3 | 81 | 29%	3 | 30 | 28%	—	3 | 14 | 40%
Other weather	4 | 79 | 28%	4 | 29 | 27%	4 | 38 | 27%	4 | 12 | 34%
Company management failure	5 | 76 | 27%	5 | 27 | 25%	1 | 43 | 31%	5 | 6 | 17%
Inadequate regulatory oversight	6 | 69 | 24%	5 | 27 | 25%	3 | 39 | 28%	—

* 1 | 94 | 33% = rank | number | percentage within category

Note: These circumstantial factors are not mutually exclusive.

Source: U.K. Civil Aviation Authority

Table 3

of requirements for an existing technology might have helped to prevent the catastrophic outcome," the report says.

Another technological circumstantial factor, although lowest in the top 10, was "non-fitment of presently available ATC [air traffic control] system or equipment." The example given of such a technology is the minimum safe altitude warning system for ATC radar displays. Lack of state-of-the-art ATC equipment was found in 25 fatal accidents, 9 percent of the total.

The third most frequent circumstantial factor, "failure in CRM," was the only factor appearing in both the causal factor and circumstantial factor lists in the study. "If an accident investigation report clearly cited failure in CRM as a causal factor, then the AAG [the CAA Accident Analysis Group] would also judge it to be a causal factor," the report says. "However, if this was not the case, but the AAG felt that had CRM been to a higher standard during the situation such that the accident might have been prevented, then CRM would be cited as a circumstantial factor."

"Failure in CRM" — with cross-check/coordinate cited as an example — was involved in 81 fatal accidents, or 29 percent of the total.

Of the top 10 circumstantial factors in terms of on-board fatalities, "poor visibility or lack of external visual reference" and "aircraft safety equipment" were practically tied, at 33 percent and 32 percent of fatalities, respectively (Table 2). Again, "non-fitment of presently available ATC system or equipment" came well down on the list, associated with 15 percent of on-board fatalities.

In the overall score among all classes of aircraft in the study, "aircraft safety equipment" ranked at the top, from analysis of reports of 94 fatal accidents (Table 3). It was the most common circumstantial factor for fatal accidents involving jets and business jets, and ranked fourth for those involving turboprops. "Aircraft safety equipment" was a circumstantial factor in 17 business jet fatal accidents, 49 percent of all the business jet fatal accidents in the database.

Analyzed according to the type of flight (Table 4), "aircraft safety equipment" ranked first among circumstantial factors in passenger flights, involved in 63 fatal accidents, or 37 percent of all fatal passenger flight accidents. That circumstantial factor was ranked second among ferry or positioning flights and fourth among cargo flights.

In terms of operator regions, "aircraft safety equipment" ranked highest in the Asia and Middle East region and the Caribbean, Central and South America region (Table 5). It was a contributing factor in 48 percent of the fatal accidents the Caribbean, Central and South America region and a contributing factor in 31 percent of fatal accidents in Europe.

As in the other tables, "poor visibility or lack of external reference" ranked second overall and was tied with "company management failure" in Africa for highest.

Notes

1. U.K. Civil Aviation Authority. "Global Fatal Accident Review 1997–2006." CAP 776. July 21, 2008. Available via the Internet at <www.caa.co.uk/docs/33/CAP776.pdf>.
2. Included in the database were jet and turboprop airplanes (including airplanes built in the Soviet Union or Russian Federation); maximum takeoff weight above 5,700 kg/12,500 lb; civil passenger, cargo, and ferry or positioning flights; and at least one fatality to an occupant. Accidents known to have resulted from terrorism or sabotage were excluded.

Top Circumstantial Factors, Worldwide Civil Aviation Fatal Accidents, by Type of Flight, 1997–2006

Circumstantial Factor	All Accidents	Passenger	Cargo	Ferry/ Positioning
Non-fitment of presently available aircraft safety equipment	1 | 94 | 33%*	1 | 63 | 37%	4 | 20 | 25%	2 | 11 | 33%
Poor visibility or lack of external visual reference	2 | 89 | 31%	2 | 54 | 32%	3 | 22 | 27%	1 | 13 | 39%
Failure in crew resource management	3 | 81 | 29%	4 | 45 | 26%	1 | 25 | 31%	2 | 11 | 33%
Other weather	4 | 79 | 28%	3 | 52 | 31%	—	4 | 10 | 30%
Company management failure	5 | 76 | 27%	4 | 45 | 26%	2 | 24 | 30%	5 | 8 | 24%
Inadequate regulatory oversight	6 | 69 | 24%	—	4 | 20 | 25%	—

* 1 | 94 | 33% = rank | number | percentage within category

Note: The sum, by individual type of flight, of the number of fatal accidents allocated with "company management failure" is 77, one more that the total in the "all types of flight" column. This is because of a midair collision that involved a passenger and cargo flight, for which this circumstantial factor was counted against each type of flight. This midair collision was treated as one fatal accident in the overall statistics.

These circumstantial factors are not mutually exclusive.

