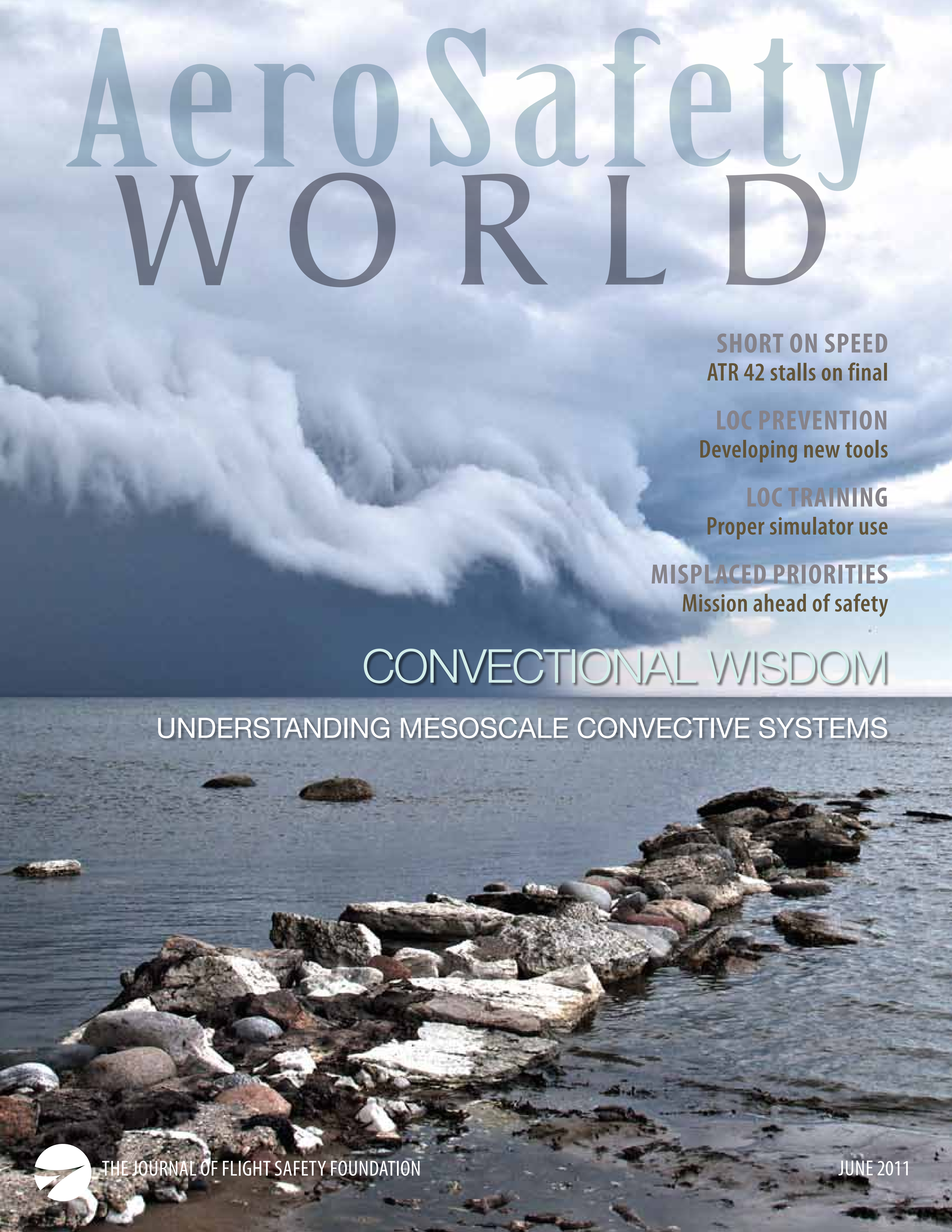

AeroSafety WORLD

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ATR 42 stalls on final

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MISPLACED PRIORITIES
Mission ahead of safety

CONVECTIONAL WISDOM

UNDERSTANDING MESOSCALE CONVECTIVE SYSTEMS

THE JOURNAL OF FLIGHT SAFETY FOUNDATION

JUNE 2011

Wide-Angle View

I recently was part of a very impressive safety meeting in Mexico City, hosted by the Latin American and Caribbean Air Transport Association (ALTA). First, I have to commend the operators and the regulators in that region for making real progress in aviation safety. Working side by side to improve safety, they have been doing all of the right things, targeting their high-risk issues and acting on them. It is clear that nobody in this region takes safety for granted.

Second, it was heartening to see that the safety focus extends all the way to the top of the airlines. In an impressive and insightful presentation, Enrique Beltranena, the chief executive officer (CEO) of Volaris Airlines in Mexico, spoke for more than an hour on safety, insurance and their relationship to the bottom line. I don't know many CEOs who can talk about safety in that depth, and with passion.

He discussed in detail the cyclical nature of the global and regional insurance market, making the point that rates and underwriting standards are likely to tighten soon. He presented an in-depth financial analysis showing that airlines in Latin America spend 2-3 percent of their operating costs on insurance, versus about 1 percent for airlines in the United States and Europe. In a market with tight profit margins, that expense differential has a serious impact on competitiveness, he said. In addition, "airlines with recent catastrophic events have incremental hits that at least double the hull premium," he said. He also noted that younger airlines are penalized by the underwriters even more than the airlines that have had catastrophic events.

I think the most important point from Beltranena's analysis was his discussion of the "contagious nature" of catastrophic events. The numbers show that an airline's insurance rate can be impacted by things that are outside the company. Risk is pooled across carriers in a region, so an accident in any carrier's aircraft can impact the insurance rates across that region. Likewise, an audit downgrading a civil aviation authority can have a significant effect on the rates for airlines in that nation. Insurers want to know that good surveillance is going on in a given country and across a region.

Beltranena's observations were music to my ears, clearly making a hard business case for investment in safety that goes beyond the boundaries of individual companies. Freeing up a safety manager to write a paper or make a presentation at a seminar may not prevent an accident in your own airline but may prevent an accident in another. Ultimately that is good business, for, as Beltranena explained, a rising safety tide does lift all boats.

Likewise, lending a hand to your regulator makes financial sense, especially if there is a risk that it may be downgraded by the United States or the European Union. Keep in mind that regulators often are underfunded and have less political clout than the big airlines. Using a little of your airline's political capital is a cheap way to protect against the potentially devastating business consequences of a downgrade.

In our business, always focused on the bottom line, it is good to see that leaders are taking a wide-angle view of the business consequences of making the industry safe. It makes our job a little easier.

William R. Voss
President and CEO
Flight Safety Foundation

AeroSafetyWORLD

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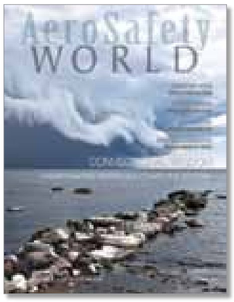

About the Cover
Mesoscale convective systems
can present serious threats to aviation..
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If you have an article proposal, manuscript or technical paper that you believe would make a useful contribution to the ongoing dialogue about aviation safety, we will be glad to consider it. Send it to Director of Publications J.A. Donoghue, 801 N. Fairfax St., Suite 400, Alexandria, VA 22314-1774 USA or donoghue@flightsafety.org.

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Changes

With this edition of *AeroSafety World*, the magazine now has been in existence for five full years. To review for those new to the party, *ASW* was created to consolidate the subject matter covered by seven publications that Flight Safety Foundation produced until 2006, and that can still be found on our Web site as archived resources. The idea behind its creation was that *ASW* should be easier to read and easier on the eye, attracting a larger readership while retaining the serious attitude toward its subject matter that was the hallmark of the retired publications. In that, I think, we have been successful.

Another mission assigned to the magazine was to attract paid advertising to defer the not-inconsiderable cost of producing the publication. In that, we have not been as successful. But, in order to be more attractive to advertisers and to adhere to the Foundation's charter of spreading safety information far and wide, it was decided to provide a free digital version of the publication via our Web site. This gained *ASW* a wide readership, but still we have been unable to attract sufficient advertising. This was caused, in part, by the fact that while the editorial talent associated with the magazine is excellent, the same can't be said of our publishing knowledge and experience. While editorial talent is essential, and obvious, for any publication to be successful, less obvious is the amount of publishing expertise required, and for that failing I am chiefly responsible.

One more thing: Due to the long succession of major FSF projects produced by the Foundation's Publications Department — such as the recent *Approach and Landing Accident Reduction Tool Kit Update* — our magazine schedule has slipped. Most of you will be getting this June issue in late July, and that is unacceptable.

So, to correct these problems, and more, several things have happened or are going to happen.

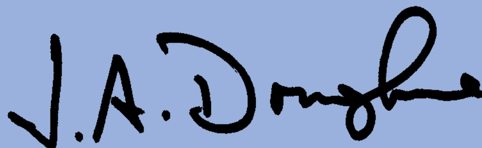
For starters, we now are selling subscriptions to the printed version of *ASW* on our Web site, US$60 for subscribers in the United States, US$80 for all others, the difference in price strictly due to postage charges.

Second, we have enlisted the experience of a skilled aviation media firm, Emerald Media, to sell our print and Web advertising and to market the Foundation's efforts. Associated with this change, you soon will see a reader survey in which we will be asking what you like and don't like in the magazine. Please let us know what you think.

And third, the next issue of *ASW* will be dated the July/August issue to help us catch up with the calendar. Those of you who have annual subscriptions, mostly through bulk purchases by some airlines, will have your subscriptions extended one additional month into the next year.

Selling subscriptions is something I've always wanted to do, believing there are still many advantages to reading a printed publication but until now lacking the software to make it happen.

There may be some other changes in the future as we at Flight Safety Foundation — and our products — evolve to account for the realities we all face. However, I promise to remain dedicated to giving our readers the most thorough and timely safety information available.



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

Serving Aviation Safety Interests for More Than 60 Years

Flight Safety Foundation is an international membership organization dedicated to the continuous improvement of aviation safety. Nonprofit and independent, the Foundation was launched officially in 1947 in response to the aviation industry's need for a neutral clearinghouse to disseminate objective safety information, and for a credible and knowledgeable body that would identify threats to safety, analyze the problems and recommend practical solutions to them. Since its beginning, the Foundation has acted in the public interest to produce positive influence on aviation safety. Today, the Foundation provides leadership to more than 1,075 individuals and member organizations in 130 countries.

Member**Guide**

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Greg Marshall, BARS program director — marshall@flightsafety.org

JULY 1 ➤ Human Factors Analysis and Classification System Refresher. HFACS Inc. Alexandria, Virginia, U.S. <info@hfacs.com>, <www.hfacs.com/store/hfacshfix-workshop-washington-dc>, 800.320.0833.

JULY 3–8 ➤ Fifth International Summer School on Aviation Psychology. European Association for Aviation Psychology. Graz, Austria. <www.eaap.net/read/56/5th-international-summer-school-on-aviation.html>.

JULY 4 ➤ Introduction to IS-BAO. International Business Aviation Council and Colt International. Calgary, Alberta, Canada. <www.cbaa-acaa.ca/convention/cbaa-2011-1/introduction-to-is-bao-workshop-and-auditor-accreditation-workshop>, +1 866.759.4132.

JULY 5 ➤ Aviation Human Factors Course. Convergent Performance and Global Aerospace Underwriting Managers. Calgary, Alberta, Canada. <www.cbaa-acaa.ca/convention/cbaa-2011-1/aviation-human-factors-course>, +1 866.759.4132.

JULY 11–12 ➤ Quality Assurance for SMS. DTI Training. Winnipeg, Manitoba, Canada. <dtitraining@juno.com>, <staboada@dtiatlanta.com>, <www.dtiatlanta.com>, +1 866.870.5490, +1 770.434.5310.

JULY 13 ➤ Basic Auditing Principles. DTI Training. Winnipeg, Manitoba, Canada. <dtitraining@juno.com>, <staboada@dtiatlanta.com>, <www.dtiatlanta.com>, +1 866.870.5490, +1 770.434.5310.

JULY 14 ➤ Transitioning to EASA Requirements for Operators. Baines Simmons. Chobham, Surrey, England. Zoe Martin, <zoe.martin@bainessimmons.com>, <www.bainessimmons.com/directory-course.php?product_id=134>, +44 (0)1276 855412.

JULY 18–22 ➤ SMS Principles. MITRE Aviation Institute. McLean, Virginia, U.S. Mary Beth Wigger, <mbwigger@mitre.org>, <www.mitremai.org>, +1 703.983.5617.

JULY 18–27 ➤ SMS Theory and Application. MITRE Aviation Institute. McLean, Virginia, U.S. Mary Beth Wigger, <mbwigger@mitre.org>, <www.mitremai.org>, +1 703.983.5617.

JULY 19–21 ➤ Human Factors and Analysis Classification System Workshop. HFACS Inc. Washington, D.C. <info@hfacs.com>, <www.hfacs.com/store/hfacshfix-workshop-washington-dc>, 800.320.0833.

JULY 21–22 ➤ EASA Regulations for Flight Operations Inspectors. Baines Simmons. Zoe Martin, <zoe.martin@bainessimmons.com>, <www.bainessimmons.com/directory-course.php?product_id=133>, +44 (0)1276 855412.

JULY 25–26 ➤ Quality Assurance for SMS. DTI Training. Yellowknife, Northwest Territories, Canada. <dtitraining@juno.com>, <staboada@dtiatlanta.com>, <www.dtiatlanta.com>, +1 866.870.5490, +1 770.434.5310.

JULY 27 ➤ Basic Auditing Principles. DTI Training. Yellowknife, Northwest Territories, Canada. <dtitraining@juno.com>, <staboada@dtiatlanta.com>, <www.dtiatlanta.com>, +1 866.870.5490, +1 770.434.5310.

JULY 29 ➤ SMS Overview/Safety Culture. The Aviation Safety Group. Myrtle Beach, South Carolina, U.S. Robert Baron, Ph.D., <www.tacgworldwide.com/07292011.htm>, 800.294.0872.

JULY 31–AUG. 2 ➤ Large Hub Winter Operations and Deicing Conference and Exhibition. American Association of Airport Executives. Seattle. Natalie Fleet, <natalie.fleet@aaae.org>, <events.aaae.org/sites/110705>, +1 703.824.0500, ext. 132.

AUG. 1–5 ➤ Investigation Management. Southern California Safety Institute. San Pedro, California, U.S. Denise Davalloo, <registrar@scsi-inc.com>, <www.scsi-inc.com/IM.php>, 800.545.3766; +1 310.517.8844, ext. 104.

AUG. 2–4 ➤ Partnering to Build the Next Generation Advanced Qualification Program (AQP). Delta Air Lines. Atlanta. Michelle Farkas, Michelle.Farkas@Delta.com, <aviationsafetyconference.com>, +1 404.715.1174.

AUG. 8–16 ➤ SMS Expanded Implementation Course. The Aviation Consulting Group. Fort Lauderdale/Miami area, Florida, U.S. Bob Baron, Ph.D., <tacg@sccoast.net>, <www.tacgworldwide.com>, 800.294.0872, +1 954.803.5807.

AUG. 15–16 ➤ Quality Assurance for SMS. DTI Training. Toronto. <dtitraining@juno.com>, <staboada@dtiatlanta.com>, <www.dtiatlanta.com>, +1 866.870.5490, +1 770.434.5310.

AUG. 15–19 ➤ Safety Management for Aviation Maintenance. University of Southern California Viterbi School of Engineering. Los Angeles. Thomas Anthony, <aviation@usc.edu>, <viterbi.usc.edu/aviation/courses/maint.htm>, +1 310.342.1349.

AUG. 17 ➤ Basic Auditing Principles. DTI Training. Toronto. <dtitraining@juno.com>, <staboada@dtiatlanta.com>, <www.dtiatlanta.com>, +1 866.870.5490, +1 770.434.5310.

AUG. 30–SEPT. 2 ➤ Fatigue Risk Management Systems (FRMS) Symposium and FRMS Forum. International Civil Aviation Organization. Montreal. <FRMS2011@icao.int>, <www2.icao.int/en/FRMS2011/Pages/Home.aspx>, +1.514.954.8219.

AUG. 31–SEPT. 1 ➤ EASA Regulations for Flight Operations Inspectors. Baines Simmons. Zoe Martin, <zoe.martin@bainessimmons.com>, <www.bainessimmons.com/directory-course.php?product_id=133>, +44 (0)1276 855412.

SEPT. 1–2 ➤ Aviation Safety Management Systems Overview Workshop. ATC Vantage. Tampa, Florida, U.S. Theresa McCormick, <info@atcvantage.com>, <www.atcvantage.com/sms-workshop.html>, +1 727.410.4759.

SEPT. 7–9 ➤ 7th Annual FAA International Aviation Safety Forum. U.S. Federal Aviation Administration. Washington. Details to be announced.

SEPT. 8–9 ➤ Flight Safety Conference. Flightglobal and Flight International. London. Lizzie Law, <lizzie.law@rbi.co.uk>, <www.flightglobalevents.com/flightsafety2011?cp=EMC-FGCON_SAFE1_20110411>, +44 (0)20 8652 8818.

SEPT. 12–15 ➤ ISASI 2011 Annual Seminar. International Society of Air Safety Investigators. Salt Lake City. <isasi@erols.com>, <www.isasi.org/isasi2011.html>, +1 703.430.9668.

SEPT. 12–15 ➤ Bird Strike North America Conference. Bird Strike Association of Canada and Bird Strike Committee USA. Niagara Falls, Ontario, Canada. <birdstrike@icsevents.com>, <www.birdstrikecanada.com/CanadaConference.html>, +1 604.681.2153.

SEPT. 12–16 ➤ Safety Management Systems Complete. Southern California Safety Institute. San Pedro, California, U.S. Denise Davalloo, <registrar@scsi-inc.com>, <www.scsi-inc.com/safety-management-systems-complete.php>, 800.545.3766; +1 310.517.8844, ext. 104.

SEPT. 12–23 ➤ Aviation Safety Management Systems. University of Southern California Viterbi School of Engineering. Los Angeles. Thomas Anthony, <aviation@usc.edu>, <viterbi.usc.edu/aviation/courses/asms.htm>, +1 310.342.1349..

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

If you have a safety-related conference, seminar or meeting, we'll list it. Get the information to us early. Send listings to Rick Darby at Flight Safety Foundation, 801 N. Fairfax St., Suite 400, Alexandria, VA 22314-1774 USA, or <darby@flightsafety.org>.

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

Safety News

Laser Penalties

The U.S. Federal Aviation Administration (FAA) says it will begin imposing civil penalties against people who shine lasers into aircraft cockpits.

"Shining a laser into the cockpit of an aircraft is not a joke," FAA Administrator Randy Babbitt said. "These lasers can temporarily blind a pilot and make it impossible to safely land the aircraft, jeopardizing the safety of the passengers and people on the ground."

The FAA said it was acting in accordance with Federal Aviation Regulations — in particular, with one provision that prohibits interfering with flight crewmembers operating an aircraft. The FAA previously has cited the regulation in cases involving passengers interfering with crewmembers performing their duties. The maximum penalty is $11,000 per violation.

U.S. Department of Transportation

"Today's interpretation reflects the fact that pointing a laser at an aircraft from the ground could seriously impair a pilot's vision and interfere with the flight crew's ability to safely handle its responsibilities," the FAA said.

In the first five months of 2011, pilots reported more than 1,100 incidents of laser cockpit illumination. The number of reported incidents has steadily risen from about 300 in 2005 to 2,836 in 2010.

The FAA attributes the increase in reported events in part to increased pilot awareness of the reporting system. The agency also cited the wider availability of inexpensive laser devices.

Legislation is pending in Congress to criminalize the intentional aiming of a laser device at an aircraft, although some defendants have been prosecuted under existing laws. Several states and cities already have passed similar measures, and the FAA said it will work with law enforcement officials to help in criminal prosecutions.

Icing Issues

A study conducted for the European Aviation Safety Agency (EASA) has recommended stricter standards for ground deicing and anti-icing and increased cooperation between the industry and aviation authorities.

The study called for continued collection and analysis of safety data, development of comprehensive regulations and guidance for operators, an ongoing review of whether regulations are being applied consistently throughout Europe and further research into the performance of deicing/anti-icing fluids.

"Overall, if the EASA adopted the recommendations, there would be a beneficial reduction in the risks associated with deicing/anti-icing," the report said. "Implementing some of the recommendations would have an initial negative economic impact; however, the gains expected, in the long term, from reduced incidents and losses will more than compensate economically. Furthermore, with improved standards of deicing/anti-icing, it is expected that fluid use and application will become more efficient, thereby providing not just economic but also environmental benefits."

The study was ordered in the aftermath of the winters of 2005 and 2006, when a number of events were reported involving "stiff or frozen" flight controls, many of them in aircraft without powered flight control systems (*ASW*, 9/06, p. 26).

"These events were attributed to the rehydration and subsequent freezing of the residues of thickened anti-icing fluids previously applied to the aircraft," the report said.

At the time, the U.K. Air Accidents Investigation Branch and the German Federal Bureau of Aircraft Accident Investigation, among others, issued safety recommendations that called for improving the availability of Type I deicing/anti-icing fluids and encouraging their use, and for consideration of approving and certifying deicing/anti-icing service providers and training organizations.

© Eneri LLC/iStockphoto

Type I fluids are half ethylene glycol and half heated water and are considered "unthickened" and more suitable for use on aircraft with nonpowered flight controls.

Flying Into Wires

Nearly two-thirds of wire strike accidents reported in Australia in the past decade involved pilots who were aware of the position of the wires before their aircraft struck them, according to research by the Australian Transport Safety Bureau (ATSB).

The agency said that, of 180 wire strike accidents reported between 2001 and 2010, the pilots involved in 63 percent told investigators that they knew the wires were there. Of the 180 accidents, 100 involved agricultural flying.

"In many of these accidents, the pilot was not completely focused on the immediate task of flying due to a change of plans," the ATSB said in a report on the research, adding that pilots should "treat any changes in your plan as a 'red flag' — that is, treat it as something you should consider and assess before going any further."

IS-BAO Restructuring

© Chad Thomas/iStockphoto

The International Business Aviation Council (IBAC) has completed an assessment of the business aviation industry's safety standard — the International Standard for Business Aircraft Operations (IS-BAO).

The assessment, conducted by an IBAC task force, concluded with recommendations calling for changes in the management structure and revenue/cost models "to enable the sustained growth and value of the industry standard as it becomes increasingly more important to the future safety oversight programs required to keep the excellent safety record of business aviation constantly improving."

IBAC also announced the appointment of James Cannon as IS-BAO program director.

Medical Guidelines

Pilots who have suffered strokes should be required to undergo specific neuropsychological evaluations before receiving medical certificates, the U.S. National Transportation Safety Board (NTSB) says.

In a safety recommendation to the U.S. Federal Aviation Administration (FAA), the NTSB said the FAA should "consult with appropriate specialists and revise the current … guidance on issuance of medical certification subsequent to ischemic stroke or intracerebral hemorrhage to ensure that it is clear and that it includes specific requirements for a neuropsychological evaluation and the appropriate assessment of the risk of recurrence or other adverse consequences subsequent to such events."

The NTSB cited the Aug. 9, 2010, crash of a de Havilland DHC-3T near Aleknagik, Alaska, U.S., that killed the pilot and four passengers. Four other passengers received serious injuries.

© Steve Greer/iStockphoto

The NTSB said the probable cause of the accident was the pilot's "temporary unresponsiveness, for reasons that could not be established." The NTSB noted that the pilot previously had experienced an intracerebral hemorrhage — a burst blood vessel in the brain — followed by "persistent and obvious cognitive deficits" for months after the hemorrhage.

The FAA was aware of the problem, but the flight surgeon who reviewed the pilot's application said that he used the FAA *Aeromedical Certification Reference Manual* in determining that the pilot was eligible for an unrestricted first-class medical certificate.

"He stated that he did not speak with any outside consultants about the accident pilot because he was comfortable with the results he received from the evaluations of the pilot, including a status report provided by a local neurologist whom the flight surgeon considered reputable," the NTSB said in the letter accompanying the safety recommendation.

