AeroSafety WORLD

THE WRONG MEDICINE
Unnecessary medevac flight ends badly

BLOW HARD
Hurricanes, cyclones and flight

ILS INTERFERENCE
Glideslope signal distortion

SCREEN TEST
Detecting pilot health risk

RUNWAY CONSTRUCTION AND SAFETY
WORKAROUND

THE JOURNAL OF FLIGHT SAFETY FOUNDATION

JULY 2012

HARSH Truth

Part of my job is to talk to the news media and help them be accurate in their aviation safety stories. Usually, my quotes are pretty popular, but recently one struck a nerve with a few people. I was working with a reporter from Bloomberg who was writing a difficult piece on U.S. regulatory policy. I said, "If anyone wants to advance safety through regulation, it can't be done without further loss of life." That sounds pretty harsh, but I stand by it. I am not calling for more fatalities or more regulation, but drawing attention to the fact that we are going down a very odd regulatory path in the largest aviation nation in the world, and it merits a thoughtful discussion.

Since the 1980s, every American president has issued executive orders requiring U.S. regulators to do detailed cost-benefit studies on every safety regulation. There are lots of things you can use to justify a regulation, but for aviation safety it largely is about pointing to a record of fatalities, and making a case that the new regulation will prevent those fatalities in the future. For every projected life saved, a regulator is allowed about $6.4 million as a credit to offset the cost of implementing the regulation. It takes a lot of lives to offset the costs of even a minor change in the big U.S. airline industry. That makes regulators think long and hard before putting in place new regulations. That isn't necessarily a bad thing because the airline industry is one of the most heavily regulated industries in the world.

But now we are in a place that no one ever anticipated. No major U.S. airline has had an accident in over a decade. The FAA was barely able to justify the long-awaited fatigue rule, and is now being criticized by Congress for not going further. New rules are needed to do basic things like overhaul outdated training programs and implement safety management systems, but without U.S. accidents, even commonsense rule changes can't be justified using the standard formula.

A work-around has been to make new safety rules voluntary. The FAA has worked closely with industry over the years, and launched many voluntary safety programs. Some of these voluntary programs would be required by law anywhere else in the world (e.g., flight data monitoring), but in the U.S., the FAA counts on credible airlines to implement them on their own. It is obvious this strategy has been incredibly successful in reducing accidents. The world can learn a lot from this extraordinary industry-government collaboration. But is there a limit to how much can be made voluntary?

A major U.S. airline that implements all the voluntary FAA programs is clearly very safe, but that airline may have to compete with another carrier that decides to cut costs and not implement any of the same programs. The gap between what is legal and what is safe already is large, and it will get bigger.

So that is the tough question: Is this regulatory approach sustainable? Is it fair to the airlines that do everything right? Is it fair to an unknowing public? I don't know. But I am sure it is a conversation worth having.

William R. Voss
President and CEO
Flight Safety Foundation

AeroSafetyWORLD

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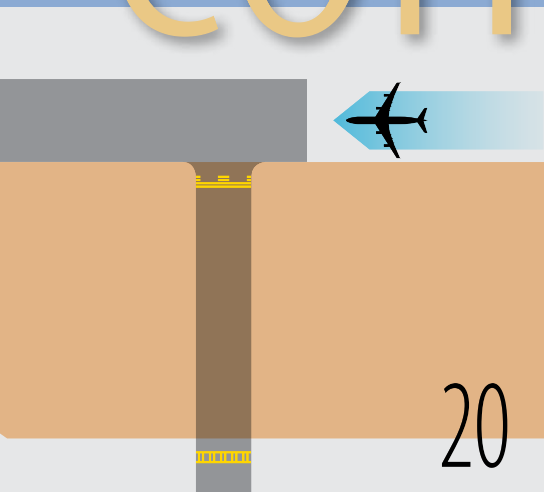

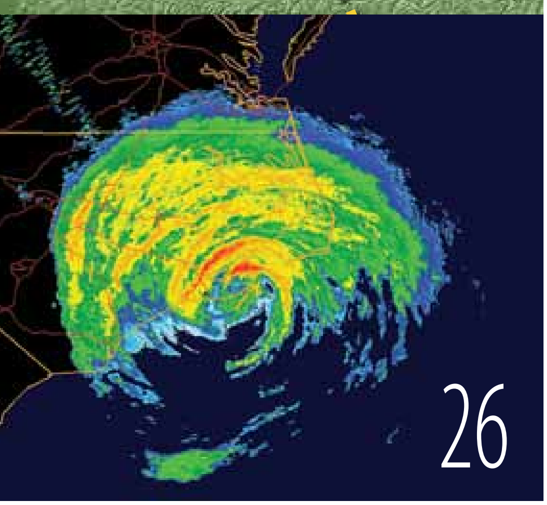

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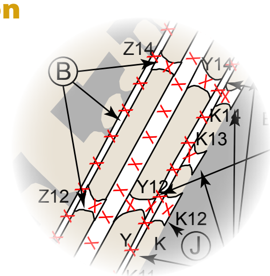

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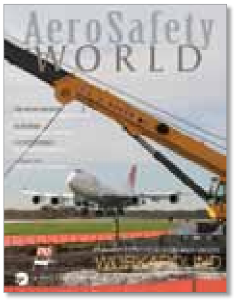

About the Cover
Runway/taxiway construction at Chicago O'Hare International Airport helped inspire a key safety initiative.
George Vickas, U.S. Federal Aviation Administration

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AeroSafetyWORLD

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LEADING BY Example

The Latin American and Caribbean Air Transport Association's (ALTA's) 3rd Pan American Aviation Safety Summit presented the region's aviation leaders with an opportunity to congratulate each other for progress in improving the region's safety record and, more importantly, to warn each other that complacency will result in an increase in accidents if for no other reason than a strong growth rate.

Multiple speakers at the summit, held in mid-June in Bogotá, Colombia, talked about the importance of cooperation among the many aviation stakeholders, about open communication, and about how both will be even more essential as the region's aviation market continues to grow. Fabio Villegas, the chief executive officer of AviancaTaca, said that safety cannot be a competitive differentiator between airlines, but rather that it must be a common objective. He went on to say that aviation is no longer a "national industry," and he called for harmonized regulations across the region.

Miguel Peñaloza, Colombia's minister of transportation and communications, described aviation as "an industry of trust," and warned that people often fill gaps in information with speculation. Aviation needs to be open and transparent, he said.

Still, comments like this are not unusual at industry events. I've heard similar remarks made at conferences, summits and seminars in North America, Europe, Asia and the Middle East. Cooperation and improved communication, while always desirable, are not new ideas.

What sets apart the Latin American and Caribbean region, however, is that it is backing up its words with action in the form of RASG-PA, the Regional Aviation Safety Group–Pan America. RASG-PA was established in late 2008 "to be the focal point to ensure harmonization and coordination of safety efforts aimed at reducing aviation risks in the North American, Central American, Caribbean and South American regions, and to promote the implementation of resulting safety initiatives by all stakeholders," according to the group's website.

The ALTA summit was my first real exposure to RASG-PA and I came away impressed with the support the group has been able to generate from industry and government in a relatively short time. I left Bogotá with the sense that major stakeholders — airlines, airports, manufacturers, air traffic control organizations and national civil aviation authorities — are aligned and moving forward together.

I don't mean that everyone agrees on all the issues; that rarely is the case. And it is obvious that the level of participation varies from country to country. But there does seem to be agreement that RASG-PA is the proper vehicle by which to advance the cause of safety.

The progress being made by RASG-PA certainly benefits the traveling public in the Americas, but it may also have wider ramifications. According to Loretta Martin, who serves as RASG-PA's secretary and the International Civil Aviation Organization's (ICAO's) regional director for the North America, Central America and Caribbean regional office, RASG-PA has proven so successful that the ICAO Council has approved it as a model for its other five regions.

That's called leading by example. It is to be lauded.

Frank Jackman
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 1,075 individuals and member organizations in 130 countries.

Member**Guide**

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SUSTAINED Membership

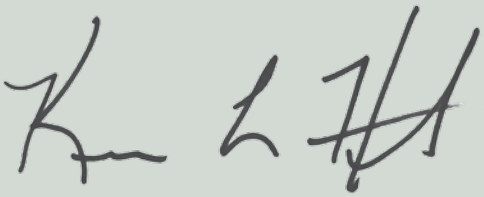
I would like to draw your attention to an article on p. 14 of this month's issue penned by our senior director of membership and business development, Susan Lausch. In the March *AeroSafety World*, I talked about the Flight Safety Foundation's value proposition and how it relates to membership. Susan has written about the Foundation's new membership structure and how it will enhance our ability to serve our members.

When we looked at our membership demographics, we found a diversified group of individuals, students, companies, airports, airlines, business aviation operations, manufacturers, governments, support services and associations in our list of more than 1,000 members. What that means is, we enjoy wide recognition and support, but we also must appeal to each constituency with some focus on what is important for them. Not an easy task, but we started looking at it in terms of what we provide to everyone. That is where the value proposition comes in.

There are two flight paths to take on the value proposition. The first is that contributing to the Foundation is socially responsible because of all the work that we have done since 1947 to keep aviation safe. Everyone who has been a part of aviation has benefited from a safe industry. In short, "It's the right thing to do." Pay back what we all have gained to continue to be safe. Contributions through membership will sustain the Foundation's ability to initiate research and to be involved in team efforts in technical aviation safety issues, so that we may all continue to benefit from being part of one of the safest transportation modes on Earth.

The second flight path is the bottom line approach. This is where there must be some type of direct return on investment (ROI for the financial types) for the dues paid to the Foundation. Many members ask me, "What do I get for my money?" The answer varies by category of membership and how much they want to gain. Basically, we provide aviation safety information and research that is delivered in three ways: our website and its many links, *ASW* and seminars. Through those outlets, you can gain a wealth of information that will keep your segment of the FSF membership demographic informed and safe. Many of you are required by regulation to demonstrate how you keep abreast of current aviation operational and safety issues. The Foundation should be right there at the top, and by the way, it is readily accepted as such. Take that statement to your CEO, COO or CFO, and they should now understand the ROI.

The Flight Safety Foundation is an honest broker in aviation safety issues, and we are able to offer that information in an independent and impartial way because we are not directly affiliated with any business or government entity. We will be able to maintain that international, independent and impartial status on aviation issues with your continued support. For that, I thank you on behalf of the Foundation.



Capt. Kevin L. Hiatt
Chief Operating Officer
Flight Safety Foundation

A Measured Response to Risk

Good message from William Voss ("SMS Reconsidered," *ASW*, 5/12, p. 1).

With the proliferation of consultants, computerized tracking systems and self-proclaimed experts, we seem to have lost sight of the simple goal of an SMS: to reduce risk to its lowest possible level. Of course, getting there is the art form; I would suggest that minimalist art techniques should be employed.

"If you can't measure it, you can't manage it" is what I learned through training and experience — it has served me well through several careers. But, what to measure? Perhaps the most important item in your four-step approach is how do you know the likely cause of your next potential accident? Or, perhaps, what items should we measure?

I find that many SMS-practicing operators fail to set forth a proper set of goals/objectives for their SMS. Merely stating that the organization will manage risk to its lowest possible level is not good enough. Ensuring active participation of *all* employees in the hazard identification and risk mitigation program should be the first requirement, with special emphasis on management-level employee participation. Then, items such as expeditious processing of hazard reports (five days, just to show the organization is serious), 30-day risk mitigation follow-up, an internal evaluation system exercised at least quarterly, and regular (monthly?) *all*-employee risk mitigation (not safety) meetings form a good start for *measurable* goals.

Measurable goals based on risk management will provide a continuing answer to your key question. The term "safety" and statements such as "we are safe" may make people feel good, but safety itself is not measurable; risk is.

Incidentally, I think CFIT and ALAR checklists are excellent starting points for operational hazard identification and risk assessment.

John Sheehan
International Business Aviation Council

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

Write to Frank Jackman, director of publications, Flight Safety Foundation, 801 N. Fairfax St., Suite 400, Alexandria, VA 22314-1774 USA, or e-mail <jackman@flightsafety.org>.

AUG. 6–9 ➤ Unmanned Systems North America Show. Association for Unmanned Vehicle Systems International. Las Vegas. <info@auvsi.org>, <www.auvsishow.org/auvsi12/public/enter.aspx>, +1 703 845 9671.

AUG. 6–17 ➤ Aircraft Accident Investigation Course. (L/D)$_{max}$ Aviation Safety Group. Portland, Oregon, U.S. <info@ldmaxaviation.com>, <bit.ly/w9LKXD>, 877.455.3629, +1 805.285.3629.

AUG. 7–10 ➤ Emergency Response Training Part 2. Global Aerospace SM4 and Fireside Partners. Newark, Delaware, U.S. <safety@global-aero.com>, <sm4.global-aero.com/upcoming-events>, +1 206.818.0877.

AUG. 13–16 ➤ Bird Strike Committee USA Meeting. Bird Strike Committee USA and American Association of Airport Executives. Memphis, Tennessee, U.S. Natalie Fleet, <natalie.fleet@aaae.org>, <events.aaae.org/sites/120701/index.cfm>, +1 703.824.0500, ext. 132.

AUG. 20–21 ➤ BowTie in Aviation Safety Management. Across Safety Development. Munich, Germany. <admin@acrosssafety.com>, +43 664 8850 4098.

AUG. 21 ➤ Brazil Aviation Day. Latin American and Caribbean Air Transport Association. Brasilia, Brazil. <www.alta.aero>, +1 786.388.0222.

AUG. 22–24 ➤ Incident Investigation Training. Across Safety Development. Munich, Germany. <admin@acrosssafety.com>, +43 664 8850 4098.

AUG. 27–31 ➤ ISASI Annual Seminar. International Society of Air Safety Investigators. Baltimore, Maryland, U.S. Ann Schull, <isasi@erols.com>, <www.isasi.org/isasi2012.html#>, +1 703.430.9668.

AUG. 27–31 ➤ Rotorcraft Accident Investigation. U.S. National Transportation Safety Board. Washington. Peter Knudson, <peter.knudson@ntsb.gov>, +1 202.314.6100.

SEPT. 10–21 ➤ Aircraft Accident Investigation. U.S. National Transportation Safety Board. Washington. Peter Knudson, <peter.knudson@ntsb.gov>, +1 202.314.6100.

SEPT. 12–14 ➤ Aviation Law Americas. Latin American and Caribbean Air Transport Association. Miami. <www.alta.aero/aviationlaw/2012>, +1 786.388.0222.

SEPT. 13–14 ➤ Aviation Human Factors and SMS Wings Seminar. Signal Charlie. Pensacola, Florida, U.S. Kent Lewis, <Lewis.Kent@gmail.com>, <www.signalcharlie.net/Seminar+2012>, +1 850.449.4841.

SEPT. 17–18 ➤ Flight Safety 2012. Flightglobal. London. <events.registration@rbi.co.uk>, <bit.ly/K4OT3A>, +44 (0)20 8652 3233.

SEPT. 19 ➤ Fatigue Risk Management and Operational Human Factors. Global Aerospace SM4 and the Minnesota Business Aviation Association. Minneapolis. <safety@global-aero.com>, <sm4.global-aero.com/upcoming-events>, +1 206.818.0877.

OCT. 8–12 ➤ Aviation English for Pilots and Air Traffic Controllers. Joint Aviation Authorities Training Organisation. Hoofddorp, Netherlands. <jaato.com/courses/69>.

OCT. 10–11 ➤ EASA Annual Safety Conference. European Aviation Safety Agency. Cologne, Germany. Gian Andrea Bandieri, <asc@easa.europa.eu>, <bit.ly/y2HfJp>, +49 221 89990 6044.

OCT. 16–19 ➤ SMS II and SMS Audit. MITRE Aviation Institute. McLean, Virginia, U.S. <maimail@mitre.org>, +1 703.983.5617.

OCT. 17–18 ➤ Latin America and Caribbean Engineering and MRO Summit 2012. Latin American and Caribbean Air Transport Association and UBM Aviation. São Paulo, Brazil. <www.alta-ubma-mrosummit.com>, +1 786.388.0222.

OCT. 22–24 ➤ SAFE Annual Symposium. SAFE Association. Reno, Nevada, U.S. Jeani Benton, <safe@peak.org>, <www.safeassociation.com>, +1 541.895.3012.

OCT. 23–25 ➤ 65th annual International Air Safety Seminar. Flight Safety Foundation and Latin American and Caribbean Air Transport Association. Santiago, Chile. Namratha Apparao, <apparao@flightsafety.org>, <flightsafety.org/iass>, +1 703.739.6700, ext. 101.

OCT. 23–25 ➤ International Cabin Safety Conference. (L/D)$_{max}$ Aviation Safety Group. Amsterdam. Chrissy Kelley, Chrissy.kelley@ldmaxaviation.com, <www.ldmaxaviation.com>, 877.455.3629, ext. 3; +1 805.285.3629.

OCT. 28–29 ➤ Flight Operations Manual Workshop: Employing IS-BAO. National Business Aviation Association. Orlando, Florida, U.S. Sarah Wolf, <swolf@nbaa.org>, <bit.ly/zBvVZI>, +1 202.783.9251.

OCT. 29–NOV. 2 ➤ Global ATM Safety Conference. Civil Air Navigation Services Organisation. Cape Town, South Africa. Anouk Achterhuis, <anouk.achterhuis@canso.org>, <www.canso.org/safetyconference2012>, +31 (0)23 568 5390.

NOV. 8 ➤ Creating Safety Assurance: How to Move From Concepts to Action. Global Aerospace SM4 and the Kansas City Business Aviation Association. Kansas City, Missouri, U.S. <safety@global-aero.com>, <sm4.global-aero.com/upcoming-events>, +1 206.818.0877.

NOV. 14–16 ➤ ALTA Airline Leaders Forum 2012. Latin American and Caribbean Air Transport Association. Panama City, Panama. <www.alta.aero/airlineleaders/2012>, +1 786.388.0222.

DEC. 3–7 ➤ SMS Principles and SMS Theory and Application. MITRE Aviation Institute. McLean, Virginia, U.S. <maimail@mitre.org>, +1 703.983.5617.

DEC. 10 ➤ Implementing a Just Culture. Baines Simmons. Surrey, England. info@bainessimmons.com, bit.ly/whV9l4, +44 (0)1276 855412.

DEC. 13–14 ➤ Overview of Aviation Safety Management Systems Training. ATC Vantage. Tampa, Florida, U.S. Theresa McCormick, tmccormick@atcvantage.com, atcvantage.com/sms-workshop.html, +1 727.410.4759.

APR. 10–11, 2013 ➤ 58th annual Business Aviation Safety Seminar. Flight Safety Foundation and National Business Aviation Association. Montreal. Namratha Apparao, <apparao@flightsafety.org>, <flightsafety.org/bass>, +1 703.739.6700, ext. 101.

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

Safety News

Unreported Wire Strikes

At least 40 percent of aircraft wire strikes in Australia have gone unreported in recent years, according to a report by the Australian Transport Safety Bureau (ATSB).

The ATSB based its conclusion on surveys of commercial electricity distribution and transmission companies, all of which were asked to provide data on all known wire strikes involving their wires between July 2003 and June 2011. The ATSB also requested information from a telecommunications company, which did not have a central data center for wire strike information and therefore did not participate.

During the eight-year period, pilots or operators had reported 166 wire strikes to the ATSB. Of these, about half involved crop spraying, and 17 percent involved aircraft engaged in aerial stock mustering, fire control, surveying and photography — all operations that typically are conducted at low altitudes.

Information from electricity distribution and transmission companies indicated that an additional 101 wire strikes had not previously been reported to the ATSB.

The ATSB urged pilots and operators to report all future wire strikes "so that they can be investigated, if required, and so that occurrence details can be collected for research purposes to identify emerging safety trends.

"Information reported to the ATSB increases our understanding of wire strikes, the trends, as well as how and why they happen. It is only with reported information that the ATSB can improve aviation safety by establishing the true extent of wire strikes and determining how and where they occur so that actions can be directed toward the most appropriate areas to reduce wire strikes."

Benchill/Wikimedia

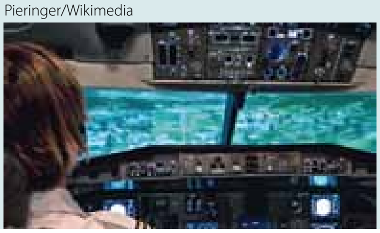
Simulator Time

New requirements for Australian pilots to undergo training and checking exercises in simulators will lessen risks of accidents during training, the Civil Aviation Safety Authority (CASA) says.

The requirements, which will take effect April 1, 2013, call for conversion command training, as well as training and checking, for pilots of multi-engine airplanes with 10 to 19 passenger seats to be conducted in "an appropriate simulator, if one is available in Australia."

CASA says that pilots who are training to fly aircraft with at least 20 passenger seats must receive training in a simulator "if one is available in Australia or a recognized foreign state."

Pieringer/Wikimedia



Canadian Watchlist

The Transportation Safety Board of Canada (TSB) has issued its 2012 Watchlist of the most critical safety issues facing aviation and other transportation systems in Canada.

Of the nine critical issues on the list, four involve aviation.

One issue involves air safety management systems (SMS), which the TSB said should be addressed with effective monitoring of "the integration of SMS practices into day-to-day operations."

The TSB also called for action to address landing accidents and runway overruns. The agency said pilots must receive timely information about runway surface conditions during bad weather, and called for longer runway-end safety areas or the installation of engineered material arresting systems to safely stop overruns.

In addition, the TSB cited the risk of runway collisions, calling for improved runway procedures and the use of enhanced collision warning systems at the country's airports.

Finally, the agency cited collisions with land and water, which it said should be dealt with through improved non-precision approach procedures.

The Watchlist is the second to be issued by TSB. The original list, released in 2010, also cited the need to address runway collisions, collisions with terrain, landing accidents and runway overruns.

"The TSB found on some issues, there has been little or no change," said TSB Chair Wendy Tadros. "Planes continue to run off our runways, or to collide with land and water."

She urged the aviation community to act on the critical safety issues cited on the Watchlist, adding, "Canadians deserve the safest transportation system in the world.

The TSB noted progress in some 2010 Watchlist items, such as planned improvements for cockpit voice recorders.

Weather Warning

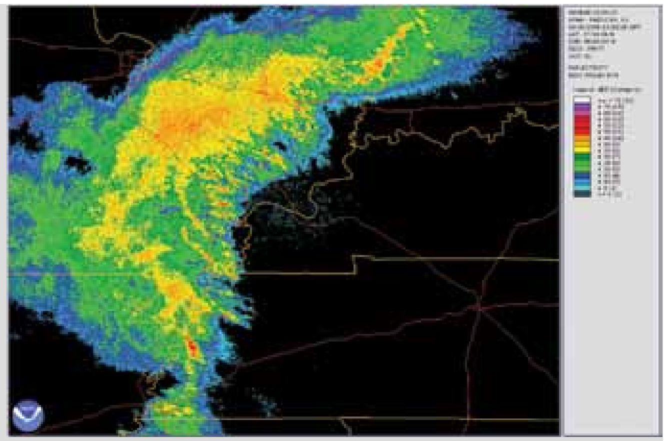
Pilots using certain types of weather display systems should be aware that the data being displayed may be as much as 20 minutes older than the display indicates, the U.S. National Transportation Safety Board (NTSB) says.