Source: U.K. Civil Aviation Authority

Table 4

Top Circumstantial Factors, Worldwide Civil Aviation Fatal Accidents, by Operator Region, 1997–2006

Circumstantial Factor	All Accidents	Africa	Asia and Middle East	Caribbean, Central and South America	Europe	North America	Oceania
Non-fitment of presently available aircraft safety equipment	1 | 94 | 33%*	5 | 14 | 22%	1 | 22 | 37%	1 | 22 | 48%	2 | 22 | 31%	4 | 13 | 32%	5 | 1 | 33%
Poor visibility or lack of external visual reference	2 | 89 | 31%	1 | 17 | 27%	4 | 19 | 32%	3 | 16 | 35%	3 | 21 | 30%	2 | 24 | 34%	2 | 2 | 67%
Failure in crew resource management	3 | 81 | 29%	—	2 | 21 | 35%	2 | 19 | 41%	3 | 21 | 30%	—	—
Other weather	4 | 79 | 28%	4 | 15 | 23%	2 | 21 | 35%	4 | 12 | 26%	5 | 17 | 24%	5 | 12 | 29%	2 | 2 | 67%
Company management failure	5 | 76 | 27%	1 | 17 | 27%	5 | 14 | 23%	5 | 8 | 17%	1 | 23 | 33%	2 | 14 | 34%	5 | 1 | 33%
Inadequate regulatory oversight	6 | 69 | 24%	3 | 16 | 25%	5 | 14 | 23%	—	—	1 | 16 | 39%	2 | 2 | 67%

* 1 | 94 | 33% = rank | number | percentage within category

Note: The sum, by individual operator region, of the number of fatal accidents allocated with "company management failure" is 77, one more that the total in the "all regions" column. This is because of a midair collision that involved a European and a Middle Eastern operator, for which this circumstantial factor was counted against each region. This midair collision was treated as one fatal accident in the overall statistics.

Accident reporting criteria are not consistent throughout the world, so the number of factors assigned to fatal accidents may vary widely among the different operator regions. Care should be taken when drawing conclusions from these data, the U.K. CAA says.

These circumstantial factors are not mutually exclusive.

Source: U.K. Civil Aviation Authority

Table 5

'You Shouldn't Be Anywhere Near Kilo'

An FAA slide presentation includes animations of actual incidents demonstrating how pilot deviations can lead to runway incursions.

WEB SITES

Reducing Pilot Deviations, <www.faa.gov/safety/programs_initiatives/pilot_safety/deviations/reducingpds/>

"United 1448, you shouldn't be anywhere near [Taxiway] Kilo, hold your position please, just stop."

"Ah, this is United 1448, we are currently on a runway, I am looking out to the right with a Kilo … ah, we need to go on the Kilo taxiway."

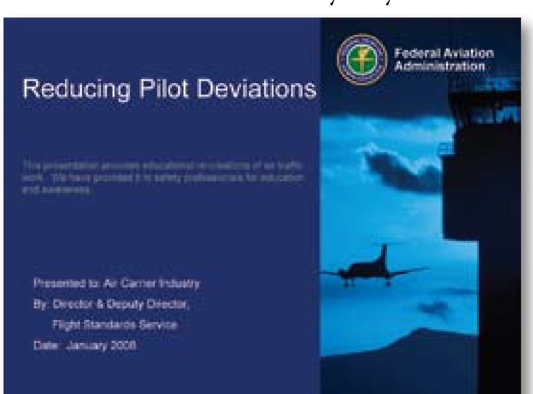
"United 1448, you were supposed to taxi November and Tango, I need to know what runway you're on, I can't see anything from the tower."

"We are by Kilo to our right and we just overshot Kilo, we did not see it."

"United, stand by please. USAir 2998, Runway 5R, fly runway heading, cleared for takeoff."

"Ma'am, I'm trying to advise you, we're on an active runway, United 1448."

That is part of a dialogue between an air traffic controller and a flight crew who had inadvertently strayed onto the runway as communication broke down during a foggy night at Providence, Rhode Island, U.S. The situation, an actual occurrence, is illustrated with a sound recording, an audio transcript and an animation showing the aircraft's movement on an airport diagram. It's one of several animated files in the U.S. Federal Aviation Administration (FAA) Flight Standards Service (AFS) "Roadshow Presentation: Reducing Pilot Deviations," a slide presentation released to the air carrier industry in January 2008, now on the FAA Web site.



The opening slide says, "This presentation provides educational re-creations of air traffic work … provided to safety professionals for education and awareness." The "Roadshow" reviews the FAA's August 2007 "call to action" to the industry to re-energize and re-focus on the issue of runway safety efforts; describes expected air carrier short-term actions to improve runway safety — for example, improving pilot training on airport surface operations, reviewing cockpit procedures to identify and eliminate distractions, enhancing training for non-pilot employees who move aircraft at airports; and identifies resources such as booklets, online courses, seminars and information tools the FAA has made available to pilots.

The presentation says that, in investigations, the FAA classifies runway incursions as air traffic controller operational errors, pilot deviations and vehicle/pedestrian deviations. Several slides chart data on pilot deviations, numbers and causes of runway incursions, and numbers and types of vehicle/pedestrian deviations. Examples of occurrences of pilot deviations and air traffic control errors are given.

The videos show aircraft movements and illustrate deviations and errors made during taxiing, takeoff and landing of several commercial flights at U.S. airports. Communications between pilots and air traffic controllers are audible and may also appear in closed captions. Supporting files contain airport diagrams, event descriptions, personnel statements and other information.

An interactive "taxi to … " quiz by FAA's Alaskan Region Runway Safety Office for U.S. Federal Aviation Regulations Part 91 operators is included in the video collection.

The "Roadshow" contains large compressed zip files. The Web site provides instructions for downloading the presentation and video files. Handouts, brochures for pilots, U.S. National Transportation Safety Board recommendations and other materials can also be downloaded, printed or viewed online. All materials, including the presentation and videos, are free.