The neurologist's evaluation, however, did not discuss the pilot's medical fitness for flight, the NTSB said.

"It is not clear that a sufficiently thorough aeromedical evaluation of the pilot would have denied the pilot eligibility for a first-class medical certificate," the NTSB said. "However, a more rigorous decision-making process for evaluating this pilot with a history of [intracerebral hemorrhage] would have decreased the potential for adverse consequences."

NextGen Delays

Development and implementation of a data communications program that will be a key element of the U.S. Federal Aviation Administration's (FAA's) Next Generation Air Transportation System (NextGen) is likely to be delayed by at least two years, a federal audit says.

The audit by the U.S. Department of Transportation Office of Inspector General, published June 15, says that the System Wide Information Management (SWIM) program — designed to streamline data communications among all NextGen air traffic systems — may experience additional delays "because of a lack of clear lines of accountability for overseeing and managing the program."

The FAA also has increased the costs for the first of three SWIM segments by more than $100 million, the report says.

The first SWIM segment, originally scheduled for implementation between 2009 and 2013, is expected to facilitate the sharing of air traffic management information, including airport operational status, weather information, flight data, status of special use airspace and airspace restrictions.

The second segment, scheduled for implementation from 2012 through 2016, is expected to support improvements in flight planning throughout the National Airspace System, as well as "improved flight arrival, surface and departure flow, and restricted and regulated airspace capabilities." It also will give NextGen users improved access to aviation weather data.

© Eurocontrol

The third segment, scheduled between 2016 and 2019, is intended to provide improvements in communications and surveillance that will allow for reduced separation between aircraft on transoceanic routes and better airport surface traffic management.

Proposed Penalties

The U.S. Federal Aviation Administration (FAA) has proposed civil penalties totaling more than $1 million against two U.S. airlines.


© Gordon Tipene/Dreamstime.com

The FAA proposed a $584,375 penalty against United Airlines for alleged violations of federal regulations governing random drug and alcohol tests for safety-sensitive employees. The company "failed to perform required pre-employment drug tests and receive verified negative test results" before it transferred 13 people to safety-sensitive jobs, the FAA said.

The agency's proposed $425,000 penalty against Atlantic Southeast Airlines came in response to the airline's alleged operation of two Bombardier CRJs that were not in compliance with FAA regulations because they did not undergo required inspections after they were struck by lightning in 2008. The airplanes were flown on a total of 13 revenue passenger flights while they were not in compliance with the requirement, the FAA said.

Each airline has until mid-July to respond.

Fire Containment Cover

AmSafe Industries has introduced a fire containment cover to protect palletized aircraft cargo in case of fire.

The covers, manufactured from fire-retardant fabric, are designed to contain fires with temperatures as high as 1,500 degrees F (816 degrees C) for as long as four hours, isolating the flames from other cargo pallets.

They are intended primarily for use on palletized loads being shipped in unprotected Class E cargo compartments on the main decks of freighter airplanes and in Class D under-floor holds.


© AmSafe Industries

New Fatigue Standards

The International Civil Aviation Organization (ICAO) has adopted new international standards for fatigue risk management systems (FRMS) to be used as an alternative to prescriptive flight and duty time limitations for flight crewmembers (see p. 33).

© Stephen Strathdee/iStockphoto

The new standards will take effect Dec. 15.

"Current flight and duty time regulations are a 'one size fits all' solution," said Nancy Graham, director of ICAO's Air Navigation Bureau. "Operators using FRMS have reported greater operational flexibility than current flight and duty time regulations, while maintaining, and even improving on, current safety levels. The new standards will facilitate the development and globally harmonized implementation of the systems while making it easier for regulators to assess and monitor their use."

ICAO — working with national regulators, scientists and the aviation industry — has published guidance material designed to help operators in the development and implementation of FRMS.

The new standards will allow nations to choose whether to establish FRMS regulations, but ICAO said that the "provision of prescriptive flight and duty time limitations regulations remains mandatory for all states."

In Other News …

In a move intended to increase **public access** to general aviation flight information, operators of general aviation aircraft in the United States will no longer be permitted to cite privacy concerns as a reason to prevent the public from viewing flight information on the Internet, the U.S. Federal Aviation Administration says. … The Council of the International Civil Aviation Organization (ICAO) has adopted a **code of conduct** for the collection and use of aviation safety information. … The Australian Civil Aviation Safety Authority has issued new safety regulations to govern **aviation maintenance**, including personnel licensing and airworthiness requirements.

Compiled and edited by Linda Werfelman.

Convectional Wisdom

Mesoscale convective systems must be understood to mitigate their threat to aviation.

BY ED BROTAK

In October 2006, following a series of fatal crashes, the U.S. National Transportation Safety Board (NTSB) issued a safety alert describing procedures pilots should follow when dealing with "thunderstorm encounters." Despite these instructions, incidents continued to occur. One concern is that terminology often used by meteorologists is unfamiliar to some in the aviation community. For example, the fatal crash of the Hawker 800A at Owatonna, Minnesota, U.S., in June 2008 (*ASW*, 4/11, p. 16) involved a "mesoscale convective complex." The crash of Air France Flight 447 in June 2009, involving an Airbus A330 with a loss of 228 lives, was believed to involve a mesoscale convective system near the equator. More recently, the fatal crash of a medical helicopter in March 2010 in Brownsville, Tennessee, U.S., was related to a "mesoscale convective system with a bow shape."[1]

To improve the warning capabilities of the various weather services, convection has been studied extensively in recent years, leading to many new discoveries. Although breakthroughs in the science have increased our understanding and improved convection forecasts, the problem of conveying the information to those who need it remains, complicated by the flood of new terminology which often accompanies scientific advances.

The study of convection deals with vertical motions in the atmosphere caused by temperature or, more precisely, density differences. The adage "warm air rises" is well known. In meteorological parlance, a parcel of air will rise if it is less dense than air in the surrounding environment. Warmer air is less dense and will rise. Conversely, colder air, being denser, will sink. As pilots, especially glider pilots, know, you don't need moisture — that is, clouds — to have rising and sinking currents of air. However, when air rises it expands and cools. If the air cools to its dew point, condensation occurs and a cloud forms if sufficient moisture is present.

U.S. National Oceanic and Atmospheric Administration

The bowing section of a squall line (left) can be accompanied by strong winds.

Cumulus clouds are the typical convective clouds. Convection, in operational meteorology vernacular, refers to convective precipitation — showers and thunderstorms that are the end products of convective activity.

Convective precipitation can be divided into two broad types — unorganized and organized. Unorganized convection would be the typical "air mass showers and thunderstorms" that develop in the warm season. They are the result of daytime heating of humid air masses. The resulting convection is usually haphazard, with no recognizable pattern. Although all convection represents a problem for aviation, these storms tend to be weak by most standards. Occasionally, a pulse storm (*ASW*, 10/09, p. 12) will produce strong surface winds, but that's about it. Individual convective cells, the storms themselves, are fairly small — several miles across at most — and are rather short-lived, lasting an hour or less. For aviation purposes, they usually can be avoided or waited out.

At other times, convection becomes organized. This is either the result of larger-scale atmospheric forces at work or the interaction of various convective elements independent of outside forces. Organized convection takes the form of a mesoscale convective system (MCS), the generic name for a wide variety of systems. MCSs can be as large as several hundred miles across and can persist for hours. An MCS must, by definition, contain some convection but also may contain stratiform precipitation — areas of rain — and areas of cloud with no precipitation. Their size and duration make them more of a hazard for aviation.

The most recognizable and best-known MCS configuration is the squall line. A squall line is a more or less continuous line of thunderstorms, at least initially. If conditions are favorable, the squall line can persist for hours and evolve into a much larger and complex system (Figure 1, p. 14). There may be several lines of convection, with the strongest on the leading edge of the system, usually the east or south side in the northern hemisphere mid-latitudes, and progressively weaker behind it.

A larger region of mainly stratiform rain with possibly some embedded convection can develop behind the line or lines of stronger convective cells, usually to the west or north. And trailing this, you can have a mesoscale low pressure area called the "wake low." Squall lines may be symmetrical, with the stratiform rain area just behind, to the west of the convective line, or asymmetrical, with the convective cells more to the south and the stratiform precipitation more northward.

In terms of aircraft operation, there are several areas to watch. Ahead of the main line of thunderstorms, to the east or south, is the

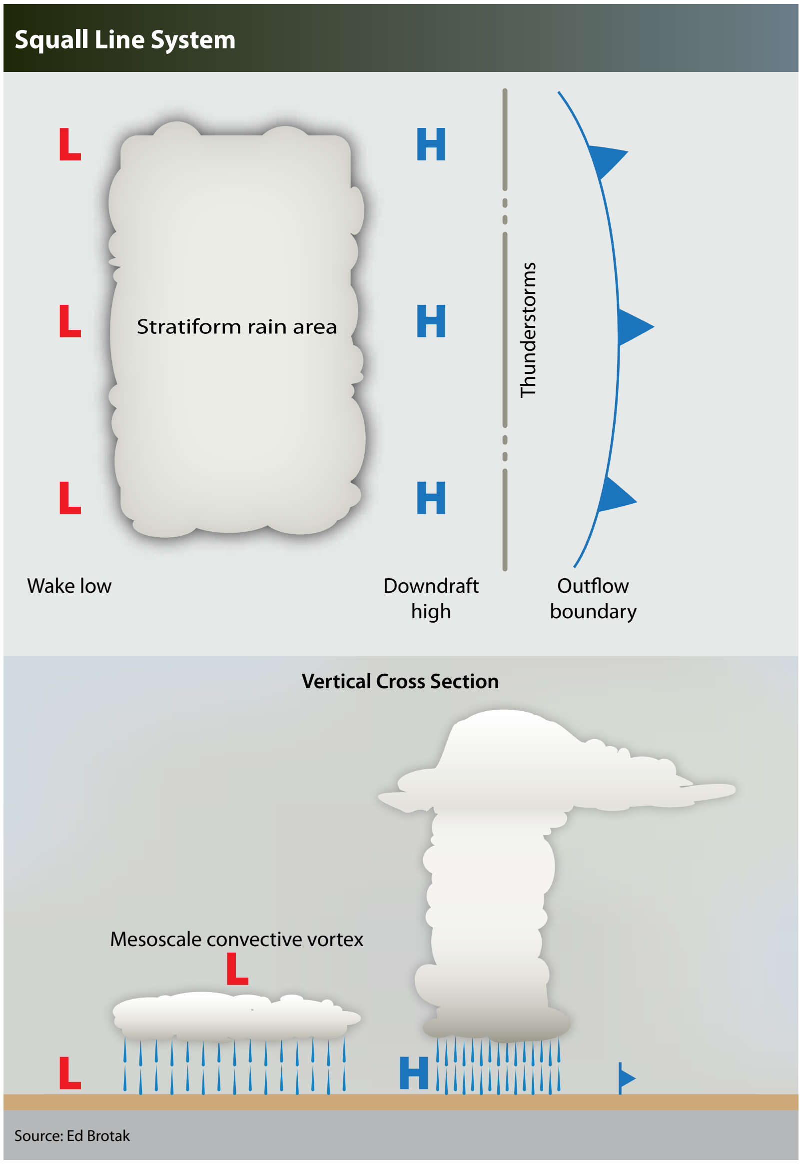


Figure 1

low-level outflow boundary also known as the gust front. A rapid change in wind direction and increase in wind speed often follow its passage. Obviously, the main line of storms should be avoided due to the strong downdrafts and winds at the surface and turbulence aloft. The trailing stratiform rain area is not as turbulent but still may produce problems. The final wake low could be accompanied by strong, gusty winds.

Another feature which may affect aircraft is the mid-level "mesoscale convective vortex" (MCV). This cyclonic circulation can develop above the stratiform precipitation area. It can be 30 to 60 mi (50 to 100 km) across and 1 to 3 mi (2 to 5 km) deep. MCVs occasionally have a life of their own, existing as long as 12 hours after the parent squall line has died out. Importantly, they can generate new convection or intensify existing convection as they move. On May 8, 2009, a particularly intense MCV ravaged parts of Kansas, Missouri and Illinois in the United States, with straight line winds over 100 mph (161 kph), large hail and dozens of tornadoes, some of them violent.

To show what airport conditions are like during the passage of a mature MCS, consider the observations taken at Columbia, South Carolina, U.S., on the evening of June 3, 2011: At 19:56 local standard time (LST), winds were from the east-northeast at 7 kt, the visibility was 6.0 mi (9.7 km) in haze, the temperature was 91degrees F (33 degrees C), and thunder could be heard with cumulonimbus clouds to the north. A wind shift was noted at 19:57 LST. This was with the passage of the outflow boundary or gust front. By 20:17 LST, the winds had picked up from the northeast at 12 kt, the temperature had dropped to 88 degrees F (31 degrees C), and barometric pressure was rising rapidly. At 20:31 LST, the airport was under the leading convective cells. Winds were blowing from the north at 27 kt with gusts to 43 kt. The visibility had dropped to 1.5 mi (2.4 km) in a heavy thunderstorm with rain and constant lightning. The temperature had dropped to 75 degrees F (24 degrees C). The heavy thunderstorms continued for 25 minutes. At 21:08 LST, only a weak thunderstorm was reported and barometric pressure was falling rapidly. However, moderate to heavy rain continued for another 50 minutes. At 21:56 LST, a gust of 26 kt accompanied the passage of the wake low. The rain ended at 22:01 LST and the temperature was 70 degrees F (21 degrees C).

If a squall line or part of a squall line begins to curve or bow outward, it is referred to as a "bow echo." Echo refers to a radar return, as these systems were first discovered and are usually still identified on weather radar. The bowing segment of the line can move very quickly, occasionally in excess of 50 kt. Bow echoes are often associated with strong straight-line winds and occasionally weak tornadoes. On March 25, 2010, the pilot of the medical helicopter stationed in Brownsville referred to earlier decided he could beat a convective line and make it safely back to Brownsville from Jackson. The line developed a bow, which shot ahead of the main system with an estimated forward speed of 60 kt. Radar indicated that the helicopter was overtaken by strong convection before reaching its destination and this may have resulted in the crash, which killed the three people aboard.

Another variation of the squall line is the quasi-linear convective system (QLCS). The QLCS has some linear parts but also other discrete elements. This means that some storms are in a squall line but other nearby storms are separate. QLCSs are often associated with strong straight-line winds and tornadoes.

Another term which comes up in discussions about convection is “derecho.” Not really a different type of MCS, a derecho adds a time element to the description. It is a long-lived, often large convective system which produces strong and often damaging winds for hours.

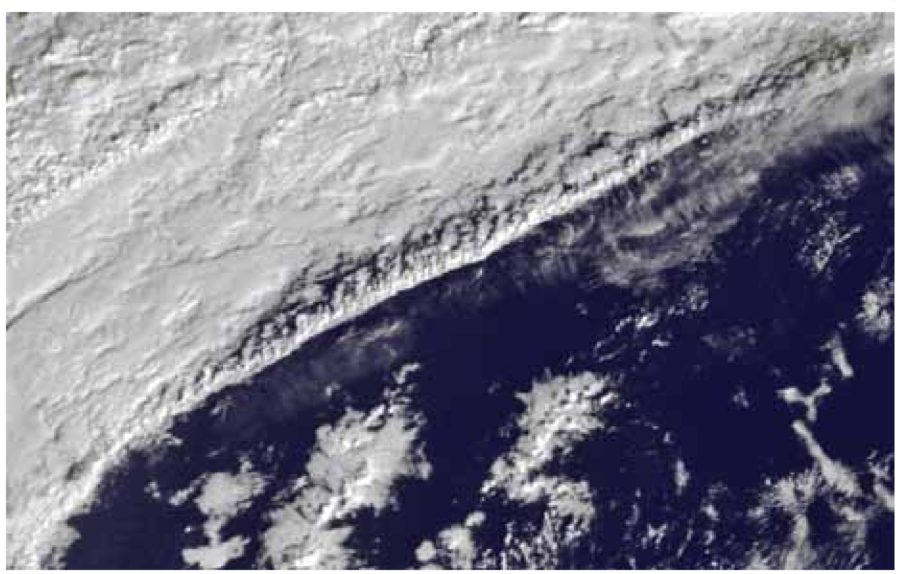
Squall lines usually develop where there is moderate to strong synoptic forcing — in other words, the line is the result of not just instability but other atmospheric effects. Usually, squall lines occur in the warm sector of an extratropical cyclone or low, ahead of the associated cold front. There is often an upper-level trough just to the west with the jet stream. Other MCSs can develop on their own without much help.

Before meteorologists came up with the generic MCS classification, they had already identified a very specific type of MCS which they named a mesoscale convective complex (MCC). An MCC differs from other MCSs in shape; it is rounded or at least elliptical. MCCs are also large, covering thousands of square miles and can last six hours or more. Primarily a summer phenomenon, MCCs develop in what appears to be a fairly benign environment, often on the east side of an upper-level ridge, away from any low pressure areas or fronts. MCCs often start as unorganized, air mass convection in the late afternoon or early evening. The initially independent storms start to interact and form a cohesive, self-maintaining complex that often lasts into or through the night. The strongest convection, similar to a squall line, is on the outside perimeter of the system, with stratiform but often heavy rain in the middle.

In the case of the Hawker 800A crash, the leading edge of the MCC with the strongest convection had affected the Owatonna airport an hour earlier but had moved on by the time the aircraft arrived. However, the heavy stratiform rain region was still affecting the terminal when the landing was attempted. The wet runway complicated the pilot’s efforts to stop the airplane, leading to his belated decision to attempt a go-around that ended in the fatal accident. Linear squall lines and rounded MCCs are just two types of MCSs. If a system doesn’t fit into either of those categories, it is simply referred to as an MCS.

The movement of MCSs is affected by two things — simple advection by the wind and propagation of the whole system, which is the result of development and dissipation of individual convective elements — the storms themselves. Advection by the wind is simple enough, with convective cells being driven by the mean wind — the average wind in the layer of air containing them. Individual cells or storms can move rapidly at rates up to 60 kt. Propagation effects are more complicated. Individual convective cells, which have a much shorter lifespan than the MCS, form and dissipate within the MCS. This affects the overall movement of the mesoscale system. Convective cells and convective systems tend to propagate in the direction from which warm, moist air is being “fed” into them. This is usually from the south, in the northern hemisphere. This causes a seeming deflection to the right. Supercell thunderstorms are notorious “right movers,”

The squall line leading this MCS is obvious in this photo from space.



U.S. National Oceanic and Atmospheric Administration

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moving well to the right of the mean wind. For an MCS such as a squall line, new cells tend to develop on the south end of the line while older ones to the north die out. This causes the whole system to move or propagate to the right of the mean wind. For example, it is common for a squall line to move due east while individual storms within it move rapidly northeast.

MCSs are not confined to mid-latitudes. There are tropical versions, too. It is widely believed that a tropical MCS was involved in the Air France Flight 447 crash in the tropical Atlantic not far north of the equator. Information gathered from the recently recovered black boxes indicated that the airplane was cruising at 35,000 ft with no problems. But just ahead was an area of thunderstorms that infrared satellite imagery indicated had tops of 50,000 ft. The pilots were aware of this and warned the cabin crew of potential turbulence. Instruments showed that the turbulence never became more than moderate. However, the pitot tubes for the airspeed sensors iced over when the plane encountered the high clouds, triggering a series of events that ended with the aircraft stalling and falling into the ocean.

The area of thunderstorms Flight 447 encountered was the result of an MCS embedded in the inter-tropical convergence zone (ITCZ). The ITCZ is where the northeast trade winds from the Northern Hemisphere collide with the southeast trade winds from the Southern Hemisphere. The resulting convergence produces lifting and, with the very moist air, showers and thunderstorms. Although the ITCZ is fairly continuous, there are areas of enhanced lifting and convection. This was what Flight 447 flew into. Some of the cloud bands were curved and there seemed to be a circulation center, both indications of a well-developed MCS. If conditions are favorable and the ITCZ is far enough away from the equator for the Coriolis effect[2] to enhance rotation, a tropical MCS produced along the ITCZ can become a full-fledged tropical cyclone. Tropical cyclones up to and including hurricanes and typhoons are just larger versions of tropical MCSs.

Besides the ITCZ, tropical waves — also called easterly waves or African waves — can generate convection in the Atlantic basin. They are common in the warm season, May to November. Tropical waves are inverted troughs of low pressure, with the lowest pressure to the south. Low-level features move westward in tropical easterly winds or trade winds at an average speed of 15–20 mph (25–35 kph). They have wave lengths between 1,000 and 1,500 mi (2,000–2,500 km) and continue for about three days. Low-level convergence is found just to the east of the trough axis and often generates convection. The convection can organize into tropical squall lines. Moving to the west in the tropical easterly winds, these squall lines have the strongest convection on their west side, with the stratiform rain area to their east. In the summer, these waves can impact locations in the subtropics, such as Florida, Texas or Mexico.

Although the name may not be widely known, mesoscale convective systems are common in many parts of the world. They produce much more serious hazards to aviation than individual thunderstorms. Understanding them is essential to treating them with proper respect when they are encountered.

Edward 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.

Notes

1. NTSB Preliminary Report, ERA10MA188.
2. Coriolis effect is the tendency for any moving body on or above the Earth's surface — for instance, winds — to be deflected by the Earth's rotation.

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Short on Speed

An ATR 42 with split flaps stalled during an unstabilized night approach in icing conditions.

BY MARK LACAGNINA

Distracted by a flap anomaly, the flight crew of an Avions de Transport Régional ATR 42 freighter did not monitor their airspeed during a night instrument approach in icing conditions, and the airplane stalled and struck terrain short of the runway at Lubbock, Texas, U.S., said the final report by the U.S. National Transportation Safety Board (NTSB).

The airplane, registered to FedEx Corp. and operated by Empire Airlines, was substantially damaged, according to the report. The captain was seriously injured, and the first officer sustained minor injuries.

Factors contributing to the Jan. 27, 2009, accident were "the flight crew's failure to follow published standard operating procedures in response to a flap anomaly; the captain's decision to continue with the unstabilized approach; the flight crew's poor crew resource management; and fatigue due to the time of day in which the accident occurred and a cumulative sleep debt, which likely impaired the captain's performance," the report said.

NTSB also faulted the dispatch of the cargo flight into an area of freezing drizzle that was forecast to continue beyond the estimated time of arrival in Lubbock. Freezing drizzle comprises supercooled large droplets (SLD) that can splatter and freeze on contact with an airplane, causing accumulations of ice that can exceed the capabilities of the anti-icing and deicing systems.

Three of the five NTSB members did not totally agree with the conclusions published in the report and filed separate statements of their opinions (see "Difference of Opinion," p. 21).

One Approach Available

The ATR 42 departed from Fort Worth (Texas) Alliance Airport at 0313 local time as Flight 8284 to Lubbock Preston Smith International Airport.

The captain, 52, had 13,935 flight hours, including 1,896 hours as an ATR 42 pilot-in-command. "The captain was experienced with in-flight icing conditions because he had worked as a pilot in the Pacific Northwest and Alaska for 30 years," the report said. "He stated that he had been dispatched into freezing drizzle before and that, while flying in such conditions, he maintained a heightened awareness of the flying environment."

The first officer, 26, the pilot flying, had 2,109 flight hours, including 130 hours as a second-in-command of ATR 42s. "The first officer had limited experience flying in icing conditions before working at Empire Airlines, and the ATR 42 was the first airplane in which she had flown that was equipped with deicing and anti-icing systems," the report said.

Light freezing rain and ice pellets had begun to fall the previous evening in the Lubbock area and had changed overnight to light freezing drizzle. As the airplane neared the airport, reported visibility was 2 mi (3,200 m), the sky was overcast at 500 ft, and the surface winds were from 350 degrees at 10 kt.

While en route, the crew had learned that Runway 08/26 was closed. Runway 17R/35L was the only available runway suitable for the ATR 42, but the nonprecision approach to Runway 35L, which would have allowed a landing into the wind, was not available. Nevertheless, the tail wind component for a landing on Runway 17R was within the airplane's 15-kt limit. Thus, the crew prepared for the only approach available, the instrument landing system (ILS) approach to Runway 17R.