In a Safety Alert issued in mid-June, the NTSB said the warning applies to pilots who view "mosaic" imagery that is created from Next Generation Radar (NEXRAD) data and made available via flight information service–broadcast (FIS–B) and private satellite weather service providers. Airline pilots, who obtain their weather information from other sources, are not affected by the warning.

Mosaic images are created from data from multiple radar ground sites, and the NTSB said that "when a mosaic image is updated, it may not contain new information from each ground site."

In addition, the NTSB said, "the age indicator displays the age of the mosaic image created by the service provider. Weather conditions depicted on the mosaic image will *always* be older than the age indicated on the display."

The agency cited two fatal accidents in recent years in which NEXRAD mosaic imagery was available to pilots. In one accident — the March 25, 2010, crash of a Eurocopter AS350 B3 near Brownsville, Tennessee — the pilot had received a



U.S. National Oceanic and Atmospheric Administration

NEXRAD image labeled as 1 minute old, although the weather conditions depicted were 5 minutes old (*ASW*, 3/12, p. 45). The image showed severe weather about 7 mi (11 km) from the landing site, but in reality, the weather had reached the site.

The crash killed the pilot and two aeromedical personnel. The NTSB said the probable cause was "the pilot's decision to attempt the flight into approaching adverse weather, resulting in an encounter with a thunderstorm with localized instrument meteorological conditions, heavy rain and severe turbulence that led to a loss of control."

Airport Improvements

The International Civil Aviation Organization (ICAO) and Airports Council International (ACI) have agreed to cooperate on efforts to enhance safety at airports worldwide.

The agreement — signed in mid-June by ICAO Council President Roberto Kobeh González and ACI Director General Angela Gittens — calls for increased support for an ACI program to identify safety vulnerabilities and correct them, to work together on technical assistance projects, to exchange safety information and to promote regional cooperation (*ASW*, 4/12. p. 22).

Kobeh said the agreement "reflects ICAO's continuing efforts to take a more action-oriented approach to promoting safety."

Gittens added that the agreement was indicative of a new effort to expand ACI's Airport Excellence in Safety Programme, which helps airports address safety issues through on-site peer reviews, information sharing, training and assistance in implementing management structures.

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Ending Idle Chatter

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Inappropriate "chat" on the aeronautical emergency radio frequency 121.5 MHz could interfere with legitimate use of the frequency and should be eliminated, Eurocontrol says.

The agency said in mid-June that it had been told, "on numerous occasions, about the misuse of the … frequency, most recently involving inappropriate 'chat' related to the ongoing EURO 2012 football championship."

Such conversations should be avoided "in order to maintain the integrity of the frequency for the purposes for which it is intended," Eurocontrol said.

The agency asked operators to remind flight crews about the appropriate use of 121.5 MHz, as defined by national aviation authorities and the International Civil Aviation Organization.

Stick Pusher Protections

The U.S. National Transportation Safety Board (NTSB), citing the 2009 crash of an Avions de Transport Regional (ATR) Alenia ATR 42, says steps should be taken to ensure that the aircraft's stick pusher activates before the stall angle-of-attack (AOA) is reached when ice is accumulating on the airframe.

The 2009 crash prompted the NTSB to review the ATR 42 stall protection system, which "provides an aural warning and stick shaker to alert pilots that a stall is imminent and if the … (AOA) is further increased, a stick pusher activates to automatically limit or reduce the AOA," the NTSB said.

"For a clean wing with no ice contamination, the ATR 42 is expected to stall at 14.4 degrees AOA, and the stick pusher activates at an angle lower than the clean-wing stall AOA. … However, the stick pusher's activation AOA does not change when the ice protection system is turned on, and therefore it may not offer stall protection when the airplane encounters icing conditions."

In its safety recommendations, the NTSB said that the European Aviation Safety Agency (EASA) should revise the ATR 42's stick pusher activation AOA "to ensure that the stick pusher activates before the stall AOA in the presence of airframe ice accretions."

The NTSB also said that the EASA should evaluate all stick pusher–equipped transport category airplanes that it has certificated "to ensure that the stick pusher activates at an angle-of-attack that will provide adequate stall protection in the presence of airframe ice accretions."

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The NTSB issued two similar recommendations to the U.S. Federal Aviation Administration.

The recommendations were developed in the aftermath of the Jan. 27, 2009, crash of an ATR 42 cargo airplane, registered to FedEx and operated by Empire Airlines, during an approach to Lubbock Preston Smith International Airport in Texas (*ASW*, 6/11, p. 18).

The captain was seriously injured, and the first officer received minor injuries in the crash, which resulted in substantial damage to the airplane. The NTSB said the probable cause was the flight crew's "failure to monitor and maintain a minimum safe airspeed while executing an instrument approach in icing conditions, which resulted in an aerodynamic stall at low altitude."

Contributing factors included the crew's failure to comply with standard operating procedures associated with a flap anomaly, the captain's decision to continue an unstabilized approach, poor crew resource management and the crew's fatigue and cumulative sleep debt, the NTSB said.

100 Audits and Counting

Flight Safety Foundation's Basic Aviation Risk Standard (BARS) program in June conducted the 100th safety audit of the 2-year-old program.

The 100th audit was conducted at Karratha Flying Services (KFS), a charter company in the Pilbara region of Western Australia. KFS was one of the first aviation companies to become a BARS member organization and one of the first to undergo an audit. The June BARS audit was the company's most recent.


© Karratha Flying Services

The BARS program, introduced in 2010, was developed by Flight Safety Foundation in conjunction with several major mining and resource companies. The program's goal is to establish a single comprehensive risk standard for all aviation companies providing aviation services to resource companies.

In Other News …

The Association for Unmanned Vehicle Systems International has published a code of conduct for its members and others who operate **unmanned aircraft systems** (UAS), emphasizing "safety, professionalism and respect in all uses of UAS." … The U.S. Federal Aviation Administration (FAA) has proposed a $206,550 civil penalty against Martinaire Aviation for alleged violations of regulations governing the transportation of **hazardous materials** in 2011. Martinaire has 30 days after it receives the FAA's enforcement letter to respond.

Compiled and edited by Linda Werfelman.

FLIGHT SAFETY FOUNDATION MEMBER

Changing

Flight Safety Foundation is very appreciative of its members' continued support throughout the years. The Foundation has been setting safety trends and standards and, in essence, changing the conversation of aviation safety for more than 65 years. We do that by being independent and impartial. Our work is global, and your membership dues directly help us to further our common mission as the leading voice of safety for the global aviation community.

With that in mind, the Foundation is making changes to its overall membership structure to better serve current and new members. These improvements and changes will begin in July and continue throughout the year. After that, you will continue to see membership updates and information on the Foundation's work.

The changes will include: exclusive access to *AeroSafety World* magazine before public availability, an updated design for the FSF website's homepage, an enhanced members-only section of the website that will include updates pertaining specifically to each membership category; and new, more specific membership categories with dues amounts that better correlate to each. More value-added benefits will be incorporated in each category. Improvements in the communication of the Foundation's work and general updates will be seen throughout social networking outlets, email communication and *ASW*.

Beginning in February 2013, the digital version of each new *AeroSafety World* issue will be available to FSF members for several months before it is posted on the homepage for all to read and download. *ASW* is the flagship publication of the Foundation and our most popular member benefit. Members deserve to see it first.

The homepage will change to give a better understanding of everything that the Foundation does, and it will have an easier-to-read format. The members-only section of the website will be divided into tabs by membership category so that members can see which of the Foundation's projects have both indirect and direct benefits in each category. There will be special articles of interest, white papers, etc. within each category that will discuss useful information for you and your organization. All new members will be able to sign up electronically, and all current members will be able to renew their membership online.

Details on each category including descriptions and dues amounts will be provided at <flightsafety.org>. The current and new value-added benefits will be spelled out more clearly. Please keep checking the website for updates.

The Foundation will increase communication with its membership through its website and social media outlets such as Facebook, Twitter and LinkedIn, where comments and interaction will be strongly encouraged. General updates and information will continue to flow via *ASW* and email.

Flight Safety Foundation continues to change the conversation of aviation safety with the end goal being the prevention of accidents and loss of life. Our members are an integral part of that conversation. These changes have been put in place to encourage current and new members to have an active role in that dialogue. Stay tuned. …

— Susan Lausch, Senior Director of Membership and Business Development

New Membership Categories

BARS Benefactor
Benefactor
Patron

Academic
Airport (Small, Medium, Large)
Business Aviation (Small, Medium, Large)
Air Carrier (Small, Medium, Large)
Government
Individual/Student
Manufacturer (Small, Medium, Large)
Non-Profit
Support Services


CASSIOPEE
PUT YOUR FLIGHT DATA TO WORK
singulier et associés - Photo : Getty Images

© Don Wilson/Port of Seattle

What's on Your Runway?

NOTAMs enhanced with airport diagrams help pilots mitigate risks during U.S. runway/taxiway construction.

BY WAYNE ROSENKRANS

Operating aircraft near runway/taxiway construction projects adds extraordinary complexity for everyone involved. Today's risk mitigations consequently have the best chance of success under a blame-free, open communication approach with all airport stakeholders well versed in the latest safety resources and planning tools, says a current U.S. Federal Aviation Administration (FAA) educational campaign.

Pilots, for example, already may be familiar with U.S. air traffic controllers' use of special clearance phraseology during such projects. However, clearance wording introduced last September to heighten flight crew awareness of reductions in available takeoff/landing distance is just one of many defenses against human error and safety system issues related to temporarily shortened runways.

Threats to flight operations from construction-related communication issues and other factors have necessitated these extra mitigating actions, says Jim Krieger, chairman of the FAA's Airport Construction Advisory Council (ACAC) and staff manager, Chicago-O'Hare International Airport (ORD) Air Traffic

Control Tower. Relevant safety events at ORD in 2009 were among many analyzed before taking these actions.

Latent effects of runway/taxiway construction are often difficult to predict or even to detect, Krieger said. "Many serious events have happened because of airport construction, and it is difficult to see them coming," he said. "If the closure pattern and sequence are not well planned, for example, bottleneck intersections and extra runway crossings raise the safety risk, so it's important to get the details right. A big red flag for the ACAC is when we hear someone say, 'This is just a taxiway project,' or 'We have done this a million times.'

"This effort is not about blame because that approach gets us nowhere. The key in any given safety event is to determine why everything made sense to the individuals involved at the time. Once we know that, we have something to work with."

Characteristic Hazards

Operations on runways shortened due to construction represent the riskiest type of activity that involves air traffic control (ATC), Krieger said. "These operations are the only situation in which we intentionally put aircraft, people, vehicles and sometimes other objects on the same piece of pavement all at the same time," he said.

The common denominator in recent construction-related flight safety events has been that "pilots, controllers and airfield personnel sometimes are just not aware of construction notices to airmen [NOTAMs]," Krieger said. "At the moment of truth, for whatever reason, people don't know something has been altered on the runway, taxiway or wherever. While this is not new, the consequences of missing such information at the times that they need it most — like during the takeoff or landing phases of flight — cannot be overlooked. Sometimes people knew about the NOTAM at one point and later forgot; on other occasions, they simply never knew about the construction NOTAM at all."

At major U.S. airports, aviation professionals sometimes have struggled to handle the high volume of raw data, to "separate the wheat from the chaff" in Krieger's words. He noted that ORD typically publishes six pages of NOTAMs a day, and other U.S. airports publish 15 pages or more.

"When a serious 2009 safety event happened one evening in Chicago involving a shortened runway, more than 70 NOTAMs were in effect," Krieger said. "The NOTAM that made all the difference in the world to this flight crew was buried in the list at about no. 56. The list's no. 1 NOTAM, prioritized by currency, was, 'Runway 22L windsock unlit' — not too important in the grand scheme of things."

The ACAC concluded in 2010 that causal factors in aircraft safety events associated with runway/taxiway construction include missed, forgotten or obsolete construction information that affects dispatchers, pilots and ATC; ineffective ATIS broadcasts; potential airport diagram improvements; confusion surrounding ATC's use of the term "full length"; missing or ineffective visual cues on the airport surface to reinforce or back up pilot/driver alertness to construction effects such as shortened runways; numerous unprioritized NOTAMs; and diverse human factors issues.

Key Web Page

The ACAC's leaders urge the aviation community to take advantage of the FAA's free and continually updated *Runway and Taxiway Construction* Web page <www.faa.gov/airports/runway_safety/runway_construction>. The Web page provides graphically enhanced NOTAMs called *construction notices;* a simple interface for searching, sorting and checking NOTAMs; a partial runway construction closure checklist; runway-taxiway construction best practices and lessons learned; and airport construction frequently asked questions. Using this Web page already has been shown to improve recognition of significant items within NOTAMs, enabling pilots and dispatchers to reduce the risk of missing construction-related information, Krieger said.

"We expect more website capabilities to be added as needed in the future, along with fillable online construction checklists for air traffic managers," he said. The ACAC also has made

U.S. Federal Aviation Administration — Experimental sign at ORD presentations to many industry conferences. These have included advising aircraft operators and their flight operations safety specialists to note all the other changes. This will help to ensure that pilots recheck aircraft performance on shortened runways, he added.

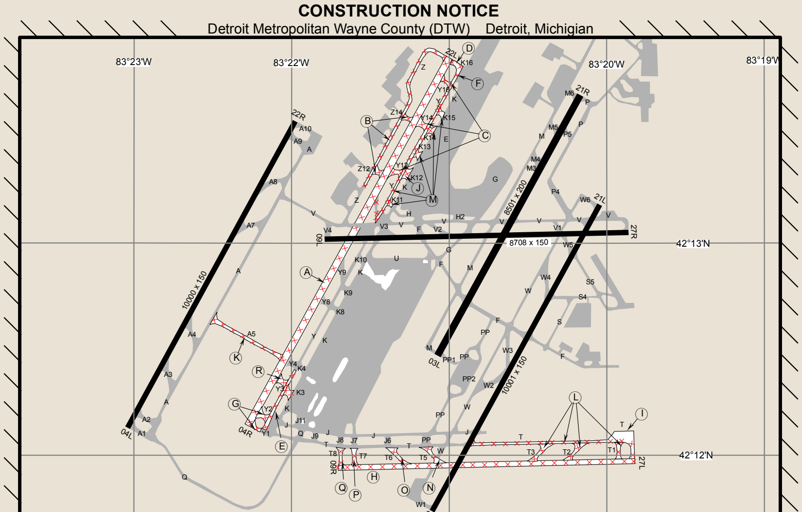
Although rollout of changes within the FAA has met expectations, early data show lower Web page traffic from pilots than planned, Krieger said. The ACAC expects continued support from a dozen industry groups in promoting routine use of the Web page while other communication channels and materials — such the FAA's *What's on Your Runway?* promotional card — evolve.

Persuading non-FAA stakeholders to take advantage of the appropriate tools — especially if they may require updates to standard operating procedures — has been a challenge. "Getting the information out is the crux of what we are facing," Krieger said. "We have different audiences — the pilot community, dispatchers, airport managers, the air traffic manager community and ATC facility personnel. The pilot crowd is tough to reach because they are a diverse group using different types of communication. So, we've started with the Web page. But we will have failed if pilots do not know about the improved NOTAM access tools, construction notices, other safety information and where to find all these online."

The FAA's *Runway and Taxiway Construction* Web page simplifies NOTAM access and adds graphical construction notices.

CONSTRUCTION NOTICE

Detroit Metropolitan Wayne County (DTW) Detroit, Michigan



NOTAM			START DATE	FINISH DATE
A	04/357	RWY 4R/22L CLSD	APR 23, 2012	SEP 6, 2012
B	04/172	TWY Z, Z12, Z14 N OF FEDEX RAMP CLSD	APR 16, 2012	SEP 5, 2012
C	04/182	TWY Y12, Y14, Y16 CLSD	APR 19, 2012	SEP 6, 2012
D	04/183	TWY Y CLSD AT 22L APCH	APR 19, 2012	AUG 1, 2012
E	06/219	TWY Y BTN TWY Y1 AND TWY Y4 CLSD	JUN 28, 2012	JUL 3, 2012
F	04/221	TWY Y BTN TWY K15 AND APCH END RWY 22L CLSD	APR 19, 2012	SEP 5, 2012
G	06/216	TWY Y1, Y2 CLSD	JUN 28, 2012	JUL 3, 2012
H	06/066	RWY 9R/27L CLSD	JUN 11, 2012	JUN 29, 2012
I	06/070	TWY T RUNUP PAD AT APCH END RWY 27L CLSD	JUN 11, 2012	JUN 29, 2012

NOTAM			START DATE	FINISH DATE
J	04/397	TWY K12 CLSD	APR 30, 2012	AUG 1, 2012
K	05/001	TWY A5 CLSD	MAY 1, 2012	JUL 10, 2012
L	06/082	TWY T1,T2,T3,T BTN RWY 3R/21L AND APCH END 27L CLSD	JUN 11, 2012	JUN 29, 2012
M	04/398	TWY K11, K13, K14, K15, TWY Y BTN TWY V AND TWY K15 CLSD	APR 30, 2012	JUL 1, 2012
N	06/211	TWY T5 CLSD	JUN 28, 2012	JUL 7, 2012
O	06/212	TWY T6 CLSD	JUN 28, 2012	JUL 7, 2012
P	06/213	TWY T7 CLSD	JUN 28, 2012	JUL 7, 2012
Q	06/214	TWY T8 CLSD	JUN 28, 2012	JUL 7, 2012
R	06/217-218	TWY Y3,K3 CLSD	JUN 28, 2012	JUL 3, 2012

NOTE: This diagram is intended to display published NOTAMs and is checked and updated daily (Mon. - Fri. only; no holidays); temporary closures/openings of less than 24 hours are not depicted; runway length shown is maximum length (shortened distances are not depicted); diagrams containing new runway surfaces will be deleted after (FAA) revised airport diagrams are published. Always CHECK CURRENT NOTAMs

Consult NOTAMS for Latest Information

Highlights of Work

The ACAC was put together in 2010 as an ad hoc effort, said David Siewert, air traffic manager, John F. Kennedy International Airport (JFK) Air Traffic Control Tower, and a leader-spokesman for the ACAC. Early this year, the FAA asked the ACAC to write a charter to become a permanent part of the Air Traffic Organization (ATO). As of July, the charter was in near-final form, he said.

This agency support has enabled the ACAC to expand its composition, do more to publicize the changes already made, furnish on-site technical support for local airport construction projects and follow up on further proposed changes, Siewert said.

In 2012, the ACAC has focused on addressing new safety issues involving runway/taxiway construction, adding people and organizations that bring wider expertise and perspectives, and joining forces with international efforts and non-U.S. counterparts.

Some changes that the ACAC championed in 2010 now remind or warn pilots about their situation. One was made in FAA Order JO 7110.65S, *Air Traffic Control.* The policy requires that the words *warning* and *shortened* be added to ATIS broadcasts to say, for example, "Warning Runway 14R shortened, 9,800 ft [2,987 m] available, consult NOTAMs." Also, the word *shortened* has been adopted by ATC for takeoff and landing clearances; for example, "Runway 10 shortened, cleared for takeoff [or cleared to line up and wait]" and "Runway 10 shortened, cleared to land."

The policy change also has eliminated the word "full length" in ATC phraseology when clearing pilots to take off or line up and wait on a shortened runway. The ACAC's 2010 analysis had documented some runway safety events in which U.S. and non-U.S. pilots cited confusion about ATC use of the term.

Other policy changes for ATC management were adopted into FAA Order JO 7210.3V, *Facility*

Operation and Administration. These include the required notification of the ACAC about all construction projects at U.S. airports; training of ATC personnel prior to construction, if possible; and a pre-broadcast review of ATIS messages by a person other than the message originator.

Construction Notices

The Aeronautical Information Service office in ATO Mission Support invented the construction notices to address pilot-reported shortcomings of the NOTAM system — focusing on the difficulty for pilots and dispatchers in recognizing and prioritizing the scattered information pertaining to runway/taxiway construction. "We believe that construction notices are the most intuitive way to communicate this NOTAM information," Krieger said.

Each construction notice developed as part of a trial program has a simplified airport diagram with overlaid red "X" marks that show construction project areas with letters and arrows indicating corresponding NOTAMs, start dates and finish dates in an adjacent legend. Based on updates and verification of closures by FAA headquarters staff — currently performed weekdays excluding holidays — the construction notices are hosted on the National Flight Data Center website.

Positive Signs

Proposed airfield signs, as already approved for experimental use at ORD, indicate at runway intersections that a runway has been shortened and show pilots the takeoff run available from that point. "We've asked the FAA Office of Airports to allow all airports to temporarily install approved signage at certain intersections that both the airport manager and the air traffic manager agree are most used by departing aircraft," Krieger said. This office agreed to expedite its response to this request but a firm time frame has not been announced, he said.

The latest version of prototype lighted signage tested at ORD under a waiver of existing standards contains the message format "RWY 14R SHORTENED, TORA 9,685 FEET." Signage showing runway remaining from taxiway intersections already is used by some non-U.S. airports, according to Krieger and Siewert. They have proposed the use of "safety orange" and a pattern of alternating diagonal white and orange stripes as a standard for temporary airport construction-related signage and markings. This color already is used for airport obstacles. Some ATC facilities, in cooperation with airports, will add temporary construction-related signage to communicate that a runway has been shortened.

"The Office of Airports is exploring the human factors aspects of the ACAC's request to use this color on all runway and taxiway signage related to active construction closures," Krieger said.

Evidence of Value

Siewert said that many reports from the field offer preliminary evidence that the ACAC initiatives overall are making a difference to some pilots and other stakeholders. While providing on-site support during construction at Lafayette (Louisiana, U.S.) Regional Airport, ACAC representatives heard controllers report that pilots often follow up a clearance to land containing "shortened" with questions about the partial runway closure, such as "Which end is shortened and by how much?"

"These pilots said they did not know that the runway had been shortened until they heard our 'Runway XX shortened' phraseology," Siewert said. "We also have received that feedback from other places. The tools that we have implemented are taking hold and have had an effect on enhancing safety."