"Assessing Fitness to Fly," <www.caa.co.uk/docs/923/FitnessToFlyPDF_FitnesstoFlyPDF.pdf>

A U.K. Civil Aviation Authority (CAA) announcement, "CAA Launches Fitness to Fly Patient Assessment Guide," said, "There were 514 emergency calls made by U.K. airlines in 2007 due to medical emergencies, resulting in 58 diversions — a 26 percent increase since 2003. Many diversions are caused by passengers who are not fit to fly or do not make their medical condition known to their airline before traveling."

The top three causes of in-flight emergencies were neurological, cardiological and respiratory conditions, the announcement said.

In response to an increase in emergency diversions due to medical incidents experienced by passengers, the CAA Aviation Health Unit developed a guide to help medical professionals assess and advise patients regarding their fitness to fly.

An introduction to the four-page guide says it gives "an understanding of the physics and physiology of flying and how this may interact with pathology." The guide briefly describes what the human body may experience in some medical situations due to changes in oxygen and other gas levels in the body and barometric pressure in an airplane.

The guidelines highlight physiological changes that occur at altitude for medical conditions including pregnancy, cardiovascular disease, respiratory disease, post-surgical condition, diabetes, hematological disorders, orthopedic disorders, and deep vein thrombosis.

For example, passengers who had recent surgical intervention, such as an ophthalmological procedure for retinal detachment, may experience difficulties when flying because of oxygen that was introduced into the surgical site. Cardiovascular contraindications to flying include complicated myocardial infarctions within the previous four to six weeks and uncontrolled hypertension, or high blood pressure.

Additional medical and passenger resources are listed. The guide may be printed or downloaded at no cost.

Helicopter Safety.org, <www.helicoptersafety.org.uk>

The Web site's organizer, Helicopter Safety UK, says that the site "exists to promote helicopter safety around the world, primarily in the [United Kingdom]." The site, produced by a group of pilots, contains a significant amount of accident and safety information. The British Helicopter Advisory Board, the U.K. Civil Aviation Authority, the General Aviation Safety Council and the air traffic services provider, NATS, have offered support.

The Web site describes its U.K. helicopter accident and incident database as comprehensive, containing data from 1997 to the present. There are several ways to access the database. Using a detailed search form, a researcher can search by a number of criteria (e.g., manufacturer, helicopter type, date or causal factor) to locate a specific accident or incident, or to create a list of events matching the search criteria.

Another way to search is to select from prepared lists with category titles such as date, accident type, model, mechanical failure, weather, pilot experience, and causal factor.

Once an accident or incident is identified, the researcher can review a synopsis of the accident or incident and link to full investigative reports, full-text sources, regulatory documents, related safety information and other accompanying information.

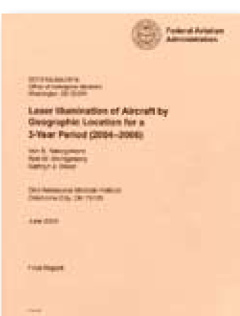
Photographs and videos of actual events accompany many entries in the database. Database records are linked to the U.K. Civil Aviation Authority aircraft registration Web site that provides additional helicopter details, photographs and statistics.

The site reports results of a study of 366 helicopter accidents, ranked by "factors in accidents," "fatal accident causes," "accident pilot experience," "manufacturer," "model" and the aircraft's "role," with accident dates. For example, "mishandled controls" is first in the "factors in accidents" list. "Loss of control" is first under the heading, "fatal accident causes."

REPORTS

Laser Illumination of Aircraft by Geographic Location for a 3-Year Period (2004–2006)

Nakagawara, Van B.; Montgomery, Ron W.; Wood, Kathryn J. U.S. Federal Aviation Administration (FAA) Office of Aerospace Medicine. DOT/FAA/AM-08/14. Final report. June 2008. 13 pp. Figures, references, appendix. Available via the Internet at <www.faa.gov/library/reports/medical/oamtechreports/2000s/media/200814.pdf> or from the National Technical Information Service.*



Incidents involving laser illumination of aircraft are a concern primarily because of their possible performance impairment of flight crews during critical operations, especially approach and landing. Laser exposure can cause temporary visual interference — called "flash-blindness" — as well as distraction, which can disrupt cockpit procedures, crew coordination and communication with air traffic control.

This study uses information contained in a database of laser exposure incidents maintained at the Civil Aerospace Medical Institute, and examines the frequency and rate of incidents for the 2004–2006 period. "Analysis involved stratification of incident data by location … for each year of the study and calculating incident rates per 100,000 flight operations," the report says. "In addition, other operational and visual effect data contained in the laser incident reports were collated and analyzed to provide a better understanding of the safety issues associated with the illumination of aircrew personnel by lasers during critical phases of flight."

A total of 845 incident reports were collected for the study period. Of those, 467, or 55 percent, involved laser illumination of the cockpit. Only the 832 incidents, or 99 percent, that took place within the United States were included in the analysis.

"For the period, total laser incident rates ranged from 0.00 in the Alaskan Region to 0.86 in the Western Pacific Region," the report said. Among the 202 airports where laser incidents occurred, 20 reported 10 or more incidents during the study period, although one was omitted from the analysis because flight operations data were unavailable. For 53 percent of the airports, laser incidents were most frequent in 2005. The total number of incidents for 2006 — 240 — outnumbered those for 2004 and 2005 — 18 and 186, respectively — principally because the Mineta San Jose (California) International Airport had a disproportionately high number in that year.