The ATR 42 had encountered icing conditions during cruise at 18,000 ft. The captain recalled that the airplane had shed "substantial amounts of ice" during the descent in a relatively warm inversion layer. The airplane again encountered icing conditions in freezing drizzle below 6,000 ft. The report said that the SLD conditions were "outside the airplane's icing certification envelope."

Red Bug Speed

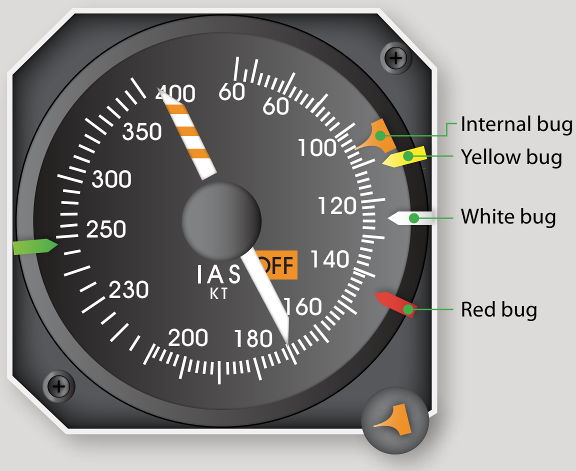
While conducting the descent and approach checklists, the captain confirmed that the airplane's ice-protection systems were set to the highest level. While reviewing the reference speeds, or airspeed indicator "bug" speeds, for the approach, he told the first officer that the "icing speed" — the minimum airspeed for an approach in landing configuration and in icing conditions — was 106 kt.

However, the captain had incorrectly read this, and other, airspeeds, from the reference card for takeoff and landing at 33,000 lb (14,969 kg). It actually corresponded to the minimum airspeed for a *takeoff* in icing conditions; the correct airspeed for landing was 116 kt.

The airplane struck the ground short of the threshold and came to a stop off the right side of the runway

U.S. National Transportation Safety Board

Airspeed Bugs



Notes: The ATR 42 pilots had set the red bugs on their airspeed indicators to 143 kt, the minimum airspeed for an approach in icing conditions with flaps retracted. The white bug references the minimum approach speed in non-icing conditions with flaps retracted; the yellow bug references the target approach speed plus 5 kt with full flaps. These three bugs are on the outside of the instrument's glass face and are manually slid into place. The orange "internal" bug, set with the knob, references the minimum approach speed in icing conditions with full flaps; this reference speed drives the fast/slow scales on the pilots' attitude director indicators.

Source: Adapted from U.S. National Transportation Safety Board report by Susan Reed

Figure 1

This error was inconsequential, according to the report, because the captain had correctly briefed the minimum airspeed for a no-flap approach in icing conditions as 143 kt. This airspeed provided "sufficient reference to maintain the minimum safe airspeed" during the approach, the report said, noting that the pilots set the red bugs on their airspeed indicators accordingly (Figure 1).

'We Have No Flaps'

The airplane was about 1,400 ft above ground level (AGL) and nearing the ILS outer marker at 0434, when the first officer called for flap extension to 15 degrees, the approach setting, and for the landing gear to be extended.

Perceiving that something was amiss, she then said, "What the heck is going on?"

The captain replied, "You know what? We have no flaps."

Recorded flight data showed that the two flaps on the left wing had extended only 8 to 10 degrees and that the two flaps on the right wing remained retracted. The autopilot compensated for the flap asymmetry by applying left aileron.

The report said that both pilots became distracted by the flap anomaly, and their crew resource management and adherence to standard operating procedures deteriorated. No call-outs of subsequent airspeed or flight path deviations were made. The cockpit voice recording also indicated that the pilots did not discuss the flap problem or the checklist actions to address it.

Postaccident interviews revealed that the pilots did not recognize the nature of the problem and did not see any warning messages such as "AILERON MISTRIM" on the advisory display unit. The captain said that "things were happening quickly" and that he "did not know which checklist to run."

The first officer continued flying the coupled approach while the captain repositioned the flap handle several times, to no avail. "After finding that no circuit breakers were out, he moved the flap handle back to the 'up' (or 0-degree) position because he did not want the flaps to travel inadvertently during the approach," the report said.

During simulator training, the pilots had been taught to initiate a go-around if a flap anomaly occurs on approach and then complete the applicable quick reference handbook procedures. The captain told investigators that, in this case, he "just wanted to land as soon as possible."

'Keep Descending'

The airplane was at about 900 ft AGL and indicated airspeed was 125 kt when the aural stall warning sounded, the stick shaker activated and the autopilot automatically disengaged. With the flaps up, the stick shaker normally activates at an angle-of-attack (AOA) of 11.6 degrees, or at 7 degrees AOA with the ice-protection systems activated.

The first officer voiced an expletive, and the captain said, "Yeah, don't do that. … Just keep flying the airplane, OK?"

"Should I go around?" the first officer asked.

"No," the captain replied. "Keep descending."

The first officer had pulled the power back to about 3 percent torque after the flap asymmetry occurred. She now increased power to about 70 percent torque, and the airplane began to deviate above the glideslope and right of the localizer.

The first officer applied about 40 lb (18 kg) of pressure on the left rudder pedal and about 13 lb (6 kg) of control wheel force to counter the flap asymmetry. Her voice was strained when she said, "We're getting close here." The captain asked her if she wanted him to take the controls, and she replied, "Yes, please."

The ATR 42 was at about 700 ft AGL and airspeed was 143 kt when control was transferred to the captain. He applied substantial control forces to correct the flight path deviations and reduced power to about 10 percent torque, causing airspeed again to decrease below the red-bug airspeed of 143 kt. About this time, the flaps automatically returned to a symmetric state, with the left flaps retracting to about 4.5 degrees and the right flaps extending to about 4.5 degrees.

A few seconds later, as the airplane descended below the clouds at about 500 ft AGL, the aural stall warning sounded and the stick shaker activated again. The terrain awareness and warning system (TAWS) generated a "PULL UP, PULL UP" warning. About this time, the first officer called the runway in sight.

The airplane was at about 200 ft AGL and airspeed was 124 kt at 0436:19, when the captain called for maximum propeller speed and increased engine torque. The airplane then entered a series of roll oscillations before striking flat, grassy terrain short of the runway and coming to a stop off the right side of the runway at 0436:27.

The right main landing gear separated on impact, and the right wing and a large section of the upper fuselage were destroyed by fire. The right engine and propeller also were damaged by the impact and fire.

Seeing fire on the right side of the airplane, the pilots exited through the left forward cargo door. Aircraft rescue and firefighting personnel arrived about five minutes later and contained the fire, which eventually was extinguished with help from the local fire department.

The captain told investigators that in the last seconds before impact, he had no lateral control of the airplane and that the controls were almost "snatched" out of his hands.

The report said that a performance study indicated that "the performance degradation due to ice accretion never exceeded the airplane's thrust performance, nor would it have exceeded the airplane's flight control capabilities if the minimum safe airspeed [143 kt] had been maintained. … The captain's failure to immediately respond to

Difference of Opinion

Individual members of the U.S. National Transportation Safety Board (NTSB) sometimes prepare separate statements for an accident report when their personal opinions differ from the consensus conclusions and findings related to the accident. The report on the ATR 42 accident at Lubbock, Texas, included statements by three board members.

NTSB Vice Chairman Christopher Hart contended that the report is inconsistent in concluding that the captain should have conducted a go-around while also recommending that deliberate operation in icing conditions caused by freezing precipitation should be prohibited.

"Either the conditions were flyable and should have been re-entered on a go-around, or the conditions were not flyable and the captain appropriately continued his approach, despite being unstable," Hart said. "I believe that the evidence supports the conclusion that the conditions were flyable and the captain should have gone around."

Hart also challenged the report's conclusion that fatigue likely impaired the captain's performance. "Even if the crew had been fatigued, which they probably were to some extent, I do not see any basis in the report for concluding that fatigue resulted in impairment sufficient to cause or contribute to this accident."

NTSB Member Earl Weener agreed that the report provides insufficient evidence to support the conclusion that fatigue impairment of the captain's performance was a causal factor in the accident. "Although fatigue may have played a role in the captain's performance during the accident sequence, the final report does not sufficiently make the case that fatigue played a causal role in the event," he said.

NTSB Member Mark Rosekind, an internationally recognized fatigue specialist, asserted that there was sufficient evidence to support a conclusion that fatigue affected the performance of *both* pilots. He specifically disagreed with the report's conclusion that the first officer's errors likely resulted from her distraction with the flap anomaly and her lack of experience in the airplane and in icing conditions. Rosekind said that there was equally compelling evidence that fatigue contributed to her errors.

"This accident exemplifies the increased safety risks associated with overnight shifts and operations during the window of circadian low," he said.

—ML

the aural stall warning, the stick shaker and the TAWS warning resulted in his inability to arrest the airplane's descent and avoid impact with the ground."

Flap Anomaly Unsolved

The report said that the flap asymmetry might have been caused by a mechanical problem, jamming of the flap actuator or hydraulic fluid contamination. Impact and fire damage to the flap system precluded a conclusive determination of the cause.

The system is designed to prevent an asymmetry greater than 10 degrees by isolating electrical power from the flap-control switch. "The flaps will stop in the positions reached at the time of the power interruption, [and] the flaps will not move in response to movement of the flap-control lever until maintenance personnel reset the system on the ground," the report said.

When an asymmetry occurs, the flap-position indicator shows the average position of the flaps. There also are lighted markings on the external flap fairings on both wings that provide the pilots with a means for a direct visual check of flap position. The pilots apparently did not check these markings.

The report did not say why the flaps returned to a symmetrical state shortly before impact but noted that this normally occurs if a restriction to flap movement is removed: "The resulting flap position will be the average of the right and left flap positions when the asymmetry occurred."

Airport firefighters arrived within five minutes and, with the help of municipal units, extinguished the post-impact fire.

U.S. Federal Aviation Administration

Sleep Debt

A few days before the accident, the captain and the first officer had commuted on commercial flights from their homes in Portland, Oregon, and Salt Lake City, Utah, respectively, to Midland, Texas. The previous evening, they had flown a trip from Midland to El Paso, Texas, and to Fort Worth, where they landed about three hours before beginning the flight to Lubbock.

The report said that although the accident occurred at a time that was in opposition to the crew's normal circadian rhythm, both pilots "took some actions before the accident to reduce the likelihood of performance decrements associated with being awake during the nighttime hours."

The first officer's actions were deemed more effective, in that she had acclimated herself to sleeping during the day and being awake at night. "She indicated that she felt rested on the evening of the accident," the report said.

The captain had deliberately awakened at 0400 the morning before the accident and had napped for nearly six hours that afternoon. The report said that although the nap likely was beneficial, the pilot had accumulated a sleep debt and "was likely experiencing some fatigue at the time of the accident."

Role Playing Recommended

Based on the findings of the investigation, NTSB made several recommendations to the U.S. Federal Aviation Administration (FAA). Among them was to require "role-playing or simulator-based exercises that teach first officers to assertively voice concerns and that teach captains to develop a leadership style that supports first officer assertiveness" (*ASW*, 5/11, p. 46).

The board also said that the FAA should prohibit air carrier, air taxi and fractional ownership operators from dispatching or operating airplanes in known freezing precipitation "unless the airplane manufacturer has demonstrated that the airplane model can safely operate in those conditions."

This article is based on NTSB report NTSB/AAR-11/02, "Crash During Approach to Landing; Empire Airlines Flight 8284; Avions de Transport Régional Aerospatiale Alenia ATR 42-320, N902FX; Lubbock, Texas; January 27, 2009." The report is available at <ntsb.gov/Publictn/2011/AAR1102.pdf>.

Not Worth Being UPSET

BY WAYNE ROSENKRANS | FROM ORLANDO

Recent U.S. law influences specialists' proposals for simulator upgrades and limited use of all-attitude, all-envelope training airplanes.

Refinements to airplane upset prevention and recovery training (UPRT) for airline pilots will reduce the risk of accidents involving loss of control in flight (LOC-I), panels of specialists predicted during the World Aviation Training Conference and Tradeshow (WATS 2011). In the hands of well-prepared instructors, flight simulation training devices (FSTDs) already in use worldwide adequately reinforce stall awareness and avoidance, several said at the April 19–21 event in Orlando, Florida, U.S.

The international working group they represent, however, almost literally has stepped "outside the box" as they have been drafting a recommendation for UPRT in all-attitude, all-envelope training airplanes at an intermediate stage of airline pilot preparation. Other proposals still in development call for simulation enhancements that, in the long term, would enable airline flight crews to experience — in FSTDs — correct control inputs and responses of specific types of aircraft in the post-stall region of the aerodynamic lift curve.

Sunjoo Advani, chairman of the International Committee for Aviation Training in Extended Envelopes (ICATEE) and president of International Development of Technology, joined the panelists in presenting results of the committee's assessment of airline industry needs compared with the capabilities of existing training infrastructure. The 80-member committee was created in June 2009 by the Flight Simulation Group of the U.K. Royal Aeronautical Society.

ICATEE has gained significant momentum in the context of LOC-I accidents, Advani said. Early work has included products for the U.S. Federal Aviation Administration (FAA) Stall and Stick Pusher Working Group and advice to an FAA aviation rulemaking committee on airline training.

Wayne Rosenkrans

"The mission of ICATEE is to deliver a comprehensive, long-term strategy to reduce the rate of LOC-I incidents and accidents through enhanced UPRT," Advani said. "There is no single solution or tool in UPRT. Safety is enhanced when training is integrated through proper academics, aircraft-based training and simulator-based training. The key element to that whole process is the qualified instructor."

Although upset scenarios can include atmospheric disturbances, icing, spatial disorientation and flight control system failures, aerodynamic stalls persist as a major precursor. "We haven't dealt with stalls very systematically," he said of previous industry-government initiatives.

"Pilots who might find themselves in a roll upset at 100 degrees of bank or more — yet have been provided [only] with the normal paradigm of unusual attitude training, where they have not seen anything beyond 60 degrees of bank — are probably not well-equipped [to recover]. From anecdotal experience in providing [all-attitude] training, we have seen that most pilots who did not have this training were not able to 'fight their way out of that box.'"

ICATEE so far has specified the training objective of each proposed maneuver, the appropriate method to provide corresponding training and a quality-controlled delivery process, he said. The committee strongly advocates scenario-based, crew-oriented training — adding unexpected conditions — rather than exclusively maneuver-based training.

Training errors of the past also must be rectified without delay. These have included instructors teaching a stall recovery technique that begins with selecting full power and prioritizes minimum loss of altitude rather than immediately reducing angle-of-attack (*ASW,* 11/10, p. 41). Pilot errors have included mismanaging automation and applying techniques of upset recovery that work in the FSTD but would not be effective in the airplane. "All of these have led to a degradation of skills in UPRT," Advani said.

Pilots' academic study of relevant aerodynamic principles, airline indoctrination and recurrent UPRT in simulators can be improved significantly, he said, noting that "simulators have replaced aircraft for most advanced training [and] most of our UPRT training can be completely done in the simulator."

A Fresh Start

The *Airplane Upset Recovery Training Aid, Revision 2* (November 2008) — available at <flightsafety.org/archives-and-resources/airplane-upset-recovery-training-aid> (*ASW,* 2/09, p. 34) — remains "excellent resource material that provides very thorough academic training," Advani said. This 443-page, multimedia tool has not been adopted as widely as first envisioned in 1998, however, he added.

"The book has some limitations: It applies to swept-wing jets of 100-plus passengers and … is perhaps too large and too difficult to absorb and recall at that very critical time of need [for a flight crew]," Advani said. "It's also non-regulatory, not mandated and primarily for airline operations. … ICATEE is developing UPRT manuals, based on this training aid, for pilots, instructors and regulators. We also already have proposed the [simulation] model validation standard and revisions to the simulator qualification manual."

Wayne Rosenkrans

Advani, left, and Burks.

The ICATEE consensus on pilot exposure in an airplane to the all-attitude, all-envelope flight environment is ground-breaking. "We need a psychological component: the startle factor, the reality factor," he said. "Physiologically, we need to give pilots the experience of the [positive/negative] 'g' environment [i.e., accelerations unlike standard gravitational acceleration (g)]." G-awareness and accurate recovery techniques that will not cause in-flight structural breakup of a large commercial jet are essential, he added. Despite using airplanes certificated for upset maneuvers, this should not be described as aerobatic pilot training, Advani said.

In the future, to expose pilots entering airline careers to "accelerated-g maneuvers and some of the extreme maneuvers, we really see no replacement for aircraft training," explained Bryan Burks, a Boeing 737 captain for Alaska Airlines. This concept reflects the reality that the global airline industry now lacks an infrastructure to use such airplanes in recurrent training of about 300,000 pilots.

"There are pros and cons to the use of the aircraft for UPRT," added Kip Caudrey, senior manager for simulator evaluation, standards and regulatory compliance at Boeing Training. "It also has been quite important to pilots who are currently flying commercial aircraft that there wouldn't be any requirement for them to go back and find some kind of an aerobatic aircraft to become qualified in upset prevention and recovery." ICATEE expects to recommend that UPRT in airplanes be required for all commercial pilot licensing — and that certification level only — and for those in multi-crew pilot license programs, he said.

Full-flight FSTDs thus will remain the principal tool for UPRT among the airline industry's resources. "We must respect the limitations of simulators in terms of the aerodynamic model limits," Advani said, especially the lack of realism of g-cueing and the motion-cueing limits. "ICATEE's tasks are to provide better feedback to the instructor and the pilots; to avoid negative training; and to migrate more toward the scenario-based training approach [*ASW,* 8/10, p. 30]."

ICATEE panelists agreed with several attendees that information presented at instructor/operator stations (IOSs) ideally would include displays of g-loading, angle-of-attack and the validated aerodynamic envelope for the airplane type — but raw data presented to pilots in an FSTD must match the airplane flight deck. "New instrument displays on the IOS would give the instructor more awareness and more ability to provide critical feedback to close the training loop," Advani said.

Today, airlines already conduct stall training in FSTDs with "great accuracy and with the airflow perfectly attached" to the wing until the point of stall warning. Within the so-called amber region beyond the warning point on the lift curve, stall training also is being conducted successfully with an imperfect but acceptable level of fidelity (*ASW,* 11/10, p. 45), he added.

"However, if we talk about training in the [post-stall] red region, more modeling work would be required," Advani said. Research shows that a significant benefit of such training with validated envelopes would be to mitigate the pilot startle factor. "If we can do this effectively, we can significantly reduce the [LOC-I] incidence rates," he said.

Surprising Shortcomings

ICATEE's survey of FSTD operators and follow-up work revealed an unexpectedly high prevalence of negative training, said Alaska's Burks, citing examples such as organizations operating a simulator outside the validated envelope, lack of feedback about the simulation fidelity and false assumptions that demonstration (demo) modes are part of the validated envelope and suitable for training. Practicing a maneuver in an FSTD demo mode can lead the pilot to apply more aggressive flight control inputs than the airplane would require, or even to improvise "alternative control strategies, which can be very negative," he said. Similarly, the high fidelity of current simulators in 98 percent of normal maneuvers has given instructor pilots, line pilots, training providers and airlines false confidence about

realism outside the validated envelope. "Sometimes, extremely aggressive flight control inputs in the simulator are actually rewarded by getting [the simulator] out of the maneuver earlier [yet] the pilot actually would have caused damage to the aircraft," Burks said.

ICATEE research also discovered that FSTDs can momentarily disable flight controls during resets by instructors without awareness by the pilots. "As the simulator is slewed from the normal attitude [at the IOS] to begin the maneuver … it 'washes out' or inhibits flight control inputs by the pilot. … The instructor and the pilot [must] understand that those flight control inputs are not going to be honored," he said.

Consistent Standards

"Competent studies have shown that pilots can do almost all of the maneuvers in the training aid with today's simulators," said Jeff Schroeder, chief scientific and technical adviser, FAA. "Most of what we do, or are required to do, today is train pilots to the first indication of stall, which is often the stall warning. … One [ICATEE-recommended addition] is checking each simulator's performance for high-altitude cruise stall."

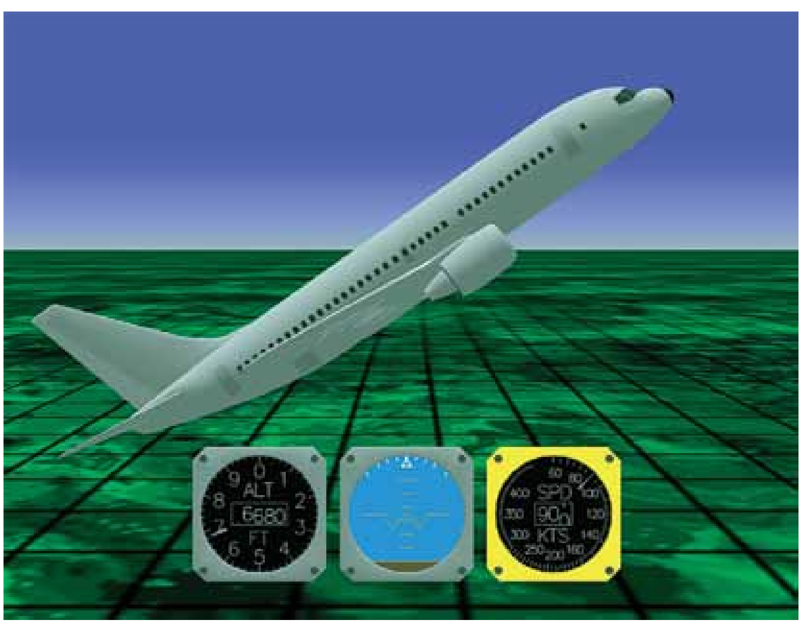
ICATEE members so far have spent the most time on advancing simulation in the red region for two reasons. "The first reason is the U.S. law that requires Part 121 air carriers to provide flight crewmembers with ground training and flight training, or flight simulator training, to 'recognize and avoid the stall' … or 'if not avoided, to recover from the stall,'" Schroeder said.

The second is markedly different flight dynamics. "The worry that we have in simulation, potential training or demonstration is that the [startle factor] might contaminate or harm the proper recovery technique," he said. "The pilot then might be paying attention to the roll axis, getting the wings level, instead of reducing angle-of-attack."

From a stall-modeling point of view, another ICATEE concern is: "What's the availability of flight test data on which to base any model improvements?" said Bob Curnutt, senior technical fellow, Boeing Training. "We are looking for a more representative model in the red region, but to get as close as we reasonably can requires [finding valid] flight test data. … There will be a number of airplanes, particularly smaller airplanes, for which we will have the stall speeds and so on, but perhaps no data [that goes] as far as we might like."

Advani said, "We do not necessarily need perfection of the data … especially in the regions around the stall," citing ICATEE's efforts to specify the minimum set of data good enough to achieve the UPRT purpose.

'A stall is characterized by any, or a combination, of the following: buffeting, lack of pitch authority, lack of roll control [and] inability to arrest the descent rate,' says the *Airplane Upset Recovery Training Aid, Revision 2*.



Upset Recovery Industry Team

Several panelists and attendees urged caution, conservatism and appreciation for the time involved in introducing airline pilot training in the red region. "For the moment, we really don't believe that we need to go into the red region [where] it is going to be difficult to get the correct data," said Jacques Drappier, a captain and senior training adviser, now retired from Airbus.

Lou Nemeth, chief safety officer, CAE, concurred in part. "We can certainly get good stall training without going into the red region, but we [already] are finding often that there does not seem to be an appreciation for the dynamics of the vehicle in that region," he said. While considered extremely rare, the issue is that the pilot's excursion in the red region will be "almost an 'Oh, my God!' moment … although I have no idea how often that happens," Nemeth said.

Panelists and attendees also discussed diverse perspectives of the relationship between periodic manual handling during line operations and UPRT. "We need to be very careful and conservative about any intuitive answer to the question of whether manual-handling skills benefit UPRT," Advani said. "[Some people are] assuming that manual-handling skills translate to recovery skills — that is not the case. … Some upset recovery skills are actually counterintuitive."