Similarly, numerous air carrier crews questioned ATC at San Francisco International Airport (SFO) about the state of the runway upon receiving their clearance to land with the "shortened" phraseology, Krieger added. "If our phraseology prompts them to ask these questions about what's closed on that runway, that's great," he said. "That's exactly the kind of response that we were hoping for — an opportunity for clarification and increased awareness. Without the information exchange, I don't think that pilots were always aware of partial closures that could affect aircraft performance and safety."

The ACAC also collaborates on flight safety issues involving runway/taxiway construction with stakeholders around the world, Krieger said. In 2012, the ACAC briefed the secretariat of the International Civil Aviation Organization (ICAO) Air Navigation Bureau in February and the ICAO Air Navigation Commission in March. In response to ICAO's request, the ACAC during July presented proposed construction-related revisions to ICAO Doc 9137, *Airport Services Manual,* Chapter 8, "Airport Operational Services."

In summary, Krieger said, "It's risky to let the scope of a runway/taxiway construction project lull people into thinking that they don't have to be concerned about flight operations safety. The 'small' projects have caused just enough confusion to result in accidents with many fatalities. We simply cannot afford to let down our guard."

To read an enhanced version of this story and a table of ACAC safety event examples, go to <flightsafety.org/aerosafety-world-magazine/july-2012/construction-council>.

Crossed Signals

BY MARK LACAGNINA

Entering an ILS critical area can cause problems for aircraft on approach.

The flight crew was in for a surprise. They had established their large air carrier aircraft on the localizer during a coupled instrument landing system (ILS) approach to Chicago O'Hare International Airport's Runway 28 and were awaiting glideslope interception when their glideslope course deviation indicators (CDIs) abruptly moved from the full-up position to full-down. The airplane pitched nose-down and descended 100 ft before the pilot flying disengaged the autopilot and hand flew the airplane back to the appropriate altitude. "While leveling, I saw the glideslope indicator go back to the correct indication of full-up," the pilot said.[1]

The anomaly likely was caused by disruption of the glideslope signal by a large cargo aircraft holding for takeoff on Runway 28. Tower personnel told the crew that, because of the weather conditions — 2 1/2 mi (4,000 m) visibility in snow and a 1,500-ft overcast ceiling — they were not required to protect the ILS critical area.

Incidents like this prompted the U.S. Federal Aviation Administration (FAA) in April to issue a notice "to remind operators of the potential for erroneous glideslope and/or localizer indications caused by movement of aircraft or equipment through ILS critical areas."[2]

The notice said that there had been several recent reports by pilots and air traffic controllers about fluctuations of glideslope and/or localizer indications in aircraft on ILS approaches. "This well-known phenomenon may occur when aircraft or vehicles are moving through the ILS localizer and/or glideslope critical areas and is due to interference with the ILS signals," the notice said, adding that in several of the reported incidents, pilots were conducting coupled approaches, and the autopilots tracked the distorted ILS signals, causing excessive pitch and roll excursions.

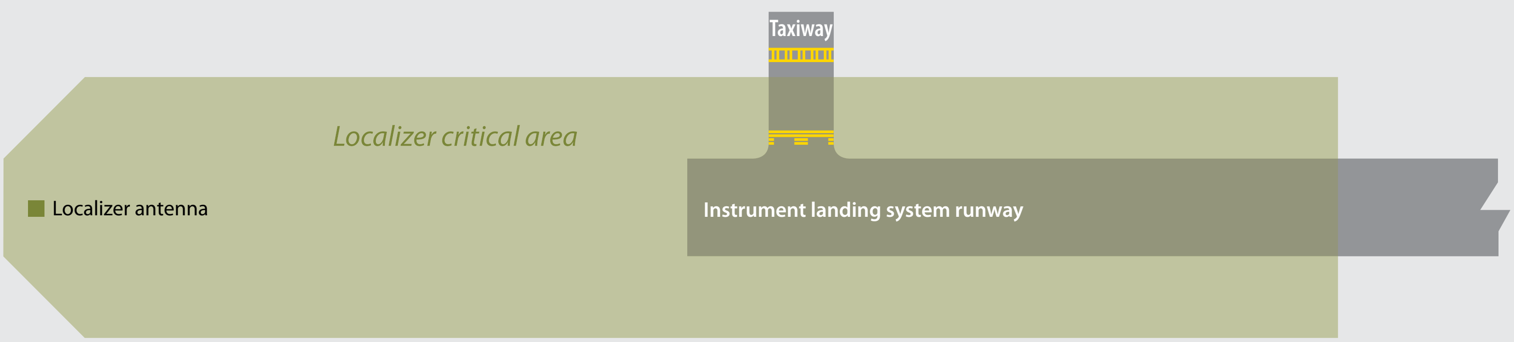
The notice recommended that pilots review the guidance contained in the *Aeronautical Information Manual* (*AIM*) and be "continually aware of the conditions under which [localizer/glideslope] critical area protections are imposed and whether or not the ILS fluctuations are likely caused by movement through the ILS critical area or an actual equipment malfunction."

Partial Protection

"Most ILS installations are subject to signal interference by … surface vehicles, aircraft or both," the *AIM* says. "ILS critical areas are established near each localizer and glideslope antenna."

The localizer antenna is located beyond the departure end of the runway; the glideslope antenna is off the side of the runway, close to the approach end. The dimensions of their designated critical areas vary according to such factors as the size of the aircraft that operate at the airport.[3]

ILS critical areas are "protected" by airport traffic controllers only under the specific conditions spelled out in the *AIM*. Chief among them is that visibility must be less than 2 mi (3,200 m) or the ceiling must be lower than 800 ft. Another key factor is that critical areas are protected only when an arriving aircraft has crossed the ILS outer marker or final approach fix (FAF).



Protection might consist of a ground controller telling a crew taxiing an aircraft to the runway to "hold short of the ILS critical area."[4] The holding position is designated by markings (two yellow lines spanning the taxiway and enclosing pairs of perpendicular yellow lines) and an adjacent sign ("ILS" in white on a red background).

When visibility is less than 2 mi, the ceiling is lower than 800 ft and an aircraft is inside the FAF, critical areas might not be protected against aircraft that have landed and are exiting the runway, or are on a missed approach or departure. Controllers are required to keep critical areas clear of such operations only when runway visual range (RVR) is 2,000 ft (600 m) or less, or the ceiling is less than 200 ft, *and* the arriving aircraft is inside the ILS middle marker.

At uncontrolled airports, there is no protection of ILS critical areas. The *AIM* recommends that pilots be especially alert when conducting a coupled approach to an uncontrolled airport, but it provides no guidance for ground operations.

As noted in the *AIM*, vehicles also can disrupt ILS signals. The pilots of a twin-turboprop business airplane found this to be true while conducting a hand-flown approach to the uncontrolled airport in Barre-Montpelier, Vermont. They reported "spurious and random oscillations" of the localizer CDI, with half-scale deflections occurring about five times.[5] "After landing, we observed a large tractor-style mower cutting grass at the far end of the runway, in the vicinity of the localizer antenna array," the pilot monitoring said. "We surmised that the movement of the mower through this area might have accounted for the erratic behavior of the localizer signal during our approach."

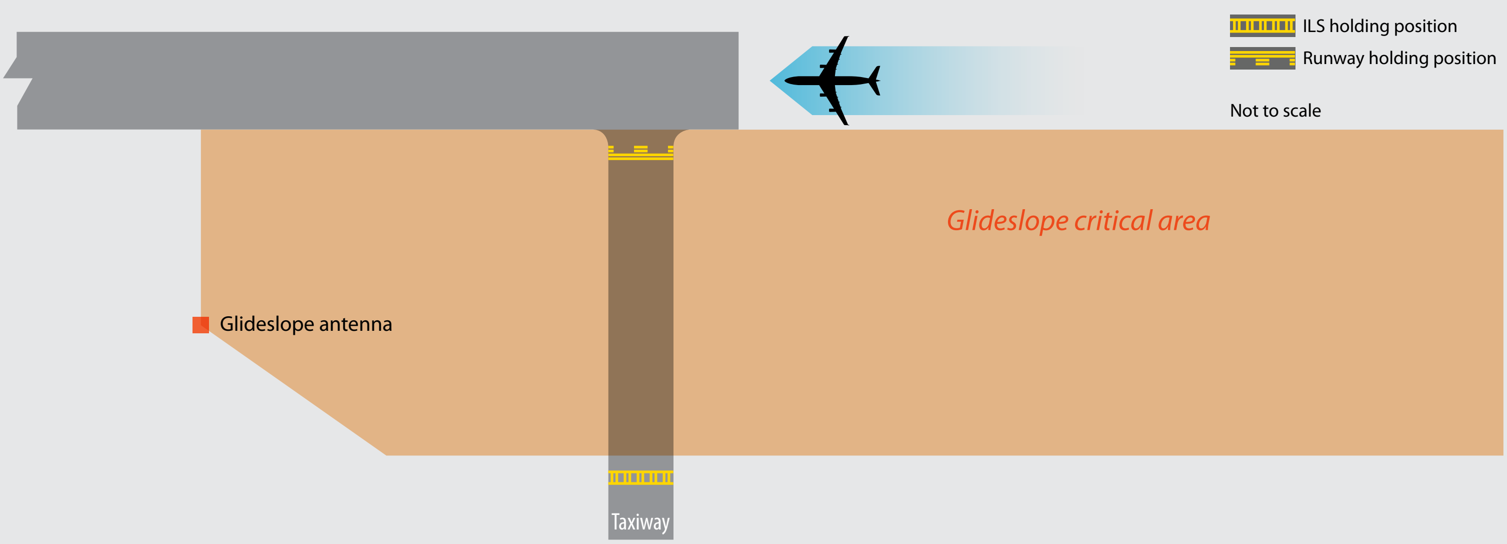
False Courses

The *AIM* also warns of *false courses* generated outside the ILS service area as a normal byproduct of ILS signal generation. Depending on the ILS installation, an aircraft might be 40, 50 or 60 degrees left or right of the localizer course or on a 9-degree glide path while the CDIs show on-course indications with no warning flags.[6]

Erroneous localizer and glideslope signals also may be radiated during maintenance or testing of the ILS ground equipment, which usually is brought to pilots' attention by notices to airmen (NOTAMs) and/or by removing the Morse code identification normally transmitted on the ILS frequency.

Notes

1. U.S. National Aeronautics and Space Administration Aviation Safety Reporting System (ASRS) report no. 871505, January 2010.
2. FAA Information for Operators (InFO) 12007, April 26, 2012.
3. FAA Order 6750.16D, *Siting Criteria for Instrument Landing Systems.*
4. FAA Order 7110.65U, *Air Traffic Control.*
5. ASRS report no. 837437, May 2009.
6. FSF editorial staff. "Erroneous ILS Indications Pose Risk of Controlled Flight Into Terrain." *Flight Safety Digest*, July 2002.



Susan Reed

U.S. National Oceanic and Atmospheric Administration

© Ryan Spencer Morgheim/Airliners.net

The pilot had been awake more than 14 hours when he lost control of this King Air during an attempted go-around at Atqasuk.

BY MARK LACAGNINA

Accident report questions decisions to launch a medevac flight in adverse conditions.

High Risk, Low Need

The pilot had been home about two hours when the telephone rang around midnight on May 16, 2011. It was the chief pilot, asking if he could conduct an emergency medical services (EMS) flight. Although the pilot had been on duty for 10 hours earlier that day, he accepted the assignment, which entailed a short flight from the operator's home base in Barrow, at the northern tip of Alaska, to Atqasuk, an Eskimo village about 50 nm (93 km) southwest, where two medical crewmembers were to assess the condition of a patient. Depending on the results, the crew either would return to Barrow or transport the patient to Anchorage, in southern Alaska, for further diagnosis and treatment.

The lead medical crewmember told the pilot that, based on information that the 77-year-old patient had fallen several times and was experiencing weakness in her left arm, it was likely that she had suffered a stroke. She estimated a 90 percent probability that the patient would have to be flown to Anchorage.

Less than two hours later, the crew was en route to Atqasuk in a Beech King Air B200. "Given the long duty day and the early morning departure time of the flight, it is likely the pilot experienced significant levels of fatigue that substantially degraded his ability to monitor the airplane during a dark night instrument flight in icing conditions," said the U.S. National Transportation Safety Board (NTSB) report on the subsequent accident, in which the airplane picked up a load of ice on approach and crashed out of control during an attempted go-around. The three crewmembers sustained minor injuries.

The NTSB report, issued in April 2012, said that the absence of a formal risk assessment before the flight was launched was a contributing factor in the accident. "Had a thorough risk assessment been performed, the decision to launch a fatigued pilot into icing conditions late at night may have been different, or additional precautions may have been taken to alleviate the risk," the report said.

Moreover, noting that the patient was known to have a "non-critical injury/illness," the safety board questioned the decision by local medical authorities to request that the patient be transported in a public-use aircraft, without considering an alternate mode of transportation. "Pressure to conduct EMS operations safely and quickly in various environmental conditions — for example, in inclement weather and at night — increases the risk of accidents when compared to other types of patient transport methods, including ground ambulances or commercial flights," the report said.

No Duty/Rest Rules

The King Air was among several public-use aircraft operated by the North Slope Borough, a local government entity. The report noted that most EMS flights in the United States are conducted under Federal Aviation Regulations Part 135 standards for commuter and on-demand operations, but, because the King Air was a public-use aircraft, the accident flight was conducted under the general operating and flight rules of Part 91.

The chief pilot told investigators that the pilot was the most suitable choice for the EMS flight because he was the only pilot on duty earlier that day who had not been assigned a flight.

The pilot, 62, held an airline transport pilot certificate and had 9,000 flight hours, including 8,500 hours as pilot-in-command and 6,500 hours in multiengine airplanes, with 500 hours in type. He reported 5,000 hours of night flying experience and 2,000 hours in actual instrument meteorological conditions. He had completed a B200 flight review at a FlightSafety International training center about five months before the accident.

According to the chief pilot, the pilot had just returned from a six-week vacation and mostly had flown the borough's Learjet before that; the pilot had not flown the King Air for nearly four months.

Beech King Air B200

© Chris Sorensen Photography

The King Air line of twin-turboprop business airplanes dates back to the early 1960s, when Beech Aircraft performed a trial installation of United Aircraft of Canada — now Pratt & Whitney of Canada — 500-shp (373-kW) PT6A-6 engines on a modified Queen Air.

After changing from square to round windows and adding a supercharger-driven cabin-pressurization system, Beech introduced the King Air 90 in 1964. Maximum takeoff weight was 9,300 lb (4,218 kg). Among early production changes was a bleed-air system to pressurize the six- to eight-seat cabin.

The King Air 100 debuted in 1969 with a stretched fuselage to accommodate eight to 13 passengers and with the wings, tail and 680-shp (507-kW) PT6A-28 engines from the Model 99 Airliner. That year, Beech also began work on the Super King Air 200, which has the 100's fuselage, longer wings housing auxiliary fuel tanks, 850-shp (634-kW) PT6A-41 engines and a T-tail. Deliveries began in 1974.

The B200 was introduced in 1981 with PT6A-42 engines that, while still rated at 850 shp, improved climb and high-altitude performance. Maximum takeoff and landing weight is 12,500 lb (5,670 kg). Maximum rates of climb are 2,450 fpm with both engines operating and 740 fpm with one engine inoperative. Maximum cruising speed at 25,000 ft is 289 kt, and service ceiling is 35,000 ft. Maximum range is 2,000 nm (3,704 km).

The larger and more powerful 300 and 350 models appeared in the 1980s, and "Super" was dropped from the name in 1996. Hawker Beechcraft currently manufactures the King Air C90GTx, 250 and 350i.

Sources: *Jane's All the World's Aircraft*, *The Encyclopedia of Civil Aircraft* and Hawker Beechcraft

The airplane departed from Barrow at 0148 local time. It was about 35 nm (65 km) from Atqasuk, cruising at 15,000 ft in visual meteorological conditions, when the pilot was cleared by air traffic control (ATC) to fly directly to an initial navigational fix for the global positioning system (GPS) approach to Runway 06 and to descend to and maintain 2,000 ft until established on the approach. ATC also cleared the pilot to switch to the uncontrolled airport's common traffic advisory frequency.

Weather conditions at the airport included 3 mi (4,800 m) visibility in blowing snow and fog, an 800-ft overcast and surface winds from 070 degrees at 15 kt. The temperature was minus 3 degrees C (27 degrees F), and the dew point was minus 4 degrees C (25 degrees F).

The pilot told investigators that he initially leveled at 2,200 ft, to stay "slightly above the cloud tops" until reaching the initial approach fix; after descending to 2,000 ft, the King Air "was mostly in the clouds." Ice began to accumulate on the airplane, but the pilot said that the rate of accumulation "did not seem excessive."

Stall on Go-Around

Data from the operator's satellite tracking system and from the airplane's on-board monitoring system showed that during most of the initial approach, the King Air's indicated airspeed remained at or above 140 kt, the minimum airspeed recommended by the manufacturer for operating in continuous icing conditions. Airspeed decreased below 140 kt about the time that the pilot extended the flaps and the landing gear while inbound to the final approach fix.

The pilot activated the deice boots four times before crossing the final approach fix at the published minimum altitude of 1,700 ft. "The deice boots seemed to shed [the] ice almost completely, and all seemed to be in order," the pilot said. "I intermittently used the autopilot to help maintain control while inflating the deice boots."

Airspeed was about 100 kt when the King Air crossed the final approach fix. The pilot said that he increased power, but the indicated airspeed continued to decrease. The recorded data showed that the airplane's descent rate increased, reaching a maximum of 2,464 fpm.

"The chief pilot for the operator said that the pilot reported to him that … the airplane [had] accumulated a large quantity of airframe ice and he decided to discontinue the approach," the report said.

The pilot applied maximum climb power and retracted the flaps and the landing gear. "We were in full go-around mode at this point," he said. "There was some shuddering as the airplane climbed slowly to approximately 2,000 ft and we started to break out of the clouds." He said that he activated the deicing boots during the climb but was too busy flying the airplane to visually inspect the wings.

Airspeed continued to decrease. "The stall warning started going off continuously as the airplane began to clear the clouds," the pilot said. "The nose had to be lowered to stop the stall, and the airplane re-entered the clouds. At this point, directional control was nonexistent, and full attention was directed at keeping the airplane from inverting. After breaking out at about 800 ft, it appeared at times that I might be able to regain control of the airplane. However, that was not to be the case."

The last data recorded showed the airplane descending at 1,651 fpm with a pitch attitude of 20 degrees nose-up and an indicated airspeed of 68 kt. The wings were level when it struck flat, snow-covered tundra 7 nm (13 km) southwest of the airport at 0218. "The tail section aft of the passenger cabin was severed from the fuselage," said the report, which classified the airplane damage as substantial.

In a written statement, the pilot said he believed that tailplane icing had triggered the stall. "The injuries were very minor, considering the severity of the impact," he said, noting that he had a slight cut on his forehead and "low-grade lower back pain," one medical crewmember bit the tip of her tongue, and the other had a headache.

One of the crewmembers was able to transmit a text message via mobile phone to North Slope Borough, and local search-and-rescue personnel reached the accident site less than two hours later. "The morning of the accident, the patient subsequently took a commercial flight [to Anchorage] to receive medical treatment," the report said.

In its determination of probable cause, NTSB said, "The pilot did not maintain sufficient airspeed during an instrument approach in icing conditions, which resulted in an aerodynamic stall and loss of control. Contributing to the accident were the pilot's fatigue, the operator's decision to initiate the flight without conducting a formal risk assessment that included time of day, weather and crew rest, and the lack of guidelines for the medical community to determine the appropriate mode of transportation for patients."

'Unacceptable Response'

The report noted that NTSB over the years has issued numerous recommendations intended to improve the safety of EMS flight operations. Several recommendations stemmed from the board's special investigation of 55 accidents in 2002 through 2005 that resulted in 54 fatalities and 18 serious injuries.

Among the recommendations was A-06-013, issued in 2006, urging the U.S. Federal Aviation Administration (FAA) to require EMS operators to develop and implement flight risk evaluation programs. The FAA initially replied that it would incorporate the requirement as part of the operations specifications for EMS operators but later said that it would pursue formal rulemaking instead.

In the continued absence of a final rule, the recommendation at press time was still classified by NTSB as "open" and as having received an "unacceptable response" from the FAA.

Another recommendation, A-09-103, called on the Federal Interagency Committee on Emergency Medical Services (FICEMS), created in 2005 by the U.S. Congress, to develop national guidelines for selecting the appropriate mode of EMS transportation. "The most recent correspondence from FICEMS indicated that the guidelines are close to being finalized and distributed to members," the report said. "Such guidance will help hospitals and physicians assess the appropriate mode of transport for patients."

This article is based on NTSB accident report no. ANC11TA031 and related docket information.

The pilot said he believed that tailplane icing had triggered the stall.

The GREATEST STORMS on Earth

BY ED BROTAK

Even in the mildest of tropical storms, dangerous flight conditions prevail.

U.S. National Aeronautics and Space Administration

When Hurricane Irene came ashore on the Outer Banks of North Carolina, U.S., on Aug. 27, 2011, the small airport servicing Cape Hatteras reported wind gusts to 74 kt and visibility at times of less than 1 mi (1.6 km) in very heavy rain. As Irene moved up the East Coast, it weakened. By the time it came ashore again the next day just south of New York City, Irene had been downgraded to a tropical storm. Throughout the day, the winds at John F. Kennedy International Airport (JFK) gusted to 50 kt, and, at times, visibility fell below 2 mi (3.2 km) in heavy rain.

Even though Irene had lost strength, its effects on aviation operations were significant. The New York airports and others in the storm's path were closed for an extended period during the busy Labor Day weekend. Airlines canceled 12,000 flights. Aircraft were moved to safer locations. It took days for airport operations to get back to normal. United Airlines and Continental Airlines alone reported total losses of $40 million.

Hurricanes present two obvious problems to the aviation industry. First, flying conditions even in minimal storms are dangerous, with the combination of strong winds, heavy rain and low ceilings. Takeoffs and landings are risky, and airports usually close with the approach of a storm. Second, there is the potential for physical damage, both to aircraft on the ground and to airport structures.