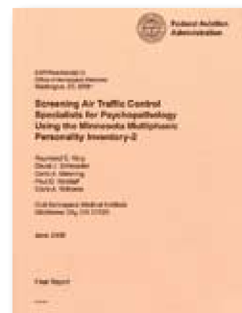
The total number of reported incidents increased from 46 to 451 during the study period, an 880 percent increase. In addition, the rate of incidents increased by 957 percent during the three years. The largest increase in the number of reported incidents, 517 percent, occurred between 2004 and 2005, compared with 45 percent between 2005 and 2006. The report hypothesized that much of the difference was caused by the issuance on Jan. 12, 2005, of FAA Advisory Circular 70-2, "Reporting of Laser Illumination of Aircraft," which heightened sensitivity to the issue and provided a format for reporting incidents.

The study found that, in a particular region, "an increase in operations does not necessarily result in a proportional increase in laser illuminations." It said that the considerable discrepancy in rates among regions was "not entirely clear," but noted that in some cases, incidents "spiked" over brief periods — for instance, 81 during three days at San Jose. Such clusters occurred during time spans ranging from one day to several months.

"The most serious consequences found in this study included the closing of a runway, a missed approach and the pilot-in-command relinquishing control of the aircraft," the report says. "Incidents that resulted in potential ocular injury were rare (3.4 percent of all incidents), and no evidence of serious, long-term injuries was found. As laser technologies improve and become more available, the hazard to aviators may also increase. At present, prompt reporting of [laser] incidents by aviators and the public, as well as quick action by local air traffic and law enforcement authorities, is the most effective deterrent against this threat to aviation safety."

Screening Air Traffic Control Specialists for Psychopathology Using the Minnesota Multiphasic Personality Inventory-2

King, Raymond E.; Schroeder, David J.; Manning, Carol A.; Retzlaff, Paul D.; Williams, Clara A. U.S. Federal Aviation Administration (FAA) Office of Aerospace Medicine. DOT/FAA/AM-08/13. Final report. June 2008. 16 pp. Figures, tables, references, appendix. Available via the Internet at <www.faa.gov/library/reports/medical/oamtechreports/2000s/media/200813.pdf> or from the National Technical Information Service.*



FAA Order 3930.3A, "Air Traffic Control Specialist Health Program," says that an applicant for an air traffic control specialist (ATCS) position must have no established history of "a psychosis; a neurosis; [or] any personality or mental disorder that the Federal Air Surgeon determines clearly indicates a potential hazard to safety in the air traffic control system."

Presumably, a person falling into one of the prohibited categories who applied to become an air traffic controller would be either ignorant of having a disorder or would choose not to share the knowledge with the FAA. Traditionally, the FAA has used the 16 Personality Factor (16 PF) test, whose present version dates from 1968, to screen applicants for mental and emotional disorders. In a 1996 paper written under contract to the FAA, researchers urged that the Minnesota Multiphasic Personality Inventory (MMPI-2) be considered as an alternative means of identifying controller candidates with symptoms that suggest emotional instability and require additional assessment.

"This study was designed to explore the feasibility of utilizing the MMPI-2 to replace the 16 PF as the initial screen," the report says. A sample of 1,014 ATCSs in training voluntarily completed the MMPI-2 for the research.

The MMPI-2 consists of 13 scales. The first three are "validity scales," which attempt to determine, based on the subject's answers to certain questions, how honestly he or she answers all the questions on the test. The rest of the questions are the basis for "clinical scales" designed to measure various dimensions of psychopathology.

"The clinical scales [of the ATCSs tested] are remarkably similar to the general population normative group published in the MMPI-2 manual," the report says. But the values found on certain scales that might be acceptable in the general population could be a problem in ATCSs. There is no hard rule about where to draw the line, or "cut score," above which a candidate would undergo further scrutiny. At a relatively low threshold, the 65T cut score, about 15 percent of subjects had one or more scales above the cut score.

Scale 1 had the lowest percentage of subjects identified across all four cut scores calculated. It measures "hypochondriasis," an excess of vague, generalized health concerns. The scale with the highest percentage of subjects identified across all cut scores was scale 9, "hypomania," overactivity, poor impulse control and irritability.

The report discusses what combination of cut scores would be most useful for testing and the percentage of candidates it would be likely to identify for further testing.

Source

* National Technical Information Service
5385 Port Royal Road
Springfield, VA 22161 USA
Internet: <www.ntis.gov>

— Rick Darby and Patricia Setze

Dead-Stick Landing

Ice crystals cause dual flameout.

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

No Training or Guidance on Hazard

Raytheon Beechjet 400A. Minor damage. No injuries.

The Beechjet was on a fractional ownership operation positioning flight from Indianapolis to Marco Island, Florida, U.S., the afternoon of Nov. 28, 2005. The airplane had been flown at Flight Level 400 (approximately 40,000 ft) for 30 minutes and at FL 380 for about 15 minutes when the flight crew received clearance from air traffic control (ATC) for further descent to FL 330.

"The flight was operating in visual meteorological conditions [VMC] in the vicinity of cumulonimbus buildups," said the final report on the incident, issued in June by the U.S. National Transportation Safety Board (NTSB).

The first officer, who had 3,100 flight hours, including about 20 hours in type, was flying the Beechjet from the left seat. When he pulled back the throttles to begin the descent, the pilots heard loud pops and saw that both engines had flamed out. They donned their oxygen masks, declared an emergency, established a glide speed of 180 kt and diverted the flight to nearby Jacksonville International Airport.