Drappier, the Airbus representative, added, "Airbus does not recommend encouraging airline pilots to fly the airplane manually [during line operations] because the airline passengers have paid to get the maximum level of safety. Most of the time, the autopilot is the best route." That makes FSTDs the most appropriate practice environment, he said.

Some airline representatives pointed to specific exceptions in their training policies. Session participants especially agreed, however, that an FSTD is the only place that pilots should be exposed to high-altitude manual handling to be proficient, as a backup to recovery with automation.

Simple tools to PREVENT LOC

Practical, low-cost technologies are within reach to reduce the risk of loss of control.

BY DON BATEMAN

Loss of control (LOC) and lack of aircraft control (LAC) accidents continue to mar commercial aviation's great safety record, but there are cost-effective technologies that could help reduce the risk of these accidents years before more elegant and sophisticated systems can be created and fitted to new aircraft designs.[1]

LOC and LAC currently are the leading causes of fatalities in commercial aviation. There were 34 accidents in the last 10 years that cost more than 3,100 lives and $4 billion in financial losses. Spatial disorientation and suspected reversion or confusion between Western and Eastern (Soviet-era) attitude indicator formats accounted for nearly half of the losses (Figure 1). Undetected airspeed decreases leading to stalls were involved in about 20 percent of the losses.

In the "Others" category are wake turbulence upsets, a growing risk as RNP (reduced navigation performance) procedures increasingly confine aircraft tracks during departure and initial approach. Other causes of LOC/LAC are pilot training practices that foster overcontrol of the rudder, autopilot mode confusion and failure to decrease angle-of-attack (AOA) to regain control.

Display Disorientation

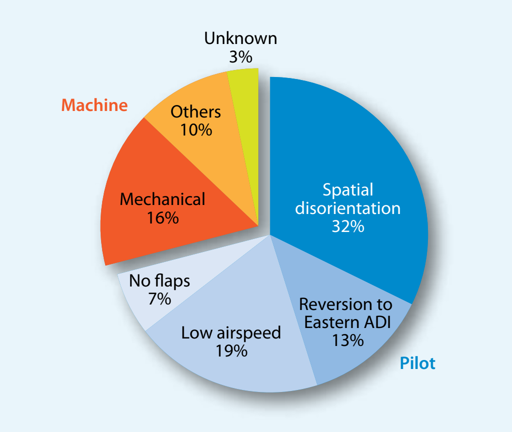
The attitude director indicator (ADI) is a key instrument for manual flight control and for monitoring automatic flight control. However, when a pilot attempts to recover from an unusual attitude, an unfamiliar ADI display can cause or contribute to confusion, uncertainty and/or delay.

The unfamiliarity typically is introduced by Eastern versus Western display formats (Figure 2). Overcoming a lifetime of flying experience with either type can prove to be very difficult for a pilot transitioning to the other type of display.

The major differences in these formats are that the Western horizon line tilts in alignment with the outside horizon and the airplane symbol remains fixed horizontally, while the Eastern horizon line remains horizontal and the airplane symbol tilts to show the airplane's bank angle. The Western format is an "inside out" display, while the Eastern format is an "outside in" display. The latter is the picture that the pilot of a following aircraft would see of the preceding aircraft. Military pilots often claim it is a better display when maneuvering in fast combat.

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 J.A. Donoghue, director of publications, Flight Safety Foundation, 801 N. Fairfax St., Suite 400, Alexandria VA 22314-1774 USA or donoghue@flightsafety.org.

LOC/LAC Accident Factors



LOC = loss of control; LAC = lack of aircraft control;
ADI = attitude director indicator

Source: Don Bateman

Figure 1

The Eastern ADI was designed in the early 1920s. It is less complex mechanically and simpler to build. Many pilots trained on this display format have had difficulty adapting in abnormal or unusual attitude situations to the ADIs in Western-built aircraft acquired by Eastern operators in the 1990s.

With the concepts and knowledge available today, a better, "universal" ADI could be developed to help reduce the learning time required during transition and to improve the probability of recovery when a pilot suddenly encounters an unusual attitude.

In 1966, Honeywell developed the *positive attitude control system*, a modified helicopter ADI intended to aid pilots, especially inexperienced pilots, in quickly learning to control helicopters in "brownouts" caused by blown-up dust, at night and in other reduced-visibility conditions. The system enabled the pilot to use the cyclic control to position the aircraft symbol on the ADI to the desired attitude. The symbol would gradually wash out as the roll and pitch attitudes were adjusted, and then return to its normal centered position on the ADI.

The mechanization gave an excellent stability control margin even in turbulence. It was amazing how a pilot with little or no experience in fixed-wing aircraft or in helicopters could quickly adapt and easily control a helicopter in flight.

The evolution of "glass" cockpits with electronic flight information systems (EFIS) and electronic ADIs makes this abandoned and essentially forgotten concept now very practical.

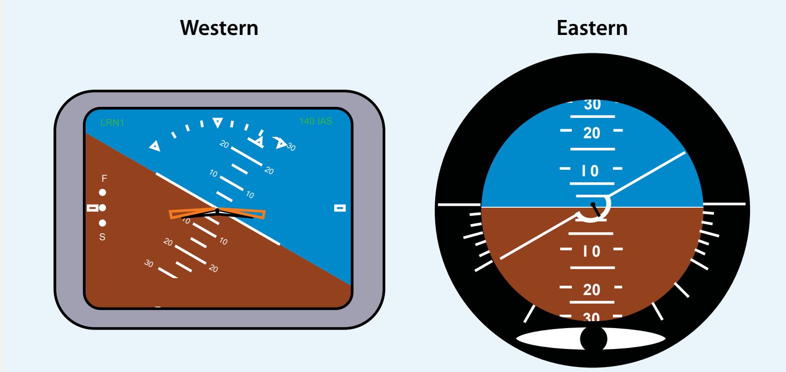
This Way Up

The risk of LOC is at least 10 times higher for aircraft with conventional pulley-and-cable controls than for fly-by-wire (FBW) aircraft with automatic protective envelopes. The greatest challenge is recovery from an inadvertent excessive bank angle when the pilot either believes that the autopilot is engaged or has tried to engage the autopilot after being startled by the unusual attitude.

Bank angles exceeding 35 degrees in conventional pulley-and-cable aircraft are common in real-world operations. Enhanced ground-proximity warning system (EGPWS) data recorded during 9 million flight departures shows a rate of about 1.8 bank angle exceedances per 1,000 departures.

Safety specialists are considering the use of roll and pitch recovery "arrows" on ADI/EFIS displays to help pilots recover from unusual attitudes (Figure 3, p. 30). In a simulation study,

ADI Display Formats

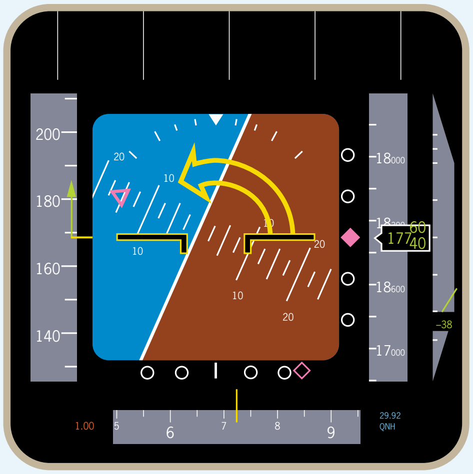


ADI = attitude director indicator

Source: Don Bateman

Figure 2

EADI Recovery Arrow



EADI = electronic attitude director indicator

Source: Don Bateman

Figure 3

Gary Gershzohn of Boeing showed that a recovery arrow helped reduce errors by 90 percent.[2] Participating pilots could quickly and correctly determine how to correct the bank angle. For many existing ADI/EFIS displays, this could be a modification with minimum investment.

The EGPWS computers currently installed in more than 42,000 aircraft provide an optional "BANK ANGLE" warning when bank exceeds 35 degrees. Honeywell is considering the addition of an aural advisory such as: "Roll left to level." The EGPWS computer simultaneously could provide a signal to the ADI that would activate the recovery arrow. These would be relatively simple software changes to most EGPWS computers and ADI/EFIS displays.

Synthetic Displays

If the pilot can see the horizon clearly outside the aircraft, the probability of LOC is very low. When the pilot cannot see the horizon, a synthetic vision system (SVS) can display an outside view overlaid with primary flight instrument indications similar to those found on a head-up display (HUD).

Both SVS and HUD are very valuable tools for LOC avoidance. Nonessential information can be removed automatically from the display to help the pilot concentrate on recovery from an unusual attitude.

Another possible improvement for conventional-control aircraft is tactile warning of excessive bank angle, such as a "stick nudger" based on aileron or control wheel position. This would be similar to a pre-stall stick shaker.

Honeywell has experimented with a simple device installed in a Beech King Air. The stick nudger was designed to be fail-safe to prevent the possibility of jamming the control cables. The advantages of the device are its simplicity and no change to the existing rigging or cable controls.

Aural Alerts

A number of accidents have involved pilots who did not notice a progressive loss of airspeed until the stick shaker activated with insufficient altitude to recover. These comprised about 20 percent of all LOC/LAC accidents.

The U.S. National Transportation Safety Board has repeatedly recommended installation of an aural and visual airspeed-alerting system. One FBW aircraft manufacturer has added an aural "AIRSPEED" alert to help pilots identify the need to reduce AOA when it reaches a protective envelope maximum value.

The ADI/EFIS displays in some conventional-control aircraft have a box around the airspeed readout that flashes at the minimum operating speed. Unfortunately, if the pilot is not scanning the airspeed readout, he or she might not notice the silent flashing box. An optional aural alert, "AIRSPEED LOW," has been developed to supplement the flashing airspeed box. This is a software function hosted in the EGPWS computer and requires no change to hardware or aircraft wiring.

Some accidents and incidents have involved aircraft that lost airspeed or AOA indications, or that had unreliable indications. Many were caused by sensor orifices blocked or restricted by tape applied during painting or by other contaminants.

A useful option offered by Airbus for both long-range and single-aisle aircraft is a backup airspeed scale and altitude scale that replace the normal scales when all three air data references are disengaged due to unreliable speed/altitude indications. The backup speed scale information is based on AOA and depends on the slat/flap configuration.

The backup altitude scale displays the global positioning system (GPS) altitude.

No-Flaps Alert

Accidents have resulted from attempts by flight crews to take off with the flaps improperly set. Most of the accidents involved unrecognizable takeoff warnings generated by the configuration warning systems or systems that were inoperative. Contributing factors included warning horns that can mean other problems with configuration, such as stabilizer trim, mismatched flaps or asymmetric thrust.

There also have been many incidents in which crews heard the configuration warning horn as they advanced the thrust levers. The wise pilots immediately rejected the takeoff and pulled off the runway to properly set the flaps. Some not-so-wise pilots attempted to set the flaps during the takeoff run, believing that the runway was long enough to do so.

One simple way to reduce the risk is to provide an aural "CHECK FLAPS" message when an aircraft enters a runway for takeoff without takeoff flaps set. This is possible, without hardware or wiring changes, with current EGPWS equipment that uses flap position to enable reactive wind shear functions. Acceptable takeoff flap setting data are all that is required. EGPWS already has sufficient runway data to create a "virtual box" around the runway. The hosted takeoff function would be completely independent of the configuration warning system and could also provide a visual text message, "FLAPS," on an existing display.

Wake Turbulence 'Tails'

Many LOC incidents and a few accidents have been caused by inadvertent flight into wake turbulence. The risk of these events could be decreased by adding "tails" to displayed Automatic Dependent Surveillance–Broadcast (ADS-B) targets to represent possible vortex locations and strengths (Figure 4).

Engineers tend to overcomplicate the computation of vortex locations and intensities. But a simple algorithm based on Isaac Newton's momentum flow, which gives an airplane its lift, would provide a good first-order approximation of vortex locations. Wind information, the other aircraft's position and other aircraft data would improve the calculation of where the wake turbulence probably exists.

Displaying areas to avoid or stay above would be a powerful tool for pilot awareness of wake turbulence and potential LOC.

Improve Training

Even the best technology can be of limited effectiveness without good professional training. Exposing the pilot to unusual attitudes and recoveries in a simulator, especially with the particular ADI/EFIS that the pilot uses in everyday operations, is invaluable.

Even the best technology can be of limited effectiveness without good professional training.

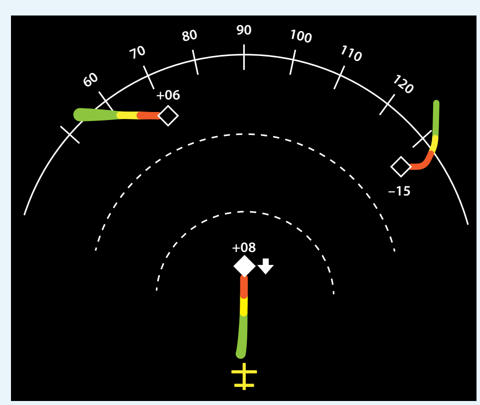
Airmanship needs to be practiced and enforced with proven standard operating procedures and knowledge gained from real-world experience and from research and development. Ingenuity and innovation can help drive down simulator costs so that every transport pilot can learn and handle somatogravic illusions.[3]

The advanced maneuver and upset recovery training being practiced by several airlines should greatly reduce LOC risk.

Soft Protection

Another possible LOC/LAC solution is to utilize existing autopilot servos and servo amplifiers to automatically avoid unusual roll and pitch attitudes. The autopilot servos installed in almost every airplane today are torque-limited, which allows the pilot to overpower the servo if necessary. This would also help give tactile feedback in the form of a "soft protection" for the aircraft.

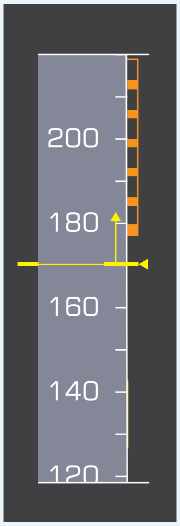
Wake Turbulence Display



Source: Don Bateman

Figure 4

Airspeed Scale



Source: Don Bateman

Figure 5

Unfortunately, the complexities of certification and application of using existing autopilot components could be very difficult and probably too expensive to implement.

As discussed earlier, FBW aircraft with full or resistive tactile protective envelopes have proven in service to be significantly resistant to the excessive bank angles that can lead to LOC. However, these aircraft are not immune to flight into terrain or to inducing somatogravic illusion that could lead to an inadvertent pitch down during a go-around close to the ground. There have been at least two accidents in which the pilots did not respond to EGPWS warnings and flew into water or ground while executing a go-around.

One of the weaknesses of some FBW aircraft designs is the lack of tactile feedback from sidesticks and the possibility of both pilots adding or subtracting their stick input. Sidesticks that provide tactile feedback are now available and should be used.

The lack of tactile feedback from thrust levers while changing power is another weakness of FBW designs.

Honeywell successfully demonstrated automatic recoveries in 2005 using an "assisted recovery" algorithm for autopilots in both conventional and FBW aircraft. Recoveries were made from flight paths toward mountainous terrain and obstacles.

A simple dive-recovery and wings-level algorithm would suffice to prevent most FBW aircraft accidents short of the runway. The level of integrity must be high to prevent inadvertent activations.

To ensure the integrity of runway terrain and obstacle data, EGPWS flight history currently is accumulated automatically in nonvolatile memory for all alerts and warnings. Flight history also is retained for every approach and take-off in GPS WGS-84 latitude-longitude, altitude and track coordinates. The data are then audited to validate accuracy and nuisance-free operation.

Reverse the Tape

I believe that the EFIS airspeed tape, or scale, used on most transport aircraft should be reversed.

The scale typically has a red-striped box bordering the speeds at which flap and aircraft overspeed occur (Figure 5). As airspeed increases and the trend arrow points into the overspeed-warning box — both upward movements on the scale — the pilot's natural reaction is to push forward on the control column, inadvertently increasing airspeed further.

There have been accidents and incidents in which a flap overspeed alert coupled with spatial disorientation likely contributed to a critical distraction at a critical time, leading to LOC.

In the 1980s, there was considerable debate over airspeed scale orientation. The industry gravitated toward the rising scale, and thousands of aircraft now have them. Thus, although reversing the scale would involve only a simple program pin and wire relocation, the change might be seen as introducing difficult training and adaptation problems for pilots. However, some operators have experienced no such problems for pilots flying either airspeed tape orientation in the same business aircraft type.

With losses from LOC/LAC accidents averaging about 300 lives and $400 million per year, the industry must focus on practical technology solutions for conventional and FBW aircraft.

Don Bateman, chief engineer for flight safety technologies at Honeywell Aerospace, led engineering teams in the development of the ground-proximity warning system (GPWS) and the enhanced GPWS. This article was adapted from the author's presentation to the FSF European Aviation Safety Seminar in March 2011. The opinions expressed do not necessarily reflect those of Honeywell or the Flight Safety Foundation.

Notes

1. A *loss of control accident* is one in which an aircraft is unintentionally flown into a position from which the flight crew is unable to recover due to aircrew, aircraft and/or environmental factors. A *lack of aircraft control accident* is one in which a controllable aircraft is unintentionally flown into a position from which the crew fails to recover due to aircrew, aircraft and/or environmental factors.

2. Gershzohn, Gary. "Unusual Attitude Recovery With the Roll Arrow." Presented at the FSF 16th Annual European Aviation Safety Seminar, March 2004.

3. *Somatogravic illusion* is a false sensation that the airplane is climbing when it actually is accelerating. A pilot may react by decreasing AOA.

Elusive Bright Line

Fatigue scientists resist flight crew schedulers' demand for go/no-go modeling tools as U.S. airlines brace for sweeping new regulations.

BY WAYNE ROSENKRANS

Airline representatives, fatigue researchers and aviation regulators expect significant near-term progress in reducing the risk of degraded pilot alertness through better application of fatigue theory to flight operations. Some attendees at a recent U.S. symposium, however, criticized government and industry slowness to adopt change. Other specialists expressed confidence that a confluence of cultural changes is now catching up to fatigue science, improving prospects for flexible regulatory oversight and safety enhancement.

The symposium, organized by the MITRE Corp. in cooperation with Flight Safety Foundation and titled "Aviation Fatigue: Building a Bridge Between Research and Operational Needs," was held June 6–8 in McLean, Virginia, U.S., to follow an April 2010 MITRE fatigue summit of 40 aviation leaders. The event comprised discussions of scheduled airline operations, on-demand operations, military operations, shift work such as air traffic control and aviation maintenance, fatigue-prediction tools, and fatigue modeling. This article focuses on issues affecting scheduled airline operations.

A strong undercurrent of the symposium was the U.S. airline industry's anticipation of the Federal Aviation Administration's (FAA's) final rule establishing new flight time limitations and rest requirements (*ASW*, 12/10–1/11, p. 23). Details of the final rule were unknown at press time.

Flights on the backside of the clock present special fatigue challenges.

Nevertheless, requirements for pilot fatigue education and awareness, and optional fatigue risk management systems (FRMSs) under airline fatigue risk management plans (FRMPs), in the rule will reflect a "societal shift" toward better understanding of fatigue and becoming proactive, said John Allen, director of the FAA Flight Standards Service. Allen said that the final rule will be issued on Aug. 8, 2011. "People expect airplanes to have the same safety as any utility, like water or electricity," he said. "When the FAA does a rule, we must strike a balance between safety and cost to the industry. … We cannot say [the final rule] will save this many accidents; we now say, 'This is the amount of risk we will mitigate.'"

Components of an FRMS include a flight duty time and rest policy, requirements for fatigue and alertness awareness and education, a fatigue reporting system, a system for monitoring flight crew fatigue, evaluation of system performance, and incident reporting (see "Operating Safely During Major Regulatory Transition").

The rule will spell out how to implement an FRMP, the foundation for conducting day-to-day flight operations under an FRMS, said Tom Nesthus, engineering research psychologist at the FAA Civil Aerospace Medical Institute. FRMSs, initially approved by the FAA and reviewed every 24 months, will provide an alternative to compliance with the new prescriptive language.

A theme of several attendees' questions was how FAA oversight under the new rule will differentiate between safe and unsafe operations. "All current operations are within the current regulations but we can't assume they are fatigue-free," Nesthus said. Every carrier has some operations that could be deemed unsafe by fatigue criteria, "but they are flown legally," he added. In

Operating Safely During Major Regulatory Transition

The shift from compliance with decades-old pilot flight time limitations and rest requirements in U.S. Federal Aviation Regulations Part 121.471 to new requirements — set to be announced Aug. 8, 2011 — will be challenging and costly, says Jim Starley, a captain and managing director of flight operations at United Airlines. In a presentation during the MITRE Corp.–sponsored fatigue research symposium in June, Starley cautioned attendees that what actually transpires could differ from his speculation because the airline industry has not seen the U.S. Federal Aviation Administration's (FAA's) final rule.

"Three pages describe the rule we're currently operating under," he said. "It is simple and straightforward to explain to operations [personnel]. … The notice of proposed rulemaking is much more complex than what we currently have. Implementation of the final rule will require significant modification of existing systems and every aspect of our scheduling infrastructure … and will change how the industry operates." He predicted the transition would take "a couple of years … and full fatigue risk management system [FRMS] integration could span well beyond that" before improving safety.

United's existing safety programs include an aviation safety action program; irregularity reporting; individual pilot self-reports of fatigue and potential fatigue reviewed for immediate tactical management of fatigue events; aggregated pilot reports reviewed to identify trends and recommend corrective measures; a flight operational quality assurance program set up to trigger investigations of potential fatigue; fatigue-prediction models to distinguish fatigue factors and windows of circadian low in schedules; an ongoing ultra-long-range versus long-haul operations study involving 70 Boeing 777 pilots; and annual ground school recurrent training of pilots on fatigue causal factors, effects of sleep loss, countermeasures, benefits of napping, results of fatigue studies and research findings.

Concerns include possible future accountability for accommodating circadian rhythms of individual flight crewmembers; routinely submitting new reports for different types of FAA oversight; mandatory FRMS for operations longer than 16 hours; uncertainty in differentiating domestic and international operations; one duty rest period irrespective of type of operation; accounting for time zone transitions and their effects on flight and duty time; a new type of reserve program; changes to consecutive nighttime operations and transportation of "deadheading" pilots; differences to operate in unsafe geographic areas; and modifying software to handle reports to the FAA and FAA audits of scheduling practices.

"Other elements we will have to contend with [are] rebuilding how we describe fatigue policies and regulations [to operations personnel] and establishing new flight and duty time baselines from which labor agreements are negotiated," Starley said.

— WR

contrast, the application of FRMSs, notably in ultra-long-range (ULR) flights — nonstop segments longer than 16 hours — has provided a level of fatigue risk that has been consistently acceptable.

"The last two decades of scientific research have produced excellent insights, but translating science into effective operational uses remains a challenge," said Hasan Shahidi, director of aviation safety at MITRE. "Complexity, uncertainty and diversity have yet to be addressed."

Mark Rosekind, a member of the U.S. National Transportation Safety Board, said that an operator's accident-free history does not mean that fatigue risk has been mitigated. The board cited fatigue as a causal factor in six air transport accidents in 1997–2009 and issued more than 190 fatigue-related recommendations for all modes of transportation. "We will need multiple solutions," he said. "We will need to learn from other industries [such as long-haul trucking], to share data and not just results, to expand and apply knowledge even within companies, and to capitalize on emerging knowledge and technology."

The value to airlines of taking the FRMS route is inherent incorporation of current fatigue science. Scientists consider fatigue to be a phenomenon primarily associated with time elapsed since awakening but also involving biological sleep need and sleep opportunity in relation to the exact timing of a person's circadian clock (rhythm) and rate of adaptation to circadian disruptions, said Melissa Mallis, chief scientist, operational and fatigue research, Institutes for Behavior Resources. She estimated that 35 U.S. air carriers have at least partially adopted an FRMS.

An FRMS also is flexible and adaptable as airline operations change over time. "It mitigates the effects of fatigue for a specific operation using a data-driven and evidence-based process," Mallis said. "An FRMS addresses physiological and operational factors, offers an interactive way to safely schedule and conduct flight operations on a case-by-case basis, and continuously monitors and manages safety risks associated with fatigue-related error."