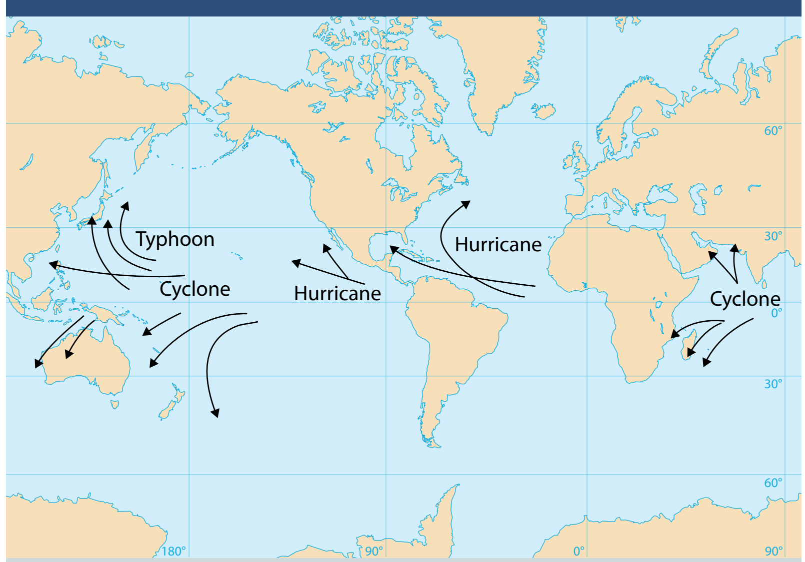
Based on statistics alone, it is unusual for a major hub to be hit by a severe hurricane. This is not the case with smaller, regional airports, which are far more numerous. In August 2004, Hurricane Charley came ashore in southwestern Florida with winds of more than 113 kt. Although inland, the town of Lake Wales took a direct hit from the storm, and every building at the local airport was either destroyed or badly damaged. It has taken years to rebuild.

Tropical Cyclones

Hurricanes are one type of tropical cyclone — a low pressure area that develops only over water with a temperature of at least 80 degrees F (26.7 degrees C). Tropical cyclones, called by various names, are common around the world, primarily on the west side of ocean basins (Figure 1). Many tropical cyclones develop from tropical waves, low-level disturbances that are embedded in the easterly trade winds. A few tropical cyclones develop from cold fronts or other midlatitude systems that move over warm ocean waters.

Officially, the Atlantic hurricane season begins June 1 and ends Nov. 30; however, there have been storms outside of the "official season." The peak of the hurricane season

Tropical Cyclones



Source: Ed Brotak

Figure 1

Radar Chart From Hurricane Irene

Note: Radar shows Hurricane Irene moving across coastal North Carolina. Variations in color indicate corresponding variations in storm intensity. Orange and yellow indicate the strongest winds and heaviest rainfall, compared with the surrounding areas of green and blue.

Source: U.S. National Oceanic and Atmospheric Administration

Figure 2

occurs in the latter part of August and the first half of September, when ocean temperatures are warmest.

When a tropical cyclone moves over land or colder water, it weakens and dissipates. This is why hurricanes don't occur off the West Coast of the United States and Canada — the water is too cold.

The average diameter of a hurricane — the entire circulation of the storm, not just the hurricane-force winds — is about 250 mi (402 km). The hurricane-force winds usually are found close to the center of the storm.

Hurricanes vary in size, however. Irene was a large storm, nearly 400 mi (644 km) across. Hurricanes typically are asymmetric, with a large wind field to the north and east of the center, in the Northern Hemisphere. For aviation interests, dangerous conditions can persist for many hours, and poor flying conditions can spread well ahead to the north and east of the storm center. Numerous hubs can be affected at the same time.

Unlike typical winter storms, which have large areas of consistent or "stratiform" precipitation aligned along fronts, tropical cyclones have no fronts and the precipitation occurs in bands of convection. Bands of showers and thunderstorms, similar to midlatitude squall lines, move within the cyclonic circulation. These somewhat curved "spiral bands" contain the strongest winds and heaviest rainfall. Farthest from the center are the "outer rain bands." As each band moves through, it is accompanied by rain and wind. Then, as it passes, the rain and winds slack off. Closer to the center, the frequency and strength of the bands increase (Figure 2).

Around the center of the storm is the "eye wall," a partial, or sometimes complete, ring of showers and thunderstorms surrounding the eye. This is where the strongest winds and heaviest rainfall are concentrated.

The eye is the relatively calm center of the storm. Sinking air inhibits cloud production. Strong storms can have clear, cloudless eyes. During a storm's passage, the eye provides a lull in the extreme weather.

To accurately forecast short-term weather conditions in a tropical cyclone, check the weather radar.

Tropical convection differs from the typical midlatitude showers and thunderstorms. It develops in a deep tropical air mass that is warm and moist throughout its vertical profile. Lapse rates aren't that steep, and instability isn't that great. The tropopause, which acts as a lid on convection, is much higher in the tropics. Convective cells can reach great heights, more than 60,000 ft, but with the lack of temperature contrast, the updrafts aren't strong. Overall, tropical convection is less turbulent than midlatitude convection.

Making Landfall

All this changes if and when the convection moves over land. Increased friction produces more physical turbulence. Lapse rates and instability tend to increase. The convection becomes stronger, sometimes strong enough to generate tornadoes, primarily in the right forward quadrant of the storm.

Strong winds are what most people expect when they think of tropical cyclones, but in fact, a wide range of wind speeds can accompany a tropical system. If winds in a tropical cyclone are between 26 and 33 kt, it is called a *tropical depression*. Winds of 34 to 63 kt are associated with a *tropical storm*. Winds greater than 64 kt qualify a storm as a *hurricane*. In an average year in the Atlantic Basin, there are 11 systems of at least tropical storm strength, including six full-fledged hurricanes. Even with hurricanes, there is considerable variability. To make it easier for the public to quickly understand the strength of a storm, hurricanes are ranked from 1 to 5 using the Saffir-Simpson Scale (Table 1).

Major hurricanes with winds of 96 kt or more — those in Category 3 or higher — occur, on average, twice a year. Category 5 storms, with winds of 135 kt or more, are the strongest and do not occur every year.

The strong winds associated with tropical cyclones produce major problems for pilots in controlling aircraft, especially during takeoffs and landings. Even the winds produced by a tropical depression create difficulties. Making matters worse is the gusty nature of the winds. The convective downdrafts in showers and thunderstorms bring the stronger winds aloft down with them.

U.S. National Aeronautics and Space Administration

Vertical Profile

A few things should be noted about the vertical wind profile of a tropical cyclone. As in all types of winds, friction near the surface slows the wind speed considerably. At 1,600 ft above the ground, wind speeds can be 20 percent higher than they are at the surface. This equates to a one-category increase in storm strength. But higher up, winds decrease. This is not the case with extratropical cyclones, the typical winter storms, which are tied in with the upper-level jet stream and become stronger with height (*ASW*, 2/12, p. 47). Tropical cyclones are more low-level systems and weaken above 10,000 ft.

Rainfall Rates

Heavy rain is another characteristic of tropical cyclones that affects aviation. Rainfall rates of several inches per hour are common and significantly reduce visibility. In addition, serious ponding occurs on runways. Fresh water flooding is a concern in areas prone to such occurrences.

Saffir-Simpson Hurricane Scale

Category	Winds	Surge	Central Pressure
1–Minimal	64–82 kt	4–5 ft (1.0–1.5 m)	greater than 980 mb or 28.94 inHg
2–Moderate	83–95 kt	6–8 ft (1.8–2.4 m)	965–979 mb or 28.50–28.91 inHg
3–Extensive	96–113 kt	9–12 ft (2.7–3.7 m)	945–964 mb or 27.91–28.47 inHg
4–Extreme	114–135 kt	13–18 ft (4.0–5.5 m)	920–944 mb or 27.17–27.88 inHg
5–Catastrophic	greater than 135 kt	greater than 18 ft	less than 920 mb or 27.17 inHg

Source: U.S. National Oceanic and Atmospheric Administration

Table 1

Airports along the immediate coast can be endangered by storm surges. These wind-driven high tides can range from a few feet (1 m) up to 30 ft (9 m). On top of the surge of ocean water are waves that can crest more than 20 ft (6 m) higher. The pounding waves are capable of destroying buildings and often do more physical destruction than any other element of a storm.

In areas with large tidal variations, this can mean the difference between little or no damage and a catastrophe.

A storm surge is a direct result of strong winds that physically push the water onshore. The highest surge occurs where the center of the storm crosses the coast and just to the right of that point. There is some heightening of sea level and storm surge due to the lower pressure in the eye of the storm. But most of this maximum surge where the center of the storm crosses the coast is due to the proximity of the strongest winds at the eye wall. The actual height of the storm surge is influenced by a variety of factors: the strength of the storm, the size of the storm, and, most importantly, the normal high and low tide cycle. In areas with large tidal variations, this can mean the difference between little or no damage and a catastrophe.

Forecasting

Forecasts for Atlantic tropical cyclones come from the U.S. National Hurricane Center (NHC) in Miami.[1] Meteorologists at the NHC forecast a storm's movement and intensity by using computer models and applying their own knowledge and experience to modify the results.

Even before a full-fledged tropical cyclone has developed, the NHC tracks disturbances in the tropics using satellite imagery and issues regular updates on the likelihood of intensification. Once a tropical depression forms, the NHC sends out regular advisories every six hours describing the current status of the storm and providing a five-day forecast of its movement and intensity. When a system reaches tropical storm strength, it is given a name — a practice adopted to aid in storm-related communication. If a storm is particularly destructive, its name is retired.

Watches and Warnings

If a storm is forecast to threaten land, the NHC sends out a tropical storm watch or hurricane watch and, if need be, a subsequent upgrade to a tropical storm warning or hurricane warning. A watch means that tropical storm/hurricane force winds *may* affect a given area within 48 hours. A warning means that tropical storm/hurricane force winds *are expected* somewhere within the given area in 36 hours or less.

Forecasting the movement of a tropical cyclone involves forecasting the "steering currents" — the prevailing winds that surround a storm and direct its movement. As powerful as these storms may get, they are still just small eddies flowing within the "rivers" in the larger atmosphere. Today's advanced computer models are good at predicting these steering currents and the tropical cyclones embedded in them. For example, they correctly forecast Irene's march up the East Coast.

Forecasting the strength of tropical cyclones is more challenging. There are many variables. Rapid intensification is the most dangerous scenario. Fortunately, this seldom occurs near land. However, Florida Hurricanes Andrew in 1992 and Charley in 2004 show that this type of intensification can occur. Major hurricanes often go through cycles of intensification and weakening tied to internal structural changes that are not well understood.

Ed Brotak, Ph.D., retired in 2007 after 25 years as a professor and program director in the Department of Atmospheric Sciences at the University of North Carolina, Asheville.

Note

1. Online at <www.nhc.noaa.gov>. In other parts of the world, various government agencies and private companies provide similar forecasts.

Further Reading From FSF Publications

Brotak, Ed. "Forecasting Thunderstorms." *AeroSafety World* Volume 7 (May 2012): 14–18.

Brotak, Ed. "Winter Hurricanes." *AeroSafety World* Volume 7 (February 2012): 47–50.

Brotak, Ed. "Dusty and Gusty." *AeroSafety World* Volume 6 (September 2011): 42–46.

Brotak, Ed. "Convectional Wisdom." *AeroSafety World* Volume 6 (June 2011): 12–16.

Brotak, Ed. "Thundersnow." *AeroSafety World* Volume 5 (October 2010): 18–22.

Pilot survey explores safety-related communication with flight attendants.

BY JAMIE CROSS

Sources of Friction

On March 10, 1989, an Air Ontario Fokker F-28 with four crewmembers and 65 passengers on board crashed shortly after takeoff from Dryden (Ontario, Canada) Municipal Airport during a heavy snow squall.[1] The captain and first officer, one of two flight attendants and 21 passengers were killed. The accident investigation commission focused partly on the pre-takeoff reluctance of the two cabin crewmembers to inform the flight crew about passenger concerns that the wings needed to be deiced.

Results from the author's 2011 survey of 263 flight attendants (*ASW*, 11/11, p. 44) and 2012 survey of 264 airline pilots suggest that issues revealed by such reluctance continue to impede safety-related communication between these work groups.

As passengers boarded Air Ontario Flight 1363 at Dryden for its next leg to Winnipeg, snow was falling, increasing in intensity and accumulating on the airplane's wings. By the time the flight crew had taxied to the runway threshold, a number of passengers, the flight attendants and two company captains traveling as passengers had noticed the buildup of snow on the wings, later estimated as at least 0.5 in (1.3 cm) of wet layered snow.

During its hearing, the commission repeatedly asked why two flight attendants, two captain-passengers and the other cabin occupants who had perceived danger had not brought the wing contamination to the captain's attention. A surviving passenger, a special constable of the Royal Canadian Mounted Police, testified that he had asked the flight attendants why the airplane was not deiced, and he had doubted the incorrect explanation.

The surviving flight attendant told the commission — and the commission found — that this airline's cabin crews essentially had been trained to trust flight crews' judgment and not to question it. From knowledge of a similar 1987 situation and her experience, she said she expected certain captains not to treat seriously operational concerns expressed by flight attendants. Moreover, company flight attendant training had no technical content about the effects of snow and ice on lift.

The flight attendant said, in part, "The pilots and the flight attendants have respect among one another as friends but when it comes to working as a crew, we don't work as a crew. We work as two crews. You have a front-end crew and a back-end crew, and we are looked upon as serving coffee and lunch and things like that."

Pilot Survey

The author's 2011 *ASW* article about the survey of flight attendants explored the history of how several factors have led to breakdowns of cabin-to-cockpit communication. Some responses about communication noted disrespect from pilots, being treated with scorn, surly rejection of their input, a sense of intimidation and an attitude that the cabin crew's safety role was insignificant.

The survey of pilots also looked at these factors. The findings indicate that responding pilots were aware of sometimes instilling feelings of alienation among cabin crew. While pilots may become very busy dealing with a situation, consequences may be serious if they neglect to keep the cabin crew informed. Unwillingness to believe what they are told is going on in the cabin may be due partly to few or no cabin crew inputs during flight simulator sessions.

Both groups indicated that, in practice, "two crews" still exist and work independently, with each group lacking a full concept of the information the other group needs. Some said the groups are working better together than ever before, but it is a forced harmony, dictated more by corporate pressure than by mutual respect and understanding. They suggested that joint rostering, joint training and consistent preflight introductions and briefings would strengthen their effectiveness as one aircraft crew.

Survey Methodology

The anonymous survey of global airline pilots, contacted through the Professional Pilots Rumour Network forum <www.pprune.org> and other methods, consisted of a 28-item, Web-based questionnaire posted for two months. A number of questions duplicated those in the survey of flight attendants, to allow the pilots' perceptions and interpretations of a survey scenario to be directly compared to those of flight attendants.

In the pilot sample, 98 percent of the responses were from males, and 57 percent of respondents were in the 26-45 age range. The majority (76 percent) self-identified as currently employed as pilots with airline experience of between two to five years in which at least one flight attendant was aboard, and 53 percent were captains or training captains.

The research found that 19 percent of 196 total responses to the question gave the opinion that cabin crew "sometimes" or "occasionally" take their work seriously, especially in matters of safety (Table 1). It also found that 48 percent of 196 respondents were "not at all" confident or were "occasionally" confident in flight attendants' ability to accurately describe or name parts of the airplane such as the flaps, winglets or horizontal stabilizer. Eighty-five percent of 196 respondents indicated that a flight attendant at least "occasionally" had reported to them safety information that the pilot considered trivial, unimportant or inconsequential.

Some pilots presumed that safety information originating with the cabin crew would be of low quality, and therefore, they would be less likely to act upon information from the cabin, and perhaps would respond negatively.

Through added comments, some pilots indicated that they generally were willing to entertain any communication from a flight attendant. Data also showed that 44 percent noted there was at least "sometimes" reluctance — fearing they would be chastised, ignored or dismissed — among cabin crew to pass information forward to the flight deck

How seriously do you believe cabin crew take their work, especially in matters relating to safety?

Answer Options	Response Percent	Response Count
Never seriously	0%	0
Occasionally seriously	9%	17
Sometimes seriously	10%	20
Usually seriously	54%	105
Frequently/always seriously	28%	54

Note: A total of 264 airline pilots completed the 28-item survey; 196 answered this question. Percentages are rounded.

Source: Jamie Cross

Table 1

Wayne Rosenkrans

(Table 2). Thirty-seven percent of 196 responses indicated that pilots ignored interphone calls from the cabin at least "occasionally."

History Matters

On Aug. 31, 1988, Delta Air Lines Flight 1141, a Boeing 727, crashed shortly after takeoff from Runway 18L at Dallas-Fort Worth (Texas, U.S.) International Airport. Among the 108 people on board, there were 14 fatalities and 26 were seriously injured.[2] The probable cause was the inadequate cockpit discipline that resulted in the flight crew's attempt to take off without the wing flaps and slats properly configured, and the failure of the takeoff configuration warning system. One finding was that the flight crew's vigilance had been reduced by extensive, non-duty-related conversations and the lengthy presence of a flight attendant in the cockpit during the 25-minute taxi.

Thirty-seven percent of 196 responses indicated that pilots ignored interphone calls from the cabin at least 'occasionally.'

On Feb. 3, 1988 — about five minutes before landing at Nashville (Tennessee, U.S.) International Airport — the cabin crew of American Airlines Flight 132, a McDonnell Douglas DC-9-83, observed and quickly took the initiative to report light smoke and irritating fumes. These later were determined to have emanated from undeclared, improperly packaged and mislabeled hazardous materials causing a chemical reaction in the cargo compartment.[3]

One of the four flight attendants continued to report deteriorating cabin conditions to the first officer, but investigators found these reports were not taken seriously by either pilot. On final approach, part of the cabin floor had started to soften and sink — and passengers in one row had to be moved — because of the heat generated.

The captain only began to verbalize that more than fumes might be involved when a deadheading first officer corroborated the flight attendant's observations. Nevertheless, the captain remained skeptical about the smoke, did not declare an in-flight emergency and after landing, did not order an evacuation until the deadheading first officer described "a big problem" of smoke and heat coming through the floor, said the investigation report.[4]

The flight crew landed safely, and there were no serious injuries during an evacuation via slides, but the report said no evacuation instructions had been given to the passengers over the public address system, the evacuation should have been conducted on the runway, and aircraft rescue and fire fighting (ARFF) personnel should have been requested to meet the landing airplane. The report said that "while it is unlikely that the captain could have taken any action to land the airplane more quickly, the cockpit crew failed to use the cabin crew effectively to obtain an accurate understanding of the developing problem."

Less serious events reported by flight attendants also have described cabin-cockpit challenges. An Airbus A320 on arrival at an airport was met by ARFF vehicles. It was only after deplaning that a flight attendant found out from ARFF personnel that they had responded to an engine fire as the aircraft taxied from the runway.[5] A Boeing 777 flight crew shut down an engine, dumped fuel and returned to the departure airport, reportedly without communicating with the cabin crew, including a flight attendant who had noticed the fuel dumping.[6]

During their training, flight attendants learn that pilots prioritize their actions in response to an emergency or abnormality, and may consider communication with them a low priority. However, a concern expressed by some survey respondents was that routine lack of communication only alienates them as a work group, and

Do you believe cabin crew are reluctant to contact the flight deck with safety information in case they may be chastised, ignored or dismissed?

Answer Options	Response Percent	Response Count
Often reluctant	2%	4
Occasionally reluctant	21%	41
Sometimes reluctant	21%	41
Rarely reluctant	33%	64
Never reluctant	23%	46

Note: A total of 264 airline pilots completed the 28-item survey; 196 answered this question. Percentages are rounded.

Source: Jamie Cross

Table 2

may even strengthen an inclination to act independently when acting collaboratively would be best.

Exploring Implications

Together, these surveys suggest some ways that undesirable patterns may develop gradually in cabin-cockpit communication. If an airline's flight attendants lack adequate training about what safety information the pilots need, how to present this information and when the timing is suitable to present the information, their tendency — commendably — may be to pass forward to the flight deck everything that, to them, seems to have potential value.

An example cited by the pilots was flight attendants not being trained, or being trained inadequately, for reseating passengers within the cabin; 7 percent indicated that they were not consulted, or only sometimes were consulted, when the cabin crew shifted a significant number of passengers enough to possibly affect the aircraft center of gravity.

If these pilots perceive the typical flow of information from the cabin crew as irrelevant or rarely relevant to safety, or presented in a unprofessional manner, or presented at an inappropriate time, their response or lack of response may come across as rude and, on occasion, offensive to a flight attendant. A cycle of conflict and hostility — an us-versus-them culture — could evolve.

The Dallas-Fort Worth accident was the basis for one survey question about adherence to the sterile cockpit rule. In response, 70 percent of the pilots reported that they had been contacted for non-emergency events during taxi, 5 percent had been contacted for non-emergency events during takeoff, and 57 percent had been contacted for non-emergency events during the climb below 10,000 ft, all phases where the sterile cockpit rule applies. In addition, 26 percent marked that their cabin crews "never" adhere to this rule.

These rule infringements may imply a need for renewed emphasis on compliance, with periodic reminders of the lessons learned from relevant accidents and voluntary safety reporting. They also may go some way in explaining the sometimes negative responses of pilots to cabin crewmembers; that is, the context of being interrupted unnecessarily too many times in safety-critical phases of flight when workload is high.

The survey also asked what pilots would do during an in-flight scenario in which they had failed to identify which engine was on fire, and a flight attendant tried to present them accurate information. This scenario, also posed to flight attendants, was adapted from the fatal 1989 accident in which a British Midland Airways Boeing 737 crashed short of the runway after shutdown of the wrong engine.[7]

When asked if they received information from the cabin crew that there was a discrepancy between the engine they had shut down and engine fire observed by the cabin crew, 16 percent of the pilots said they would act immediately based solely on that information. They either would restart the engine or restart the procedure to identify the affected engine. However, the majority, 84 percent, said that they would ask for additional confirmation from the reporter or in-charge cabin person before they would reconsider their initial decision.

Although the majority's response takes extra time, that viewpoint can be understood partly in terms of how airline pilots respond in simulators based on procedures, which call for implicitly trusting instrumentation and checklists. Rarely does such training include a call from a flight attendant saying that, maybe, they should reconsider their decision.

Jamie Cross is a master's degree graduate in air transport management from Cranfield University, U.K., currently working as an aviation analyst, researcher and instructor in an airline transport pilot license ground school.

Notes

1. Moshansky, V.P. *Final Report – Commission of Inquiry Into the Air Ontario Crash at Dryden, Ontario.* The Commission (Ottawa) Canada, 1992. The report noted that "Air Ontario F-28 pilots had access to numerous cautions, warnings and instructions not to take off unless all of the aircraft lifting surfaces were completely cleared of ice and snow." An analysis in its human factors appendix noted that "it seems inconceivable that the crew would have been unaware of snow on the wings."
2. U.S. National Transportation Safety Board (NTSB). *Delta Air Lines, Boeing 727–232, N473DA, Dallas–Fort Worth International Airport, Texas, August 31, 1988.* NTSB/AAR–89/04, 1989.
3. NTSB. *In-Flight Fire, McDonnell Douglas DC-9-83, N569AA, Nashville Metropolitan Airport, Nashville, Tennessee, February 3, 1988.* NTSB/HZM-88/02, 1988.
4. Investigators found varying degrees of thermal damage, such as a melted and separated aluminum strap supporting aft bulkhead liners, only in the aft one-third of the mid-cargo compartment and the area immediately above the compartment ceiling panels, up to and including the cabin flooring.
5. U.S. National Aeronautics and Space Administration (NASA) Aviation Safety Reporting System (ASRS) report no. 714718, July 2006.
6. NASA ASRS report no. 577723, February 2003.
7. U.K. Air Accidents Investigation Branch. *Report on the Accident to Boeing 737-400 G-OBME Near Kegworth, Leicestershire on 8 January 1989.* Aircraft Accident Report 4/90, 1990.