The captain, a check airman with 8,200 flight hours, including 1,800 hours in type, attempted unsuccessfully to restart the engines using battery power. Descending through FL 260, the crew increased airspeed to 230 kt to attempt a windmill restart, but there was no indication of engine rotation.

"During the descent, ATC provided vectors to the ILS [instrument landing system] approach to Runway 7 at Jacksonville," the report said. "The flight was in clouds during the descent, with moderate to heavy rain beginning at about 10,000 ft. As the airplane neared the airport, ATC provided continuous callouts of the distance remaining to the runway that the pilots later stated was very helpful in managing their descent and approach to the airport."

The captain assumed control at about 9,000 ft. The landing gear was extended manually, and the Beechjet broke out of the clouds at about 1,200 ft. "After they landed and rolled off the runway onto a taxiway, the right landing gear tire deflated," the report said.

Investigators determined that ice crystals had caused the flameouts (*ASW*, 6/08, p. 12). "Research revealed that convective storms can lift significant amounts of water into the upper atmosphere and that the blow-off from the tops of these storms can contain significant amounts of ice crystals," the report said. "A post-incident study showed that the ice crystals could partially melt passing through the low-pressure compressor of the [Pratt & Whitney Canada] JT15D-5 engines due to the increase in temperature of the air being compressed.

"Further, the study determined that with the engine anti-ice turned off, it was possible for the ice crystals to accrete on the leading edges of the front inner compressor stator leading edges. If a significant buildup of ice had occurred, any change in the airflow angle-of-incidence that would occur as power is reduced would cause any ice that had accreted on the leading edges of the stators to break away and would result in the engine surging and possibly flaming out.

"The study also revealed that after the engine had flamed out, the radiant heat from the oil tank, which is in the core of the engine, between the low- and high-pressure compressors, could cause the ice on the front inner compressor stators to melt, and the water could run back and refreeze in the high-pressure compressor impeller, acting like a wedge to prevent engine rotation and restart."

The report said that research and flight tests also have shown that ice-crystal icing can temporarily block an orifice designed to trap water in the combustion chamber pressure-signal (P3) line and cause an abnormally rapid drop in fuel flow to a level that will not support combustion.

The report said that lack of training and guidance on the hazard of high-altitude ice-crystal icing was a contributing factor in the incident. Pilots interviewed during the investigation said that they did not know about the hazard or the need to activate the engine anti-ice system when flying near convective weather activity.

Glass Cockpit Goes Dark

Airbus A319-131. No damage. No injuries.

A major electrical failure occurred as the A319 neared FL 200 during departure in VMC from London Heathrow Airport for a scheduled flight with 76 passengers to Budapest, Hungary, the night of Oct. 22, 2005. "The crew reported that there was an audible 'clunk' and the flight deck suddenly became very dark, with a number of systems and flight information displays ceasing to function," said the U.K. Air Accidents Investigation Branch (AAIB) report.

The flight crew's primary flight displays and navigation displays went blank, as did the upper electronic centralized aircraft monitor (ECAM). The master warning sounded as the autopilot and autothrottles disconnected. The VHF radio and interphone failed, and most of the flight deck lights went out. "A number of other, less-critical systems were also affected," the report said.

The commander, the pilot flying, referred to the standby instruments and the external horizon to establish level flight at FL 230, which conformed to the last ATC clearance, and attempted unsuccessfully to transmit a mayday call. Meanwhile, ATC had noticed the loss of radio communication and information from the A319's transponder.

The commander told investigators that the integral lighting for the standby instruments also had failed, and the instruments were poorly illuminated by the remaining flight deck lights. "The commander concentrated on flying the aircraft while the copilot worked sequentially through the checklist actions that had appeared automatically on the lower ECAM display," the report said. "The pilots were using active-noise-reduction headsets, and the loss of the flight interphone made communication between them difficult."

The lower ECAM indicated that the primary fault was the no. 1 transformer rectifier, which converts alternating current to direct current. About 90 seconds after the electrical failure occurred, most of the affected systems were restored when the copilot selected the "AC ESS FEED" (alternating current essential bus feed) switch to "ALTN" (alternate). The commander declared an urgency, reported the electrical failure to ATC and requested and received clearance to fly a holding pattern. "The commander handed over control of the aircraft to the copilot, so that he could assess the situation," the report said. "While in the hold, the cabin crew and passengers were briefed as to the situation, and the auxiliary power unit was started as a precaution."

"The commander handed over control of the aircraft to the copilot, so that he could assess the situation."

The commander established radio communication with a company maintenance control engineer. After discussing the situation for 40 minutes with the engineer, the commander decided to continue the flight to Budapest, where the aircraft was landed without further incident.

"This is the sixth reported occurrence of a failure involving the loss of the same five electronic flight displays on A320-family aircraft," the report said, noting that such failures also have occurred in other types of aircraft. As a result of the incident investigation, the AAIB recommended that the European Aviation Safety Agency consult with other civil aviation authorities in considering whether pilots should receive initial and recurrent training for flight with sole reference to standby instruments.

Blown Tire Disables Hydraulic System

Boeing 747-400. Substantial damage. No injuries.

There were 424 people aboard the 747 when it departed from Los Angeles International Airport before dawn on Oct. 20, 2007, for a flight to Brisbane, Australia. "As the aircraft became airborne, a tire on the left body landing gear disintegrated and a section of tire debris impacted a line of the no. 1 hydraulic system in the left body landing gear well," said the report by the Australian Transport Safety Bureau (ATSB). "That caused fluid and pressure loss from that system."