Researchers hope to better accommodate different individual responses to sleep loss and circadian disruption, but FRMSs already are "sufficiently robust for implementation in operations — such as in an FAA-approved ULR operations specification [ops spec] — that can't otherwise be accommodated under prescriptive rules," she said.

Some symposium presenters cited innate differences among pilots — called *genetically instantiated trait-like features* that affect their ability to remain alert and to perform at the required cognitive level — as a significant frontier for aviation fatigue modeling and prediction.

"We know that half to two-thirds of [behavioral alertness is] attributable to this trait of the person's biology," said Daniel Mollicone, president of Pulsar Informatics. "Some people are unbelievably robust in the face of fatigue stressors. So I see this [differential susceptibility to fatigue stressors] as an opportunity in the future to be more exact in models by capturing that trait. … This will involve an appeal to professionalism [with each of us] needing know who we are [as to] our susceptibility to chronic sleep restriction or to profound deficits during night work."

Symposium attendees drew attention to aviation professionals being expected to report fit for duty, and to the apparent contradiction with scientists' statements that individual pilots have limited ability to assess their own alertness when fatigued. "People are not able to predict when they will have a microsleep or a lapse," Mallis said. "We can be trained to know fatigue signs and to evaluate others, and this addresses our inability to self-monitor."

Ultra-Long-Range Impact

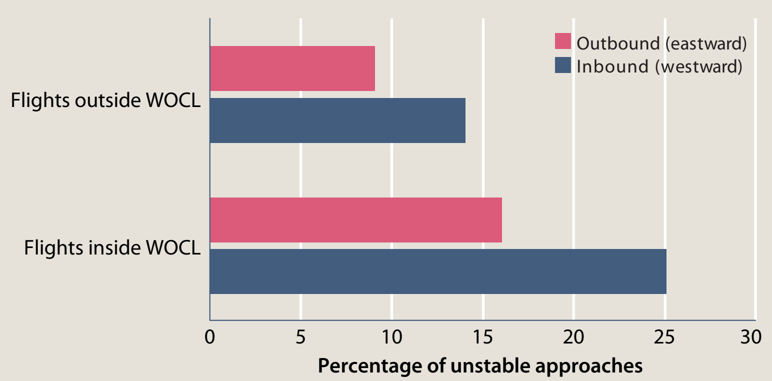
As predicted in 2003 when an earlier work group addressed flight crew alertness during ULR operations by Singapore Airlines (*Flight Safety Digest*, 8/05-9/05, p. 1), operators of long-range and short-range flights can benefit from the same principles, data and experience, presenters said.

The FAA's Nesthus described how the agency collaborated on research protocols and then approved the New York–Mumbai, India, ULR city pair for Delta Air Lines. A November 2008 FAA proposal to standardize ULR ops specs was withdrawn in response to industry comments, and instead, American, Continental and Delta agreed to participate in new airline-funded, parallel ULR research projects. The FAA has worked with these airlines on this research focusing on 70 pilots per carrier, all operating Boeing 777s under FRMSs.

Each airline has been following a common protocol — based on actigraphy (using a wrist-worn device to record all time awake and asleep for three weeks), psychomotor vigilance tests (PVTs) on smartphones, personal activity logs, and self-described levels of fatigue, alertness and sleep quality. Each airline added customized elements to the common protocol.

Presenting one year of ULR research, Greg Belenky, research professor and director of the Sleep and Performance Research Center at Washington State University Spokane, said that cognitive performance by the same group of Continental pilots was measured on a sequence of ULR

Possible Links Between Fatigue Risk and Unstable Approaches



FOQA = flight operational quality assurance; ULR = ultra long range; WOCL = window of circadian low (0300-0500)

Notes: Transatlantic flights between the same ULR city pairs were operated by 70 captains and first officers on Boeing 777s in research for American Airlines. The company analyzed FOQA data for predefined parameters deemed to indicate unstable approaches, and compared pilot alertness at the corresponding time.

Source: Martin Moore-Ede, Circadian

Figure 1

and long-range flights on 777s. "The point of the study was to see if ULR operations were as safe as the long-range operations [for the same pilots]," he said.

This research was unique in collecting flight operational quality assurance (FOQA) data "in the hope of seeing relationships between FOQA and PVTs, etc.," Belenky added.

Martin Moore-Ede, a physician and chairman and CEO of Circadian, summarized American's ULR research project. The reason for replicating research done for Singapore Airlines was to employ the common protocol and database design being used by Delta and Continental, he said. "We now have data that can be compared for 210 pilots, with a few exceptions because of differences in the nature of fatigue," Moore-Ede said.

American's research beyond the common protocol focused on validating the company's FRMS and fatigue modeling, and testing a new metric called "descent unstable landing" — extrapolated from selected flight parameters in FOQA data to discover relationships between alertness and stable approaches. Researchers decided that pilots would find it "more interesting [than PVT results] to have the model predict an unstable approach," Moore-Ede said.

"We find that the low-risk crew pairings have higher rates of stable landings and lower rates of unstable landings [compared with high-risk crew pairings]," he said (Figure 1). High-risk pairings include flight during the body clock's 0300–0500 window of circadian low.

"We have looked at other variables, such as the difficulty of the approach, but it looks as though fatigue is the strongest driver," Moore-Ede said. "This may become an operationally relevant crew standard, a very interesting tool for FRMS with [an expert scoring system that] would cost the airline no more to track [the daily] percentage of final approach instability events."

Douglas Rohn, director of the Aviation Safety Program Office of the U.S. National Aeronautics and Space Administration (NASA), said that NASA also is looking at the relationship between alertness measurements, FOQA exceedances, and errors and events revealed by other data sources. "NASA and easyJet are specifically studying pilot fatigue in short-haul work schedules … predictive tools and mitigation design," Rohn said.

However, Belenky noted that some fatigue scientists are less enthusiastic about prospects of correlating unstable approaches with alertness data, given the complexity of variables such as 20–30 minutes of sleep inertia immediately after a ULR crew rest period, and close to the time of the approach.

Regional Airline Research

Prescriptive requirements in the FAA's final rule "level the playing field for smaller operators that can't afford an FRMS," said Scott Foose, senior vice president, operations and safety, Regional Airline Association (RAA; *ASW,* 5/11, p. 34). "Depending on the final rule, we expect 80 percent of RAA members to have an FRMS while 20 percent, the smaller carriers, will be absolutely fine and safe operating under the prescriptive rules, " he said.

Almost no fatigue research has been conducted on multi-segment, short-haul operations

— typically five takeoffs and landings per day, Foose said. In the context of FAA rulemaking, the RAA contracted with the Sleep and Performance Research Center.

Foose and Hans Van Dongen, a research professor at the center, announced a few of the preliminary results of the first phase, based entirely on laboratory modeling. Van Dongen said that the objective was "to predict the performance consequences of additional workload associated with five-segment duty days as compared to one-segment long-range duty days of the same duration."

The regional airline pilot who begins his or her workday early in the morning can maintain "a net stable level of alertness through the first 12 to 16 hours of the day," he said. "Time on task augments fatigue but this is overcome by [overnight sleep after duty]."

ICAO Perspectives

The International Civil Aviation Organization (ICAO) expects to complete FRMS standards and guidance soon, said Michelle Millar, FRMS project officer at ICAO. Recently, the organization has been forging a global agreement on FRMS that regulators will follow to provide oversight of operators in their jurisdictions. ICAO's timetable calls for FRMS standards and guidance to be effective in October 2011 and implemented on Dec. 15, 2011, she said.

These amendments to ICAO annexes will say that "states must have limitations [on flight and duty time] and also may allow FRMSs based on scientific principles," Millar said. New materials will recommend best practices to states.

Any organization planning to monitor or compare the FRMSs of different entities will benefit from ready access to shared data, said Emma Romig, principal investigator, flight deck research and development, Boeing Commercial Airplanes. Such access will become a critical aspect of judging FRMS effectiveness and performing quality control.

Romig has been converting legacy data sets, including those from the early ULR work for Singapore Airlines and Delta, to Boeing's proposed data-interchange specifications, called the *alertness data standard format* and the *common alertness prediction interface.* Boeing is willing to share these specifications with the research community for common benefit.

Pilot Sleep Disorders

Flights selected for study should reflect the range of typical airline pilots and their health conditions, not have only pilots matching narrow health criteria, Circadian's Moore-Ede said in response to audience questions about how to account for pilot sleep disorders.

Jim Mangie, a captain and pilot fatigue program director for Delta, said he sees no need for mandatory screening of pilots for sleep disorders because "a significant percentage of [U.S.] pilots have been diagnosed and treated [for sleep disorders] and are back flying." This has been a desired result of ongoing FAA and airline initiatives to update the education of aviation medical examiners, pilots and air traffic controllers, Mangie and other presenters said.

Other attendees wanted fatigue-prediction software features that generate a so-called "bright line" — that is, giving the user an unambiguous, automated decision about safe or unsafe fatigue risk. Some suggested that a minimum prediction of, say, 77.5 percent of the flight crew's baseline/optimum alertness as determined by a PVT would serve that purpose. The scientists present disagreed with this premise.

"We always want the tools to estimate [only] the range of fatigue risk … not set an arbitrary number with a risk of people relaxing [operational vigilance] at that point. … Tools are not a way of ranking every single trip and individual," Moore-Ede said.

Airlines understandably want new tools with built-in "threshold tie breakers" and "decision makers," agreed David Neri, deputy director, Warfighter Performance Science and Technology Department, U.S. Office of Naval Research. A *threshold* is an informational caution and interventional warning from a software tool to the operator.

"There has been a big call from operators for a measure of when someone is 'good to go,'" Neri said. "They say they need a way to resolve ties [among alternatives presented rather than] using model output as a caution. … Models are seductive when people want a bright line, but the people who make decisions should consider many factors."

A non-U.S. researcher was optimistic about the pace of implementing fatigue science within the global airline industry. "I'm astonished by how far things have moved forward. [Aviation professionals now] are really wrestling with operational implementation issues," said Philippa Gander, professor and director of the Sleep/Wake Research Centre at the Massey University campus in Wellington, New Zealand.

The industry should look at FOQA exceedances as one of many possible sources of operational data that could be relevant to FRMSs but have not been used that way, Gander added. "Models possibly have been oversold and accepted at face value," she said. "One clear message from regulators is that no operational decision should ever be made solely based on a fatigue model threshold."

The NTSB is pressing for action to reinforce professionalism in the wake of recent accident-related lapses.

SHAPE UP

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BY LINDA WERFELMAN

Citing a "disturbing number" of events involving nonadherence with standard operating procedures by pilots and air traffic controllers, the U.S. National Transportation Safety Board (NTSB) is complaining of "an erosion of … professionalism" and urging action to improve on-the-job behavior.

The NTSB added "pilot and air traffic controller professionalism" to its new "Most Wanted List" of the top 10 changes needed to prevent accidents in aviation and other forms of transportation.

"Recent accidents and incidents have highlighted the hazards to aviation safety associated with departures by pilots and air traffic controllers from standard operating procedures and established best practices," the NTSB said. "NTSB aviation accident reports describe the errors and catastrophic outcomes that can result from such lapses, and — though the NTSB has issued recommendations to reduce and mitigate such human failures — accidents and incidents continue.

"The costs of these events extend beyond fatalities, injuries and economic losses; they erode the public trust."

In general, the NTSB said, the issue must be addressed by the aviation industry, including labor and management, as well as by aviation associations and government.

"An open and ongoing dialogue among these parties will raise awareness of the importance of reinforcing professionalism," the NTSB said.

"The industry can provide better guidance on expected standards of performance and professional behavior. Pilots, controllers and managers can reinforce these standards through their day-to-day actions on the job. And, though there is no way to guarantee that every pilot and controller will make the right choice in every situation, monitoring performance and holding them accountable will reinforce the absolute importance of maintaining the highest level of professionalism."

Major Accidents

The NTSB cited several recent major accident and incident investigations that have identified issues involving pilot or air traffic controller professionalism, and discussed recommendations that were issued as a result of those investigations.

The earliest of these accidents occurred July 13, 2003, when an Air Sunshine Cessna 402C was ditched in the Atlantic Ocean about 7 nm (13 km) west-northwest of Treasure Cay Airport on Great Abaco Island in the Bahamas, after the failure of the right engine. Two passengers were killed, five passengers and the pilot received minor injuries, and two passengers were uninjured in the crash, which the NTSB said resulted in substantial damage to the airplane (*Aviation Mechanics Bulletin,* 11–12/05).

The NTSB said that the probable causes of the accident were the engine failure and the pilot's "failure to adequately manage the airplane's performance after the engine failed." The agency added that a factor contributing to the passenger fatalities was the failure of the pilot to conduct an emergency briefing.

The NTSB also noted that its review of U.S. Federal Aviation Administration (FAA) records showed that the pilot had failed nine flight checks between April 1983 and February 1998. The agency's safety recommendations — issued in January 2005 — included one calling on the FAA to require all Federal Aviation Regulations Part 121 and Part 135 air carriers to evaluate notices of disapproval from a pilot's previous flight checks for certificates and ratings before deciding whether to hire the pilot.[1]

The NTSB issued a related recommendation in May 2005 as a result of its investigation of the Dec. 18, 2003, crash of a FedEx Boeing McDonnell Douglas MD-10 while landing in Memphis, Tennessee, U.S.[2] Two of the seven people in the airplane received minor injuries, and the airplane's right wing and parts of the right side of the fuselage were destroyed, the NTSB said (*Accident Prevention*, 10/05).

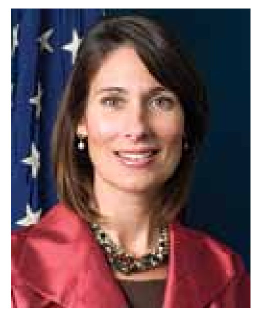
The NTSB cited as probable causes "the first officer's failure to properly apply crosswind landing techniques to align the airplane with the runway centerline and to properly arrest the airplane's descent rate (flare) before the airplane touched down" and "the captain's failure to adequately monitor the first officer's performance and [to] command or initiate corrective action during the final approach and landing."

In a letter to then-FAA Administrator Marion Blakey, the NTSB expressed concern that post-accident interviews and a review of the first officer's training history "suggested a pattern of below-standard performance." Nevertheless, before the accident, his "repeated substandard performances on check rides" had been addressed as "singular events" and he had received no additional oversight.

The NTSB said that FedEx pilot training procedures — like those of other operators at the time of the accident — emphasized a pilot's check ride performance, "with little or no review of that pilot's performance on check rides months or years earlier."

As a result, the NTSB recommended that the FAA require Part 121 air carrier operators to "establish programs for flight crewmembers who have demonstrated performance deficiencies or experienced failures in the training environment that

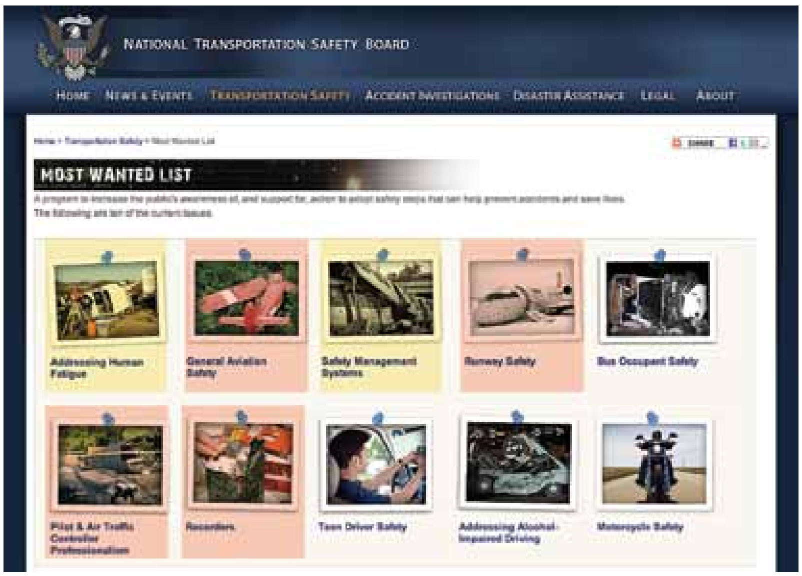
NTSB Chairman Deborah A.P. Hersman has called the Most Wanted List "the most powerful tool we have to highlight our priorities."


U.S. National Transportation Safety Board

would require a review of their whole performance history at the company and administer additional oversight and training to ensure that performance deficiencies are addressed and corrected."

'Inappropriate Response'

Both recommendations were reiterated in the NTSB's safety recommendation letter that followed the most recent accident cited in the board's discussion of professionalism — the Feb. 12, 2009, crash of a Colgan Air Bombardier Q400 during approach to Buffalo Niagara (New York, U.S.) International Airport (*ASW*, 3/10, p.20). All 49 people in the airplane and one person on the ground were killed, and the airplane was destroyed in the accident. The NTSB said the probable cause was the captain's "inappropriate response to the activation of the stick shaker, which led to an aerodynamic stall from which the airplane did not recover."



The NTSB's Most Wanted List of transportation safety improvements includes four areas — including enhanced professionalism — that focus on aviation. Two other areas affect several forms of transportation, including aviation.

The NTSB's list of contributing factors included the flight crew's failure to monitor airspeed and failure to adhere to sterile cockpit procedures, as well as the captain's "failure to effectively manage the flight."

The board also cited the captain's "several disapprovals" in seeking pilot ratings and certificates and "training problems throughout his flying career," both before and after he was hired by Colgan.

In a discussion of pilot professionalism contained in the safety recommendation letter, the NTSB said that, "on the basis of his actions during the flight, including the late performance of checklists and callouts because of an ongoing conversation, the captain showed inadequate leadership."[3]

The NTSB noted that, especially because the captain had held that position for more than two years, "his failure to establish the appropriate cockpit tone during the initial stages of the operation and show strong command authority during the flight is disconcerting."

The FAA does not require Part 121 operators to provide training to help new captains make the transition to pilot-in-command (PIC), but at the time of the accident captain's 2007 upgrade, Colgan offered upgrading captains a one-day course on their new duties and responsibilities. However, the NTSB said that the course concentrated on a captain's administrative duties and paid little attention to leadership skills, management oversight and command authority.

"For many new captains, including the accident captain, the initial upgrade represents the first time in which they are held responsible for leading and managing multiple crewmembers during air carrier operations," the NTSB said. "Because of the PIC's critical role in establishing and maintaining safe operating conditions, upgrading captains would greatly benefit from specific training on command and leadership skills."

As a result, the NTSB recommended that the FAA issue an advisory circular to provide guidance to Part 121, Part 135 and Part 91K fractional ownership operators on leadership training for their upgrading captains, "including methods and techniques for effective leadership; professional standards of conduct; strategies for briefing and debriefing; reinforcement and correction skills; and other knowledge, skills and abilities that are critical for air carrier operations."

Also included among the 25 recommendations was a call for the FAA to require Part 121, Part 135 and Part 91K operators to provide specific leadership training for upgrading captains. Another recommendation said that the FAA should "develop, and distribute to all pilots, multimedia guidance materials on professionalism in aircraft operations that contain standards of performance for professionalism; best practices for sterile cockpit adherence; techniques for assessing and correcting pilot deviations; … and a detailed review of accidents involving breakdowns in sterile cockpit and other procedures."

'Poor Airmanship'

The Oct. 14, 2004, crash of a Pinnacle Airlines Bombardier CRJ200 prompted another recommendation calling on the FAA to work with pilot associations in developing an air carrier pilots' program "that addresses professional standards and their role in ensuring safety of flight."[4]

The captain and the first officer — the only people in the airplane for the repositioning flight — were killed and the airplane was destroyed in the crash, about 2.5 mi (4.0 km) south of Jefferson City Memorial Airport in Missouri, U.S. (*ASW*, 7/06, p. 44). The crash followed an aerodynamic stall, loss of control of the airplane and flameouts of both engines following a climb to 41,000 ft and subsequent flight below the minimum required airspeed for engine restart, the NTSB said.

The NTSB said that the absence of passengers or other crewmembers "presented the pilots with an opportunity to aggressively maneuver the airplane and operate it at the CRJ maximum operating altitude." The pilots' behavior was an example of "optimizing violations, which occur when someone disregards defined procedures intentionally to make a job more interesting or engaging, to push limits or to impress another," the NTSB said.

The NTSB said the probable causes of the accident were "the pilots' unprofessional behavior, deviation from standard operating procedures and poor airmanship, which resulted in an in-flight emergency from which they were unable to recover, in part because of the pilots' inadequate training"; "the pilots' failure to prepare for an emergency landing in a timely manner, including communicating with air traffic controllers immediately after the emergency about the loss of both engines and the availability of landing sites"; and "the pilots' improper management of the double engine failure checklist, which allowed the engine cores to stop rotating and resulted in the core lock engine condition."[5]

Controller Judgment

The Aug. 27, 2006, crash of a Comair Bombardier CRJ100 during takeoff from Blue Grass Airport in Lexington, Kentucky, U.S., resulted in issuance of a recommendation dealing with job performance by air traffic controllers (*ASW*, 11/07, p. 38).

The NTSB said that its investigations of several events involving air traffic controllers "highlight a safety issue related to controller vigilance, judgment and safety awareness."

The crash followed the flight crew's attempt to take off from 3,500-ft (1,068-m) Runway 26, which they had mistaken for their assigned Runway 22, which was twice as long. All but one of the 50 people in the airplane were killed, and the survivor suffered serious injuries in the crash, which destroyed the airplane.

The NTSB said the probable cause was the crewmembers' "failure to use available cues and aids to identify the airplane's location on the airport surface during taxi and their failure to cross-check and verify that the airplane was on the correct runway before takeoff."

In the safety recommendation, the NTSB noted that the lone controller in the airport traffic control tower had issued a takeoff clearance and then, instead of monitoring the takeoff and departure, turned to an administrative task.

The NTSB said that its investigations of several events involving air traffic controllers "highlight a safety issue related to controller vigilance, judgment and safety awareness that should be addressed."

The accompanying safety recommendation called on the FAA to "require all air traffic controllers to complete instructor-led initial and recurrent training in resource management skills that will improve controller judgment, vigilance and safety awareness."

Notes

1. NTSB. Safety Recommendations A-05-01 and A-05-02. Jan. 27, 2005.
2. NTSB. Safety Recommendations A-05-014 through A-05-018. May 31, 2005.
3. NTSB. Safety Recommendations A-10-10 through A-10-34. Feb. 23, 2010.
4. NTSB. Safety Recommendations A-07-1 through A-07-11. Jan. 23, 2007.
5. "Core lock" is a rare condition in which an engine core freezes after an in-flight flameout and could prevent a windmill restart.
6. NTSB. Safety Recommendation A-07-34. April 10, 2007.

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Misplaced Priorities

The NTSB blames an overemphasis on 'getting the job done' for helping create the weak safety culture that led to a fatal crash.

BY LINDA WERFELMAN

Charlie Mauzé/Airliners.net

An organizational culture that "prioritized mission execution over aviation safety" contributed to the 2009 crash of a New Mexico State Police Agusta A-109E that killed the pilot and the lost hiker he had just rescued from a mountainous wilderness area, the U.S. National Transportation Safety Board (NTSB) says.

The NTSB, in its final report on the accident, cited as its probable cause "the pilot's decision to take off from a remote, mountainous landing site in dark (moonless) night, windy, instrument meteorological conditions."

The NTSB added that factors contributing to the accident included the organization's emphasis on mission completion, as well as "the pilot's fatigue, self-induced pressure to conduct the flight and situational stress."

Also cited were "deficiencies in the NMSP [New Mexico State Police] aviation section's safety-related policies, including lack of a requirement for a risk assessment at any point during the mission; inadequate pilot staffing; lack of an effective fatigue management program for pilots; and inadequate procedures and equipment to ensure effective communication between airborne and ground personnel during search and rescue [SAR] missions."

"One thing we learned from this accident," NTSB Chairman Deborah A.P. Hersman said in a news release, "is that if safety is not the highest organizational priority, an organization may accomplish more missions, but there can be a high price to pay for that success."