Driven to Distraction

BY WAYNE ROSENKRANS

Deadly inattentive behaviors with portable electronic devices outpace scientists' grasp of vehicle operator risks.

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A U.S. National Transportation Safety Board (NTSB) forum on distracted driving of motor vehicles, citing parallel issues in the aviation sector, has noted significant gaps in the scientific understanding of cognitive distractions in general. While acknowledging that differences in safety training and performance vary between, for example, professional pilots and average motor vehicle drivers, human factors research offers only a few insights into the nature of risks when either group uses portable electronic devices (PEDs) during vehicle operation.

The purpose of the March 27 forum in Washington, D.C., was to examine countermeasures that can mitigate distracted driving behaviors. Overall, the presenters advised caution whenever PEDs are used while a vehicle is being operated. The NTSB in December 2011 called for a federal ban on all drivers' non-emergency use of PEDs, other than those designed to support the driving task.

More than 3,000 people were killed in the United States during 2010 in distraction-related motor vehicle crashes, the NTSB and presenters said, citing National Highway Transportation Safety Administration (NHTSA) data, and presenters agreed that about 3.5 percent of these involved driver behavior with PEDs such as text messaging, email messaging, talking on handheld and hands-free mobile phones, using smartphone applications and accessing content on the Internet.

Studies of accident data in which the driver's mobile phone use was verified show four times the risk of crashing when a driver is using the phone, said Anne McCartt of the Insurance Institute for Highway Safety. "New [risk] awareness technologies in vehicles may help prevent crashes that occur due to distraction, fatigue and other kinds of inattentions," she said. "So we actually may be able to solve a lot of the problem without fully understanding it."

NTSB Member Mark Rosekind noted that, unlike safety specialists from non-aviation sectors, motor vehicle drivers have not learned from aviation events that, for example, pilots' "head down" time while interfacing with aircraft automation has to be mitigated by training, procedures and system design because of the serious risk of accidents while multitasking. "It shouldn't surprise us that [as] we're putting all this technology into the car, whether it's built-in or nomadic, basically we've just created the same situation and … that's created a [safety] problem," he said.

"At the NTSB, we've seen distracted operations on our nation's railways, airways, waterways and, most commonly, on our roadways," Chairman Deborah A.P. Hersman told the forum. "In the past, the norm was an attentive driver, and we recognized that there were occasional distractions. The challenge now is that we have got distractions competing full-time for a driver's attention, and there's just no limit as to what can be brought into the vehicle or what can be put into a vehicle."

Donald Fisher, University of Massachusetts, said that all remedies must combine engineering, enforcement and education. The research community agrees that operator glances away from a vehicle's path ahead should last no more than two seconds, but it does not know the minimum time that attention has to be devoted to the path to successfully anticipate a hazard, he said.

In recent years, society's assumption that the human brain can multitask or multiplex cognitive activities has been upended scientifically, but recasting multitasking as a myth has not been popular. Fisher told the NTSB that methods such as magnetic resonance imaging of the brain have yet to prove "what we're actually processing simultaneously," but the current consensus about human performance is "there's no doubt that if we're trying to do two things at once, we're compromised."

John Lee, University of Wisconsin, said that he recently found himself focusing attention five seconds or longer — at highway speeds — on tasks such as selecting songs on his vehicle's entertainment system. "I never talk on my cell phone, hands-free or handheld, in the car and yet I was inadvertently distracted — tempted to do something much more distracting," he said. "I was seduced in the moment by technology. … The danger of distraction comes from the huge proliferation of new types of distractions.

"All of the data that we've been talking about were collected during [2003–2004]. Facebook was introduced in 2004, Twitter in 2006, the [Apple] iPhone in 2007 and the apps for the iPhone in 2008. … The [PED technology] environment is changing almost more quickly than we can analyze the data, let alone collect it.

"Texting brings together a perfect storm of dangerous situations … visual off-the-road glances where operators are not processing the road because they are not looking at it … cognitive engagement in conversation … the social compunction to continue that conversation … [and, absent safety consequences], the failure in the course of driving to get feedback [and recognize] that they've just done something very dangerous."

Social aspects of PEDs remain a huge research gap. "We know that people respond [by PED] very quickly or feel compelled to answer very quickly, and in the context of driving, they're still willing to peek at that phone or [text] because a [15-second] delay in response sometimes can have a social meaning as well," said Daniel McGehee, University of Iowa Center for Policy.

Under proposed NHTSA guidelines, functions of in-vehicle electronic devices may need to be locked out by software before they are released (see "Proposed Lockouts"). "Especially as it relates to human factors for automated or semi-automated driver support/control systems, we are actively engaging our counterparts on the aviation side, the defense side and others," said John Maddox, NHTSA. "We don't need to reinvent the wheel. … [However,] we don't have PED manufacturers [or smartphone] apps developers [working with us] on the same page. … They need to be engaged."

Proposed Lockouts

Software *lockouts* — which automatically prohibit a function or task of installed electronics from being operated unless the vehicle is parked or not moving — comprise the following under NHTSA's proposed guidelines:

- Video images;
- Static images not related to driving;
- Manual text entry;
- Displaying more than 30 characters of text;
- Displaying automatically scrolling text;
- Tasks that require more than two seconds of operator attention at a time; and,
- Tasks that overall require more than 12 seconds to complete.

Off the Mark

BY LINDA WERFELMAN

A common method of identifying pilots at risk of cardiovascular problems missed about half those who soon experienced trouble.

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A widely used tool for predicting cardiovascular problems failed to identify more than half of the 15 pilots who experienced cardiovascular events within five years of being evaluated, according to a study by a team of New Zealand researchers.[1]

The team's report on the study of 16 years of data, published in the May issue of *Aviation, Space, and Environmental Medicine*, said that during that time frame, they identified 15 cases involving cardiovascular events in pilots working for an operator identified only as an Oceania-based airline.

Of the 15, six were detected during a routine cardiovascular screening involving use of a risk calculator that considered the pilot's age and sex, cholesterol levels, blood pressure and whether he or she was diabetic or smoked tobacco. The remaining nine cases were classified as sudden clinical presentations that had not been foreseen.

Of the 15 cases, only one occurred during flight, and it did not incapacitate the pilot, the report said.

"While the number of incapacitations that may occur is low, the potential consequences are so significant that this remains a high risk area," the report said.

The report noted that civil aviation authorities consider cardiovascular disease a serious medical condition not only because it presents the risk of a pilot's sudden incapacitation but also because of its association with long-term disability and loss of a pilot's license. Other researchers have found that nearly half of all pilots who are found to be "long-term unfit" for flight duty have cardiovascular disease.

The study focused on the New Zealand Civil Aviation Authority's (CAA's) method of evaluating the cardiovascular risk of anyone over age 35 who applies for medical certification. The CAA's five-year risk evaluation is conducted using guidelines based on the Framingham Heart Study risk calculator,[2] adjusted by the New Zealand Guidelines Group (NZGG), an independent organization that aids in the development of health care guidelines.

"The existing NZGG methods apply Framingham's risk prediction tools, which are based on data collected more than 30 years ago," the report said, noting that questions have developed "regarding the accuracy of the NZGG risk chart in the current era."

An earlier study found that the Framingham approach was "fairly valid" for the general population, the report said. Nevertheless, it added, "very little evidence has been found on the accuracy of this method in occupational groups, especially in the airline pilot population."

In the authors' study, the pilots who experienced cardiovascular events were considered relatively young — between the ages of 43 and 63 — and half were diagnosed with premature ischemic heart disease (defined as occurring before age 55 in men and before age 65 in women). The cardiovascular events reported were unstable angina, revascularization, myocardial infarction and ischemic stroke (see "Cardiovascular Conditions").

The study indicated that the current aeromedical screening process "is not effective at identifying clinically significant disease."

Other data on in-flight cardiovascular incapacitation are limited, the report said, and those limitations hindered the researchers' ability to make safety recommendations on the matter.

Correct Emphasis

In an earlier report on a study of a similar issue, two British researchers said that their analysis of all incapacitations occurring among U.K. commercial pilots in 2004 concluded that the aeromedical community is correct in its continuing emphasis on minimizing cardiovascular risk and monitoring pilots' mental health.[3]

The study, published in the January 2012 issue of *Aviation, Space, and Environmental Medicine*, identified 16,145 licensed professional pilots with Class 1 medical certificates in the United Kingdom in 2004. Of that number, 36 experienced events that year — including six events that occurred in flight or in a simulator

Cardiovascular Conditions

The following are among the cardiovascular conditions associated with pilot incapacitation, impairment and unfitness:[1]

- Angina is chest pain associated with poor flow of blood through the heart's blood vessels. Stable angina is associated with stress or activity; unstable angina, which can be more severe, occurs with or without activity or stress.
- Revascularization is a medical procedure in which new channels are created through the heart in the hope that, as they heal, they cause the formation of new blood vessels. Such procedures include coronary bypass surgery and coronary angioplasty. For purposes of the study, the procedure was classified as a cardiovascular event in cases in which a pilot's condition was detected during medical screening.
- A myocardial infarction, more commonly called a heart attack, occurs when a blood clot interrupts blood flow through a coronary artery leading to the heart.
- Stroke is an interruption of blood flow to the brain. Most strokes are ischemic strokes, caused by a blockage in an artery carrying blood to the brain. Less common are hemorrhagic strokes, which occur if an artery in the brain ruptures or leaks blood.
- Subarachnoid hemorrhage — a type of hemorrhagic stroke — is bleeding between the brain and the tissues that cover it.

— LW

Note

1. U.S. National Library of Medicine. *A.D.A.M Medical Encyclopedia*. <www.ncbi.nlm.nih.gov/pubmedhealth>.

— that were characterized as incapacitations; half of the 36 events involved cardiac or cardiovascular problems. When the researchers examined only in-flight incapacitations, however, they found that the causes typically were psychiatric issues.

"The emphasis placed on the prediction of sudden cardiac and vascular events by aviation regulators by screening for underlying coronary artery disease and predisposing factors for stroke appears to be well founded," the report said. "The increased risk of incapacitation from these disorders with age is clearly demonstrated, although it is noteworthy that the youngest pilot to have a stroke was only 33."

Of the 36 events classified as incapacitations, cardiovascular events were most frequent, cited in 13 events. Four events were attributed to stroke and 18 were classified as stemming from "other" causes (Table 1).

The youngest pilots involved in the 36 events were two 24-year-old men. One suffered a perforated appendix and the other was incapacitated because of epilepsy, the report said. The oldest were two 64-year-olds, one of whom had a heart attack and the other, a panic attack.

Determining Risk

Regulatory authorities determine what level of risk is acceptable, and that level varies, depending on the type of flight operation and the existence of mitigating factors. The U.K. CAA, for example, has established a maximum incapacitation risk level of 1 percent per year for a commercial pilot in a multi-pilot operation — the so-called 1 percent rule.

The 1 percent rule was developed by aeromedical specialists who said that the likelihood that a pilot would suffer cardiovascular incapacitation could be predicted through an evaluation of his or her risk factors, including hypertension, elevated cholesterol and age. Typically, if the evaluation determines there is less than a 1 percent chance of cardiovascular incapacitation within the year, the certificate is approved; if there is a greater than 1 percent chance, the certificate is denied.

Professional Pilot Incapacitations in 2004

Cause of Incapacitation	Number of Events	Ages of Pilots
Cardiovascular		
Acute myocardial infarction	6	39, 52, 54, 58, 59, 64
Chest pain	2	48, 60
Arrhythmia	3	42, 50, 66
Pulmonary embolus	2	45*, 49
Cerebrovascular		
Stroke	4	33, 42, 50, 59
Subarachnoid hemorrhage	1	48
Other		
Panic attack	3	34*, 35*, 64*
Spontaneous pneumothorax	4	30, 40, 44, 62
Gastric ulcer	1	47
Perforated appendix	1	24
Syncope	1	54
Bowel obstruction	1	48
Biliary colic	1	51*
Migraine	1	47
Prolapsed intervertebral disc	1	52
Epilepsy	2	24, 55
Vestibular disturbance	1	39*
Spontaneous abortion	1	40
Total	**36**	

* Occurred in flight or in the simulator

Note: Data were compiled in a study of 16,145 licensed U.K. professional pilots who had Class 1 medical certificates in 2004.

Source: Evans, Sally; Radcliffe, Sally-Ann. "The Annual Incapacitation Rate of Commercial Pilots." *Aviation, Space, and Environmental Medicine* Volume 83 (January 2012): 42–49.

Table 1

'Unfit Notifications'

As part of their effort to determine the actual incapacitation rate, the researchers gathered data that showed that the 16,145 professional pilots with U.K. CAA/European Joint Aviation Authorities Class 1 medical certificates had received a total of 720 "unfit notifications" during 2004. The 720 notifications involved 700 pilots — 20 of whom had been involved in two episodes apiece of unfitness — or 4.3 percent of the total.

The major cause of temporary unfitness was some type of accident, the report said, noting that 131 of the 720 episodes were

Episodes of Temporary Unfitness, 2004

Causes	Number	Percentage
Accidents	131	18
Pregnancy related	24	3
Cardiovascular	103	14
Cerebrovascular	8	1
Dermatologic	3	<1
Diabetes	8	1
Ear, nose and throat	46	6
Endocrine	5	<1
Gastrointestinal	59	8
Genitourinary	30	4
Hematologic	2	<1
Infectious disease	9	1
Information not received	5	<1
Miscellaneous	12	2
Musculoskeletal	126	18
Neurologic	21	3
Neoplasms	25	3
Ophthalmologic	17	2
Psychiatric	71	10
Respiratory	15	2
Total	**720**	**100**

Note: Data were compiled in a study of 16,145 licensed U.K. professional pilots who had Class 1 medical certificates in 2004.

Source: Evans, Sally; Radcliffe, Sally-Ann. "The Annual Incapacitation Rate of Commercial Pilots." *Aviation, Space, and Environmental Medicine* Volume 83 (January 2012): 42–49.

Table 2

attributed to accidents. Of the medical (non-accident) issues, musculoskeletal problems were most common, involved in 126 episodes of unfitness. Of the other leading causes of medical unfitness, 103 were cardiovascular, 71 were psychiatric and 59 were gastrointestinal (Table 2).

Because only 26 episodes involved female pilots, the study focused on the 539 male pilots who experienced temporary medical unfitness. Older pilots were affected most frequently, the study found.

"The number of episodes demonstrated a plateau between the late thirties and late fifties, with a marked drop after age 59, reflecting the usual retirement age [at that time] of 60," the report said. "The increased risk of experiencing an episode of unfitness with increasing age is clearly demonstrated."

In-Flight Medical Events

The U.K. study identified 16 medical events that occurred either during flight — while a pilot was part of the flight crew or a passenger — or during simulator sessions (Table 3).

Of the 16 events, six were psychiatric issues, and five others stemmed from "nonspecific symptoms that may have had psychiatric contributing factors," the report said.

Two episodes of panic attacks were experienced by the same pilot during two flights that were six months apart. The pilot was 34 years old when the first event occurred and 35 by the time of the second.

"The high proportion of in-flight events attributed to panic disorder … serves to emphasize the truly incapacitating nature and threat to flight safety presented by this condition," the report said. "Noteworthy is the fact that two of the episodes occurred to the same pilot, indicating the need for careful assessment and monitoring of individuals with a history of this condition."

Self-Reporting

Reviewing reports filed under the U.K. Mandatory Occurrence Reporting System (MORS), the report's authors identified 25 in-flight medical events involving flight crewmembers.[4] Of the 25 events, only four were considered likely to also have been included in the "unfit notifications" examined by the authors.

In two of the 25 events, flight crews declared an urgent situation in an effort to get help quickly for the ailing pilots — a Boeing 747 pilot with an inner ear problem associated with severe dizziness and a 777 pilot with nausea.

Only one of the 25 MORS events was classified as "sudden and overt" — a situation in which the single pilot of a Britten-Norman Islander experienced vertigo soon after takeoff but "managed to join the circuit and landed successfully," the report said.

14 Deaths

Fourteen of the 16,145 professional pilots with Class 1 medical certificates died in 2004, the report said. Four of the deaths presumably were sudden, the results of two heart attacks, a subarachnoid hemorrhage and a gastrointestinal hemorrhage.

Considering data from all sources — the unfit notifications, MORS reports and notifications of sudden death — the authors calculated that 40 pilots were incapacitated in 2004 and that the annual incapacitation rate was 0.25 percent.

They measured a steady increase in the annual incapacitation rate as male pilots aged through their 60s.[5] Those who were ages 17–19 had an annual incapacitation rate of zero. Pilots from 20–29 had an annual incapacitation rate of 0.11 percent; those from 30–39, 0.12 percent; 40–49, 0.23 percent; 50–59, 0.42 percent; and 60–69, 1.20 percent. The number of pilots over age 70 was considered "too small for meaningful analysis."

"Pilots in their 40s have approximately the same number of incapacitations that would be expected with an even distribution of age," the report said. "Pilots in their 50s have a 1.5- to 2.0-fold increase, compared with the number of expected incapacitations. "Pilots in their 60s account for 15 percent of all incapacitations but only 3 percent of all male pilots. A pilot in his 60s has five times the risk of incapacitation of a pilot in his 40s."

The report's authors characterized their findings as "consistent with the view that the greatest risk factor for incapacitation is age."

The authors also calculated that the annual rate of a medical event "with the potential to affect flight safety" was 0.8 percent, based on 76 unfit notifications, 14 MORS reports, 36 incapacitations and four sudden deaths.

Low Risk

In-flight medical impairments and incapacitations are rare and, in multi-pilot crews, typically are mitigated by the presence of another pilot, the report said, noting that an earlier study by researchers for the U.S. Federal Aviation Administration (FAA) found that, from 1993 through 1998, two non-fatal accidents could be attributed to in-flight incapacitations involving U.S. airline pilots.[6]

The flight risk presented by an incapacitation is mitigated in multi-pilot crews because another pilot can take over for the incapacitated colleague; nevertheless, the additional workload, distraction and stress also contribute to increased risk.

Regular aeromedical exams aid in risk mitigation for individual pilots, the report said, because medical examiners are able to identify each pilot's greatest health risks. Pilots under age 40 are likely to reap the greatest benefits from these exams, the report added.

These pilots are those "least likely to experience an incapacitation [in the near future] but for whom prevention of future incapacitation would provide the most benefit for flight safety in the future," the report said. "Ongoing monitoring of incapacitating events is essential to understand which type of medical conditions present the greatest flight safety risk and to focus efforts on reducing those risks."

In-Flight Medical Events Resulting in Notification of Unfitness, 2004

Cause of Unfit Episode	Number	Age of Pilot (years)	Situation
Panic attacks (same pilot)	2	34/35	In flight
Anxiety attack	1	50	Simulator
Panic attack	1	64	Passenger
Panic disorder	1	36	In flight
Stress	1	44	Simulator
Lightheaded/visual disturbance	1	54	In flight
Paresthesia in arm	1	42	In flight
Vestibular disturbance	1	39	In flight
'Unwell'/visual symptoms	1	43	In flight
Dizziness/blurred vision	1	35	In flight
Acute sinusitus/vertigo	1	47	In flight
Perforated tympanic membrane	1	48	In flight
Transient ischemic attack	1	50	In flight
Pulonmary embolus	1	45	Heavy crew
Biliary colic	1	51	Simulator

Note: Data were compiled in a study of 16,145 licensed U.K. professional pilots who had Class 1 medical certificates in 2004.

Source: Evans, Sally; Radcliffe, Sally-Ann. "The Annual Incapacitation Rate of Commercial Pilots." *Aviation, Space, and Environmental Medicine* Volume 83 (January 2012): 42–49.

Table 3

Notes

1. Wirawan, I. Made Ady, et al. "Cardiovascular Risk Score and Cardiovascular Events Among Airline Pilots: A Case-Control Study." *Aviation, Space, and Environmental Medicine* Volume 83 (May 2012): 465–471.
2. The risk calculator was developed during the course of the Framingham Heart Study, a multi-year study that began in 1948, involving about 5,200 men and women from ages 30 through 62 from Framingham, Massachusetts, U.S., to identify common factors in cardiovascular disease.
3. Evans, Sally; Radcliffe, Sally-Ann. "The Annual Incapacitation Rate of Commercial Pilots." *Aviation, Space, and Environmental Medicine* Volume 83 (January 2012): 42–49.
4. MORS is designed for the reporting, collection, storage, protection and dissemination of information about incidents that "if not corrected, would endanger an aircraft, its occupants or any other person." Crew incapacitation is among the occurrences that must be reported.
5. Because female pilots accounted for only 4 percent of the total, the study did not examine the relationship of their age to incapacitation events.
6. DeJohn, Charles A.; Wolbrink, Alex M.; Larcher, Julie G. "In-Flight Medical Incapacitation and Impairment of U.S. Airline Pilots: 1993 to 1998," DOT/FAA/AM-04/16. FAA Office of Aerospace Medicine. October 2004.

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GAUGING WILDLIFE HAZARDS

Airport personnel and pilots can do a better job of getting the word out.

BY GARY W. COOKE

For years, I have seen variations of the vague notation "birds on and invof arpt" in the remarks sections of the airport data included in the U.S. Federal Aviation Administration (FAA) *Airport/Facility Directory* (*A/FD*). But I have often wondered what, exactly, it means.

This *A/FD* notation, as well as the similar and often-heard "caution, birds in vicinity of the airport" in automatic terminal information system (ATIS) broadcasts, do not give pilots accurate information to properly evaluate the wildlife hazards that may be present, thus weakening aviation risk management.

This article will attempt to examine why such ambiguous statements are issued, present tools to more accurately evaluate bird/wildlife hazards and propose better ways for airports and pilots to manage the risks.

Remarks in the *A/FD* listing for a particular U.S. airport come directly from the master record for the airport that is on file with the FAA and usually maintained by the airport manager. The FAA advises that remarks entered into an airport master record should be "worded as clearly as possible so as to avoid pilot confusion."[1] The guidance on *how* to enter a remark is pretty clear, but the FAA is not very clear on *what* to enter. As a result, the remarks do little to avoid pilot confusion.

As mentioned, pilots need concise, accurate information on where and when they can expect to encounter bird/wildlife hazards, the severity of the hazards and what steps, if any, the airport is taking to mitigate them. It also would be useful to know if any hazard reported in the *A/FD* has changed. This is where notices to airmen (NOTAMs) and ATIS broadcasts could be better utilized to strengthen risk management.