The flight crew saw a warning of the hydraulic system failure on the engine indicating and crew alerting system (EICAS) and received a report from the cabin crew that a "bang" had been heard just before the 747 became airborne.

"The crew reported that they completed the appropriate checks and were advised by [ATC] that tire debris, but no other material, had been recovered from the runway," the report said. "The crew confirmed that all other aircraft systems were functioning normally and, after considering the status of the aircraft and the option of dumping fuel and returning for a night landing at Los Angeles, decided to proceed toward the planned destination while closely monitoring the aircraft's systems and fuel usage." Airline maintenance control personnel concurred with the crew's decision.

The 747 had to be towed from the runway because the nosewheel steering system had been disabled.

The 747 was landed without further incident at Brisbane but had to be towed from the runway because the nosewheel steering system had been disabled by the failure of the no. 1 hydraulic system.

In the report, the ATSB noted conflicting information in the flight crew operations manual (FCOM) and the flight crew training manual (FCTM). The FCOM recommended landing at the nearest available airport if more than one of the 747's four hydraulic systems failed; however, "for a single hydraulic system failure, the checklist listed the aircraft services that the relevant system operated," the report said. "It did not suggest a course of action." The FCTM recommended that following a tire failure on takeoff, the flight crew should not consider continuing the flight to the destination if other damage, such as a hydraulic system failure, also has occurred.

The report said that although pilots primarily use the FCOM for guidance in flight, the conflicting information in the 747 FCOM and FCTM "create the potential for confusion and a less-than-optimal response by the crew." The airline recommended that Boeing review "operational policy statements" in the FCTM. "The manufacturer accepted that suggestion and indicated that an examination would be undertaken as part of its ongoing standardization program," the report said.

Distraction Blamed for Incursion

Boeing 737, Cessna Citation. No damage. No injuries.

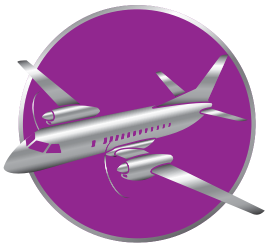
VMC prevailed the morning of Sept. 7, 2006, when the fight crew of a 737-800 with 178 people aboard was cleared by ATC to taxi to holding position A1 for departure from Runway 01L at Oslo Airport in Gardermoen, Norway, and the crew of a Citation IISP with two pilots and an unspecified number of charter passengers aboard was cleared to holding position C1 for departure from the runway.

A1 is near the approach end of the 3,600-m (11,812-ft) runway, and C1 is about 1,462 m (4,797 ft) from the approach end and close to the general aviation ramp.

After clearing the 737 crew for takeoff, the airport traffic controller noticed that the Citation had passed the assigned holding point and was about to enter the runway. The controller told the 737 crew to abort the takeoff, which was accomplished "without any real danger of a collision," said the report by the Accident Investigation Board of Norway.

The Citation had crossed lighted stop bars and markings at the holding point. The commander told investigators that his vision was impaired because the airplane was taxiing toward the rising sun. He also said that his attention was diverted to other tasks, including helping his relatively inexperienced first officer complete before-takeoff checks.

TURBOPROPS



Too Fast for Landing on Short Runway

Beech A90 King Air. Destroyed. One fatality, one serious injury.

The pilots were conducting a local flight from Sarasota, Florida, U.S., to disperse Mediterranean fruit flies under contract to the U.S. Department of Agriculture the afternoon of June 12, 2006, when both propeller secondary low-pitch stop lights illuminated. The right propeller then feathered, and the pilots diverted to "an airport with short runways approximately 3.2 nm [5.9 km] from their present position, rather than to an air carrier airport located 8.5 nm [15.7 km] away," the NTSB report said.

The pilot entered a close right base to the 2,688-ft (819-m) runway at 155 kt — 51 kt above the appropriate single-engine approach speed — and overshot the turn to final approach. The landing gear and flaps were retracted when the King Air touched down on a taxiway near the departure end of the runway and then struck several obstacles and a house. The pilot was killed, and the copilot was seriously injured.

NTSB said that probable causes of the accident were the pilot's "poor in-flight planning [and] his failure to establish the airplane on a stabilized approach for a forced landing." Investigators were unable to determine why the propeller-governing systems failed.

Pitot/Static Icing Causes False Indications

De Havilland Canada Dash 8. No damage. No injuries.

The aircraft was climbing in moderate icing conditions and nearing the assigned cruise altitude, FL 160, during a scheduled flight with 71 passengers from Edinburgh, Scotland, to Belfast, Northern Ireland, the night of Dec. 10, 2006, when the primary flight displays (PFDs) showed an "ALT MISMATCH" alert. The altitude displayed on the commander's PFD was 150 ft lower than the altitude displayed on the copilot's PFD.

"Soon after reaching FL 160, the crew began to experience further discrepancies between both indicated altitudes and airspeeds," the AAIB report said. "The autopilot then disconnected automatically." The altitude and airspeed information on the captain's PFD then was replaced by red failure indications. The crew reported the instrument problems to ATC and requested and received clearance to descend to FL 80.

The copilot's air data computer was selected to provide information to both PFDs. During the descent, the altitude and airspeed indications decreased rapidly and were replaced by failure indications. The crew declared an urgency and conducted the emergency checklist. "The controller assisted by providing the crew with groundspeed readouts and Mode C altitude information," the report said.

"Recorded flight data indicated that the standby pitot/static probe heat switch had not been selected 'ON' prior to flight, and the investigation concluded that, in all probability, the remaining two pitot/static probe heat switches also had not been selected 'ON,'" the report said.