Call for Help

The crash occurred about 2135 local time June 9, about 2 ½ minutes after departure from a landing site in the Pecos Wilderness about 20 nm (37 km) northeast of Santa Fe. In addition to the two deaths, a state highway patrol officer who acted as a spotter during the SAR mission was seriously injured. The helicopter was substantially damaged, the report said.

The SAR flight was initiated in response to a call from the lost hiker, identified as a Japanese citizen, who had used her cell phone about 1646 to ask for help. SAR personnel organized a search, and, anticipating delays because there were no roads in the search area, they requested that an NMSP helicopter join the effort.

At 1756, a police shift supervisor asked the pilot, who earlier in the day had completed an eight-hour shift that included three flights, if he "(felt) like going up again." The pilot initially responded that it was too windy in the search area to fly at that time of day; he called back several minutes later to say that, having checked the winds, he would make the flight.

Post-accident interviews indicated that the pilot, who was also the chief pilot[1] in the NMSP aviation section, had asked the other full-time helicopter pilot about taking the flight and accepted the mission himself after learning that the other pilot was unavailable.

The spotter told accident investigators that the pilot had warned him before takeoff about possible turbulence in the mountains; he said he did not remember comments about any other safety concerns.

About 1851, the pilot told the dispatcher that the helicopter was en route to the search area; regular communication continued with the dispatcher, who was speaking with the hiker via telephone, to better determine her location. About 1942, the hiker told the dispatcher that the helicopter was directly above her. The pilot and the spotter saw her about 2010 and began searching for a suitable landing area.

At 2030, about 20 minutes before sunset, the pilot told the dispatcher that they had landed in a clear area on a hill about 0.5 mi (0.8 km) above the hiker. The spotter said that, as they opened the helicopter's doors, they felt strong, cold westerly winds and saw sleet begin to fall. Because the hiker needed help reaching the helicopter, the pilot walked down the hill, located her and carried her back up the hill to the helicopter.

About 2127, the spotter told the dispatcher that they were about to fly back to Santa Fe.

He later told investigators that "almost immediately after takeoff, the helicopter was in the clouds with zero visibility and that the flight was very turbulent." Radar indicated that the helicopter initially headed northwest, then, about

SAR teams found the helicopter on rocky, snow- and ice-covered terrain.

one minute after takeoff, "began to fly erratically in a northeasterly direction and to climb, crossing terrain as high as 12,500 ft before descending rapidly near the crash site," the report said.

About 2134, the pilot radioed the dispatcher, "I struck a mountainside. [I'm] going down." She asked, "Are you [OK]?" The pilot answered "negative."

"The pilot continued to key his microphone, and on the dispatch recording, he could be heard breathing rapidly for about the next 39 seconds," the report said. "The dispatcher inquired, 'Santa Fe 606?' The pilot then said, 'Hang on [unintelligible]' and the radio transmission cut off immediately thereafter."

The last radar return was recorded at 2135.

The spotter said that after the crash, he was alone in the wreckage of the fuselage. Despite a broken ankle, chipped vertebrae, separated ribs and other injuries, he crawled out of the wreckage, yelling to the pilot, who yelled back from a distance. He found the hiker and determined that she had died, but he was unable to locate the pilot, who no longer answered his calls.

He spent the night inside the wrecked fuselage. In the morning, SAR personnel found him attempting to hike down the mountain to find help. SAR teams found the helicopter at 1816 on June 10 on rocky, snow- and ice-covered terrain.

Chief Pilot

The accident pilot had been hired as a patrol officer by the NMSP in 1995, after serving in the U.S. Marine Corps. He was transferred to a pilot position in 2002 and began pilot training. At the time of the accident, he had 1,331 flight hours, including 482 hours in helicopters — 411 of which were in the A-109E.

He held a commercial pilot certificate with airplane single- and multi-engine land ratings, a rotorcraft/helicopter rating, an airplane instrument rating and a first class medical certificate. He had received specific training in the A-109E and Cessna 421, in addition to instruction in mountain flying and the use of night vision goggles (NVGs). Records showed that he met U.S. Federal Aviation Regulations Part 61 night currency requirements for both helicopters and airplanes.

The pilot did not have a helicopter instrument rating, and one was not required by the NMSP because their helicopter operations typically were conducted as visual flight rules (VFR) operations.

The report said that a July 23, 2008, memo written by the head of the state Department of Public Safety (DPS) specified that the pilot must be "accompanied by a more experienced pilot when operating the helicopter above 9,000 ft or in mountainous terrain." Several authorities within the NMSP and DPS told accident investigators that they believed the restrictions had been removed, but there was no written indication of the removal.

In addition to his flight duties, the pilot was assigned in 2007 to serve as NMSP public information officer (PIO). In 2009, he was appointed chief pilot of the four-pilot operation. The other pilots — all of whom had more experience — described the accident pilot as a "competent pilot" and a "very skilled manipulator of the controls … for his experience level," the report said.

His colleagues disagreed about the pilot's aeronautical decision making. The report said that during interviews with accident investigators, "the full-time helicopter pilot said that the accident pilot usually examined all aspects of a mission and selected an intelligent strategy," while the part-time helicopter pilot said that the accident pilot "lacked 'temperance' because of his youth and inexperience."

Some of the other pilots told investigators that the accident pilot had refused flights in the past, either because of poor weather or fatigue, but one also said he was a "very heroic type person" who disliked turning down requests that he fly.

His wife, the state police emergency dispatcher working at the time of the accident, added that the pilot probably had accepted the accident flight because the winds were not unsafe, he was concerned about the hiker's safety and a supervisor had asked him to fly. "If he could do the mission and help, that was his focus," she said.

The report said that the pilot had taken a prescribed antidepressant for several years, with no side effects. Accident investigators found no indication of any preexisting medical condition that might have affected the pilot's performance during the flight.

Late-Night Phone Calls

The pilot typically worked from 0700 to 1500 Monday through Friday, but the pilot's wife said that he often was on call, either as a pilot or as PIO, and that she could not remember the last day that was totally free of work-related duties.

For example, during the weekend that preceded the Tuesday accident, the pilot was on call for both PIO duties and pilot duties. In his PIO role, he worked with the news media periodically throughout the day Saturday and Sunday. He received work-related telephone calls around 0035 Sunday, around 2330 Sunday and around 0245 Monday. His duty day on Monday had begun around 0300 and ended around 1100. On Tuesday, he worked a typical 0700 to 1500 shift before being called back for the SAR flight.

"The pilot's wife stated that her husband loved flying and appreciated that the NMSP had given him the opportunity to work as a pilot," the report said. "However, the pilot's wife stated that her husband 'absolutely hated' his duties as the NMSP PIO."

He disliked having to talk in front of news cameras and worried that the time spent answering reporters' questions prevented him from getting adequate rest for flying, she said.

'Get Over It'

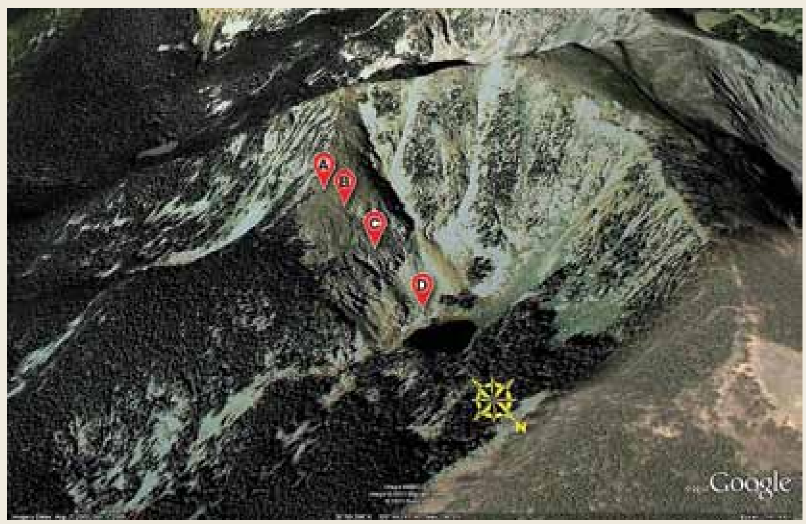
She added that when her husband told NMSP upper management that his PIO duties conflicted with his chief pilot duties and that he could not get adequate rest, "he was told to 'get over it' and to do his job," the report said.

The pilot's immediate supervisor — the NMSP special operations captain — shared the concern about the pilot's dual assignments and told investigators that the previous chief pilot had tried but failed to have the accident pilot relieved of his PIO assignment.

NMSP upper management saw no problem with the accident pilot's workload, however.

"The chief of police told investigators that the aviation section pilots were 'not overworked. They don't fly enough hours. They have a lot of idle time,'" the report said. "He stated that he had not relieved the accident pilot of his PIO duties after appointing him chief pilot because he 'didn't feel it was a conflict. … They're not flying that often, and the PIO position … if there's nothing big happening in the state, you're not doing anything.'

A tail strike occurred at an undetermined location before the Agusta crashed on a ridgeline. The highest piece of wreckage was found at point A, impact marks at B, the tail boom at C, and the main fuselage wreckage at D.



AP Photo/U.S. National Transportation Safety Board

"The chief of police further stated, 'Look at the number of hours they fly and divide that by the number of pilots. … He's flying a couple hundred hours a year.'"

The head of the DPS said that he also had performed the PIO job and other extra duties during his tenure as chief pilot in the early 1990s and that he saw no conflict. He said he was unaware that the pilot had asked to be relieved of PIO duties.

The pilot who had held the chief pilot's position immediately before the accident pilot was assigned the job in 2009 said that he had been "relieved of his chief pilot responsibilities" — on the orders of the head of the DPS — because he had refused to send the two most junior pilots "on a mission that he considered extremely high risk."

The A-109E was manufactured in 2003 and delivered to the Department of Public Safety later that year; it had accumulated 1,710 flight hours. It had two Pratt & Whitney Canada PW206C turboshaft engines; the right engine had accumulated 1,667 hours and the left, 1,132 hours. The department had three sets of NVGs intended for use in the helicopter. The investigation found no indication of pre-impact problems.

'Poor Decision Making'

The NTSB said that when the pilot accepted the flight, weather and lighting conditions "did not preclude the mission." Nevertheless, because the flight was to be at high altitudes in a mountainous area in approaching darkness and deteriorating weather conditions, the report added that the pilot "should have taken steps to mitigate the potential risks involved, for example, by bringing cold-weather survival gear and ensuring that [NVGs] were on board and readily available."

Later, the pilot "exhibited poor decision making when he chose to take off from a relatively secure landing site at night and attempt [VFR] flight in adverse weather conditions," the report said, adding that his decision probably resulted from fatigue, self-induced pressure and stress.

"Although there was no evidence of any direct [NMSP] or [DPS] management pressure on the pilot during the accident mission, there was evidence of management actions that emphasized accepting all missions, without adequate regard for conditions, which was not consistent with a safety-focused organizational safety culture," the report said.

Recommendations

In April 2010, a DPS memo — included in the NTSB accident docket — said that the department was working to "establish a quality safety management approach to controlling risk" within the NMSP aviation section. The actions being taken included the development of new procedures for dispatching crews and aircraft; appointment of a 4,000-hour chief pilot, an aviation section safety officer and a training officer; and development of new standard operating procedures and a new risk management program.

As a result of the accident investigation, the NTSB issued 15 safety recommendations, most of them directed to law enforcement associations but several addressed to the governor of New Mexico.

The recommendations included a call for the Airborne Law Enforcement Association to revise its standards to ensure that pilots receive adequate rest periods and to require that all pilots are instructed on how to fly safely out of instrument meteorological conditions.

Recommendations to the National Association of State Aviation Officials and the International Association of Chiefs of Police included encouraging association members to review and modify their policies in accordance with forthcoming guidance from the Airborne Law Enforcement Association and to implement risk management procedures for their operations. The associations also should encourage the installation of 406-MHz emergency locator transmitters in all member aircraft, as well as flight-tracking equipment.

The NTSB called on the state of New Mexico to "bring its aviation section policies and operations into conformance with industry standards," to implement a comprehensive fatigue management program for NMSP pilots and to revise policies to ensure direct communication between NMSP aircraft and SAR ground personnel during SAR operations.

This article is based on NTSB accident report NTSB/AAR-11/04, Crash After Encounter With Instrument Meteorological Conditions During Takeoff From Remote Landing Site; New Mexico State Police, Agusta S.p.A A-109E, N606SP; Near Santa Fe, New Mexico; June 9, 2009. *Adopted May 24, 2011.*

Note

1. According to NMSP documents, the chief pilot was the "day-to-day administrator and supervisor" of four other pilots and one maintenance technician, and was responsible for "all daily flight operations, maintenance coordination, purchasing, training, planning and personnel matters involving aircraft and pilots." The report said that the chain of command placed five police officers above the chief pilot; the top official was the secretary of the Department of Public Safety, a member of the governor's Cabinet. Of those who outranked the chief pilot, only the Cabinet secretary had any knowledge or experience with aviation.

BY RICK DARBY

Australian Air Charter Safety Looking Up

Accident rate still exceeded that of regular public transport, but the trend is encouraging.

Australia's celebrated aviation safety record took a "headline hit" in 2010 when an Airbus A380 en route from Singapore to Sydney suffered an uncontained engine failure on Nov. 4, with a fractured turbine disk causing structural and systems damage. While the investigation continues, the Australian Transport Safety Bureau's (ATSB's) latest analysis indicates no overall adverse trend and an improvement in the charter operations accident rate in the most recent year for which it could be calculated.[1]

In Australian air transport during 2010, accidents and serious incidents involved loss of aircraft separation, loss of control in flight, powerplant and propulsion, terrain collisions, and runway and ground operations. Among incidents in general, the most common concerned wildlife strikes, pilot failure to comply with air traffic control instructions or clearances, mechanical systems, and airframes. The data are included in a review of 10 years of occurrence statistics by the ATSB.

Among commercial air transport occurrences in the 2001–2010 study period, most occurrences were incidents.[2] "About 1 percent of all air transport occurrences were serious incidents or accidents," the report says. "On average, there were about two fatal accidents every year involving these aircraft, and they belonged mainly to the category of charter operations."

Fatal accidents per million departures in all types of commercial air transport ranged from a high of 4.0 in 2002 to 0.0 in 2004 and 2009, with departure information — and therefore rates — not yet calculated for 2010 (Table 1, p. 48). The 2009 accident rate of 9.8 per million departures was 45.6 percent of the average rate for the preceding eight years and 39.2 percent of the 2008 rate.

The period's accident rates showed a dip-rise-dip pattern, reaching their lowest point in 2009 (Figure 1, p. 48). Fatal accident rates showed no discernible trend. The accident rates for charter aircraft were about five times that for high- and low-capacity regular public transport (RPT) operations, the report says.[3]

Despite an increase in the number of incidents — some 18.5 percent more in 2010 compared with 2009 — involving high-capacity VH- (Australian)-registered RPT aircraft, the rise in departures has meant that "the rate of incidents reported has been steadily decreasing from 2006," the report says. In 2009, accidents per million departures were the lowest in the study period at 2.1 (Table 2, p. 49). That was 66 percent lower than the 6.2 per million departures in 2008, and less than half the 2001–2008 average of 4.46.

There were no fatal aviation accidents involving Australian RPT during the study period. The last was in 1975, a ground accident that occurred during pushback.

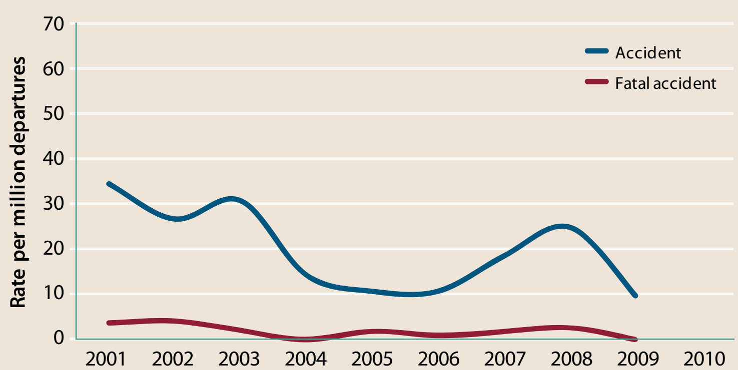
Australian Commercial Air Transport Operations, 2001–2010

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Number of aircraft involved										
Incidents	3,141	3,011	2,695	3,464	4,120	3,709	3,919	4,055	3,871	4,494
Serious incidents	9	10	15	30	31	16	45	47	24	33
Serious injury accidents	1	3	1	0	2	0	1	3	2	2
Fatal accidents	4	4	2	0	2	1	2	3	0	1
Total accidents	38	27	31	16	12	12	22	29	11	22
Number of people involved										
Serious injuries	4	8	4	0	2	0	1	15	3	2
Fatalities	10	12	8	0	18	2	2	6	0	2
Accident rates										
Accidents per million departures	34.6	26.8	30.9	14.4	10.8	10.8	18.6	25.0	9.8	—
Fatal accidents per million departures	3.6	4.0	2.0	0.0	1.8	0.9	1.7	2.6	0.0	—

Source: Australian Transport Safety Bureau

Table 1

Australian Commercial Air Transport Accidents, 2001–2010



Source: Australian Transport Safety Bureau

Figure 1

"The number of serious incidents increased from 2004 onwards," the report says. "This, in part, was due to a review of the ATSB's classification of immediately reportable matters, which took effect in July 2003. The number of serious incidents declined in 2009, but has risen again in 2010."

The accident rate of VH-registered aircraft operated in low-capacity RPT, which had reached zero in 2004, 2006 and 2008, rebounded to 8.1 per million departures in 2009 (Table 3). The rate had reached a high of 18.2 per million departures in 2002. The period's only fatal accidents in Australian low-capacity RPT occurred in 2005 and 2010. On March 22, 2010, an Embraer EMB-120ER crashed on a training flight, killing both pilots.

"Of all [Australian] air transport operations, charter had the highest … rate of accidents and fatal accidents per million hours and departures," the report says.[4] "The accident rate declined after 2001 until 2005, but then increased from 2006 to 2008 to levels similar to those found in 2003" (Table 4, p. 50).

In a notable reversal, the 2009 rate of charter accidents, 17.2 per million departures, was a far cry from the previous year's rate of 52.5, let alone 2001's rate of 71.3. That 2009 rate also was 41 percent of the average for 2001–2008. There were no fatal charter accidents in 2009 and 2010, compared with a 2001–2008 average of 2.1.

Non-VH-registered aircraft operating in Australian airspace had no accidents during the study period, and one serious incident in 2010, in which an Airbus A330 in instrument meteorological conditions was descended below the "radar lowest safe altitude."

In all general aviation — including Australian- and non-Australian-registered aircraft — the 2009 accident rate was 48.6 per million departures, exactly the same as in 2008. "The accident rate was twice as large in general aviation as in commercial air transport, and the fatal accident rate was three times as large," the report says.

Emergency medical operations were a bright spot. "Of all aerial work categories with comparable rate data, accident rates per million hours for emergency medical operations were the lowest of any category," the report says. "This is in

Australian High-Capacity Regular Public Transport, 2001–2010

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Number of aircraft involved										
Incidents	1,732	1,776	1,478	1,976	2,392	2,184	2,244	2,457	2,408	2,854
Serious incidents	5	6	6	10	11	4	16	20	9	13
Serious injury accidents	1	1	1	0	1	0	1	1	1	2
Fatal accidents	0	0	0	0	0	0	0	0	0	0
Total accidents	3	1	1	1	1	1	3	3	1	2
Number of people involved										
Serious injuries	1	1	4	0	1	0	1	12	1	2
Fatalities	0	0	0	0	0	0	0	0	0	0
Accident Rates										
Accidents per million departures	8.8	3.2	3.1	2.6	2.5	2.4	6.9	6.2	2.1	—
Fatal accidents per million departures	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	—
Accidents per million hours	3.8	1.4	1.3	1.1	1.1	1.0	3.0	2.7	0.9	—
Fatal accidents per million hours	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	—

Source: Australian Transport Safety Bureau

Table 2

Australian Low-Capacity Regular Public Transport, 2001–2010

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Number of aircraft involved										
Incidents	750	561	579	636	691	540	606	493	470	525
Serious incidents	1	1	0	10	7	5	8	11	4	6
Serious injury accidents	0	0	0	0	0	0	0	0	0	0
Fatal accidents	0	0	0	0	1	0	0	0	0	1
Total accidents	3	4	3	0	2	0	1	0	1	1
Number of people involved										
Serious injuries	0	0	0	0	0	0	0	0	0	0
Fatalities	0	0	0	0	15	0	0	0	0	2
Accident rates										
Accidents per million departures	10.9	18.2	14.7	0.0	10.2	0.0	6.1	0.0	8.1	—
Fatal accidents per million departures	0.0	0.0	0.0	0.0	5.1	0.0	0.0	0.0	0.0	—
Accidents per million hours	12.0	19.2	15.2	0.0	10.1	0.0	6.3	0.0	9.6	—
Fatal accidents per million hours	0.0	0.0	0.0	0.0	5.0	0.0	0.0	0.0	0.0	—

Source: Australian Transport Safety Bureau

Table 3

Australian Charter Operations, 2001–2010										
	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Number of aircraft involved										
Incidents	357	411	374	445	522	578	690	713	600	499
Serious incidents	0	1	3	9	6	6	16	13	10	14
Serious injury accidents	0	2	0	0	1	0	0	2	1	0
Fatal accidents	4	4	2	0	1	1	2	3	0	0
Total accidents	32	20	26	15	9	10	18	26	8	20
Number of people involved										
Serious injuries	3	7	0	0	1	0	0	3	2	0
Fatalities	10	12	8	0	3	2	2	6	0	0
Accident rates										
Accidents per million departures	71.3	45.2	60.2	30.4	18.8	21.1	33.2	52.5	17.2	—
Fatal accidents per million departures	8.9	9.0	4.6	0.0	2.1	2.1	3.7	6.1	0.0	—
Accidents per million hours	68.2	44.6	60.2	31.0	18.6	20.8	32.9	49.9	17.0	—
Fatal accidents per million hours	8.5	8.9	4.6	0.0	2.1	2.1	3.7	5.8	0.0	—

Source: Australian Transport Safety Bureau

Table 4

spite of the sometimes higher risks and difficulty associated with approaching and landing at unusual places." There were no fatal accidents in emergency medical operations in 2010 and none since 2003.

"The accident rate in helicopters performing any type of operation (about 97 accidents per million hours) is about 2.3 times the accident rate in airplanes performing any type of operation (about 42 accidents per million hours)," the report says. There were no RPT helicopter operations in Australia during the study period, but some helicopter charter flights. In charter flights from 2001 to 2010, helicopters had 36 accidents per million flight hours versus 39 per million flight hours for airplanes. But helicopters had the greater rate of fatal accidents: 5.6 per million flight hours for helicopters versus 3.6 per million flight hours for airplanes.

For all aircraft categories during 2010, the most frequent accident and serious incident types involved aircraft separation, aircraft control, powerplant and propulsion, miscellaneous events, terrain collisions, and ground operations events (Table 5).

The largest category, aircraft separation, included airprox and breakdown of separation.[5] The report says, "In all breakdown of separation occurrences for air transport in 2010, the separation conflict was with another aircraft rather than a vehicle on the runway. A radar standard was being used in 50 percent of [the] events, a procedural standard in about 35 percent and a runway standard in 15 percent. Fifty percent of the aircraft were on reciprocal tracks, 35 percent were on the same track and 15 percent were on crossing tracks."

Aircraft control–related serious incidents and accidents in air transport mostly involved wheels-up landings and hard landings, the report says. All wheels-up landings in 2010 were in charter operations. Two of the year's three hard landings involved helicopters.

Notes

1. ATSB. *Aviation Occurrence Statistics: 2001 to 2010.* Report AR-2011-020. March 2011. Available via the Internet at <www.atsb.gov.au/media/3428685/ar2011020.pdf>.

2. Commercial air transport is defined as "scheduled and nonscheduled commercial operations used for the purposes of transporting passengers and/or cargo for hire or reward." An occurrence is an accident or incident. Categories include the following:

   Accident — an occurrence involving an aircraft where a person dies or suffers serious injury; or the aircraft is destroyed or seriously damaged; or any property is destroyed or seriously damaged.