No Specific Guidance

In speaking with FAA and airport operations personnel, I have found that

CAIRNS AIRPORT BIRD WATCH REPORT | 2012/03

Condition: Low – Flying Fox

Issue date: 3 February 2012 | Review date: 13 February 2012

Legend

Bird Watch condition SEVERE. Heavy concentration of birds on or immediately above the active runway or other specific locations that represent an immediate hazard to safe flying operations (>100 FF in a 10 min period).

Bird Watch condition MODERATE. Concentrations of birds observable in locations that represent a probable hazard to safe flying operations (>50 and <100 in a 10min period).

Bird Watch condition LOW. Above normal bird activity on and above the airfield with a low probability of hazard.

Bird Watch ALERT. Weather, time of day and seasonal conditions which make an influx of birds onto the airfield likely.

Location:
Above normal Flying Fox (FF) numbers continue to be sighted over the airport and southern approach. The FF are coming from the south east and flying both to the west of the airport and across the southern end of Runway 15/33 heading in a northerly direction (see attached flight path map). They have been observed at altitudes between 100 and 400 ft.

Time of Day:
(All times local): The fly outs are currently occurring between 1900 and 1945 hrs but depending on cloud cover and weather conditions the peak times can vary by 30 minutes either side of these times. Any time between dusk and dawn there maybe isolated Flying Foxes in the vicinity of the airport and in the approaches.

Number of Birds / Wildlife:
A "Moderate" Bird Watch condition was cancelled on 30 Jan '12. FF numbers at that time were approx 150 per night in 10 minute blocks of up to 76. Since that time numbers have remained consistent at 20-30 per 10 minute period. Although numbers are not large enough to trigger a "moderate" condition, they do reflect a slightly elevated strike risk.

Australia's Cairns Airport publishes timely and detailed information about wildlife hazards. This is a portion of the first page of a recent three-page report.

no specific guidance exists on what remarks to publish in the airport master record when identifying bird/wildlife hazards. Airports are free to include pertinent remarks of their choosing.

I researched the *A/FD* remarks for the 50 largest airports in the United States and found that only three lack cautions regarding birds or wildlife on or near the airport. Even though the managers of these three airports choose not to include even a vague bird/wildlife caution, I am quite certain that the bird/wildlife threat is always present to some degree.

Some airports specify deer or other local species, and some have expanded the remarks to include specific times when the hazard is greatest. A few airports even reference the U.S. Air Force Bird/Wildlife Aircraft Strike Hazard (BASH) "Phase I" and "Phase II" hazard-intensity categories in their *A/FD* remarks. However, this likely is helpful only to military-trained pilots who are familiar with the BASH program and recognize that Phase II indicates increased bird/wildlife activity due to factors such as historic migration or nesting patterns and that Phase I indicates reduced activity.

A/FD remarks should be as accurate and up-to-date as possible, and identify the top two or three bird/wildlife hazards that pilots can expect when operating at a particular airport. A concise historical perspective on the bird/wildlife hazards that pilots have encountered at the airport in the past also would enhance risk management. Examples are gull activity at a nearby landfill that has been observed to peak immediately after sunrise and taper off near sunset, or observed turkey vulture migration in April and October.

NOTAMs are excellent tools to help identify dynamic bird/wildlife hazards that are not noted in *A/FD* remarks. In accordance with International Civil Aviation Organization standards, NOTAMs alert pilots of hazards at specific locations. Therefore, a NOTAM is the perfect medium to advise that a bird/wildlife hazard identified in *A/FD* remarks is no longer valid or has changed. Examples are a deer population that is noted by the *A/FD* as flourishing but that actually has been decimated by an epidemic, or Canada geese that have settled in the area due to recent wet weather.

Showing the Way

Cairns Airport in Queensland, Australia, provides an outstanding example of how NOTAMs can be supplemented by special reports to inform pilots about ever-changing bird/wildlife hazards. The illustration above shows a portion of a bird watch report that was issued in March to warn pilots about above-normal flying fox activity at the airport. The report also included information about the animal — what attracts it and how it behaves — as well as a map showing typical flight paths over the airport and details about what the airport is doing to manage the hazard posed by these large bats.

Notice that the title of the bird watch report designates "condition: low." The legend explains that this means "above-normal bird activity on and above the airfield with a low probability of hazard." Definitions of other conditions also are included in the legend.

A NOTAM that was published in conjunction with the bird watch report said, in part: "Increased flying fox (bats) hazard exists. Observed overflying Rwy 15/33 and approaches up to 400 ft AGL [above ground level]."

Bird watch reports and NOTAMs such as those published for Cairns Airport are an excellent method of identifying bird/wildlife hazards and educating pilots about bird/wildlife behavior, common terminology and programs designed to mitigate the hazard.

Crying Wolf

Risk management also could be improved by better utilizing ATIS broadcasts to warn of local bird/wildlife hazards. The messages should be specific and tactical — that is, issued only when the bird/wildlife hazard is present. An ATIS message continually warning of birds in the vicinity of the airport is commensurate to saying that the winds are blowing and there are clouds in the area.

When airport traffic is very light, I often challenge air traffic controllers on initial radio contact about the meaning of the ATIS phrase "caution, birds in vicinity of airport" and have been amused by some of the responses I have received. Some replied that there are always birds in the area; others said that local policy dictates that the statement is to always be included.

My hunch is that our litigious society has driven airports to continuously warn pilots just in case a damaging strike occurs, thereby reducing their exposure to legal liability.

The airport at which I am based includes the cautionary ATIS phrase only if the controllers observe birds/wildlife in the area or if birds/wildlife are reported by pilots or airport personnel. When controllers are questioned about the message, they can provide the specifics.

Unfortunately, due to the ever-present ATIS warning at many other airports, most pilots have become complacent about it, a sort of boy-crying-wolf scenario. Airports need to do a better job of warning pilots about existing bird/wildlife hazards, and pilots need to do a better job of reporting what they see, especially when a bird/wildlife strike occurs.[2]

Reporting a bird/wildlife strike and identifying the species are extremely important elements in mitigating a bird/wildlife hazard. But far too many bird/wildlife strikes go unreported, and remains are not collected and sent to specialists for identification.

Bird/wildlife strike reports and associated species identifications are entered into the FAA Wildlife Strike Database, which, among other uses, helps airport personnel to recognize the local bird/wildlife hazards and allows them to formulate customized risk-management programs. Information obtained from the database plays an integral part in developing an airport's wildlife hazard mitigation plan (WHMP), which is the foundation for bird/wildlife risk mitigation. The database also is an excellent tool that pilots can access in order to identify the hazards they may encounter at a specific airport during a specific time of year. Ensuring that the database is accurate and up-to-date helps maximize its effectiveness.

In summary, airports need to do a better job of giving pilots precise and timely information about the bird/wildlife hazards they may encounter. The forewarning they convey in the *A/FD*, NOTAMs and ATIS broadcasts needs to be precise and unambiguous. If the information is not accurate or up-to-date, it should be modified or deleted. And pilots need to do a better job of reporting bird/wildlife hazards and strikes, enabling the airports to more accurately analyze their local bird/wildlife hazards and establish mitigations.

All this can be done economically and effectively using data gleaned from the airport's WHMP and the FAA Wildlife Strike Database, as well as information disseminated by existing communication channels. Using the Cairns Airport bird watch report program as a benchmark would be an immense improvement over the current system. It is vital that pilots report to air traffic control what birds/wildlife they observe locally and follow published guidance when a bird/wildlife strike occurs. If we implement these changes now, we soon will have safer airports and fewer bird/wildlife strikes.

Gary Cooke has more than 20 years of experience in aviation safety and has presented papers on bird/wildlife strike prevention and other topics at numerous seminars. He is a pilot and safety officer for a major U.S. corporation, and a lieutenant colonel in the U.S. Air Force Reserve, serving as a Lockheed C-5 instructor pilot and chief of flying safety for the 439th Airlift Wing at Westover Air Reserve Base in Massachusetts. Cooke is a member of the FAA Safety Team and the National Business Aviation Association Safety Committee and chairs the NBAA Bird Strike Working Group.

Notes

1. FAA Advisory Circular 150/5200-35A, *Submitting the Airport Master Record in Order to Activate a New Airport*. Sept. 23, 2010.
2. Bird/wildlife strikes can be reported to the FAA Wildlife Strike Database at <wildlife-mitigation.tc.faa.gov/wildlife/>. Searches of the database also can be performed at this address.Mus et perum quiatur

InSight is a forum for expressing personal opinions about issues of importance to aviation safety and for stimulating constructive discussion, pro and con, about the expressed opinions. Send your comments to Frank Jackman, director of publications, Flight Safety Foundation, 801 N. Fairfax St., Suite 400, Alexandria VA 22314-1774 USA or jackman@flightsafety.org.

BY RICK DARBY

Striking Coincidence

Bird strikes are on the increase in Australia.

Australia is home to some 800 bird species, ranging in size from the 8-cm (3-in) weebil to the emu (up to 2 m [7 ft] in height), which doesn't fly but can run 31 mph (50 kph).[1] Some of the natural birds and other creatures present a significant risk to engineered birds — airplanes and helicopters.

"While it is uncommon that a bird strike causes any harm to aircraft crew and passengers, many result in damage to aircraft, and some have resulted in serious consequential events, such as forced landings and high speed rejected takeoffs," says a recent report by the Australian Transport Safety Bureau (ATSB) on the nation's aviation wildlife strikes from 2002 to 2011.[2]

"In 2011, there were 1,751 bird strikes reported to the ATSB," the report says. "For high capacity aircraft operations,[3] reported bird strikes have increased from 400 to 980 over the last 10 years of study, and the rate per aircraft movement also increased."[4]

The ATSB, by regulation, is notified of accidents and incidents by pilots, airlines, airport personnel, air traffic control and others involved in the aviation industry. The report says that one type of event that must be reported is "a collision with an animal, including a bird, for all air transport operations (all bird and animal strikes) and [for] aircraft operations other than air transport operations when the strike occurs on a licensed aerodrome." For the report's purposes, bird strikes are strikes from all flying animals, including bats, and animal strikes are strikes from all flightless animals, including flightless birds.

Not only did the annual numbers of reported bird strikes per year increase over the 10-year study period, but also, in 2010 and 2011, "bird strikes were significantly higher than in previous years, although both years had similar numbers of bird strikes," the report said. The ATSB did not estimate how much of the difference among years was due to greater consciousness of the risk and stronger reporting compliance.

Nevertheless, bird strike rates — measured in strikes per 10,000 aircraft movements — also increased over the reporting period for high capacity air transport (Table 1). The report says, "High capacity air transport aircraft have a significantly higher bird strike rate than all other operation types. It is likely that the speed and size of these aircraft, longer takeoff and landing

Australian Bird Strike Rates, by Operation Type, 2002–2011

Operation type	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
High capacity air transport	6.45	6.32	7.85	8.45	7.49	7.35	7.76	8.28	9.34	9.03
Low capacity air transport	1.23	1.31	1.40	1.51	1.52	1.52	1.71	2.18	2.12	—
General aviation	0.17	0.17	0.19	0.21	0.18	0.26	0.30	0.37	0.28	—

Notes: Rates are per 10,000 aircraft movements. An aircraft movement is a takeoff, landing or circuit.

High capacity air transport includes regular public transport (RPT) and charter operations on aircraft certified as having a maximum capacity exceeding 38 seats or a maximum payload exceeding 4,200 kg (9,260 lb).

Low capacity air transport includes all RPT and charter operations on aircraft other than high capacity.

General aviation includes all aerial work, flying training, and private, business, and sport aviation.

Data are not available for 2011 for low capacity air transport and general aviation.

Source: Australian Transport Safety Bureau

Table 1

rolls, and large turbofan engines are factors contributing to the higher rate."

The increase in low capacity air transport bird strike rates "has accelerated since 2007, and appears to be becoming more significant," the report says.

Airplanes in the second-greatest weight category were most prone to bird strikes in 2010, the last year for which data were available (Table 2). Those included aircraft with a maximum takeoff weight (MTOW) between 27,001 and 272,000 kg (about 60,000 to 600,000 lb). "Typical aircraft models in this category flying in Australia range from the Bombardier Dash 8 Q400 to the Boeing 737 and Airbus A320, and include larger widebody aircraft such as the Airbus A330," the report says.

Between 2002 and 2010, the sharpest rate increase was in the third-greatest weight category, with MTOW between 5,701 and 27,000 kg (about 12,500 and 60,000 lb). The 2010 rate was 112 percent of that for 2002.

Very large, and generally long-haul, aircraft — those with an MTOW greater than 272,000 kg — "had a strike rate of less than half that of smaller, typically domestic, jet aircraft," the report says.

"Both the number and rate of bird strikes are significantly lower for most helicopter weight categories when compared with most airplane groups," the report says. "For helicopters with [an] MTOW below 2,250 kg [about 5,000 lb], the number and rate of reported bird strikes is similar to that for fixed-wing aircraft. The lower number and rate of bird strikes generally seen for helicopters may be due to helicopters flying at lower speeds, making it easier for birds and pilots to see and avoid each other.

"There is a notable increase in the strike rate between 2007 and 2009 for helicopters with maximum weight categories below 27,000 kg, which has remained high in 2010. It is worth noting though that these figures are still slightly lower than those for the lightest airplane category."

The report says that although the helicopter bird strike rate is low, the consequences are generally more severe, depending on the component struck. Therefore, the risk to flight safety can be much higher than the number of occurrences suggests.

"The vast majority of bird strikes occurred at airports," the report says. "More than 40 per cent of bird strikes with a known phase of flight involving airplanes occurred during takeoff, and almost 30 per cent occurred during landing [Figure 1]. In total, 96 percent of bird strikes with a known phase of flight occurred while the aircraft was on the runway, on approach to land or just after takeoff." There was little variation in the proportions of phase of flight for high capacity, low capacity and general aviation airplanes.

The picture was different for helicopters in the study period. Cruise, "standing" and approach were the most common phases of flight for helicopter bird strikes (Figure 2). "A high proportion of bird strikes while on the ground (standing) is likely to be due to birds colliding with the moving rotor blades of a stationary helicopter," the report says. "The lower proportion of strikes during landing and takeoff may be due to the louder and varying noise caused

Australian Airplane Bird Strike Rates, by Airplane Weight Category, 2002–2010

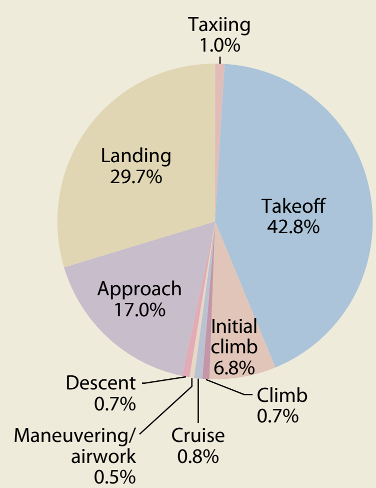
Maximum weight category	2002	2003	2004	2005	2006	2007	2008	2009	2010
Over 272,000 kg (599,657 lb)	3.49	2.11	4.05	5.3	3.39	3.08	1.74	2.95	4.06
27,001–272,000 kg (59,527–599,657 lb)	6.59	7.03	8.2	8.88	7.68	7.61	7.93	8.36	9.55
5,701–27,000 kg (12,569–59,525 lb)	2.83	3.02	3.93	3.63	4.25	4.26	4.25	5.49	5.99
2,251–5,700 kg (4,963–12,566 lb)	0.66	0.7	0.77	0.93	1.15	1.08	1.17	1.45	1.14
Less than 2,250 kg (4,960 lb)	0.29	0.25	0.26	0.29	0.34	0.3	0.28	0.42	0.35

Note: Data for 2011 are not available.

Source: Australian Transport Safety Bureau

Table 2

Australian Airplane Bird Strikes, by Phase of Flight, 2002–2011



Note: Percentages represent bird strikes where phase of flight was known.

Source: Australian Transport Safety Bureau

Figure 1

by helicopter rotor speed and pitch changes during these flight phases."

Over the study period, bird strikes were most common between 0730 and 1030 (Figure 3). Numbers then slumped to a low from about 1330 to 1430, picking up again from around 1800 to 2000. A steady reduction followed, reaching the lowest numbers from 0130 to 0400.

Common sense explains the finding — not that birds feel especially eager to fly in the morning and evening, taking a siesta in between, but that more aircraft movements occur at the "rush hours." However, different species' habits influenced the times they were most often struck. In the combined category of bat/flying fox (often confused with one another), they were most at risk in the nighttime, around 1800 and 1900 hours. Ducks were unluckiest around 1800. The most lethal period by far for curlews and sandpipers, a single category, was between 1900 and 2100.

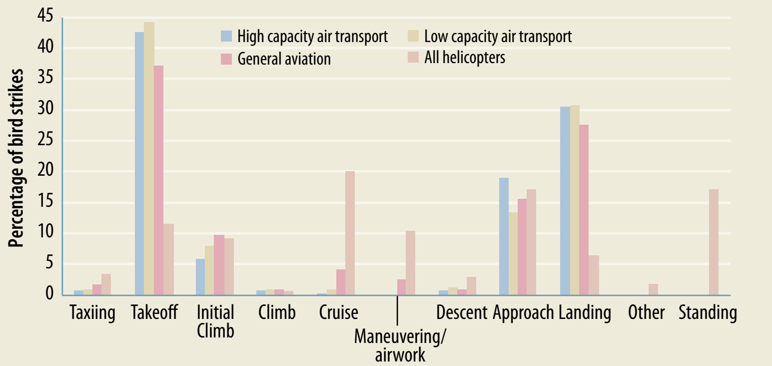
"Flying foxes and bats were the most commonly struck species in Australia between 2002 and 2011, with the majority of strikes occurring at locations on the east coast," the report says. "Birds in the lapwing and plover families were the second most frequent bird type struck over the 10-year period; however, it is likely that this is influenced by the broad species range included in this bird type (banded plover, black-fronted plover, dotterel, lapwing, masked lapwing, masked plover, oriental plover, pacific golden plover, plover, [and] spur-winged plover)."

In 2011, the galah — a type of cockatoo with a pink breast and gray wings — was the single most frequent species struck by aircraft across Australia.

"Bats and flying foxes had the most significant increase in the number of reported strikes per year in the last two years, with these species being involved in an average of 119 strikes per year compared with 78 times per year on average across the entire 10-year reporting period," the report says.

Pelican strikes were hardest on aircraft during the period. "More than 65 per cent of pelican strikes resulted in aircraft damage, with the swan, magpie goose and Australian brush turkey having a high rate of damaging strikes (at least one in every three reported strikes resulted in some level of damage)," the report says. "More than one in every five reported bird

Australian Bird Strikes, by Phase of Flight and Type of Operation, 2002–2011



Notes: Data are aggregated for the entire 10-year period.

High capacity air transport includes regular public transport (RPT) and charter operations on aircraft certified as having a maximum capacity exceeding 38 seats or a maximum payload exceeding 4,200 kg (9,260 lb).

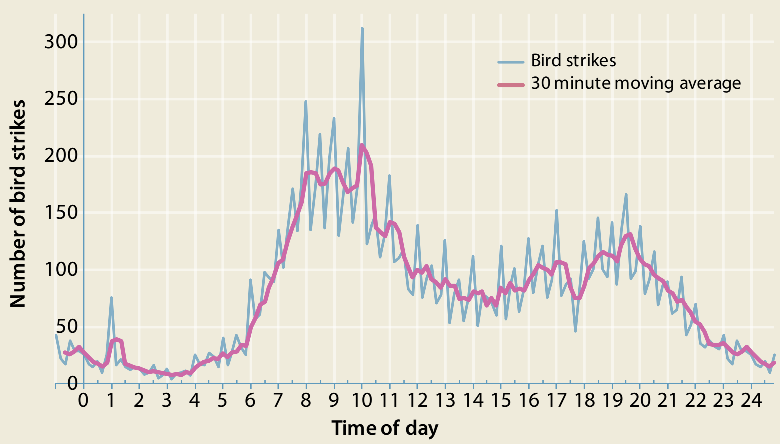
Low capacity air transport includes all RPT and charter operations on aircraft other than high capacity.

General aviation includes all aerial work, flying training, and private, business, and sport aviation.

Source: Australian Transport Safety Bureau

Figure 2

Australian Bird Strikes, by Time of Day, 2002–2011



Note: Data, recorded at 10-minute intervals, are aggregated for the entire 10-year period. One hour is repeated on the horizontal scale to enable the 30-minute moving average to be calculated.

Source: Australian Transport Safety Bureau

Figure 3

strikes involving eagles, bustards, ibis and frigates resulted in damage."

For every bird type involved in aircraft-damaging strikes, instances of minor damage far outweighed those involving serious damage. Seven reported bird strikes in which the bird type was known caused serious aircraft damage between 2002 and 2011. One involved a pelican that hit a Robinson R44 helicopter conducting low capacity air transport operations, and the others involved general aviation operations.

Researchers examined whether daily rainfall had any correlation with bird strikes during 2010 and 2011. Of 58 airports studied, a statistically significant relationship was found at seven. But at those seven airports, the correlation was "weak."

Because of its relatively large number of bird strikes, Sydney Airport was chosen for a case study of bird strikes and average rainfall per month (Figure 4). Except in Australia's late spring and early summer months of November and December, no close correlation was visible.

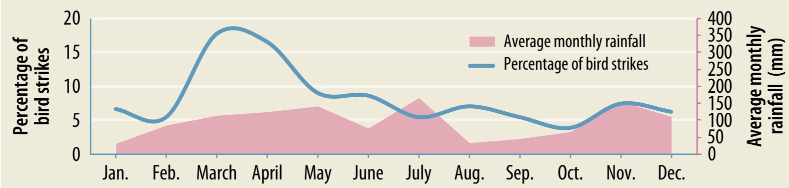
Strikes of birds of all sizes increased during the study period (Figure 5). Over the full study period, in every operation type, medium-sized birds were struck the most often, followed by small birds.

"Proportionally, the number of larger birds struck has increased more than other sizes of birds struck," the report says. "This was especially the case in 2010 and 2011, where an 80 percent increase above the 10-year average was observed for strikes involving large birds. This is compared with a 41 percent increase for strikes involving small birds, and a 24 percent increase for those involving medium-sized birds."

The report says that nonflying animal strikes are rare compared with bird strikes, but "there is a relatively high possibility that animal strikes could more frequently result in significant aircraft damage when compared with bird strikes." High capacity air transport animal strikes averaged 13.1 per year over the study period. Hares and rabbits were the most common animals struck, followed by kangaroos, dogs and foxes, and wallabies.

In case you were wondering: No duck-billed platypus strikes were reported, probably because this strange mammal spends most of its time in the water.