While discussing the icing conditions and aircraft systems during the emergency descent, the pilots noticed that the pitot/static heat switches were off. They apparently turned the switches on, and altitude and airspeed indications subsequently returned to normal. The aircraft was nearing Belfast, and the crew decided to continue to the destination.

The investigation found that the copilot habitually turned the probe heat switches on before the action was called for by the "Taxi" checklist but that, while preparing for departure from Edinburgh, he had been distracted by an abnormal engine indication before the commander called for the checklist. "The copilot had become used to responding to the checklist item 'pitot static' with the knowledge that he had already moved the switches and therefore probably did so on this occasion without positively checking the switches," the report said, noting that neither pilot noticed the pitot-heat alert on the caution/warning panel.

Line Technician Killed by Turning Prop

Pilatus PC-12/45. Minor damage. One fatality.

The single-engine turboprop, with eight people aboard, was landed at about 0220 local time at Wiley Post Airport in Oklahoma City on Jan. 3, 2008. "Upon reaching the FBO's [fixed base operator's] dimly lit ramp, a line technician … used lighted wands to marshal the airplane to a parking spot," the NTSB report said.

The pilot set the parking brake and was shutting down the engine when he heard a loud "thud" and felt the airplane vibrating. "He looked up and saw the line technician rolling on the ramp toward the airplane's left wing tip."

One of the passengers, a physician, administered first aid until emergency response personnel arrived. However, the line technician's injuries were fatal.

The technician had completed professional line service training in September 2007. "This training included the dangers associated when working around propellers," the report said. In October, the technician received a written warning from the FBO for nonadherence to company procedure after he chocked the nosewheel of a King Air while the engines were still running.

PISTON AIRPLANES

CFIT During a Nighttime Approach

Piper Seneca III. Destroyed. One serious injury.

The pilot had conducted a charter flight to Plymouth, England, and was returning to his home base at Oxford the night of Dec. 19, 2007. The Oxford automatic terminal information system (ATIS) indicated that visibility was 3,500 m (about 2 1/4 mi) in haze and the ceiling was overcast at 500 ft.

During his initial radio call to the airport traffic control tower, the pilot said that he was establishing the aircraft on a 10-nm (19-km) final approach to Runway 01, the AAIB report said. He did not say that he had the current ATIS information or request information on weather conditions at the airport. The controller told the pilot to report 2 nm (4 km) from the runway.

However, in his next call, the pilot said that the Seneca was 4.5 nm (8.3 km) from the runway. The controller told him to report the runway lights in sight. "The pilot acknowledged this instruction, but no further transmissions were received from him," the report said.

The ILS approach to Runway 19 was not available, and the pilot apparently conducted from memory the NDB/DME (nondirectional beacon/distance measuring equipment) approach to Runway 01. Radar data recorded by a nearby ATC facility indicated that the aircraft began descending below the initial approach altitude 2.3 nm (4.3 km) before reaching the final approach fix and continued the descent below the 870-ft minimum altitude for a stepdown segment of the final approach.

The wreckage of the Seneca was found near the summit of a 539-ft hill on the extended centerline and 3.6 nm (6.7 km) from the runway. "The pilot was found 9 m [30 ft] from the burning wreckage," the report said. "He was hypothermic and suffering from chest and limb injuries, as well as burn injuries to his lower legs. He was taken to a hospital in Oxford and survived the accident.

"No technical faults or defects were identified as contributory factors to the accident, which the investigation concluded was an instance of controlled flight into terrain (CFIT)."

Leaking Fuel Pump Fitting Causes Explosion

Beech B55 Baron. Substantial damage. No injuries.

The pilot was starting the Baron's right engine in preparation for a positioning flight from Atlanta's Fulton County Airport the night of March 19, 2007, when he heard a "thump" and saw fire emerge from the engine cowling. The fire went out when he shut down the engine.

The NTSB report said that the right wing, from the nacelle to the wing tip, had been damaged by an explosion. Investigators found that a B-nut fitting on the fuel pump was leaking. "Examination of maintenance records revealed that the right main fuel cell was replaced approximately three months and 12 flight hours prior to the accident," the report said.

NTSB said that the probable cause of the accident was "improper maintenance of the B-nut fitting adjacent to the fuel pump."

HELICOPTERS

'Piece of Cake'

Bell 407. Destroyed. Two fatalities.

The pilot had flown a charter customer from his residence in Virginia to a golf course in Ocean View, Delaware, U.S., about midday on Dec. 14, 2006. She then repositioned the helicopter to an airport in Georgetown to refuel. A pilot who spoke with her at the airport said that she seemed to be nervous about the weather and checked forecasts, surface observations and other information several times, the NTSB report said. The pilot had more than 3,300 flight hours as a helicopter pilot-in-command but did not have an instrument rating.

The pilot departed from the airport under visual flight rules (VFR) at 1650 to pick up the passenger for the return flight to Virginia. However, she reversed course after entering fog and landed the 407 in a farm field about 7 mi (11 km) from the golf course.

The pilot notified the passenger of her whereabouts, and he was driven to the landing site at about 1800. "By the time her passenger arrived at the helicopter, darkness had fallen and dense fog had formed," the report said. "The driver stopped his vehicle in front of the helicopter and greeted the pilot. He then asked the pilot if she felt comfortable with the conditions. He specifically pointed out the power lines, irrigation equipment and a tree line adjacent to the helicopter. The pilot replied that it was a 'piece of cake' and pointed to the sky above. The driver recalled that, at the time, the stars could clearly be seen."