   Incident — an occurrence, other than an accident, associated with the operation of an aircraft which affects or could affect the safety of operation.

   Serious incident — an incident involving circumstances indicating that an accident nearly occurred.

Australian Air Transport Accidents and Serious Incidents, by Type, 2001–2010

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	Total
Aerodrome and airways facility											
Aerodrome related	0	0	0	0	1	0	0	0	0	0	**1**
Airspace											
Aircraft separation	1	4	16	14	9	5	21	11	10	18	**109**
FTC (operational noncompliance)	1	0	1	2	3	0	5	4	3	2	**21**
ATC procedural error	1	2	1	2	4	1	3	1	0	0	**15**
VCA (airspace incursion)	0	0	0	0	0	0	1	1	1	0	**3**
Breakdown of coordination	1	0	0	0	0	0	0	0	0	1	**2**
Other	0	0	0	0	0	0	1	0	0	0	**1**
Environment											
Weather	2	1	2	3	1	0	5	6	1	2	**23**
Wildlife	4	1	0	0	0	0	2	0	0	1	**8**
Mechanical											
Powerplant/propulsion	5	8	6	9	6	7	10	17	8	10	**86**
Airframe	7	12	9	8	7	2	9	7	8	3	**72**
Systems	8	3	1	4	6	3	5	8	5	1	**44**
Operational											
Aircraft control	26	14	13	8	6	6	17	20	13	11	**134**
Miscellaneous	3	2	2	9	6	5	10	26	10	8	**81**
Terrain collisions	7	3	3	4	5	4	5	8	2	5	**46**
Runway events	0	6	6	1	2	5	6	9	1	5	**41**
Ground operations	7	2	6	2	0	2	5	4	1	5	**34**
Fuel-related	3	3	4	5	2	0	4	5	2	0	**28**
Fumes, smoke, fire	1	1	2	4	4	1	1	7	3	1	**25**
Communications	0	2	3	3	1	2	2	6	1	4	**24**
Cabin safety	1	2	0	0	3	0	4	1	0	2	**13**
Flight preparation/navigation	1	1	0	1	4	0	4	0	0	1	**12**
Regulations and SOPs	3	2	1	0	1	1	0	1	0	0	**9**
GPWS/TAWS	0	1	0	1	1	0	2	0	1	0	**6**
Aircraft loading	1	1	1	1	0	0	0	0	0	1	**5**
Consequential events	18	14	13	12	17	12	18	29	16	17	**166**

ATC = air traffic control; FTC = failure to comply; GPWS = ground proximity warning system; SOPs = standard operating procedures; TAWS = terrain awareness and warning system; VCA = violations of controlled airspace

Source: Australian Transport Bureau

Table 5

Serious injury — an injury that requires, or would usually require, admission to a hospital within seven days after the day when the injury is suffered.

3. A high-capacity RPT aircraft has a maximum capacity of greater than 38 seats or a maximum payload exceeding 4,200 kg (9,259 lb). An RPT aircraft not meeting those parameters is low-capacity.

4. Charter operations involve carrying passengers and/or cargo on nonscheduled flights.

5. An airprox is "an occurrence in which two or more aircraft come into such close proximity that a threat to the safety of the aircraft exists or may exist" in uncontrolled airspace. A breakdown of separation is "an occurrence where there is a failure to maintain a recognized separation standard (vertical, lateral or longitudinal)" while under air traffic control.

Lights, Camera, Interaction

E-learning brings advantages compared with classroom instruction, but courses must be carefully designed.

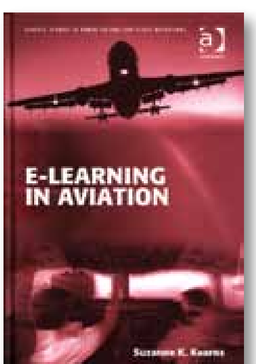
BY RICK DARBY

BOOKS

Performance-Based Learning

e-Learning in Aviation

Kearns, Suzanne K. Farnham, Surrey, England, and Burlington, Vermont, U.S.: Ashgate, 2010. 194 pp. Figures, tables, references, index.



Aviation training needs a new paradigm, Kearns says.

It is no longer enough, she believes, to "sort" learners — those who pass from those who fail, those who get better grades from those with worse grades, the sheep from the goats. That kind of instruction, she says, was "more focused on following procedures than on decision-making or problem-solving skills. However, the training needs of the industry have advanced. The increasing congestion of airspace, advanced technology in the cockpit and an influx of low-time pilots into the airline sector present unique training challenges. … It has become evident that a mastery of standard operating procedures is insufficient preparation for every possible situation, as anomalies arise and pilots must possess the critical thinking skills necessary to solve complex and novel problems."

To develop critical thinking ability, all learners must be given the time and training to reach their maximum level of performance, rather than just attaining a baseline, Kearns says. She argues for performance-based learning: "Rather than providing student pilots with a predetermined number of practice hours on certain maneuvers or phases of flight training, as mandated by current regulations, performance-based training allows training to be tailored to the skill of each student. Students receive practice on skills they are weakest in and do not waste time on areas they have already mastered. Regulators worldwide are opening regulatory doors for this approach, allowing high-quality flight training institutions an alternate means of complying with pilot licensing requirements."

Such flexible, adaptive instruction would require almost a one-on-one interaction between instructor and student under conventional training, and be prohibitively expensive. "However, with electronic learning (e-learning), it is a feasible option," Kearns says.

E-learning provides educational materials and computer-mediated communication (CMC) through electronic means, primarily the Internet or an organization's intranet — an alternative to classroom instruction. Delivery methods fall into three broad categories, Kearns says:

Synchronous. "Learners and an instructor log into a virtual classroom simultaneously at a predetermined time from their separate locations." Some kind of CMC is involved, such as a webcam and a headset with a microphone, or instant messaging software.

Asynchronous. "Asynchronous e-learning, by comparison, is completed independently by each user. Although CMC may be used, it is in the form of an electronic mailing list or message board in which learners post comments to a forum for classmates and the instructor to review at a later time. Students interact with peers and their instructor by reading and commenting on each other's posts."

Blended learning. "Stand-alone synchronous or asynchronous approaches do not always meet the needs of learners or instructors. Therefore, a combination of e-learning (either synchronous or asynchronous) and traditional classroom instruction is often used."

Blended learning uses e-learning to support, not replace, classroom instruction. "Some aeronautical universities have recently introduced blended learning courses," Kearns says.

She cites advantages of e-learning, compared with classroom instruction:

- Cost-efficiency;
- Geographic flexibility, with the course available in any location;
- Training that is available any hour, any day;
- Content that is standardized among instructors across an entire organization;
- Interactive exercises;
- Standard software, so almost any computer can run the training identically;
- Immediate learner feedback, tailored specifically to performance; and,
- Automatic tracking of learner performance with a company-wide database.

"E-learning revolutionizes how instructors interact with students," Kearns says. "In a classroom setting, it is common for a small handful of students to answer all of the instructor's questions. Unfortunately, the instructor has no way of determining if the others in the class are keeping up with the material or are hopelessly lost until they encounter a quiz or a final exam. The interactivity of e-learning allows instructors to assess and track performance more frequently and to intervene when a student is falling behind."

No technology can take the place of well-qualified human instructors.

Still, these benefits will be diluted unless the e-learning is built on a sound instructional design, tailored to the needs of the student and the organization. "There is a very wide range of quality in e-learning programs," Kearns says. "In fact, when researchers review the effectiveness of e-learning compared to classroom instruction, they find that some computer-based courses significantly outperform their classroom-based counterparts. However, an equally large percentage of e-learning courses significantly underperform classroom-based training."

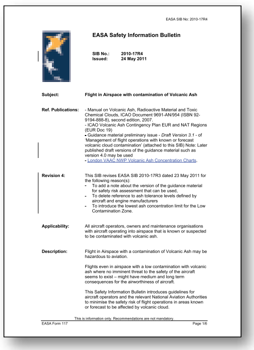
There are disadvantages to e-learning as well. Kearns says, "Course design, creation and implementation can cost more than the projected savings. Learners require a higher level of motivation and self-direction. Learners lose direct contact with their instructor in asynchronous learning environments, or [lose] nonverbal cues such as body language and voice inflection in synchronous learning environments."

To be fully effective, e-learning course developers cannot just take a traditional classroom course or PowerPoint slides and send them over the Internet. "The entire premise must be rethought," Kearns says. "Companies that are eager to save training costs jump on the e-learning bandwagon without fully understanding how to make this type of training effective."

No technology can take the place of well-qualified human instructors, she adds. Ideally, the electronic medium provides a way to use the instructor's abilities more efficiently. "The best way to maximize the strengths of e-learning is through careful instructional design and an understanding of which attributes have been shown to improve learning, and which [attributes] are probably ineffective," Kearns says.

REPORTS

Ash Cloud Computing



EASA SIB No: 2010-17R4

EASA Safety Information Bulletin

SIB No.: 2010-17R4
Issued: 24 May 2011

Subject: Flight in Airspace with contamination of Volcanic Ash

Ref. Publications: - Manual on Volcanic Ash, Radioactive Material and Toxic Chemical Clouds, ICAO Document 9691-AN/954 (ISBN 92-9194-888-8), second edition, 2007.
- ICAO Volcanic Ash Contingency Plan EUR and NAT Regions (EUR Doc 19)
- Guidance material preliminary issue - *Draft Version 3.1* - of 'Management of flight operations with known or forecast volcanic cloud contamination' (attached to this SIB) Note: Later published draft versions of the guidance material such as version 4.0 may be used
- London VAAC NWP Volcanic Ash Concentration Charts.

Revision 4: This SIB revises EASA SIB 2010-17R3 dated 23 May 2011 for the following reason(s):
- To add a note about the version of the guidance material for safety risk assessment that can be used,
- To delete reference to ash tolerance levels defined by aircraft and engine manufacturers
- To introduce the lowest ash concentration limit for the Low Contamination Zone.

Applicability: All aircraft operators, owners and maintenance organisations with aircraft operating into airspace that is known or suspected to be contaminated with volcanic ash.

Description: Flight in Airspace with a contamination of Volcanic Ash may be hazardous to aviation.

Flights even in airspace with a low contamination with volcanic ash where no imminent threat to the safety of the aircraft seems to exist – might have medium and long term consequences for the airworthiness of aircraft.

This Safety Information Bulletin introduces guidelines for aircraft operators and the relevant National Aviation Authorities to minimise the safety risk of flight operations in areas known or forecast to be affected by volcanic cloud.

This is information only. Recommendations are not mandatory.

EASA Form 117 Page 1/6

Flight in Airspace With Contamination of Volcanic Ash

European Aviation Safety Agency (EASA). Safety Information Bulletin (SIB) 2010-17R3, May 23, 2011; revised by SIB 2010-17R4, May 24, 2011. The latter is available via the Internet at <ad.easa.europa.eu/ad/2010-17R4>.

The most significant volcanic eruptions so far in 2011, of Iceland's Grímsvötn volcano in May and the Puyehue volcano in southern Chile in June, have been kinder to aviation than April 2010's blast from the Eyjafjalajökull volcano, also in Iceland. Not only are this year's events easier for non-Icelanders to pronounce, but neither has caused anything like the numbers of airport closures and flight cancellations that followed Eyjafjalajökull's eruption (*ASW*, 11/10, p. 12). No one is counting on nature's continued benevolence, however.

EASA has been actively involved in new and updated guidelines for responding to large-scale volcanic activity. Besides participating in a simulation exercise involving airlines, air navigation service providers, regulatory authorities and other organizations (*ASW*, 4/11, p. 11), the agency issued the May 23 SIB, followed the next day by a successor with slight modifications. The documents are advisory, not mandatory.

The May 23 SIB revises charts published by the London Volcanic Ash Advisory Centre (VAAC). "The charts show forecast ash concentration levels in three altitude bands and in three different zones," the bulletin says. Areas of "low contamination" are displayed in blue-green. Areas of "medium contamination" are shown in gray. Areas of "high contamination" are displayed in red. These terms replace the previously used terms "enhanced procedure zone," "time-limited zone" and "no-fly zone."

The SIB introduces guidelines for aircraft operators and civil aviation authorities to minimize safety risks of flight in areas where volcanic cloud is known or forecast. Recommendations for operating in an area of low contamination include the following:

- "Accomplish daily inspections when operating in an area of low volcanic ash contamination to detect any erosion, accumulation of volcanic ash or aircraft and/or engine damage or system degradation."
- "Protect and cover aircraft that are parked in areas that may be contaminated by the fallout or settling of volcanic ash in accordance with the aircraft and engine TC [type certificate] holder's advice where possible. Any volcanic ash residues must be removed prior to operations and following the TC holder's recommendations where available."

Additional recommendations apply to flight in medium or high contamination areas, "subject to the approval of the competent authority of the EU [European Union] member state or associated country." Two procedures are recommended.

- "Operators may be authorized to resume flight operations in areas or airspace with a medium or high contamination by presenting to their national competent authority an acceptable safety case." The bulletin references the International Civil Aviation Organization International Volcanic Ash Task Force guidance, "Management of Flight Operations With Known or Forecast Volcanic Cloud Contamination," draft version 3.1, published as an attachment to the SIB.
- "The national competent authority of the member state or associated country may decide to allow all flights within the area or airspace with a medium contamination, with or without limitations (e.g., geograph-

ic area, limitation in duration) following reconnaissance/clearance flights performed to support and justify that safe operations in the area or airspace with medium contamination can continue. This airspace, based on reconnaissance/clearance flights, should then be reclassified as an area or airspace with a low contamination."

In either case, flights may then be carried out at the operator's discretion "provided flight into visible ash is avoided."

The May 24 SIB introduces the lowest ash concentration limit for the low contamination zone and deletes the sentence, "The [ash concentration level] zones are based on volcanic ash tolerance levels defined by aircraft and engine manufacturers to ensure continued safe flight."

WEB SITES

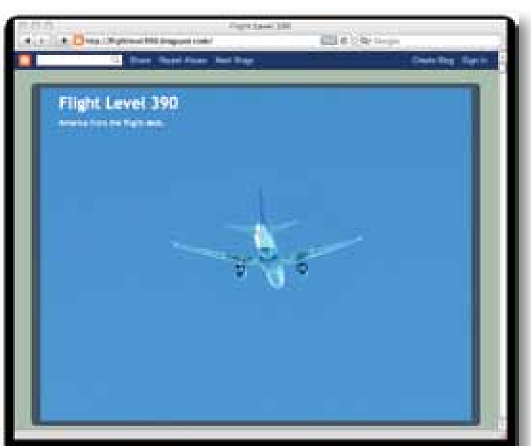
Written on the Fly

Flight Level 390, <flightlevel390.blogspot.com>

This blog is written by "Captain Dave," who describes himself as "a middle-aged airline pilot with a growing bald spot."

In "Flight Level 390" — subtitled "America From the Flight Deck" — the captain describes flights he conducts, salted with observations and opinions.

Postings about flights are prefaced with identifying details that pilots will relate to, for example:



Position: SAE (Searle VOR; Ogallala, Nebraska)
Altitude: 32,000 ft
Groundspeed: 415 kt (477 mph)
Compass Heading: 278 degrees
Equipment: A321 Enhanced
Pax on Board: 183 + 5 jumpers
Airborne ... Day number three of four.

The captain writes:

"We have been paralleling a line of Level Six thunderstorms for hundreds of miles and it appears to stretch all the way to the Rockies. The 321's multi-scan digital radar shows a clear depiction of those gigantic atmospheric water pumps to our left; to our right, another area of Level Six storms in a circular cluster about 200 mi [322 km] in diameter. In between is a hole about 75 mi [121 km] across; that is where we are, over SAE, along with many other airliners. The blow-off from the storm tops to our left has filled the gap with IMC (instrument meteorological conditions). We cannot see a thing outside except a gray nullity; no shape or form."

Many of his postings concern the human dimension of piloting:

"My copilot is a 30-something guy that captains either love or hate. About half of my buds do not care for this guy, but I have no complaints. I have flown with him numerous times over the eight years he has been on the line and I do not see the problem. He is high-strung and very intelligent, one of the best aviators on the Line. Therein might lie the problem ... . Not hard for such copilots to make the captain's flying look ham-fisted. When I have copilots like this, I give them all the flying; keep them busy and everyone is happy."

The captain's opinions on anything that comes to mind are frequently entertaining, sometimes funny. But for many readers, his word pictures of the in-flight environment will be most striking. Over Johnstone Point, Alaska:

"On the other side of the heated Plexiglas ... Extremely thin atmosphere, brilliant star fields and the aurora borealis. It is exceptionally active tonight. The cosmic streamers are undulating like electric snakes. Somehow, though, it is appropriate; an electric jet in an electric sky."

DC-8 Drags Tail on Takeoff

Freighter was too heavy for the available runway.

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

Crew Lacked Currency in Type

Douglas DC-8-63F. Minor damage. No injuries.

Procedural errors by the flight crew and their lack of currency in line operations, as well as an absence of operational oversight and control, were among the factors that led to an incident in which a DC-8's tail struck the end of the runway and dug a trench in soft ground beyond the departure threshold during takeoff from Manston Airport in Kent, England, according to the U.K. Air Accidents Investigation Branch (AAIB).

The investigation of the Aug. 11, 2010, incident revealed that the aircraft was 25,700 lb (11,658 kg) above the maximum authorized weight when the takeoff began and that during rotation, with the end of the runway looming, the commander increased the pitch attitude beyond the published value at which a tail strike can occur.

The commander felt the impact and was informed of the tail strike by air traffic control (ATC); however, seeing no apparent detrimental effect on the aircraft or its systems, he elected to continue the flight.

The aircraft was one of two DC-8s that recently had been acquired, along with two flight crews, from a cargo operator in the United Arab Emirates (UAE) by a charter operator based in Afghanistan. The incident occurred during the first commercial DC-8 flight conducted by the Afghan operator.

The aircraft had been chartered to pick up 36 polo ponies in Kent and to fly them to Buenos Aires, Argentina, with a fuel stop in the Cape Verde Islands. The DC-8 was flown to Kent from the UAE with both flight crews aboard. The crew that flew as passengers on the initial leg was scheduled to fly the aircraft from Kent to Cape Verde.

The commander, 55, had more than 15,000 flight hours, including 3,000 hours in DC-8s. The first officer, 60, had logged 2,500 of his 15,000 hours in type. The flight engineer, 62, had 13,100 flight hours, with 2,500 hours in DC-8s. "All had held senior flight operations management posts with previous employers," the report said.

None of the pilots had received familiarization training or operational training following their employment by the Afghan operator in May 2010. Only the first officer had received a check flight — a proficiency check in July. "The crew had not flown the DC-8 within the previous eight months and were not current on DC-8 line operations," the report said.

The aircraft arrived at Manston Airport the afternoon of Aug. 10. The ponies and their pens, as well as six more passengers — grooms and veterinarians for the ponies, were boarded, and the aircraft was refueled the next morning.

The crew was concerned about having enough fuel to divert to an alternate if they could not land in Cape Verde. The commander agreed to load more fuel than planned, as long as the aircraft remained within the weight limit for landing at Cape Verde. After the DC-8 was refueled according to the first officer's instructions, it had a total of 143,700 lb (65,182 kg) of fuel aboard for the flight from Kent to Cape Verde — "significantly more fuel than required," the report noted.

There was no loadmaster to aid the preflight preparations, and, according to the standard operating procedures (SOPs) employed by the UAE operator and adopted by the Afghan operator, the first officer was responsible for completing the load form and the flight engineer was responsible for completing the takeoff data card. The SOPs also dictated that the commander was responsible for checking the load form, and the first officer was responsible for checking the takeoff data card.

Nevertheless, both documents were prepared by the flight engineer, who listed a different takeoff weight on each document. The takeoff data card accurately showed the takeoff weight as 343,000 lb (155,585 kg), but the load form showed 335,410 lb (152,142 kg). The report said that the difference in the calculated takeoff weights likely was caused by the use of different standard weights for the ponies: 450 kg (992 lb) each per the cargo manifest versus 350 kg (772 lb) each per the charter operator's loading staff.

Moreover, although the 343,000-lb takeoff weight shown on the takeoff data card was accurate, it exceeded the limit for the prevailing conditions. "The flight engineer did not refer to the runway performance analysis tables, which gave runway-limited weights for varying environmental conditions," the report said. The tables showed a limit of 317,300 lb (143,927 kg) for the takeoff from Kent.

"No cross-check of the flight engineer's calculations or takeoff performance figures was made by any other crewmember," the report said, noting that the commander had become preoccupied with dispatch forms and securing South American navigation charts during the preflight preparations.

The aircraft was taxied from the stand at 1028 local time. The takeoff was conducted on Runway 28, which was dry and 2,752 m (9,029 ft) long. Surface winds were from 290 degrees at 7 kt, and the temperature was 20 degrees C (68 degrees F). Field elevation was 172 ft.

Witnesses told investigators that the aircraft appeared to accelerate slowly and that rotation was begun near the end of the runway. "A cloud of debris was thrown up from beyond the runway as the aircraft climbed away," the report said.

The takeoff technique prescribed in the aircraft operating manual (AOM) calls for initial rotation to 8 degrees. The AOM warns that a tail strike will occur at an 8.95-degree pitch attitude. The prescribed takeoff technique also says that after pausing one or two seconds at 8 degrees — while the aircraft lifts off the runway — the pitch attitude can be increased to 11 or 12 degrees for climb-out.

Recorded flight data showed that the commander began to rotate the aircraft at the target rotation speed, 160 kt. At this point, however, the aircraft was rapidly nearing the end of the runway. The commander reacted by pulling the control column aft at a steady rate and without pause until the pitch attitude reached nearly 11 degrees. After a brief reduction of the pitch rate, "a significant aft control column input was made [and] the pitch attitude continued to increase to a recorded maximum of 15.2 degrees," the report said.

The commander said that he felt two jolts as the DC-8 lifted off and suspected that a tail strike had occurred. Although ATC confirmed his suspicion, "with aircraft systems appearing normal, he decided to continue the flight to Cape Verde," the report said.

'With aircraft systems appearing normal, the commander decided to continue the flight.'

An inspection of Runway 28 revealed a tail-contact mark beginning 35 m (115 ft) from the end of the runway and a 30-m (98-ft) "trench," up to 23 cm (9 in) deep, in the soft soil beyond the runway threshold. The inspection also revealed that an approach light had been demolished by the aircraft's right main landing gear.

The report described the DC-8's tail skid assembly as having an "energy absorber" designed to deform on contact with the ground, to prevent damage to the airframe. After the DC-8 landed in Cape Verde, the energy absorber was found to have deformed by 0.4 in (1.0 cm), which was within the 0.5 in (1.3 cm) limit prescribed by the maintenance manual. No other damage was found, and the energy absorber was replaced after the aircraft landed without further incident in Buenos Aires.

The report said that "during the investigation, no evidence was forthcoming to show that the aircraft operator had exercised any meaningful operational control over its newly acquired DC-8 fleet."

The operator told the AAIB that it intended to 'cease DC-8 operations as soon as practicable.'

As a result of the incident investigation, the U.K. Department for Transport notified the Afghan operator that it would not issue any more operating permits for the company's DC-8s until corrective actions were taken. Moreover, because of the incident and a subsequent ramp check of another aircraft operated by the company, the European Commission placed the Afghan operator on its list of companies banned from operating in European airspace.

The report said that, in response to these actions, the operator told the AAIB that it intended to "cease DC-8 operations as soon as practicable and to dispose of the aircraft and crews."

Ice Causes Probe Failures

Airbus A330-202. No damage. No injuries.

The flight crew said that the A330 departed from Phuket, Thailand, in heavy rain the night of Nov. 1, 2010, and was in instrument meteorological conditions throughout the climb and during the first few moments of cruise. The aircraft was en route to Sydney, New South Wales, Australia, with 280 passengers and 11 crewmembers.