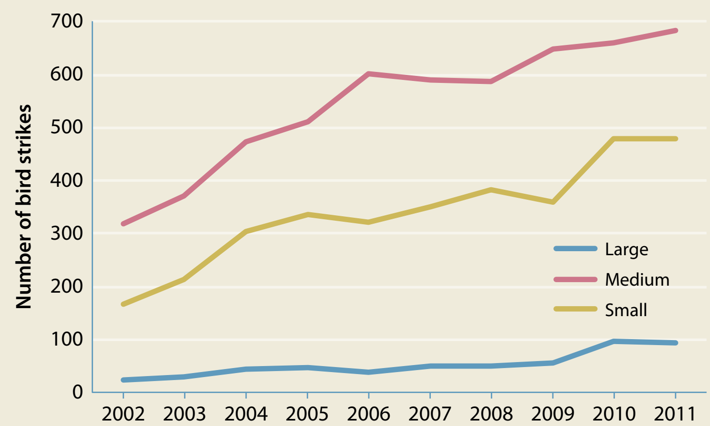
Correlation of Bird Strikes With Average Monthly Rainfall, Sydney Airport, 2010–2011



Source: Australian Transport Safety Bureau

Figure 4

Australian Bird Strikes, by Bird Size, 2002–2011



Source: Australian Transport Safety Bureau

Figure 5

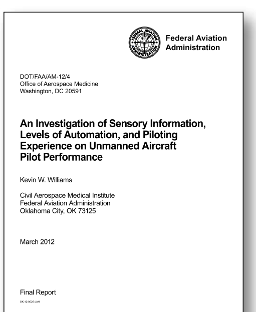
Notes

1. Wikipedia. "Birds of Australia." <en.wikipedia.org/wiki/Birds_of_Australia>.
2. ATSB. "Australian Aviation Wildlife Strike Statistics: Bird and Animal Strikes 2002 to 2011." Report no. AR-2012-031. June 4, 2012.
3. High capacity air transport includes regular public transport and charter operations on aircraft certified as having a maximum capacity exceeding 38 seats or a maximum payload exceeding 4,200 kg (9,260 lb).
4. Aircraft movements were defined as a takeoff, a landing or a circuit (flying a traffic pattern at an airport). Therefore, an aircraft completing a single flight would have one movement for takeoff and one for landing.

Sensational Development

Adding more sensory information may not improve UAS pilot performance.

BY RICK DARBY


Federal Aviation Administration

DOT/FAA/AM-12/4
Office of Aerospace Medicine
Washington, DC 20591

An Investigation of Sensory Information, Levels of Automation, and Piloting Experience on Unmanned Aircraft Pilot Performance

Kevin W. Williams

Civil Aerospace Medical Institute
Federal Aviation Administration
Oklahoma City, OK 73125

March 2012

Final Report

OK-12-0025-JAH

REPORTS

Two-Sense Worth

An Investigation of Sensory Information, Levels of Automation, and Piloting Experience on Unmanned Aircraft Pilot Performance

Williams, Kevin W. U.S. Federal Aviation Administration (FAA) Civil Aerospace Medical Institute (CAMI). DOT/FAA/AM-12/4, March 2012. 21 pp. <www.faa.gov/data_research/research/med_humanfacs/oamtechreports/2010s/media/201204.pdf>.

"Research looking at UAS [unmanned aircraft system] accident causal factors has suggested that sensory deficiencies have played a role in UAS accidents," the report says. That is, a lack of sensory information provided by the system contributed to some pilot mismanagement of UAS flight.

The experiment described in the report sought to investigate the role of sensory information, particularly as it affected pilot response to system failures, as well as other influences on UAS pilot performance.

"Other factors besides the types of sensory information available can influence the ability of a pilot to effectively manage a flight," the report says. "UAS control, for many current systems, is highly automated. Automation-induced complacency, which is the tendency for humans to become less vigilant or focused on a task that is being performed by automation, is possible when automation replaces a task that occupies a human activity. … A pilot's ability to respond to system failures, therefore, will be influenced not only by the sensory information available but also by the type and level of automation employed in the system and the control-interface requirements on the pilot."

The researchers were interested in a third "unresolved question" — Is it advantageous for UAS pilots to have experience piloting manned aircraft? The FAA requires UAS pilots to have a manned aircraft pilot certificate for most operations, but the development of a UAS-only form of pilot certification has been proposed.

The experimental design involved manipulating two levels of sensory information (visual versus visual/auditory), two levels of control automation (manual versus automatic) and two levels of manned piloting experience (some versus none).

A simulated UAS control station was devised, providing three types of aircraft control. "Manual control can be accomplished through the use of [a] throttle and joystick," the report says. "Vector control is done using the mouse and onscreen buttons for changing the altitude and heading of the aircraft. Waypoint control is accomplished by entering a series of waypoints on the moving-map display and establishing altitude settings for each leg of the flight."

Of the 32 experiment participants, half had flown as pilot-in-command of a manned aircraft; the others had no piloting experience. None of the participants had controlled a UAS.

Participants were asked to pilot a UAS along a predetermined route while responding to various system failures. They had to monitor traffic in the area and, at set times during the flight, determine the aircraft position relative to a specific location.

"It was expected that the visual/auditory level of sensory information would be superior to the visual-only level, and that participants would respond to system failures more quickly when they received both a visual and auditory failure cue," the report says. "For the two levels of automation, it was expected that the more automated condition would lead to a certain level of complacency for the participants, thus inducing slower responses to system failures and perhaps poorer performance at monitoring traffic. Finally, participants with manned-aircraft experience were expected to be better at determining the relative position of the aircraft and, because of a more effective scan, detecting system failures in the visual-only condition."

While some results were as expected, there were also surprises.

"The notion that simply adding a second type of sensory information (sound) would increase the ability of pilots to identify and respond to failures was not supported in the current study," the report says. "While the presence of sound did improve responses to engine failures, it did not improve responses to failures in heading control. One difference between the engine failure cues and heading control failure cues was the presence, in the condition where sound was used, of engine noise in addition to the auditory warning. Unfortunately, it is not possible to determine whether this additional sound cue was the cause of the difference in responding to the failures."

The expectation that higher automation levels would lead to complacency or a slump in vigilance was not borne out. "Perhaps the relatively short flight used for the experiment (approximately 40 minutes) did not allow for an effect to occur," the report says. The "relatively simple" nature of the task also might have confounded any decrease in vigilance, it adds.

Still, automation differences had some effects: "As expected, a higher level of automation led to lower estimates [by participants] of subjective workload. This was reflected in the flight technical-error performance findings that showed superior flight performance, in general, for participants in the high-automation condition."

The participants with manned aircraft experience were no better than non-pilots at monitoring traffic or estimating relative direction. But the pilots flew significantly closer to the fight path than the non-pilots, which was unexpected.

"It is difficult to believe that only the pilots noticed that the aircraft was deviating from the flight path during the first flight segment, so the question is why some of the non-pilots did not attempt to correct the deviation," the report says. "[The fact that] it occurred suggests individual differences between the pilots and some of the non-pilots could be due to either training or are innate traits that contribute to success as a pilot. If manned aircraft training and/or experience leads to more responsive flight-path control, it would be important to identify what portion of the training was responsible."

A significant proportion of pilots responded to failures of automated heading control before the failure warning occurred, recognizing on their own that the aircraft was drifting from the commanded heading. "However, this occurred only in the no-sound condition," the report says. "The presence of an auditory warning for pilots actually seemed to inhibit a response to a heading failure. None of the non-pilots responded early to the heading control failure, regardless of the warning condition.

The expectation that higher automation levels would lead to complacency or a slump in vigilance was not borne out.

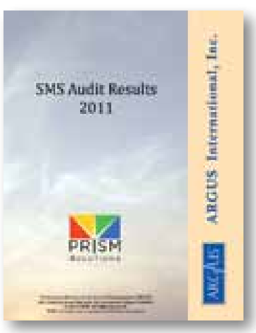
"For both pilots and non-pilots, it was clear that some of the participants noticed the heading failure early but waited for the warning by positioning the cursor over the heading recovery button. Again, there are questions of whether individual differences allowed some of the pilots to respond early, why the presence of a sound cue would prevent this response, and whether training or other factors were involved in the differences between the groups."

Under these experimental conditions, some differences appeared between those with prior manned-aircraft experience and those without. Future studies of the qualifications for UAS-only pilot certification should try to determine whether those differences resulted from pilot training and experience, or identifiable traits among people who choose to become pilots and those who do not, the report says.

Audit Trail

SMS Audit Results 2011

PRISM Solutions, a subsidiary of ARGUS International. <www.argus.aero/FreeData/PRISM_SMS_Audit_Results_2011.aspx>.



Each year PRISM Solutions reviews deidentified audits performed by its sister company, ARGUS PROS, on private and commercial flight operations. It then compiles the results from all of the audits into a single report, of which this is the most recent. "Although the audit reports highlight many positive trends and accomplishments within the SMS [safety management system] area, the annual SMS audit results report focuses on the recurring problem areas found in SMS implementation and execution," the company says.

In 2011, 74 audits were analyzed. "The majority of the 2011 audit findings point to deficiencies in a general operating manual (GOM) and SMS training," the report says. "A GOM defines policies, procedures and organizational structures to accomplish the company's goals. It must be accurate, up-to-date and consistent with other manuals in order to prevent miscommunication and confusion. A lack of employee SMS training accounted for many of the recommendations in the area of SMS training. Employees need to be active participants and have a good understanding of safety management concepts in order for an SMS to be effective."

The GOM was the subject of 64 percent of the SMS recommendations to the total 74 operators audited. These samples were cited in the report:

- "Recommend that the executive's letter on safety and non-punitive reporting policy be included in the forefront of the GOM."
- "The duties and responsibilities of the safety manager should be consistent between the operations manual and SMS manual."

As guidelines, the audits said that the GOM should contain accurate descriptions of a safety system and contain an accurate outline of the safety officer or manager responsibilities.

The next most frequent subject mentioned in recommendations was SMS training. It was recommended, for example, that "the safety manager should receive formal training for the development and implementation of [an SMS]."

Other areas of SMS recommendations included "SMS manual" (38 percent of audits); "risk assessment" (36 percent); "internal evaluation program" (28 percent); "safety policy" (24 percent); "safety committee" (20 percent); and "hazard reporting and tracking" (9 percent).

PRISM Solutions also reviewed the audit reports of the operators' emergency response programs. The largest share of recommendations — 30 percent — concerned emergency response plan (ERP) documentation. Auditors recommended, for example, that "on-site team members be identified in the SMS manual by official job position within the company, and all ERP documents be controlled." Next-of-kin notification and family assistance recommendations made up 23 percent of the total. One example was: "The ERP should include guidance offering trauma counseling to company employees in the event of an accident or other devastating event."

The report compares the 2011 audits with the total of 175 in 2008–2010. In the three-year period, the largest share of recommendations, 55 percent, concerned the internal evaluation program, versus 28 percent in 2011. The GOM, which generated 64 percent of recommendations in 2011, represented 35 percent of the 2008–2010 total.

WEBSITES

Facteurs Humains

MentalPilote, <www.mentalpilote.com>.

This site, primarily in the French language, is subheaded "*Facteurs humains, la clé du savoir agir*" — human factors, the key to knowing what to do.

MentalPilote was created by Jean Gabriel Charrier, an instructor with the training branch of the French Direction Générale de l'Aviation Civile (DGAC) and then a check pilot with the DGAC. Its theme is suggested by the description of one of the three books written by Charrier, *L'Intelligence du Pilote (Pilot Intelligence)*: "Why do certain pilots encounter fewer dangerous situations than others, and why do these same pilots commit many fewer errors? It's because they know how to take good decisions … . But for a pilot to take good decisions is not innate; it is learned."

MentalPilote articles and recommended books suggest that flying sports, such as soaring and hang-gliding, encourage pilots to develop cognitive skills to improve performance, and also enhance their safety consciousness.

The site currently contains 130 articles. Many are case studies from a threat-and-error management viewpoint. The reader can select from four categories of interest: private pilot, professional pilot, instructor and fundamental information. The menu offers a drop-down listing of further subdivisions — for example, accidents, good practices, culture, errors, stress, perception, risks and training.

In the professional pilot article archive, the first article is headed, "CRM [crew resource management] — the first steps for today. Test your knowledge."

It continues: "Over to you! Before reading the rest of this article, we invite you to perform a personal reflection: What do you associate with CRM? Take a sheet of paper and pen and note your responses. Don't cheat! This experience will be useful for the following: If you had to define CRM using only three words or key expressions, how would you define it?"

All articles are illustrated with at least one photograph, and many with several photographs and diagrams. The site is visually accented with graphic symbols.

MentalPilote links to a blog, <www.formation-facteurs-humains.fr>, for pilot self-training in human factors and safety.

Michel Trémaud, a retired Airbus safety specialist, contributes a "Pilot's Whisperer" column in English, which he says is "intended to enhance the awareness of air traffic controllers on the main features and use of automation on modern business or commercial aircraft. Indeed, it is most important for air traffic controllers to understand the pilots' working environment; this includes the fundamentals of aircraft automation (understood in this article as automatic flight guidance), how pilots interface with automated systems and how the optimum use of automation contributes to the overall management of the aircraft flight path."

The site is intended to be useful not only in France but in French-speaking areas of North and West Africa, as well as the Middle East.

Reverser Fails to Stow on Go-Around

Tail strike occurred as freighter struggled to become airborne.

BY MARK LACAGNINA

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

JETS

'Conflicting Guidance'

Airbus A300-B4-622R. Minor damage. No injuries.

In an incident that "highlights the potentially serious consequences of attempting to go around after selection of reverse thrust," the A300's tail struck the runway as the aircraft struggled to become airborne with only one engine at full power, the other engine at idle and a thrust reverser partially deployed, said the U.K. Air Accidents Investigation Branch (AAIB).

The serious incident occurred the night of Jan. 10, 2011, at East Midlands Airport in Castle Donington, Leicestershire. The aircraft was inbound on a cargo flight from Belfast, Northern Ireland, with the commander as the pilot flying. Surface winds at the airport were from 160 degrees at 20 kt, gusting to 30 kt, visibility was 15 km (9 mi) in rain, the ceiling was broken at 1,500 ft, and the temperature was 7 degrees C (45 degrees F).

While preparing for the instrument landing system (ILS) approach to Runway 09, the flight crew selected an approach speed of 144 kt, which included an addition of 9 kt to the calculated landing reference speed (V_{REF}) of 135 kt to compensate for the gusting crosswind.

"The commander stated that, as usual, he began to flare at about 30 ft AGL [above ground level] and, at about 20 ft AGL, closed the throttle control levers," the AAIB report said. "However, he considered that the aircraft's rate of descent was excessive and so increased the nose-up pitch."

The aircraft bounced after touching down on the runway at 135 kt. "The commander reduced the pitch attitude slightly to allow the aircraft to settle back onto the runway, without reducing the thrust," the report said. "The aircraft touched down again, heavily, before bouncing back into the air."

Although neither pilot later recalled having selected reverse thrust, it likely was "an automatic and subconscious action by the commander," said the report, noting that the flight crew operating manual (FCOM) states that the thrust reverse levers should be moved to the idle reverse position "immediately after touchdown of the main landing gear."

After the second bounce, the commander decided to go around and moved the throttles to the takeoff position. This caused the no. 1 engine thrust reverser to stow automatically. However, the no. 2 engine thrust reverser failed to stow completely, and the engine was kept at idle thrust by the full authority digital engine control (FADEC) system.

"The main wheels remained on the ground for approximately two seconds, during which the aircraft pitched up from 5 degrees to 12.5 degrees, finally lifting off at an airspeed of 127 kt," the report said. According to Airbus, a tail strike can occur at a pitch attitude of 11.2 degrees when the main landing gear struts are extended.

An airport traffic controller saw a shower of sparks emanate from the rear of the aircraft. "He described the aircraft appearing to fly very slowly over the runway during the go-around, rolling from side to side," the report said. "He was sufficiently concerned that he pressed the crash alarm."

With partial power, a partially deployed thrust reverser, low speed and the drag from the fully extended flaps, the A300 accelerated slowly. "The absence of high ground in the path of the aircraft was fortuitous, given the aircraft's severely compromised performance," the report said. "Eventually, the speed started to increase, and [the commander] instructed the copilot to reduce the flap setting to 'FLAP 20.' The aircraft then started to climb, at which time the gear was raised; and, as the aircraft continued to accelerate, the flaps were retracted fully."

The pilots then noticed a message on the electronic centralized aircraft monitor (ECAM) warning that the no. 2 thrust reverser was unlocked. The crew eventually shut down the no. 2 engine while completing the appropriate ECAM and quick reference handbook checklists. After reviewing weather conditions in the area, they decided to divert to London Stansted Airport, where the surface winds were from 170 degrees at 19 kt. They conducted a single-engine ILS approach to Stansted's Runway 22 and landed without further incident.

Examination of the A300 revealed that the tail skid shoe was scraped and that the fuselage skin near the tail skid was dented and buckled. The no. 2 engine thrust reverser translating sleeves were found to be only about halfway closed.

"The investigation found that the most likely reason for the no. 2 thrust reverser failure to stow was an intermittent loose connection in the auto-restow circuit," the report said. "It was further determined that conflicting operational guidance exists with respect to selection of reverse thrust and go-around procedures."

Airbus had published flight operations briefing notes on bounce recovery and rejected landings in May 2005. The briefing notes, in part, emphasized an FCOM statement that the flight crew is committed to a full-stop landing after selecting reverse thrust because of the possibility of system damage when reverse thrust is canceled while the reversers are in transit to the deployed configuration. "The information further states that thrust asymmetry resulting from one thrust reverser failing to restow has led to instances of significantly reduced rates of climb or departure from controlled flight," the report said. It noted that the operator of the incident aircraft had not distributed the information to its pilots, although the briefing notes were "freely available online."

The report said that the briefing-note information conflicts with a separate FCOM requirement for initiation of a go-around following a "high" bounce on landing. However, the report noted that Airbus planned a June 2012 revision of the FCOM, "re-emphasizing the need, under all circumstances, to complete a full-stop landing if reverse thrust has been selected."

Vibration Prompts Diversion

Boeing 737-800. Minor damage. No injuries.

The 737 was en route with 140 passengers and six crewmembers from Eindhoven, Netherlands, to Madrid, Spain, the morning of March 1, 2010, when the flight crew noticed an abnormal airframe vibration. They diverted the flight to Charleroi, Belgium, and landed the aircraft without further incident.

The aircraft was registered in Ireland, and Belgian authorities delegated the investigation of the serious incident to the Irish Air Accident Investigation Unit (AAIU). Investigators determined that the airframe vibration had been caused by oscillation of the elevator trim tab. Further examination of the trim system by Boeing, which manufactured the aircraft in 2008, revealed that the trim tab oscillation had been caused by accelerated wear of the bearing swage ring inside the attachment lug.

"The manufacturer determined that the bearing swage had worn because of 'workmanship escapement and improper tool usage' that would have occurred during component manufacture," the AAIU report said.

The airframe vibration had been caused by oscillation of the elevator trim tab.

"The manufacturer received a second report, from a different operator, of a severe elevator vibration event due to fractured aft attach lugs of the elevator tab control mechanism," said the report.

Boeing issued a service bulletin (SB) prescribing inspections and conditions for replacement of existing elevator trim tab control mechanisms on affected 737s; these actions subsequently were mandated by an emergency airworthiness directive, 2010-17-19, issued by the U.S. Federal Aviation Administration (FAA).

"The manufacturer is in the process of redesigning the tab mechanism to address the problems identified," said the AAIU report, issued in April. "An SB is being developed which installs a retention clip on the aft attach lugs of the tab mechanism; this should help to prevent future failures of the lugs."

Contamination Causes Control Jam

Cessna 560XL. No damage. No injuries.

The Citation was nearing its cruise altitude of 41,000 ft during a charter flight from Naples, Florida, U.S., to Washington, D.C., the afternoon of Dec. 2, 2011, when the flight crew received a "pitch trim miscompare" advisory. "After accomplishing the checklist items and disconnecting the autopilot, the flight crew had to exert considerable forward yoke pressure to maintain level flight," said the report by the U.S. National Transportation Safety Board (NTSB).

"The flight crew found the manual pitch trim control wheel to be 'frozen' in the forward position and were unable to move it," the report said.

'The flight crew had to exert considerable forward yoke pressure to maintain level flight.'

The crew declared an emergency, initiated a descent and diverted the flight to Orlando, Florida. After descending through 8,000 ft, the pitch trim control wheel released, and the trim system returned to normal operation. The crew canceled the emergency and landed the Citation at Orlando International Airport without further incident.

An inspection of the airplane by maintenance technicians revealed that the grease on both pitch-trim actuators was contaminated with water. Inspection and lubrication of the actuators is required every 1,200 hours. "According to the operator, the elevator trim actuators were last inspected and lubricated 562 hours prior to the incident," the report said.

Undetected Data Default

Boeing 737-400. No damage. No injuries.

After receiving load information, the flight crew used an electronic flight bag (EFB) to perform takeoff performance calculations for the flight with 142 passengers and eight crewmembers from Melbourne, Victoria, Australia, to Brisbane, Queensland, the morning of Nov. 22, 2011. They initially prepared for a departure from Runway 27, which was 2,286 m (7,500 ft) long; however, after the aircraft was pushed back from the gate, the automatic terminal information system announced that the runway in use had been changed to Runway 16, which was 3,657 m (12,000 ft) long.

The crew decided to conduct a reduced-thrust takeoff from an intersection that provided 2,345 m (7,694 ft) of available takeoff distance on Runway 16. "The first officer, who was the pilot flying (PF), recalculated the takeoff performance figures using the EFB and, in doing so, inadvertently used the distance for the full length of Runway 16, which was the default field in the EFB after runway selection, rather than the planned [intersection] departure distance," said the report by the Australian Transport Safety Bureau (ATSB).

The first officer handed the EFB to the captain, who also inadvertently used the default full distance while repeating the calculations. "The crew then cross-checked their calculation results, and, as both crew had made the same error, the figures were identical, and the opportunity to detect the mistake was missed," the report said.

The calculations included 166 kt for V_1, 171 kt for V_R and 174 kt for V_2, when the correct values for the intersection takeoff were 147 kt, 149 kt and 156 kt, respectively.

The captain, the pilot monitoring, realized that something was wrong with the takeoff data after the aircraft accelerated through 80 kt. "He subsequently called for the PF to rotate earlier than the nominated and displayed V_1 speed," the report said. "The recorded data shows the aircraft lifting off at around 165 kt. The crew reported the aircraft climbed away normally."

The pilots told investigators that they had not felt rushed during their preflight preparations. "Both crew reported having enough time to conduct the preflight preparations and to make the amendments to the EFB after push-back," the report said. "They also reported no distractions or interruptions from air traffic control or the cabin and no time pressure during the taxi to the runway."