The driver moved his vehicle away from the helicopter to watch its departure. "Due to the dark lighting conditions and the foggy weather, the driver was unable to see the helicopter or its lights," the report said. "He drove away shortly thereafter."

A farm worker heard the helicopter's engine start and walked outside to watch the takeoff. He said that the helicopter lifted off vertically to a height just above the treetops and utility lines, hovered momentarily while the landing light was cycled twice and then pitched nose-down and began to accelerate. "The witness expected to see the helicopter climb, as he had seen other helicopters do in the past," the report said. "However, it just accelerated forward in a shallow descent until it impacted the ground."

Examination of the wreckage revealed no sign of any preimpact mechanical malfunction. NTSB said that the probable cause of the accident was "the pilot's improper decision to depart under VFR into night IMC."

Disorientation Cited in Tail Strike

Eurocopter BK117. Substantial damage. No injuries.

An 11,300-hour flight instructor was training a 16,800-hour commercial pilot on confined-area operations in Slaton, Texas, U.S, on Aug. 20, 2007. Both pilots were familiar with the training area, and, before approaching it, the pilot conducted a high reconnaissance to gauge the surface winds and approach and departure paths, the NTSB report said.

The pilots planned to terminate the approach in a hover. The grass in the landing zone usually is less than a foot long but, due to unusually high rainfall, had grown 3–4 ft (1–1.2 m). While hovering, "the tall, waving grass disoriented the pilot, [who] allowed the helicopter to drift backwards into trees," the report said.

The pilots felt a vibration from the tail rotor and immediately landed the helicopter. Both tail rotor blades had been destroyed, and the tail fin gearbox mounting spar had been damaged by the impact.

Preliminary Reports

Date	Location	Aircraft Type	Aircraft Damage	Injuries
July 2, 2008	Caracas, Venezuela	Piper Cheyenne II	destroyed	3 fatal
Soon after the pilot reported a technical problem to air traffic control (ATC) during a nighttime approach, the Cheyenne crashed in a forest.				
July 6, 2008	Saanen, Switzerland	Beech King Air F90	substantial	6 NA
The King Air touched down long and overran the runway. No fatalities were reported.				
July 7, 2008	Bogotá, Colombia	Boeing 747-200	destroyed	2 fatal, 3 serious, 6 minor
Soon after departing for a cargo flight in nighttime visual meteorological conditions, the flight crew radioed that they had an engine fire and were returning to the airport. The 747 crashed on a farm about 8 km (4 nm) from the airport, killing two people on the ground.				
July 7, 2008	Saltillo, Mexico	McDonnell Douglas DC-9-15	destroyed	1 fatal, 1 serious
The freighter crashed in an industrial area short of the runway during an approach in nighttime instrument meteorological conditions. The captain was killed.				
July 10, 2008	Puerto Montt, Chile	Beech 99A	destroyed	9 fatal
The airplane crashed while departing for a scheduled flight to Melinka. Witnesses said that an engine caught fire after the 99 was rotated for takeoff.				
July 15, 2008	Kennesaw, Georgia, U.S.	Socata TBM-700	destroyed	1 fatal
ATC asked the pilot to conduct an S-turn on final approach to accommodate two departures. Witnesses said that the turboprop single rolled inverted and descended in a steep nose-down attitude.				
July 17, 2008	Mount Isa, Queensland, Australia	Piper Navajo	destroyed	1 NA
The Navajo was descending to land when it struck rugged terrain about 29 km (16 nm) north of the airport. The pilot used a mobile telephone to alert rescuers.				
July 19, 2008	Gapyeong, South Korea	Sikorsky S-92A	destroyed	2 serious, 14 minor
The Helibus struck trees during an attempted precautionary landing after the crew encountered low visibility in heavy rain.				
July 19, 2008	Chicago	Airbus A320	minor	142 none
The A320 came to a stop in an engineered materials arresting system bed after overrunning Runway 22L at O'Hare International Airport.				
July 22, 2008	Ocean Ridge, Florida, U.S.	Cessna 402B	destroyed	1 serious
The 402 crashed in a police station parking lot after an engine problem occurred.				
July 23, 2008	Beni, Bolivia	Fokker F27-400	substantial	37 NA
About 25 minutes after departing from Guayaramerin for a scheduled flight to Trinidad, the crew reported an engine problem and conducted a forced landing on a road. No fatalities were reported.				
July 25, 2008	Manila, Philippines	Boeing 747-400	substantial	365 none
The 747 was at 29,000 ft over the Pacific Ocean, en route from Hong Kong to Melbourne, Victoria, Australia, when an oxygen cylinder apparently exploded and caused a rapid cabin decompression. The crew conducted an emergency descent and landed in Manila without further incident.				
July 28, 2008	Colorado Springs, Colorado, U.S.	Raytheon Cobra	substantial	none
The unmanned aircraft system overshot a programmed final-approach waypoint and struck a light pole during an automatic approach to the U.S. Air Force Academy.				
July 28, 2008	West Chester, Pennsylvania, U.S.	Eclipse 500	substantial	2 none
The airplane crossed a road and struck an embankment after overrunning the 3,347-ft (10,982-m) runway at Brandywine Airport.				
July 31, 2008	Owatonna, Minnesota, U.S.	British Aerospace 125-800A	destroyed	8 fatal
Reported visibility was 10 mi (16 km) in rain, and surface winds were from 170 degrees at 6 kt when the Hawker struck the localizer antenna beyond Runway 30 during an attempted go-around and crashed in a cornfield.				

NA = not available

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