Shortly after exiting the clouds at Flight Level 350 (approximately 35,000 ft), the electronic centralized aircraft monitor (ECAM) displayed warnings of an airspeed discrepancy between the two flight management systems and that the selected cruise altitude was above the maximum computed altitude.

"Following this, both autopilots and the autothrottle disconnected, and the associated [ECAM] warnings were displayed," said the report by the Australian Transport Safety Bureau (ATSB). "The flight crew attempted to reconnect both autopilot systems but were unsuccessful."

The crew consulted with company operational and maintenance personnel, and decided to divert to Singapore, where the aircraft was landed without further incident about two hours and 20 minutes after the departure from Thailand.

Recorded flight data showed that the autopilots and autothrottle disconnected after the total air temperature (TAT) probes stopped providing data to the air data inertial reference units (ADIRUs). The ADIRUs use TAT data to compute true airspeed and static air temperature (SAT). "The loss of this information from the ADIRU resulted in a loss of autoflight capabilities," the report said. "The failure of all the recorded SAT parameters suggested that both the captain's TAT probe and the first officer's TAT probe failed within one minute of each other."

Airbus determined that the electrically heated TAT probes had failed because of icing. "The manufacturer concluded that the probes failed when the sensing elements within the probes were affected by high mechanical stress due to ice expansion," the report said.

"The manufacturer … reported that, since the introduction of the A330 [in 1994], a number of similar multiple TAT probe failures have been reported," said the report, which was released by ATSB in May 2011. "Due to the previous failures, a new TAT probe was certified and issued through an optional service bulletin in 2008. There have been no reported events of multiple failures involving the new TAT probe."

Loose Connection Causes Cockpit Fire

Boeing 757-200. Minor damage. No injuries.

Shortly after reaching Flight Level 360 during a flight with 105 passengers and seven crewmembers from New York to Los Angeles the night of May 16, 2010, the flight crew heard a hissing sound and saw smoke emanating from the glareshield. A few seconds later, flames emerged from the top of the glareshield, said the report by the U.S. National Transportation Safety Board (NTSB).

Both pilots donned their oxygen masks and smoke goggles. The captain transferred control to the first officer and told him to declare an emergency. The captain then discharged a portable Halon fire extinguisher onto the fire, which went out momentarily but then reignited. He then turned off all four windshield-heat switches and discharged another fire extinguisher, brought to the cockpit by a flight attendant, onto the fire, this time extinguishing it.

The crew diverted the flight to Washington Dulles International Airport, which had visual meteorological conditions (VMC), and control was transferred back to the captain. The 757 was descending through about 500 ft when the crew heard a "loud explosive bang" as the inner pane of the captain's windshield shattered. Due to the reduced visibility, the captain transferred control to the first officer, who landed the airplane without further incident.

An examination of the 757 revealed that the J5 power terminal block on the captain's windshield had been consumed by fire and that lock washers had not been installed on any of the five windshield terminal blocks. "It is likely that the connection between the connector lug and the [J5] terminal block was loose because of the missing lock washer," the report said. "A loose connection can create a point of high resistance in the electrical path between the terminal lug and terminal block, which can generate temperatures high enough to cause the terminal block to ignite."

The report noted that electrical odors had been reported on two of the three previous flights in the incident airplane. A flight on May 15 was diverted to Las Vegas, where no defects were found. During the subsequent ferry flight to San Francisco, cabin crew detected unusual odors that seemed to come from the forward galley ovens, which were replaced after landing.

Because of these reports, the captain of the revenue flight from San Francisco to New York, which preceded the incident flight, inspected the cockpit while en route to determine the source of the odors. He found that the J5 terminal block was charred and very hot to the touch, and that none of the other blocks was hot. He reported this to airline maintenance personnel.

The maintenance technician who followed up on the captain's report believed that the terminal block was part of the windshield heat bus bar and found that the airline's version of the aircraft maintenance manual (AMM) required replacement of the windshield within 50 hours if the bus bar showed signs of blackening or burning. Thus, the defect was deferred, and the airplane was returned to service. (No such deferral is allowed by the AMM furnished by Boeing.)

Thus, the defect was deferred, and the airplane was returned to service.

The report also noted that neither the Boeing AMM nor the airline's "highly customized" version specified that lock washers be used to secure the windshield terminal blocks. After the incident, Boeing issued an AMM revision with specific instructions and graphic illustrations for installation of lock washers.

Lightning Strike Binds Elevator

Embraer 145LR. Minor damage. No injuries.

The flight crew was conducting an arrival procedure at Chicago O'Hare International Airport the afternoon of March 12, 2010, when the airplane was struck by lightning at 7,000 ft. The autopilot disengaged, and "the colors on the PFD [primary flight display] and MFD [multifunction display] changed from their standard colors to variations of red, purple, green, blue and white," said the NTSB report. However, the information displayed remained accurate.

The first officer, the pilot flying, re-engaged the autopilot and noted no abnormalities. The pilots then discussed the possible location of the lightning strike and how the strike might have affected the airplane.

The first officer told investigators that after he disengaged the autopilot on short final approach, he had difficulty in lowering the nose during the flare to "soften the landing." He said, "I pushed hard, and the aircraft didn't respond. I called attention to the abnormality, and the captain attempted to push on his yoke. … The yoke seemed to be able to be pulled aft but would not move forward past about 60 [percent of its aft travel]."

Despite the elevator control anomaly, the landing was completed without further incident, and none of the 42 passengers and three crewmembers was injured.

An examination of the Embraer revealed that the lightning had struck the tail cone, causing thermal damage to the tail cone light assembly wiring and braided shielding. "A bulkhead frame was dislodged from its location due to the thermal damage present on the wiring harness," the report said. "This dislodged bulkhead came to rest on the elevator's bellcrank, which restricted the flight crew's ability to control the elevator."

TURBOPROPS

Hydroplaning Cited in Overrun

Pilatus PC-12/47. Substantial damage. No injuries.

The pilots were conducting a fractional ownership flight with five passengers from Norwood, Massachusetts, U.S., to Bridgeport, Connecticut, the morning of June 12, 2009. Weather conditions at Bridgeport's Sikorsky Memorial Airport included surface winds from 260 degrees at 5 kt, 2 mi (3,200 m) visibility in light rain and mist, and a 300-ft overcast.

They conducted the VOR (VHF omnidirectional radio) approach to Runway 24 but did not acquire the required visual cues for landing before reaching the minimum descent altitude, the NTSB report said. After conducting the missed approach, the crew received vectors from ATC for the ILS (instrument landing system) approach to Runway 6.

The copilot saw the runway lights when the PC-12 reached the decision height, and the pilot continued the approach. The pilot told investigators that she applied maximum reverse thrust and "more than average braking" after the airplane touched down about halfway down the 4,677-ft (1,426-m) runway. The airplane initially slowed but then began to hydroplane. "The pilots observed a [blast] fence at the end of the runway and decided they would not be able to perform a go-around," the report said.

The airplane overran the runway and struck the blast fence 342 ft (104 m) beyond the departure threshold. No one was injured, and an examination of the Pilatus revealed substantial damage to the left wing spar, leading edge and aileron.

The report noted that in April 1994, eight people were killed when a Piper Navajo struck the nonfrangible, steel blast fence, which had been installed to protect vehicles on a nearby highway. In March 2001, a Hawker Siddeley 125 was substantially damaged when it struck the fence, but no one was hurt.

After the Navajo crash, NTSB recommended that the U.S. Federal Aviation Administration (FAA) identify nonstandard runway safety areas and require airports to upgrade them, if feasible. NTSB also called upon state and local authorities to relocate the highway and remove the blast fence at Bridgeport. The board said that neither the FAA nor the state or local authorities have taken acceptable action in response to the recommendations.

Disorientation Led to Control Loss

Fairchild Metro III. Destroyed. One fatality.

The ATSB said that the Metro's alternating current (AC) electrical system likely was not functioning when the pilot departed from Sydney, New South Wales, Australia, in night VMC for a cargo flight to Brisbane, Queensland, on April 9, 2008.

Shortly after the aircraft took off to the southeast, over the ocean, on an instrument flight plan, a departure controller told the pilot to turn left to a heading of 090 degrees. The controller repeated the instruction when the radar display showed the Metro turning right, ATSB said in a report released in May 2011. The pilot acknowledged the instruction and said, "I've got a slight technical fault here." This was his last radio transmission.

ATC radar data showed that the aircraft subsequently made a series of turns, climbs and descents, and was descending at more than 10,000 fpm when radar contact was lost at 3,740 ft. Search vessels found a small amount of aircraft wreckage floating in the ocean south of the last recorded radar position. The pilot's body was not found; investigators determined that the impact was not survivable.

The flight data recorder and cockpit voice recorder were recovered from the ocean floor. The recorders, which are AC-powered, contained data for previous flights but not for the accident flight, a sign that the AC system was not functioning during the flight. Also, examination of a recovered attitude indicator revealed that its AC-powered gyroscopic rotor was not turning on impact.

The loss of AC power would have rendered the primary flight instruments, including the two attitude indicators, inoperative. "It is most likely that the lack of a primary attitude reference during the night takeoff led to pilot spatial disorientation and subsequent loss of control of the aircraft," the report said.

The Metro had two inverters, either one of which normally is selected before flight to provide AC power. Investigators were not able to determine why no AC power was available during the accident flight. "The absence of [AC] power could have been the result of bus failure, an inverter failure, inverter switch failure, system relay failure or pilot mis-selection of one or more of the electrical switches," the report said.

Setting Sun Cited in Runway Incursion

Cessna 208B. No damage. No injuries.

The Caravan pilot, who was conducting a scheduled freight operation, was cleared to land on Runway 25L at Phoenix (Arizona) Sky Harbor International Airport the afternoon of March 19, 2010. He told NTSB investigators that he had difficulty acquiring visual contact with the runway "because of the setting sun being right down the runway."

He set the ILS frequency in both navigation radios but noticed a discrepancy in the course deviation indicators. "Realizing he could not 'rely on the two needles for verification of the runway,' he looked up and saw that he was 'just to the left of centerline,'" the report said.

The pilot aligned the airplane with the centerline he had in sight, which was on the parallel runway, 25R, and inadvertently continued the approach to the wrong runway.

The flight crew of a Boeing 737-700 was lined up at the approach threshold of Runway 25R and awaiting takeoff clearance. The clearance was issued just as the captain saw the Caravan pass overhead at about 50 ft and touch down on the runway. The captain rejected the initial takeoff clearance and was reissued takeoff clearance after the 208 vacated the runway.

PISTON AIRPLANES

Distraction Leads to Gear-Up Landing

Piper Aztec. Substantial damage. No injuries.

The pilot said that shortly after departing from the Zebula Lodge airstrip near Bela-Bela, South Africa, the afternoon of May 5, 2010, the Aztec's door, which is on the right side of the cockpit, opened during a right turn, causing severe buffeting and a loud noise.

"He carried out a teardrop maneuver in order to turn back for landing," said the report by the South African Civil Aviation Authority. "However, due to the limited time available and distraction from the door, the pilot failed to lower the undercarriage. As a result, the aircraft landed on its belly and veered off the runway."

The report concluded that the pilot, who was the sole occupant of the aircraft, did not secure the door properly before takeoff.

Stabilator Control Cable Snaps

Piper Seneca III. Substantial damage. No injuries.

The pilot said that when he pulled back on the control yoke to flare the airplane for landing at Ankeny, Iowa, U.S., the evening of June 9, 2010, the pitch attitude did not change. The Seneca touched down hard on the nosewheel and bounced several times during the landing, damaging the fuselage and firewall.

The investigation revealed that the stabilator control cable was worn and had fractured. "The location of the fracture was in the unobstructed area in the tail cone," the NTSB report said. "The location of the fracture was not associated with a pulley, fairlead or bulkhead, and no rubbing or chafing was found in the area of the fracture."

The report said that the stainless steel cable was covered with dried grease and had been inadequately checked during an annual maintenance inspection three months before the accident. It noted that in 2011, the manufacturer and the FAA recommended replacement of stainless steel control cables with galvanized cables in specific Piper airplanes.

Mountain Wave Causes Control Loss

Beech 58P Baron. Destroyed. Two fatalities.

The Baron was cruising in night VMC at Flight Level 180 on Dec. 20, 2008, when the pilot reported that he was having severe difficulties but was not sure of the exact nature of the problem. Shortly thereafter, the airplane entered an uncontrolled descent and struck terrain at about 12,000 ft near Stonewall, Colorado, U.S.

In a final report released in May 2011, NTSB said that the Baron had encountered mountain wave activity while nearing the downwind side of a 13,000-ft ridge.

"A meteorological study of weather conditions in the accident area indicated the potential for severe mountain wave activity at the time of the accident," the report said. "There were also numerous pilot reports specifically identifying encounters with mountain waves and/or severe or extreme turbulence … close to the accident area."

HELICOPTERS

Float Bursts After Tail Rotor Fails

Bell LongRanger. Substantial damage. Two minor injuries.

The LongRanger was en route from Port O'Connor, Texas, U.S., to an oil platform in the Gulf of Mexico the morning of June 10, 2010, when the pilot heard a pop. The helicopter pitched over and yawed right. Suspecting a tail rotor failure, the pilot made an autorotative landing on the rough surface of the water.

The NTSB report said that the flexible hoses that supply gas pressure to inflate the emergency floats had been improperly installed and inspected, and the center float on the right skid burst due to overpressurization.

The pilot and the two passengers, who sustained minor injuries, exited the helicopter after it rolled inverted. They held on to the skids until they were rescued by the crew of a tugboat. The tail boom separated as the tugboat attempted to drag the helicopter to a nearby barge. The tail boom was not recovered, and the reason for the tail rotor failure was not determined.

Dislodged Object Hits Person on Ground

Aerospatiale Dauphin. No damage. One minor injury.

The emergency medical services (EMS) crew had transported a patient to a hospital in Middlesbrough, England, the afternoon of June 17, 2010. The pilot saw the flight physician return to the helicopter and close and lock the right cabin quarter-door before boarding. "The pilot then made a visual inspection of the aircraft and pulled on each of the right door handles to confirm that they were closed and locked," the AAIB report said.

The Dauphin was at 700 ft shortly after takeoff when the occupants heard a loud bang. The quarter-door had opened, and several objects, including a plastic stationery folder, had fallen out. The folder struck a person on the ground, rendering him unconscious. The report said his injuries were minor.

Following the door opening, the pilot reduced airspeed, advised ATC of the incident and completed the short flight to Durham Trees Valley Airport without further incident.

Company engineers found that the door locks were serviceable and concluded that the pins likely had been only partially engaged when the physician closed the door. "They added that the quarter-door pins could not be seen from outside the helicopter and were difficult to see from inside the cabin when a stretcher was installed, as on this flight," the report said.

After the incident, the operator retrained its EMS crews on closing and locking aircraft doors, and issued a bulletin prohibiting "unqualified passengers" from doing so.

Preliminary Reports, April 2011

Date	Location	Aircraft Type	Loss Type	Injuries
April 1	Saskatoon, Saskatchewan, Canada	CASA 212	total	1 fatal, 1 serious, 1 minor/none
The aircraft was returning from an aerial survey flight when the left engine lost power. The right engine then lost power on approach, and the 212 struck a concrete wall during the forced landing on a street.				
April 1	Yuma, Arizona, U.S.	Boeing 737	minor	2 minor, 121 none
A section of fuselage skin cracked open, causing the cabin to depressurize as the 737 was climbing through 34,400 ft en route from Phoenix, Arizona, to Sacramento, California. The crew diverted to Yuma and landed without further incident.				
April 2	Roswell, New Mexico, U.S.	Gulfstream 650	total	4 fatal
The flight crew was conducting a takeoff with a simulated engine failure for certification tests when the airplane banked steeply and crashed.				
April 4	Kinshasa, Democratic Republic of Congo	Bombardier CRJ	total	32 fatal, 1 serious
Thunderstorms were reported at the airport when the CRJ crashed on short final approach.				
April 6	near Boa Vista, Brazil	Helibras (Eurocopter) AS 355	total	3 fatal, 2 minor/none
The wreckage was found in a remote area two days after the helicopter was reported missing during a medevac flight. The patient and the pilot survived.				
April 6	Orhangazi, Turkey	Eurocopter EC 155	total	1 fatal, 1 serious, 1 minor/none
The helicopter crashed on high ground in dense fog during a flight from Istanbul to Yenisehir.				
April 11	New York, New York, U.S.	Airbus A380, Bombardier CRJ700	major	487 minor/none
The A380 was taxiing for takeoff when its left wing tip struck the vertical stabilizer on the CRJ, which was holding to cross the taxiway after landing.				
April 13	Furnace Creek, California, U.S.	Cessna Citation CJ3	minor	5 minor/none
After a reportedly normal approach and landing, the Citation overran the runway onto soft ground, where the nose landing gear collapsed.				
April 13	Caracas, Venezuela	Airbus A330	major	NA
After touching down hard on landing, the A330 was released to service after a hard-landing inspection. On the subsequent takeoff, the landing gear would not retract. The crew returned to Caracas and landed without further incident. A more detailed inspection revealed substantial gear damage.				
April 15	Valparaiso, Chile	Piper Cheyenne	total	2 minor/none
The Cheyenne overran the runway on landing and came to stop on a main road.				
April 16	Ust-Kamchatsk, Russia	Yakovlev Yak-40	major	26 minor/none
The right main landing gear collapsed in deep snow when the Yak-40 overran the runway on takeoff.				
April 17	Copenhagen, Denmark	Boeing 777	major	5 minor/none
The flight crew rejected the landing when the cargo airplane touched down hard and bounced. The tail struck the runway during the go-around, but the crew subsequently landed the 777 without further incident.				
April 20	Xian, China	Bombardier CRJ	major	NA
The nose landing gear and forward fuselage were substantially damaged when the CRJ touched down hard on landing. No injuries were reported.				
April 26	El Paso, Texas, U.S.	Cessna 208	major	1 minor/none
Surface winds were at 37 kt, gusting to 51 kt, when the Caravan was blown onto its right wing as the pilot was preparing to taxi.				
April 27	San Clemente, Chile	Bell 206	total	2 fatal
The helicopter crashed after the engine failed en route from Chicureo to Copihue.				
April 28	Moscow, Russia	Embraer ERJ-145	major	34 minor/none
After touching down with a strong tail wind, the aircraft was nearing the end of the wet runway at about 70 kt, when the flight crew attempted to steer it onto a taxiway. The 145 ground-looped and slid off the taxiway onto soft ground, where the landing gear collapsed.				
April 30	Tawang, India	Eurocopter AS 350	total	5 fatal
The helicopter crashed at 11,000 ft in mountainous terrain shortly after taking off from Tawang.				

NA = not available

This information is subject to change as the investigations of the accidents and incidents are completed.

Source: Ascend

Selected Smoke, Fire and Fumes Events in the United States, March–April 2011

Event Date	Flight Phase	Airport	Classification	Sub-classification	Aircraft	Operator
March 9	—	Raleigh-Durham, North Carolina (RDU)	Smoke indication on EICAS	Unscheduled landing	Embraer 190	JetBlue Airways
The crew declared an emergency and diverted to RDU because of an in-flight entertainment (IFE) equipment smoke indication on the engine indicating and crew alerting system (EICAS). Technicians inspected the aft cargo compartment, deactivated the IFE vent shutoff valve and found burned pins.						
March 7	Cruise	Newark, New Jersey (EWR)	Smoke in cockpit	Unscheduled landing	Boeing 757	Continental Airlines
During departure, the flight crew heard a thump or bang that they thought came from below the first officer's floor. Shortly after, they detected a very strong electrical burning–type odor. During descent for a return to EWR, the odor dissipated for a while but returned during the approach.						
March 13	Cruise	—	Fumes in cabin	Unscheduled landing	Boeing 737	Southwest Airlines
Electrical fumes were detected in the cabin. Following a diversion, maintenance technicians removed and replaced the recirculation fan.						
March 19	Climb	Grand Rapids, Michigan (GRR)	Smoke in cockpit	Unscheduled landing	Bombardier CL-600	Comair
During climbout from GRR, smoke emerged from the first officer's side wall. An emergency was declared, and the aircraft was returned to GRR for a safe landing. Maintenance found the first officer's side wall floodlight had burned.						
March 21	Taxi/ground handling	—	Smoke in cockpit	Return to gate	Embraer 145LR	American Eagle Airlines
The flight crew reported that after the no. 1 engine was started with the auxiliary power unit on and both packs selected, a smoke odor was detected in the cockpit. The crew also noticed a smoke haze. The crew immediately turned off all bleeds, packs and recirculation fans. The smoke/haze cleared out by the time the crew returned the aircraft to the gate without incident. Technicians replaced the air cycle equipment.						
March 28	Cruise	—	Smoke in cockpit	Unscheduled landing	Boeing 737	Southwest Airlines
Smoke and fumes from the R1 window entered the cockpit during cruise at Flight Level 360 (about 36,000 ft). The crew declared an emergency and conducted a diversion. Technicians removed debris from the top right window heat terminal.						
March 30	Climb	Jacksonville, Florida (JAX)	Smoke/odor in aft cabin	Unscheduled landing	McDonnell Douglas MD-82	American Airlines
Flight attendants reported an odor in the aft cabin. The crew declared an emergency and diverted to JAX. The aircraft was landed without incident. Technicians found coalescer bags extremely dirty.						
April 1	Cruise	—	Smoke in cabin	Unscheduled landing	Boeing 737	Southwest Airlines
At the cruise altitude of Flight Level 360, flight attendants reported that the cabin was full of smoke and there was a burning odor in the cabin. The flight crew declared an emergency and diverted. The smoke stopped when electrical power was removed after landing. Technicians removed and replaced the gasper fan.						
April 3	Climb	Dallas/Fort Worth, Texas (DFW)	Smoke and odor in the aft cabin	Unscheduled landing	McDonnell Douglas MD-82	American Airlines
Flight attendants reported odor and visible smoke in the aft cabin. The pilots declared an emergency and returned to DFW, landing without incident. Technicians replaced the left and right pressure regulator valves and accomplished a high pressure pack burn.						
April 6	Climb	Fort Lauderdale, Florida (FLL)	Smoke and odor in the cockpit	—	Boeing 737	Southwest Airlines
Passing Flight Level 180 on climbout from FLL, the flight crew detected an unusual odor in the cockpit. Technicians later removed and replaced the recirculation fan.						
April 19	Climb	Chicago O'Hare (ORD)	Smoke/fumes in cabin	Unscheduled landing	Boeing 737	American Airlines
The cabin crew reported strong fumes in the cabin. The pilots declared an emergency and returned to ORD. Technicians accomplished a pack burn and replaced the recirculation fan filters.						
April 20	Cruise	Philadelphia (PHL)	Odor in rear of aircraft	Normal landing	Boeing 737	US Airways
A flight attendant reported an odor similar to an electrical appliance overheating. No smoke was visible and the source could not be identified. The odor seemed to originate in the rear of the aircraft and move forward. The flight was landed without further incident. Maintenance technicians found a possible source, odor coming from a hydraulic electric pump relay stuck in pressurized mode. The relay and HEPA filters were replaced.						
April 24	Climb	Springfield, Missouri (SGF)	Odor of electrical smoke and fire	Unscheduled landing	Embraer 135	American Eagle Airlines
During the climb at Flight Level 200, the crew noticed a strong odor of electrical smoke or fire in the cockpit and cabin. The autopilot failed when engaged during a turn and descent. The crew followed procedures and the captain declared an emergency, electing to return to SGF. While the flight was returning to SGF, the flight attendant identified the odor as coming from above her jumpseat. The aircraft landed without incident. Technicians inspected the left-hand power distribution and found the captain's window leaking water onto relays. They re-secured the captain's window duct drain tube, dried the relays and relay rack, and found no defects.						
April 25	Climb	Dallas/Fort Worth, Texas	Smoke/odor in cabin	Unscheduled landing	McDonnell Douglas MD-82	American Airlines
Flight attendants reported smoke and odor in the cabin after takeoff. An emergency was declared and the flight returned to DFW, landing without incident. Technicians found a component missing from the left water separators. They replaced the right and left separators.						

Source: Safety Operating Systems and Inflight Warning Systems.