Among actions taken by the aircraft operator after the incident was an EFB modification deleting the full-runway-length default and requiring the user to select full length or an intersection.

"Errors in the calculation, entry and checking of data are not uncommon in the airline operating environment," said the report, noting that ATSB in January 2011 issued the results of research on factors that contribute to such errors (*ASW*, 2/12, p. 53).

Belly Hits Runway on Go-Around

Eclipse Aviation 500. Substantial damage. No injuries.

The pilot knew that the flap-extension system was inoperative before beginning a private flight with one passenger from Anadyr, Russia, to Nome, Alaska, U.S. En route stops in Japan and Korea were uneventful, and visual meteorological conditions (VMC) prevailed when the Eclipse reached Nome the night of June 1, 2011. The pilot conducted a visual approach to Runway 10, which was 6,000 ft (1,829 m) long.

He told investigators that he noticed the airspeed was "exceptionally high" during the approach but decided to continue. "On short final to the runway, he realized that he was not going to be able to land and decided to go around," the NTSB report said.

The fuselage struck the runway during the go-around, but the pilot was able to continue flying the airplane. While returning to the runway, he realized that he had not extended the landing gear during the first approach. "He then lowered the landing gear and landed the airplane uneventfully," the report said.

The pilot noticed only a broken antenna and scrapes on the fuselage skid pad; however, he decided to conduct a test flight before boarding his passenger the next morning. "During the takeoff roll, the airplane encountered a vibration that the pilot said felt 'like a violent nosewheel shimmy,'" the report said. "He aborted the takeoff and elected to have the airplane inspected by a mechanic, [who] discovered that the center wing carry-through structure [had been] cracked when the belly skid pad deflected upward into a stringer that the structure was attached to."

Investigators found that the flap-extension system failure had been caused by overtravel of the inboard flap actuator during a flap retraction. The report noted that the EA 500 flight manual prohibits flight with an inoperative flap-extension system.

TURBOPROPS

Looking for the Runway

Xian MA60. Destroyed. 25 fatalities.

The flight crew persisted in conducting a visual approach in weather conditions that were not suitable for visual flight rules (VFR) flight, and, during the subsequent go-around, they were still looking for the runway when the aircraft entered a steep turn and descended into the sea, said the Indonesian National Transportation Safety Committee in its final report on the May 7, 2011, accident at Kaimana, West Papua, New Guinea.

The accident occurred during a scheduled flight to Kaimana from Sorong, both on the west coast of New Guinea. The report said that both pilots had relatively low time in type. The captain, 55, had logged about 200 of his 24,470 flight hours in MA60s. The copilot, 36, had 370 flight hours, including 234 hours in type.

Kaimana does not have an instrument approach procedure or any navigational aids, and the crew learned before beginning descent that visibility at the uncontrolled airport was 3 to 8 km (2 to 5 mi) in rain and that the ceiling was broken at 1,500 ft. As the aircraft neared Kaimana, the aerodrome flight information service officer told the crew that visibility at the airport had dropped to 2 km (1 1/4 mi) in heavy rain but that the weather south of the airport was clear.

The captain told the copilot, the PF, to continue on a southerly heading, paralleling the coastline and flying past the airport. The captain gave heading, airspeed, altitude and power setting instructions as the copilot made a wide left turn over the water and rolled out on a northerly heading, roughly aligned with the 1,600-m (5,250-ft) runway. The enhanced ground-proximity warning system (EGPWS) generated an aural "minimum, minimum" warning as the aircraft descended below 500 ft AGL.

After the copilot replied, for the third time, that the runway was not in sight, the captain initiated a go-around.

The MA60 was nearing the coastline south of the airport when the captain assumed control. He asked the copilot three times if he had the runway in sight. After the copilot replied, for the third time, that the runway was not in sight, the captain initiated a go-around.

The aircraft was at 376 ft (250 ft AGL) when the captain moved the power levers forward. However, because the crew had not conducted an approach briefing or the approach and landing checklists, the engine regime selector was still set to "CRUISE," rather than to "TOGA" (takeoff/go-around); and the torque produced by the left and right engines increased to 70 percent and 82 percent, respectively, rather than to about 95 percent, the report said. The captain began a left turn toward the sea, apparently to avoid high terrain east of the airport, and the flaps and the landing gear were retracted as the aircraft began to climb.

The report said that both pilots likely were preoccupied with looking for the runway as the left bank angle increased from 11 degrees to 33 degrees. The MA60 climbed about 200 ft, and airspeed was 124 kt when it began to descend rapidly, with the bank angle increasing to 38 degrees. The descent rate increased to about 3,000 fpm, and the EGPWS generated a "terrain, terrain" warning just before the aircraft struck the water about 800 m (2,625 ft) southwest of the runway. All aboard — the 19 passengers, two engineers, two flight attendants and the pilots — were killed.

Cellphone Battery Emits Smoke

Saab 340B. No damage. No injuries.

The aircraft was being taxied to the gate after landing in Sydney, New South Wales, Australia, on Nov. 25, 2011, when a cabin crewmember noticed smoke accumulating near a passenger seat. The crewmember "instructed the passenger to throw the source of the smoke into the aisle [and] then discharged a fire extinguisher onto what was later identified as a mobile telephone," the ATSB report said. "After several minutes, the smoke cleared."

Examination of the cellphone revealed that a small metal screw, likely misplaced in the battery bay during a screen repair by an unauthorized service facility six months earlier, had punctured the lithium battery casing, causing an internal short circuit that led to heating and thermal runaway, the report said.

The report said that the incident was a "first of its type" in Australia that "highlights the risks associated with the use of nonauthorized agents for the repair of lithium battery-powered devices and reinforces Civil Aviation Safety Authority recommendations that these devices should be carried in the cabin and not in checked-in baggage."

Illusion Suspected in Tanker Crash

Convair 580. Destroyed. Two fatalities.

The flight crew circled the tanker while watching the crew of a "bird dog" Rockwell 690, which has operating speeds similar to those of the Convair, demonstrate the maneuvering required to drop retardant on a wildfire in Lytton, British Columbia, Canada, on July 31, 2010. "The bombing run required crossing the edge of a ravine in the side of the Fraser River canyon before descending on the fire located in the ravine," said the report by the Transportation Safety Board of Canada (TSB).

The established minimum altitude to cross the ravine was 3,100 ft, which provided about

100 to 150 ft of clearance above the trees on the edge of the ravine. A 90-degree left turn and a 900-ft descent into the ravine then were required to position the aircraft for the drop.

The Convair was near its maximum operating weight as it descended for its first drop. The crew flew the aircraft parallel to the edge of the ravine and made a descending left turn toward the rising terrain leading to the edge of the ravine. The Rockwell crew saw the Convair strike trees atop the edge of the ravine, jettison retardant, enter a steep bank and spin to the bottom of the ravine.

Examination of the accident site indicated that the Convair was climbing through 3,020 ft when it struck the trees and that both engines were producing maximum power. Investigators determined that, while approaching the upsloping terrain, the pilots might have experienced a visual illusion that the aircraft was higher that it actually was and that the resulting spatial disorientation "may have precluded recognition, or an accurate assessment, of the flight path profile in sufficient time to avoid the trees on the rising terrain."

"When the bombing run flight path was flown by TSB investigators several weeks after the accident, a visual illusion was observed," the report said. "During the combined downwind/base leg at 3,100 ft to 3,200 ft, proceeding toward the known site of the initial tree strikes, estimated 1 nm [2 km] away, the site appeared to be about 400 ft to 500 ft below the aircraft altitude, when it was actually 150 ft below." The report noted that the test flight was conducted in "good daytime visual conditions," while the accident occurred one hour before sunset with visibility between 6 and 9 mi (10 and 14 km).

PISTON AIRPLANES

Flaps, Gear Down on Departure

Cessna 421B. Destroyed. Five fatalities.

Dark night VMC prevailed when the 421 struck terrain while departing from Alpine, Texas, U.S., for an emergency medical services flight on July 4, 2010. The pilot, two flight nurses, the patient and a passenger were killed in the crash, which occurred at 0015 local time.

"Examination of the ground scars and wreckage indicated that the landing gear was down, the flaps were down and the engines were operating at a high power setting at the time of impact," the NTSB report said.

The safety board concluded that the probable cause of the crash was the "degraded performance of the airplane" that resulted because the pilot had not properly set the flaps before takeoff and had not retracted the landing gear after takeoff.

"Although the investigation was unable to determine how long the pilot had been awake before the accident or his sleep schedule in the three days prior to the accident, it is possible that the pilot was fatigued, as the accident occurred at a time when the pilot was normally asleep," the report said.

Control Lost in Turbulence

De Havilland DHC-2. Substantial. One fatality.

After a cargo flight the morning of July 23, 2010, the pilot was returning to his home base in Ketchikan, Alaska, U.S., which had low clouds, rain and surface winds gusting to 40 kt. The pilot requested a special VFR clearance into the Class E airspace surrounding the airport and was told by a flight service specialist to remain clear of the area until the clearance could be issued, the NTSB report said.

When the specialist radioed the pilot about eight minutes later to issue the clearance, there was no response. A company dispatcher, who was monitoring the float-equipped Beaver's progress on a moving-map display, saw the airplane enter a holding pattern about 5 nm (9 km) from the airport and then disappear from the display soon thereafter.

A witness saw the airplane flying very low over treetops. "He said that as the airplane passed overhead, it turned sharply to the left," the report said. "As he watched the airplane, the wings rocked violently from side to side, and the nose pitched up and down. As the airplane passed low over hilly, tree-covered terrain, it rolled to the right, the right wing struck a large tree and separated, and the airplane rolled inverted and descended [out of sight] behind a stand of trees."

NTSB determined that the probable cause of the accident was "the pilot's decision to continue the flight toward his destination in significant turbulence and downdrafts, and his subsequent failure to maintain control of the airplane while flying low over rising terrain."

HELICOPTERS

Gull Shatters Windshield

Agusta A109C. Substantial damage. One minor injury.

The Agusta was at 750 ft AGL and cruising at 150 kt when a bird struck and shattered the left windshield the morning of July 5, 2011. "The commander, who was flying the helicopter from the left seat, was struck by pieces of windshield and parts of the bird," the AAIB report said. The copilot assumed control, declared an emergency and landed the helicopter in a field near Kew Bridge, England.

The bird was identified as a herring gull, which typically weighs 690 to 1,495 g (24 to 53 oz).

The A109C was certified in 1989 under U.S. Federal Aviation Regulations Part 27, the airworthiness standards for normal category rotorcraft. The report said that unlike Part 29, which requires the windshields on transport category rotorcraft to meet specific standards for bird strike resistance, Part 27 — and its European Aviation Safety Agency (EASA) counterpart, Certification Specification 27 — require only that "windshields and windows must be made of material that will not break into dangerous fragments."

The report noted, however, that the FAA and EASA currently are reviewing recommendations to revise normal category rotorcraft windshield requirements.

Loose Cover Hits Rotor Blades

Eurocopter AS350-B3. Substantial damage. No injuries.

After completion of a 100-hour maintenance inspection in Aurora, Oregon, U.S., the afternoon of July 27, 2011, the pilot was conducting a positioning flight with three passengers to the helicopter's home base in Dallesport, Washington, when he "felt something that he described as similar to a bird strike," the NTSB report said.

The pilot made a precautionary landing at the Portland-Troutdale (Oregon) Airport and found that a portion of the tail rotor drive shaft cover was missing and that one main rotor blade and two tail rotor blades were damaged.

Investigators determined that the cover had not been secured properly during the maintenance inspection. The company's director of maintenance said that the maintenance technicians who had performed the inspection and the pilot likely had "looked at the cover before the accident flight and presumed that it was secure or had been secured by someone else."

Pole Struck While Taxiing

Aerospatiale AS332-L1. Substantial damage. Five minor injuries.

The helicopter was returning to Port Keats Airport, Northern Territory, Australia, during a round-trip charter flight to an offshore platform the afternoon of July 21, 2011, when the flight crew saw two Swearingen Metroliners on the apron where they had intended to park.

After landing, the pilot decided to taxi the Super Puma past the Metroliners and park it at the far corner of the apron. "His focus was directed to maintaining adequate clearance from the aircraft wing tip on his right, while directing the copilot [in the left seat] to ensure there was adequate clearance from a light pole to the left of the helicopter," the ATSB report said.

The helicopter toppled onto its left side when the main rotor blades struck the light pole. The pilots and three of the four passengers sustained minor injuries but were able to exit upward through the right side windows. A baggage handler and two people in a parked vehicle received minor injuries from flying debris; and three other vehicles and one of the Metroliners were damaged.

Preliminary Reports, May 2012

Date	Location	Aircraft Type	Aircraft Damage	Injuries
May 2	Yambio, South Sudan	Cessna 208B	substantial	2 minor, 9 none
The Grand Caravan flipped over after striking a drainage ditch on landing.				
May 2	Valley Falls, Kansas, U.S.	Bell 206B	substantial	3 minor
The JetRanger was hovering out of ground effect, with a quartering tailwind, when the pilot began a right turn. Tail rotor effectiveness was lost, and the pilot was not able to recover from the spin.				
May 5	Tintamarre Island, St. Martin, France	Piper Cheyenne III	destroyed	4 fatal
The Cheyenne crashed in the sea shortly after taking off from Grand Case for an air ambulance flight to Martinique.				
May 9	Mount Salak, Java, Indonesia	Sukhoi Superjet 100	destroyed	48 fatal
The airplane was descending during a demonstration flight when it struck the cloud-shrouded mountain.				
May 9	Mazamari, Peru	Mil Mi-17	destroyed	1 fatal, 17 serious
The police helicopter crashed in the jungle after a rotor blade separated in flight.				
May 11	Guatemala City, Guatemala	Convair 580F	substantial	2 none
The nose landing gear collapsed when the Convair drifted left while landing.				
May 11	Chanute, Kansas, U.S.	Cessna 401	destroyed	4 fatal, 1 serious
Visual meteorological conditions prevailed when the airplane struck a tree during an apparent forced landing.				
May 13	Peachland, British Columbia, Canada	de Havilland DHC-2	destroyed	3 fatal
The Beaver was observed flying over a highway before it crashed out of control in a densely wooded area.				
May 14	Marpha, Nepal	Dornier 228-212	destroyed	15 fatal, 6 serious
The Dornier was descending to land at Jomsom when the flight crew told air traffic control that they were returning to Pokhara. Shortly thereafter, the aircraft struck a mountain about 5 km (3 nm) from Jomsom.				
May 17	Munich, Germany	ATR 72-212A	substantial	62 minor/none
The flight crew shut down the right engine while returning to Munich after smoke was reported in the cabin. The nose landing gear collapsed when the airplane veered off the runway on landing.				
May 17	over Romania	Airbus A320-214	minor	155 none
The A320 was en route from Warsaw, Poland, to Hurghada, Egypt, when the cabin suddenly depressurized. An oxygen generator overheated when the oxygen masks deployed, and the fire was extinguished by a crewmember. The airplane was landed without further incident in Sofia, Bulgaria.				
May 17	Houston, Texas, U.S.	Shorts SD3-60	substantial	2 none
The cargo airplane was slightly over maximum takeoff weight, and the pilots used higher-than-normal engine power to consume fuel and reduce weight while taxiing to the runway. The wheel brakes overheated, causing the tires to deflate, and a fire erupted in the right wheel well.				
May 18	Iquique, Chile	Rockwell 500S	destroyed	2 fatal
The airplane crashed about 30 km (16 nm) offshore after departing on a night fish-survey flight.				
May 23	Hallandale, Florida, U.S.	Bombardier Challenger 600	substantial	2 none
Shortly after the Challenger departed from Opa Locka, the cabin door separated from the airplane and fell onto an unoccupied golf course. The flight crew conducted an uneventful emergency landing at Fort Lauderdale.				
May 25	Cochrane, Ontario, Canada	de Havilland DHC-2	destroyed	2 fatal, 1 serious
The float-equipped Beaver crashed while landing in strong winds on Lillabelle Lake.				
May 28	Toronto, Canada	Boeing 777-300ER	minor	334 none
The flight crew returned to the airport after the no. 2 engine lost power on departure for a flight to Japan. Engine debris struck and damaged several vehicles, but no one on the ground was injured.				
May 28	Gulf of Mexico	Bell 206L-4	substantial	1 fatal
Inbound from Grand Isle, Louisiana, U.S., the pilot was attempting to land on an offshore platform when the main rotor blades struck a derrick. The LongRanger entered a spin, the tail boom separated, and the helicopter struck the water inverted and sank.				

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

<table>
<tr><th colspan="7">Selected Smoke, Fire and Fumes Events in the United States, February–March 2012</th></tr>
<tr><th>Date</th><th>Flight Phase</th><th>Airport</th><th>Classification</th><th>Subclassification</th><th>Aircraft</th><th>Operator</th></tr>
<tr><td>Feb. 6</td><td>Climb</td><td>—</td><td>Air distribution system</td><td>Smoke</td><td>Cessna 680CE</td><td>Executive Jet Aviation</td></tr>
<tr><td colspan="7">After takeoff and climbing through 10,000 ft, a passenger informed the flight crew of an odor and haze in the cabin. Both flight crewmembers saw a white/blueish haze, along with a strong pungent odor that was difficult to identify. One passenger complained of eye irritation. The copilot went aft to try to identify the source of the problem. The pilots ran the "Abnormal" checklist for environmental system smoke and an odor of unknown source. The flight was diverted.</td></tr>
<tr><td>Feb. 6</td><td>Cruise</td><td>Kansas City, Missouri (MCI)</td><td>Flight deck windows</td><td>Smoke</td><td>Embraer EMB-170</td><td>Republic Airlines</td></tr>
<tr><td colspan="7">While in cruise flight, pilots noticed an odor, although it was only perceptible in the flight deck. The crew decided to divert and declared an emergency. Maintenance performed an operations check of air conditioning systems and packs, ran the engines, and noticed that the windshield heater element was causing the odor. Maintenance replaced the captain's windshield.</td></tr>
<tr><td>Feb. 7</td><td>Cruise</td><td>—</td><td>Flight compartment equipment</td><td>Smoke</td><td>Embraer EMB-135LR</td><td>American Eagle Airlines</td></tr>
<tr><td colspan="7">The crew reported a strong burning smell in the cockpit during flight, then declared an emergency and diverted. The aircraft was landed without further incident and removed from service. Maintenance performed a visual inspection of the internal air recirculation fan, found insulation tape obstructing the fan intake and removed the tape.</td></tr>
<tr><td>Feb. 19</td><td>Climb</td><td>—</td><td>Air distribution system</td><td>Smoke</td><td>McDonnell Douglas MD-11F</td><td>United Parcel Service</td></tr>
<tr><td colspan="7">After takeoff, when the air conditioning packs came on, smoke and fumes appeared briefly in the cockpit. The crew turned the packs to "econ off" and the smoke went away immediately. Fumes dissipated in 20 minutes. Maintenance checked the coalescer bags and found the bags clean. No debris or other abnormalities were found.</td></tr>
<tr><td>Feb. 21</td><td>Descent</td><td>—</td><td>Air distribution fan</td><td>Smoke</td><td>Boeing 737</td><td>Southwest Airlines</td></tr>
<tr><td colspan="7">At Flight Level (FL) 360, 15 mi from top of descent, cabin crew reported a strong burning odor in the vicinity of row 22. Technicians removed and replaced an equipment cooling fan.</td></tr>
<tr><td>Feb. 26</td><td>Climb</td><td>San Juan, Puerto Rico (SJU)</td><td>Engine oil system</td><td>Fluid loss, smoke</td><td>Cessna 690CE</td><td>Executive Jet Aviation</td></tr>
<tr><td colspan="7">During climbout through 5,000 ft, the cabin and cockpit started to fill with fumes and smoke, irritating the eyes and throats of both pilots. They donned oxygen masks. Bleed air for both engines was turned to the "OFF" position. The pilots declared an emergency and accomplished a successful landing. Technicians replaced the right engine.</td></tr>
<tr><td>Feb. 26</td><td>Cruise</td><td>Kansas City, Missouri (MCI)</td><td>Air distribution fan</td><td>Smoke</td><td>McDonnell Douglas MD-82</td><td>American Airlines</td></tr>
<tr><td colspan="7">The crew reported an odor in the cabin and flight deck. They declared an emergency and diverted the flight to MCI, where it was landed without incident. Maintenance found a tripped recirculation fan circuit breaker and the fan inoperative. They replaced the recirculation fan and filter.</td></tr>
<tr><td>Feb. 29</td><td>Descent</td><td>—</td><td>Air distribution fan</td><td>Smoke</td><td>Boeing 737</td><td>Southwest Airlines</td></tr>
<tr><td colspan="7">On descent, approaching Flight Level 200, a flight attendant reported hazy smoke and an acrid "burning plastic" smell. The pilots turned off the recirculation fan, declared an emergency and landed. Technicians replaced the recirculation fan.</td></tr>
<tr><td>March 2</td><td>Climb</td><td>Dallas-Fort Worth, Texas (DFW)</td><td>Cabin cooling system</td><td>Smoke, warning indication</td><td>Boeing 767</td><td>American Airlines</td></tr>
<tr><td colspan="7">The crew reported that the cabin gradually filled with oil fumes and smoke. The aft lavatory smoke detectors also began to chime. The crew declared an emergency and returned to DFW for an uneventful landing. Maintenance replaced the primary and secondary heat exchangers and air cycle machine.</td></tr>
<tr><td>March 5</td><td>Climb</td><td>—</td><td>Engine oil system</td><td>Smoke, unknown</td><td>Canadair CL-600</td><td>Atlantic Southeast Airlines</td></tr>
<tr><td colspan="7">After takeoff, the cabin filled with smoke. The crew declared an emergency and returned to the departure airport. Technicians found both engines had been "overserviced," with oil drained excessively from the oil tanks. They serviced both engines' tanks to the full mark, and replaced both coalescer bags.</td></tr>
<tr><td>March 10</td><td>Descent</td><td>—</td><td>Communication system wiring</td><td>Burning, smoke</td><td>Embraer EMB-145LR</td><td>Atlantic Southeast Airlines</td></tr>
<tr><td colspan="7">The crew reported that during descent, they perceived what smelled like an electrical fire. The aircraft was landed without incident, where maintenance inspected it and repaired wiring.</td></tr>
<tr><td>March 27</td><td>Cruise</td><td>—</td><td>Air distribution fan</td><td>Smoke</td><td>Boeing 777</td><td>Omni Air Express</td></tr>
<tr><td colspan="7">Cabin crewmembers reported electrical fumes. The fumes dissipated after the recirculation fans were selected "OFF."</td></tr>
<tr><td colspan="7">Source: Safety Operating Systems and Inflight Warning Systems</td></tr>
</table>

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